The Big Bang Quote Book

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By Paul Nethercott
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Introduction

Even though acclaimed as an undeniable fact [1, 2] the Big Bang Theory is based on many unobserved, unprovable ideas. Out of these many unsolved problems listed in this article, several have not been dealt with in previous creationist publications. Scientists admit that these are major problems but have not been able to provide any suitable answers. A theory that has so many proven facts against it should be discarded and replaced with a suitable creationist model. Four major new problems are discussed and documented.

Out of the 14 problems discussed, several major new ones are not dealt with previously on CMI books or website.

1 The amount of cosmic Lithium does not agree with Big Bang Nucleo synthesis [BBN] models.
2 The number of visible dwarf galaxies does not line up with Big Bang predictions.
3 Cuspy halos should visible around many galaxies but they are not. This refutes cold dark matter models.
4 Friction Time Scale Problem.
5 The Missing Cold Dark Matter.
6 The Missing Inflation.
7 Recent studies show that half the Hydrogen in the Universe is missing.
8 The Missing Dark Energy.
9 The Missing Galactic Bulges.
10 Massive Star Formation
11 Binary Star Formation
12 Numerous Unsolved Problems
13 There are several other newly discovered phenomena that do not line up with Big Bang models.
14 Galaxy formation has many unsolved problems.

1. The Missing Cosmic Lithium

According to astronomer Bruce Dorminey

“A relative lack of lithium in ancient stars means scientists don't completely understand how stars evolve or how the Big Bang forged the first elements.” [3] There is too much Lithium in the Universe to be a product of BBN. The answer that Bruce gives in his article is that we need “new physics” to create the excess Lithium that now exists. The idea of super symmetry and space has 10 dimensions maybe the answer. Unfortunately for Bruce, no such dimensions or the invisible particles that this idea entails have ever been found.

Grant J. Mathews from University of Notre Dame says:
“The 6Li abundance observed in metal-poor halo stars exhibits a plateau as a function of metallicity similar to that for $_7$Li, suggesting a big bang origin. However, the inferred primordial abundance of $_6$Li is ~1000 times larger than that predicted by standard big bang nucleo synthesis for the WMAP baryon-to-photon ratio. In addition, the inferred $_7$Li primordial abundance is 3 times smaller than the big bang prediction.**”** [4]

Richard H Cyburt from Michigan State University states how bad the problem is:
“The lithium problem arises from the significant discrepancy between the primordial 7Li abundance as predicted by big bang nucleo Synthesis (BBN) theory and the Wilkinson Microwave Anisotropy Probe (WMAP) baryon density, and the pre-Galactic lithium

abundance inferred from observations of metal-poor (Population II) stars. This problem has loomed for the past decade, with a persistent discrepancy of a factor of 2–3 in 7Li/H." [5]

"In using the WMAP value for η at the period of BBN, we are implicitly assuming that there has been no entropy change between BBN and the decoupling of the CMB. Note that entropy production between BBN and decoupling would require a *larger* value for η at the time of BBN and make the Li problem even worse." [6]

"Thus, the more conventional solutions to the problem have become increasingly constrained by new data. The possibility that lithium points to new physics at work in the early universe thus remains not only viable, but if anything more compelling. This possibility could receive strong support from the discovery of new physics at the Large Hadronic Collider (LHC) at CERN, slated to start running in early 2009." [7]

Julien Larena and Jean-Michel Alimi from Paris University agree that the amount of Helium 4 and Deuterium is right but the amount of Lithium is all wrong:

"In the framework of the standard big bang nucleosynthesis (BBN), such a baryon density leads to predictions for the primordial abundances of $_4$He and D in good agreement with observations. However, it also leads to a significant discrepancy between the predicted and observed primordial abundance of $_7$Li. Such a discrepancy is often termed the lithium problem.**"** [8]

Sean Bailly [9] and Karsten Jedamzik [10] offer the same solution as Bruce Dorminey. Using string theory and super symmetry will create the right amount of Lithium. Of course there is no such evidence for super symmetry. A recent article in Scientific American magazine admits it is an unproven theory.[11]

Keith A. Olive And Evan D. Skillman from the Astronomy Department, University of Minnesota admit that the Big Bang model explains some things correctly but not the levels of Lithium in the universe:

"This easily allows for concordance between measurements of the baryon-to-photon ratio (x) from WMAP, deuterium abundances, and helium abundance (although the discrepancy with Lithium remains)." [12]

Martin Asplund from Mount Stromlo Observatory admits this is a major problem to the Big Bang theory:

"Lithium's two stable isotopes, $_6$Lithium and $_7$Lithium, continue to pose intriguing questions for astrophysicists concerned with understanding the origins of this light element." [13]

The observations do not agree with the theory:
"The observed $_6$Lithium abundance is several orders of magnitude larger than that predicted from the standard big bang." [14]

Another scientist adding fuel to the fire is Professor Piau from the Joint Institute for Nuclear Astrophysics, Chicago:

"In order to have provided such a deuterium fraction, standard BBN would have to have produced much more lithium than is currently observed in halo stars on the Spite plateau. More recently, the validity of this discrepancy related to lithium found further strong support through the constraints provided by the cosmic radiation background anisotropies measured by the Wilkinson Microwave Anisotropy Probe (WMAP)." [15]

Conclusion
The creationist view has no problem here because it does not need the Big Bang theory. God simply created the present amount of Lithium a few thousand years ago.

2. The Missing Dwarf Galaxies

The cold dark matter (CDM) model predicts many visible dwarf galaxies associated with large galaxies. Observation show that they do not exist. Astronomers Joshua D. Simon And Marla Geha comment:

"The cold dark matter (CDM) cosmological model predicts that massive galaxies such as the Milky Way should be surrounded by large numbers of dark matter dominated satellite halos. The relatively modest populations of observed dwarf galaxies orbiting the

Milky Way and Andromeda, however, seem to conflict with this prediction (Kauffman et al. 1993; Klypin et al. 1999; Moore et al. 1999). This apparent disagreement between the expected and observed numbers of dwarf galaxies has become widely known as the ‘substructure’ or ‘missing dwarf’ problem.” [16]

James. S. Bullock [17] says that the answer is that the galaxies are too dark to see with modern telescopes. Andrey Kravtsov says that perhaps new views of CDM or galaxy formation will solve the problem.[18] He states in a recent article that the differences between observation and theories are major:

“Comparisons with observations revealed that there is a glaring discrepancy between abundance of sub halos and luminous satellites of the Milky Way and Andromeda as a function of their circular velocity or bound mass within a fixed aperture. This large discrepancy, which became known as the “substructure” or the “missing satellites” problem, begs for an explanation.” [19]

Mario Mateo pointed this out thirteen years ago but the problem is still not resolved: “The current fashion is to assume that the kinematic observations described above constitute part of a dark matter problem. However, it may be wise to remember that this already implies a solution to what remains a long-standing crisis in understanding the internal kinematics of galaxies.” [20]

Moore and Ghigna say that if the observations are wrong then the theory itself is wrong: “Either the hierarchical model is fundamentally wrong, or the substructure lumps are present in the galactic halo and contain too few baryons to be observed. The deficiency of satellites in galactic halos is similar to a deficiency of dwarf galaxies in the field (e.g. Kauffmann *et al.* 1993).” [21]

Peebles And Nusser discussed this in Nature magazine less than a year ago: “The disparity in the predicted number of Local Void galaxies should not be confused with the prediction of there being many more dwarf dark matter haloes than there are dwarf galaxies.” [22]

“We conclude that there is a good case for inconsistency between the theory and our observations of galaxies in the Local Void.” [22]

“The variety of problems we have considered in the interpretation of the present baseline motivates serious consideration of adjustments of the fundamental theory.” [23]

“Two clear conclusions of this Review are that galaxy formation is not well understood and that the nearby galaxies offer rich and still far from completely explored clues to a better picture of how the galaxies formed.” [23]

Conclusion

The cold dark matter theory predicts many more visible dwarf galaxies that what really exist. The theory runs contrary to the evidence.

3. The Missing Cuspy Halo Problem

“The cuspy halo problem arises from cosmological simulations that seem to indicate cold dark matter (CDM) would form cuspy distributions — that is, increasing sharply to a high value at a central point — in the most dense areas of the universe. This would imply that the center of our galaxy, for example, should exhibit a higher dark-matter density than other areas. However, it seems rather that the centers of these galaxies likely have no cusp in the dark-matter distribution at all. This remains an intractable problem. Speculation that the distribution of baryonic matter may somehow displace cold dark matter in the dense cores of spiral galaxies has not been substantiated by any plausible explanation or computer simulation.” [24]

“This persistent difference is known as the ‘core/cusp controversy’, sometimes also described as ‘the small-scale crisis in cosmology’.” [25]

“Similarly, the difficulties in reconciling a possible underlying triaxial potential with the circularizing effects of the baryons also needs to be investigated. In short, studies which, constrained and informed by the high quality observations now available, self-consistently describe and model the interactions between the dark matter and the baryons in a cosmological context are likely the way forward in resolving the core/cusp problem.” [26]

Professor Sanchez-Salcedo from Mexico City University admits there are many theories to try and explain the problem. His article offers no solution however.

“Many astrophysical mechanisms have been suggested to explain these discrepancies.” [27]

“The problems discussed above are also faced by other models whose mechanisms to produce a core are based on interactions, either elastic or inelastic, between dark matter particles.” [27]

Lam Hui from the Department of Physics, Columbia University in New York points out the problem of theory versus facts but again his article like the others offers no answer:

“Conventional Cold Dark Matter cosmological models predict small scale structures, such as cuspy halos, which are in apparent conflict with observations. Several alternative scenarios based on modifying fundamental properties of the dark matter have been proposed.” [28]

Stacy S. McGaugh from the University of Maryland says the problem is so bad many radical theories have been invoked:

“More radical suggestions about the nature of dark matter have also been made to address the cusp-core problem.**”**[29]

This problem was well known over twelve years ago. “Astronomers have gone to the well and come back perplexed. Galaxy clusters should contain large quantities of dark matter, trapped in their potential well, and we expect that matter to be sharply concentrated near the centre. But using a new method for interpreting the effects of gravitational lensing, Tyson *et al.* have inferred a much smoother and less centrally concentrated distribution of dark matter in one cluster.” [30]

In 2010 Nature magazine documented that cold dark matter and galaxy formation is far from solved: “The smallest things often cause the most trouble. The smallest galaxies are no exception: they have long caused difficulties for modern cosmology. Neither the number nor the appearance of small ‘dwarf ’ galaxies conforms to the predictions of the otherwise highly successful cold dark matter (CDM) theory of galaxy formation.” [31]

A recent paper lists a whole host of unresolved problems: “A complete explanation of spiral galaxies in CDM requires a comprehensive theory of galaxy formation. This remains lacking. Indeed, there are a number of lingering problems on small (galaxy) scales. These include the cusp-core problem (e.g., de Blok et al. 2001a), the missing satellite problem (e.g., Moore et al. 1999a), the dynamical friction time scale problem (Goerdt et al. 2006; Sanchez-Salcedo, Reyes-Iturbide, & Hernandez 2006), and a whole suite of other incongruities and apparent contradictions that arise on the scale of individual galaxies (McGaugh & de Blok 1998; Sellwood & Kosowsky 2001).” [32]

Nature magazine reports that this problem is fatal to the theory of cold dark matter: **“**For almost two decades the properties of ‘dwarf’ galaxies have challenged the cold dark matter (CDM) model of galaxy formation1.**”** [33]

“This failure is potentially catastrophic for the CDM model, possibly requiring a different dark-matter particle candidate.” [33]

“Interpreting the data in terms of dark matter leads to troublesome fine-tuning problems. Different observations require contradictory amounts of dark matter. Structure formation theories are as yet far from able to explain the observations.” [34]

Conclusion

The cold dark matter theory does not line up with the observations. The Big Bang theory predicts galactic haloes but they do not exist.

4. Friction Time Scale Problem

Another problem is the dynamic friction problem. Gravity causes globular clusters to spiral out of orbit into the centre of their parent galaxy. Since globular clusters are supposed to be 10 to 13 billion years old this should have happened billions of years ago. Tobias Goerdt comments on the problem:

"These star clusters move within a dense background of dark matter and should therefore be affected by dynamical friction, causing them to lose energy and spiral to the centre of the galaxy. We will show later that, if Fornax has a cosmologically consistent density distribution of dark matter, the orbital decay time-scale of these objects from their current positions is < 5 Gyr. This is much shorter than the age of the host galaxy, presenting us with the puzzle of why these five globulars have not merged together at the centre forming a single nucleus (Tremaine, Ostriker & Spitzer 1975; Tremaine 1976)." [35]

Sanchez-Salcedo discusses the problem and then offers the answer as cold dark matter:

"Tremaine (1976) first noticed that using the preliminary values for the radius and mass of the second most luminous of the 10 dSph satellites of the Milky Way, Fornax, this time is 1–2 Gyr, very short as compared to absolute ages estimated for these clusters (14.6 ± 1.0 Gyr for clusters 1–3 and 5, 11.6 Gyr for cluster 4; see Buonanno et al. 1998; Mackey & Gilmore 2003)." [36]

"This solution has no astrophysical interest because then a dark component has to be added as well to explain the missing mass problem in spiral galaxies. This component will become the main explanation for the missing mass at galactic scales and not only at cosmological scales (Pointecouteau & Silk 2005)." [37]

Since there is no proof of cold dark matter this is no answer at all. Oh and Lin have calculated that this free fall into the centre of the galaxy would only take one billion years:

"While the nucleus of NGC 1705 might result from a single globular cluster, for most nucleated dwarf galaxies the merger of many globular clusters at the center would be required. The results in model 1 show that cluster coalescence may also lead to off center displacement of the nucleus, which subsequently diminishes on a typical timescale of less than 1 Gyr." [38]

Oh, Lin and Richer propose a huge black hole in the centre of the galaxy or tidal disruption to explain away the problem: "In the Fornax dwarf spheroidal galaxy, globular clusters preserve their diffuse spatial distribution despite the fact that the clusters orbital decay timescale is much shorter than the estimated age of the host galaxy. We propose that this paradox may be resolved if (1) Fornax contains black holes with a sizeable fraction of the mass of these clusters or if (2) it is currently undergoing tidal disruption." [39]

At the end of the article he admits that the black hole's existence is purely hypothetical and the friction would overpower any tidal disruption. [40]

Conclusion
The cold dark model does not answer this time scale problem.

5. The Missing Cold Dark Matter

Claims have been made that Amelia Fraser-McKelvie and two other scientists from Monash University in Victoria have found cold dark matter [CDM]. A closer look reveals what they have found is just standard matter and energy listed in popular physics textbooks.

"What is needed now is an accurate determination of filaments' electron densities and plasma temperatures from spectral fitting to provide a solid comparison with the models, which will then provide more realistic predictions for the missing baryon problem." [41]

REBUTTAL:
Baryonic material is just the periodic table [**http://en.wikipedia.org/wiki/Baryon**]. It is not exotic bizarre matter.

"The low densities (10^{-6}–10^{-4} cm^{-3}) and high temperatures (100,000–10,000,000 Kelvin) expected from such structures in X-rays are presenting an observational challenge." [41]

REBUTTAL:
The matter is not cold.

"The gas is likely to be inhomogeneous, with a range of temperatures and densities, different metallicities and ionization timescales (see Bertone et al. 2008 for a review)." [41]

REBUTTAL:
It contains Periodic Table elements and is not exotic bizarre matter.

"In summary, we have detected a soft X-ray emission from the combined sample of 41 filaments with known positions using the Pimbblet et al. (2004) filament catalogue." [41]

REBUTTAL:
The energy it gives off is standard stuff found in Physics textbooks:

Another claim for finding CDM is discussed [42] by Professor Stawarz from Stanford University in California. High energy cosmic ray electrons have been claimed to be the by product of cold dark matter annihilation. Professor Stawarz concludes his examination of these claims saying that these energies are just normal energy from Super Nova Remnants:

"In this paper, we show that the observed excesses in the energy distribution of the Galactic CR electrons around energies $E = 0.1$–1 TeV may be easily reproduced without invoking any unusual source of ultra relativistic electrons (or $e \pm$ pairs), such as dark matter annihilation/decay or some nearby astrophysical object (e.g., a pulsar), other than the general diffuse Galactic components of CR electrons and protons injected by SNRs." [43]

"We do not see a satisfactory solution to this missing baryon problem at present. Considerable work remains to be done to obtain a complete understanding of the universe and its contents." [44]

As of March 2011 cold dark matter is still just a ghost without a trace:

"Although its real nature is unknown, dark matter seems to outweigh the ordinary matter visible in stars and galaxies by roughly 5.5 to 1. Down here on Earth, however, physicists struggling to answer the 'what is it?' question often feel like they're chasing a ghost. Certainly, their detectors have been giving them a lot of strange and contradictory results." [45]

This article claims [45] that cold dark matter physics is based on string theory and super symmetry. Of course there is no such evidence for super symmetry. A recent article in Scientific American magazine admits it is an unproven theory. [11]

Another author admits recently that cold dark matter's nature is entirely unknown:
"The theorist's goal is to understand these observations in a cosmological context. In the standard picture, most of the Universe is composed of dark matter, whose nature is unknown." [46]

J. A. Sellwood and A. Kosowsky have listed [47] twelve objections to the existence of cold dark matter:

1. Many galaxies do not have the right rotation curve that CDM would create.
2. The structure of SB galaxies is all wrong.
3. CDM does not give the right mass accelerations.
4. CDM does not relate the halo parameters correctly to the luminous mass distribution.
5. The predicted angular momentum of the disk is at least an order of magnitude less than that observed.
6. The spectacular variation of *f-max* between galaxies found by Sellwood (2000) and Dalcanton & Hogan (2000) indicates that DM cannot be a simple collisionless particle.
7. No observational evidence *requires* halos to have the predicted cusps.
8. Navarro & Steinmetz (2000a) describe their failure to predict the zero point of the TFR as a "fatal problem for the ΛCDM paradigm."
9. The sub clumps are more numerous than the numbers of observed satellite galaxies, and may threaten the survival of a thin disk in the host galaxy.
10. The TFR discrepancy is even worse in the CDM model.
11. Galaxies like NGC 2403 have the wrong halo shape.

12. Measurements of the microwave background power spectrum at sub-degree scales show CDM does not have to the correct answer. [47]

Conclusion

The existence of CDM is so far unverified. There are many valid scientific objections to its existence. String theory and super symmetry physics are supposed to be its basis. Of course there is no such evidence for super symmetry. A recent article in Scientific American magazine admits it is an unproven theory. [11]

6. The Missing Inflation

A recent article in Scientific American highlights some of the new problems with inflation theory: “But some of the theory’s creators, including the author, are having second thoughts. As the original theory has developed, cracks have appeared in its logical foundations. Highly improbable conditions are required to start inflation. Worse, inflation goes on eternally, producing infinitely many outcomes, so the theory makes no firm observational predictions.” [48]

What started the ignition of inflation? Evolutionists do not have any evidence as to what would start this super fast expansion process. What caused the deceleration of inflation? Since the universe is not expanding today at this super fast speed, what turned inflation off? Again there is no answer.

According to Adrienne L. Erickcek and Sean M. Carroll from California Institute of Technology the universe is not isotropic and homogeneous but lop sided: “Measurements of CMB temperature fluctuations by the Wilkinson Microwave Anisotropy Probe (WMAP) indicate that the fluctuation amplitude in one half of the sky differs from the amplitude in the other half.” [49]

“However, there is an anomaly in the CMB: measurements from the Wilkinson Microwave Anisotropy Probe (WMAP) [A] indicate that the temperature-fluctuation amplitude is larger, by roughly 10%, in one hemisphere than in the other [B]. Fewer than 1% of simulated isotropic fluctuation maps exhibit such an asymmetry, and the asymmetry cannot be attributed to any known astrophysical foreground or experimental artefact.” [49]

“The hemispherical power asymmetry in the CMB challenges the assumption that the Universe is isotropic and homogeneous.” [50]

Bartosz Lew also agrees:
“The analysis of the modulation amplitude within few multipole bins yielded a large, best-fit modulation amplitudes, that seem to significantly reject the isotropic Universe model (with A = 0). However as much as few in one hundred GRF simulations, processed as data, also yielded a similar or larger modulation values, and also excluded the A = 0 hypothesis at yet even higher confidence levels, than in the case of the V5 data. This effectively reduces the overall significance at which the isotropic model of the Universe can be rejected, down to only about 94% or = 95% using the V5 data in the range $\ell = [7, 19]$, and $\ell = [7, 79]$ respectively.” [51]

Professor H. K. Eriksen from Oslo University in Norway lists some three more unsolved problems:

“Perhaps the three most important ones were:

1) Alignments and symmetry features among low ℓ multipoles (de Oliveira-Costa et al. 2004; Eriksen et al. 2004), 2) An apparent asymmetry in the distribution of fluctuation power in two opposing hemispheres (Eriksen et al. 2004; Hansen et al. 2004), and 3) A peculiar cold spot in the southern hemisphere (Vielva et al. 2004; Cruz et al. 2005). All of these features were subsequently studied extensively by independent groups, and all remain unresolved to the present day.” [52]

Three more unsolved problems in detail:

One.

“We have investigated anomalies reported in the Cosmic Microwave Background maps from the WMAP satellite on very large angular scales. There are three independent anomalies involving the quadrupole and octopole:

1. The cosmic quadrupole on its own is anomalous at the 1-in-20 level by being low (the cut-sky quadrupole measured by the WMAP team is more strikingly low, apparently due to a coincidence in the orientation of our Galaxy of no cosmological significance).
2. The cosmic octopole on its own is anomalous at the 1-in-20 level by being very planar.
3. The alignment between the quadrupole and octopole is anomalous at the 1-in-60 level." [53]

"More importantly, the observed asymmetry is remarkably stable with respect to frequency and sky coverage.
The most intriguing possibility remains therefore that the recent findings require some fundamentally new physics on large scales in the universe." [54]

Two.
"An extremely cold and big spot is detected. This spot *(The Spot)* is seen in the SMHW coefficients at scales around 4° (implying a size of around 100 on the sky) and at Galactic coordinates *(b* = —57', / = 209°). The probability of having such spot for a Gaussian model is of only R=0.2 per cent, which implies that, if intrinsic, The Spot has not been caused by primary anisotropies in the standard scenario of structure formation because standard inflation predicts Gaussian fluctuations in the matter energy density and therefore in the CMB temperature fluctuations."[55]

"We have presented the detection of non-Gaussianity in the WMAP first-year data, in the kurtosis of the SMHW coefficients at scales around 4°, which implies a size on the sky of around 10°." [56]

Three.
"Having eliminated systematic errors as the source of the signal, the intriguing possibility is raised that the cosmological principle of isotropy is violated and/or that fundamentally new physics on large scales in the Universe is required. Further clarification of this scenario awaits further observations from *WMAP*, and ultimately the forthcoming *Planck* satellite mission." [57]

According to another article posted on Fox News website the inflation theory cannot explain the uneven distribution of cosmic background microwave radiation:

"But the normal model of inflation can't account for the asymmetry now noted." [58]

To try and get around that Carroll postulates two inflation force fields instead of one.

"To try to explain that, Carroll, astrophysicist Marc Kamionkowski and graduate student Adrienne Erickcek (all at Caltech) tested a new version of inflation theory, in which two fields are responsible for the universe's early bloom of expansion." [58]

That only makes the problem worse for the Big Bang theory. What turned both the force fields on and then later turned them off? Since the universe is not expanding today at this super fast speed, what turned double inflation off?

Conclusion
The Big Bang theory has a series of unanswered problems. This series includes:

1) The singularity;
2) Energy is converted to matter, but not antimatter;
3) The ignition of the Big Bang;
4) The ignition of inflation;
5) The deceleration of inflation;
6) Compaction of expanding gas into stars;
7) Ordering of stars into galaxies, many with rotation;
8) Ordering of galaxies into super clusters; and
9) Ordering of matter into planets, with unique orbits, rotation axes and rotation directions. [59]

7. The Missing Hydrogen

Another newly discovered problem is missing Hydrogen. This is not to be confused with cold dark matter. The amount of Hydrogen in the Universe does not agree with the Big Bang model. Galaxies should contain twice as much as they are observed to have:

"Forget dark matter, dark energy or any other hypothetical substance postulated to plug gaping holes in the fabric of the universe. Here is a tangible scandal of cosmic bookkeeping right on our doorstep. When we tot up all the everyday atoms in our galaxy - the sort that make up its stars, planets and people- about half of what we expect to see is missing." [60]

This article in New Scientist magazine admits that there is no easy solution to the problem:

"This solution is not without its problems, however. Dark matter is thought to be found within a spherical "halo" surrounding a visible galaxy, but that distribution struggles to produce the right rotation curve. Pockets of dark molecular hydrogen gas, about the size of the solar system, scattered around the outer reaches of a galaxy would do a far better job, says Pfenniger. "If we were to triple the gas content of the Milky Way, we could flatten the rotation curves," he says. That might sound nice and simple, but there's a catch: it brings us into conflict with our models of the big bang, which predict twice, not three times, the number of atoms we see. For this reason, Pfenniger thinks his model is unlikely to do away with dark matter entirely, and proposes a compromise: unseen atoms contribute around half of the rotation curve solution, with the rest still coming from dark matter." [61]

A very recent article this year in Scientific American highlights the growing problem:

"Cen, Ostriker and Dave dubbed this material the warm-hot intergalactic medium, or WHIM. If we could empirically con-firm its presence and extent, we might be able to pin down the location and condition of the missing baryons." [62]

The theory is plagued with many problems:
One
"The trouble with this model is that the flow of gas into galaxies cannot go on unabated. If it did, galaxies would grow into monsters and we know they do not: galaxies today come in only a limited range of masses. Early models seemed to reproduce the observed range of galactic masses pretty well, but in retrospect they worked only because astronomers were using a value for the overall baryon density that was about half the present value." [62]

Two
"As new measurements of the baryon fraction revised the value upward, theorists fed this information into simulations and realized that their model universes were plagued by a serious overabundance of massive galaxies that are not seen in nature." [63]

Three
"Another problem is that models predict a profusion of smallish dark matter clumps that agglomerate into progressively larger bodies. Real galaxies do not follow this pattern. Observers do not see nearly as many small galaxies as the models predict, and the most massive galaxies appear to have formed quickly and efficiently, rather than through the gradual assembly of smaller pieces." [63]

Joel N. Bregman discusses this problem and how it has been recently discovered.
"It is largely in the past decade that we have come to an appreciation of the missing baryon problem and the likely existence of a cosmologically important Warm-Hot Intergalactic Medium (WHIM) at low red shift." [64]

Later in the article he admits that these missing particles will not be discovered for a long while:

"Uncovering the missing baryons is a feasible goal, requiring only sensitivity improvements that can be attained with existing technologies. We hope that these sensitivity improvements will be realized in the coming decade through the construction of the next generation of instruments. The result would be a watershed of new discoveries." [65]

"Here we (re)define the WHIM as gas with over densities lower than that in haloes ($\rho/\bar{\rho}$ _ 100 today) and temperatures T > 105 K, to more closely align it with the 'missing baryons' that are not easily detectable in emission or Lyα absorption." [67]

"Hence, our revised definition more closely reflects the idea that the WHIM is the repository of the 'missing' cosmic baryons." [68]

“A particularly promising application of this is tracing the missing baryons with wide Ly lines because, unlike relying on high-ionization metal lines such as OVI (e.g. Tripp, Savage & Jenkins 2000) or OVII (e.g. Nicastro et al. 2005), HI line widths are independent of metallicity.” [69]

“Astronomers have long inferred that most of the material in the universe is invisible, existing as mysterious dark matter. But a recent study suggests that most ordinary matter is hidden as well.” [70]

“Some scientists had proposed that the missing stuff might be hidden in extended halos of gas surrounding galaxies, but University of Michigan astronomer Joel Bregman has dealt a blow to that idea. Studying light from distant stars that had filtered through the Milky Way’s halo, Bregman determined that “the matter really isn’t there,” he says. He suggests that perhaps much of the hot gas in the early universe was never captured by galaxies at all and instead remained scattered invisibly through intergalactic space.” [70]

Conclusion

Not only is the cold dark invisible matter missing so is the visible Hydrogen!

8. The Missing Dark Energy

Another interesting thing is dark energy. If dark matter is in doubt so should dark energy. The nature of this strange energy is still unknown.

“The main question to consider now has to be whether to accept the evidence for detection of dark energy.” [71]

“The physical nature of dark energy is not yet understood. Several explanations have been put forward including the presence of smoothly-distributed energy such as a cosmological constant or a quintessence scalar field, a large-scale modification to Einstein’s theory of General Relativity, or the effects of spatially-varying curvature in an inhomogeneous Universe.” [72]

“The main concern of this approach is that these fitting formulae may only be valid for the subset of cosmologies and galaxy formation models in which they were derived (an important point given the unknown nature of dark energy).” [72]

As far as dark matter haloes goes, section three of this essay discusses haloes around galaxies and that they do not line up with dark mater predictions.

“In addition, the form of F and the value of Σv depend strongly on details such as galaxy type, dark matter halo mass and satellite fraction.” [73]

Conclusion

Dark energy like dark matter has never been observed.

9. The Missing Galactic Bulges

“Jonathan Feng, a particle physicist and cosmologist at the University of California, Irvine, thinks we may have to accept that there is no “one size fits all” explanation for how galaxies come to be.” [74]

“Galaxies are complicated and we don't really know how they form. It's really an embarrassment.” [74]

“All that means we are left rather in the dark. ‘We need some measurements, some tests, of the nature of dark matter,’ says Peebles - until we do, we won't have any idea of its true influence on galaxy formation.” [75]

“That means there should be fewer smaller galaxies than the standard cosmology permits.” [75]

John Kormendy in The Astrophysical Journal [76] also talks about the issue of spiral galaxies not having bulges.

Conclusion
The origin of galaxies is still unknown.

10. Massive Star Formation

"The formation of massive stars is one of the major unsolved problems in stellar astrophysics. However, only few if any of these are found as single stars, on average massive stars have more than one companion." [77]

"The third problem is that the formation of massive binaries seems to require an extreme fine tuning, especially in terms of the impact parameter." [77]

"The birth of massive stars remains one of the outstanding problems in star formation." [78]

"There are currently two competing ideas as to how massive stars form." [79]

"Despite this importance, massive star formation is a poorly understood process. Observational studies are hampered by the distance to massive star-forming regions, and the high degree of obscuration in such regions. From a theoretical point of view, the very existence of massive stars presents a challenge." [80]

"The problem of massive star formation (O & B stars with masses >8 M) still represents a challenge from both a theoretical and observational point of view." [81]

"Our current understanding of massive star-forming regions remains poor, despite their importance in the structure and evolution of galactic systems, due to their strong feedback." [82]

"The lack of a detailed, observationally based evolutionary sequence for massive young stellar objects (MYSOs) limits our understanding of the early stages of high mass ($M > 8 M_\odot$) star formation." [83]

"Although high-mass ($> 8 M_\odot$) stars are clue pieces in the Universe and galaxy evolution, many questions remain open concerning their formation process. The root of the problem is that the Kelvin-Helmholtz timescale for a high-mass star is much shorter than the free-fall timescale of the natal core, and thus the star reaches the main-sequence while still accreting matter." [84]

"The onset of massive star formation is not well understood because of observational and theoretical difficulties." [85]

"The second drastic problem in the context of massive star formation is how to avoid fragmenting the massive cores in many objects." [86]

"Though they are important, in the shaping and evolution of their host galaxies, the physics of the formation and evolution of massive stars is unclear." [87]

"We identify a "supernova rate problem": the measured cosmic core-collapse supernova rate is a factor of 2 smaller (with significance 2) than that predicted from the measured cosmic massive-star formation rate." [88]

"The exact steps that lead to the formation of a high-mass star are not completely understood." [89]

"The formation of massive stars is currently an unsolved problems in astrophysics." [90]

"I review models for the evolution of these objects from the observed massive core phase through collapse and into massive star formation, with particular attention to the least well understood aspects of the problem: fragmentation during collapse, interactions of newborn stars with the gas outside their parent core, and the effects of radiation pressure feedback." [91]

“This has implications for a number of outstanding problems in star formation, including the mechanism of massive star formation, the origin of the stellar initial mass function and its relationship to the core mass function, the demographics of massive binaries, and the equation of state in star-forming gas.” [92]

“The physical mechanism that allows massive stars to form is a major unsolved problem in astrophysics. Stars with masses > 20 M_o reach the main sequence while still embedded in their natal clouds, and the immense radiation output they generate once fusion begins can exert a force stronger than gravity on the dust and gas around them. They also produce huge Lyman continuum luminosities, which can ionize and potentially unbind their parent clouds. This makes massive star formation a more daunting problem than the formation of low mass stars.” [93]

“There remains, however, the problem of getting mass from the core onto a star. This is potentially difficult because massive protostars have short Kelvin-Helmholtz times that enable them to reach the main sequence while they are still forming from their parent clouds.” [92]

11. Binary Star Formation

Evolutionists believe that binary stars are the product of the Big Bang explosion and random evolution. They currently admit that there is no consensus as to how they formed:

“The formation of binary stars remains a subject of active research and debate.” [94]

“We have no idea how short period binaries with periods much shorter than 3–5 days form. In fact, such binaries, particularly those with periods shorter than 1 day, should not exist: indeed, even if some unknown process formed contact binaries at the T Tauri stage, the relatively large sizes of the component stars would imply that the resulting orbital periods be longer than about 3–5 days.” [95]

“Formation of binary and multiple stars is a subject of active research and debate, still remaining one of the major unsolved issues.” [96]

“There are two primary reasons for this lack of predictive power. First, the results of fragmentation calculations depend sensitively on the initial conditions, which are poorly constrained. The second problem is that of accretion.” [97]

“The relative frequency of stable hierarchies in our simulations is generally comparable to those observed in MSC, but with some notable exceptions.” [98]

“Even if every disc undergoes an interaction, as might happen during dynamically triggered star formation, then the capture rate is extremely low unless the stars initially have a very low velocity dispersion.” [99]

“The magnitude of the energy transfer calculated in our simulations is greater than that of the binding energy of material exterior to periastron by a factor of two in the prograde case, and up to a factor of five in the case of the retrograde encounter. The destructive nature of the encounters indicates that a non linear treatment is essential in all but the most distant encounters.” [100]

“There are a comparable number of double neutron star systems compared to isolated recycled pulsars. We find that standard evolutionary models cannot explain this fact, predicting several times the number of isolated recycled pulsars than those in double neutron star systems.” [101]

“With the currently available limited sample we are having problems constraining the evolutionary parameters.” [102]

“The main problem arises from the fact that the pulsar’s magnetic field needs to be quenched without a significant spin-up. Possibly our understanding of the accretion physics is incomplete and future studies could solve the problem with spinning up those mildly recycled pulsars.” [103]

“How the spiral-in of the neutron star in the common envelope goes in detail is not known, and more extensive calculations are needed to pin this down.” [103]

"We do not know whether the neutron star in spiral-in tidally disrupts the core, or whether it merges with the core, before or after turning into a black hole, etc. However, it is clear that essentially no neutron stars survive the spiral-in." [103]

"Our arguments may suggest that in the standard evolutionary model for, e.g., PSR 0655 + 64 the neutron star would not survive a common envelope with the companion star, as the latter evolved." [103]

"Our calculations and estimates suggest that the standard scenario for forming binary pulsars, in which the neutron star from the first explosion spirals in through the hydrogen envelope of the secondary, does not, in general, work." [103]

According to two different articles the gas cloud accretion theory is flawed. [104, 105]

"Unfortunately, the current state of theoretical models falls short of the present and upcoming data. At the root of the theoretical difficulties is the range of extreme physical conditions encountered in many of the observed systems: high magnetic fields, angular momentum, degenerate matter, neutrino effects, etc." [106]

"That the merging rates derived from evolutionary calculations are higher, by two orders of magnitude, than those based on binary pulsar statistics only." [107]

"We wish to answer the question of why estimations of merging rates obtained from pulsar statistics are systematically less, by two orders of magnitude, than those obtained from evolutionary calculations." [107]

"We repeat, however, that the Maxwellian kick velocity distribution would be in strong disagreement with binary pulsar fractions even at low kick velocities." [107]

"The formation of massive stars is one of the major unsolved problems in stellar astrophysics. However, only few if any of these are found as single stars, on average massive stars have more than one companion." [108]

"Therefore, disk fragmentation cannot yield nearly equal mass spectroscopic binaries which are so prevalent among the observed massive binaries. Also, disk fragmentation produces only wide binaries, of order 10 - 100 AU, comparable to the radial disk extent." [108]

"The second problem with this model is the difficulty to first promote and then to avoid stellar mergers." [108]

"The third problem is that the formation of massive binaries seems to require an extreme fine tuning, especially in terms of the impact parameter." [108]

"The interplay between stellar dynamics and stellar evolution, as external and internal factors modifying the binary properties, is highly complex, and many details of these processes are not well understood" [109]

"A comprehensive theory of binary star formation is still lacking, including explanations for the observed statistical properties of binary and multiple systems – such as multiplicity fractions, periods, eccentricities and mass ratios." [110]

"The formation of close (1 AU), or even spectroscopic binaries (< 1 AU), which contribute a significant fraction to the observed binary populations, is less clear." [110]

"The birth of massive stars remains one of the outstanding problems in star formation." [111]

"The origin of the initial mass function (IMF) has been extensively debated in the literature." [111]

"However, a quantitative prediction of the star formation rate and the initial distribution of stellar masses remains elusive." [112]

"The process of star formation, particularly the origin of the stellar initial mass function (IMF), is a fundamental problem in astrophysics." [113]

"The binary-star problem is thus potentially worse in less dense clusters, because binary systems survive for longer." [114]

"There are currently two competing ideas as to how massive stars form." [116]

"The formation of close binary stellar systems is an as yet unsolved problem in the field of star formation." [117]

"The formation of high-mass stars is a large unknown in modern astronomy." [118]

"Forming close binary stars systems, is difficult even amongst lower-mass stars." [118]

"The comparison with observational data also illustrates two problems with the simulation results." [119]

"We can hope that various uncertainties in the model may be clarified by a careful comparison of the models with such observed quantities as rotation periods." [120]

"Not only do we have to guess more initial quantities, including spin periods and eccentricity as well, but we also have considerable uncertainty in the coefficients governing the tidal friction and dynamo models." [120]

"Most stars – especially young stars – are observed to be in multiple systems. Dynamical evolution is unable to pair stars efficiently, which leads to the conclusion that star-forming cores must usually fragment into ≥2 stars." [121]

"It has been shown that it is not possible to reproduce the observed f_{mult} through the dynamical evolution of star clusters that are born with a single-star population. Dynamical interactions are able to disrupt many wide binaries, but are not able to pair stars efficiently or significantly change the properties of close binaries. This leads us to the conclusion that the majority of stars must form in multiple systems." [121]

"The generally high f_{mult} for pre-main sequence late-type stars uncovers an elementary discrepancy between observation and star-formation theory if cloud cores produce $N > 3$ stars." [121]

"These conclusions place strong constraints on theories of star formation. For any theory of star formation to match observations the majority of cores *must* fragment into multiple objects. However, they can usually only fragment into 2 or 3 stars. The currently available theoretical results appear to be inconsistent with this, as the cloud-core fragmentation calculations typically form $N = 5-10$ fragments per core." [121]

"The observational result that poses the greatest challenge to theory is that both the inferred delay time between cloud formation and star formation and the ages of the young stars present can be considerably smaller than the lateral crossing time or dynamical time of the star formation region, suggesting that some kind of external 'triggering' must be involved." [122]

"The available cloud-collapse calculations have not been able to reproduce the wide range of observed periods and, in particular, do not lead to short-period ($P<10^3$ days) systems." [123]

"Despite this importance, massive star formation is a poorly understood process. Observational studies are hampered by the distance to massive star-forming regions, and the high degree of obscuration in such regions. From a theoretical point of view, the very existence of massive stars presents a challenge." [124]

"Another important constraint casting doubt on the possibility of planet formation by GI even at 100 AU comes from comparing observed masses of extrasolar giant planets." [125]

"We have shown that disks capable of producing giant planets by GI at 1 AU cannot exist on dynamical grounds—to cool efficiently, they must be too hot to be bound to the central star. This rules out the possibility of an in situ formation of close-in extrasolar giant planets by GI." [125]

"The question of binary star formation is now regarded as the central unsolved issue in star formation, given the observational evidence that the majority of stars are in binary systems both during the main sequence (e. g. Duquennoy and Mayor 1991, Fischer and Marcy 1992, Abt 1983) and pre main sequence stages" [126]

"Unfortunately, numerical simulations of the growth of the bar mode into the non linear regime have repeatedly shown that fission does not occur for compressible fluids such as stars." [127]

"In terms of forming close binaries, star-disk capture is unlikely to play a large role as the capture cross section is the disk size and thus would generally result in binaries of 100 AU." [127]

"The remaining capture mechanism, tidal capture, also requires high stellar density which is unlikely to be a general occurrence." [127]

"However, the fragmentation hypothesis, and in particular the numerical calculations which support it, also have a number of problems." [128]

12. Numerous Unsolved Problems

The Iron Discrepancy In Elliptical Galaxies[129]
A macroscopic discrepancy emerges between the expected iron abundances in the hot interstellar medium (ISM) and what is indicated by the X-ray observations, especially when allowance is made for the current iron enrichment by Type Ia supernovae. This strong discrepancy, that in some extreme instances may be as large as a factor of D20, calls into question our current understanding of supernova enrichment and chemical evolution of galaxies. Page 128

There is clearly a macroscopic discrepancy between the expected abundance, even with the lowest SN Ia enrichment, and what is consistently indicated by the X-ray observations of elliptical galaxies with four different X-ray telescopes: BBXRT and those on board Ginga, ROSAT, and ASCA. Instrumental problems, such as calibrations and the like, can therefore be firmly excluded as the origin of this iron discrepancy. Note also that the discrepancy is exacerbated by another factor of D2 if a short distance scale is adopted (h50\2). We believe that the solution of the discrepancy, whatever it is, will have profound implications for our understanding of galaxy formation and evolution. Page 129

The iron abundance of ISM should then be at least twice solar, and the discrepancy factor appears to range from 4 to 20. It may actually be even larger, considering that stellar abundances in Figure 2 are luminosity- rather than mass-weighted. Page 133

A comparison of the iron abundances as inferred from optical observations of the starlight and from X-ray observations of the hot ISM has then revealed a major discrepancy: even neglecting any ISM enrichment from SN Ia', the stellar iron abundances exceed those derived for the hot ISM by factors that range between 2 and 10. Page 134

We believe that the optical and the X-ray abundances cannot be easily reconciled, and therefore the existence of this macroscopic discrepancy opens three main options. Page 134

Here we mention yet another, admittedly exotic solution to the iron discrepancy. Page 138

Yet the iron abundance in the latter galaxies is as low as, or even lower than, that of cluster members. We conclude that dilution does not offer a viable solution either. Page 138

This strong discrepancy appears to shake our understanding of supernova enrichment and chemical evolution of galaxies. Page 141

Discrepancy In Globular Cluster Systems[130]
One of the conundrums in extragalactic astronomy is the discrepancy in observed metallicity distribution functions (MDFs) between the two prime stellar components of early-type galaxies—globular clusters (GCs) and halo field stars. Page 150

The cause of the discrepancy between these two prime stellar components of galaxies has been the topic of much interest both on theoretical (e.g., Beasley et al. 2002, 2003; Pipino et al. 2007) and observational grounds (e.g., Forbes & Forte 2001; Forte et al. 2005, 2007; Liu et al. 2011) because the disagreement signifies highly decoupled evolutionary paths between GC systems and their parent galaxies. Page 150

However, ever since *direct* photometry of spatially resolved constituent stars in a dozen nearby galaxies became possible thanks to the *HST* and large ground-based telescopes, the discrepancy between the MDFs of GCs and field stars has remained a conundrum. Page 167

However, whether the inferred GC MDFs represent the intrinsic, true ones are still unproven, and so it may be partly a coincidence. Page 167

Metallicity-Dependent Star Formation[131]

In contrast, the observed metallicity distributions of dwarf galaxies or stars within them are not bi-modal. We argue that this discrepancy points to substantial early stochastic pre-enrichment by Population III stars. Page 68

We interpret this apparent discrepancy between theoretical expectation and observations as indication that gas within regions where first Population II stars were formed was pre-enriched by Population III stars to metallicities as high as $\sim 10^{-2}$. Page 69

This discrepancy can have different explanations and we discuss some of them below. Page 72

The interpretation of this discrepancy is less certain, given that the sample of dwarf galaxies shown in the figure is not volume limited. Page 72

Blue Luminous Stars In Nearby Galaxies[132]

A comparison with the predictions of current stellar evolutionary models indicates that there are significant discrepancies, in particular with regard to the degree of chemical processing, with the models predicting a much lower degree of O depletion than observed. At the same time, the mass-loss rate derived in our analysis is an order of magnitude lower than the values considered in the evolutionary calculations. Page 39

This discrepancy between theoretical predictions and Hα and radio continuum derived mass-loss rates for mid-B types has been previously reported for Small Magellanic Cloud (Trundle & Lennon 2005) and Galactic (Crowther et al. 2006; Markova & Puls 2008; Benaglia et al. 2008) super giants. We refer the reader to Markova & Puls (2008), where this dilemma has been discussed at some length. In fact, in the case of UIT 005, the high theoretical mass-loss rate is also not consistent with the observed SED (see below). Page 48

This picture is supported by the predictions of recent evolutionary models, although we must point out that some discrepancies are still present, such as the degree of chemical processing predicted by the models. Page 49

The Sagittarius Dwarf Galaxy[133]

The discrepancy between the abundance derived from the oxygen ORL and that derived from the collisionally excited line is >1 dex. Page 39

We found that the discrepancy between O^{2+} ORL and CEL abundances is >1 dex. TheO^{2+} discrepancy has been found in many PNe including BoBn1 (see Section 4 of Otsuka et al. 2010). Page 45

In this paper, we will not examine the O discrepancy problem further. To resolve the O abundance discrepancy, it is necessary to obtain high-dispersion spectra to increase the chance of OII detections and properly de-blend these OII lines with the others. Page 46

The large discrepancy between the observed [O ii] λ3726/29 line fluxes and the model might be due to the flux calibration uncertainty around 3700 Å and the adopted monotonically decreasing R^{-2} density profile. Page 49

The large discrepancy between the 2MASS *Ks* and the models might be due to the contribution from the H_2 line. Page 49

Galaxies Of The Local Group[134]
This is smaller, by about a factor of 2, than the well-known discrepancy between theory and observation at low metallicity commonly derived for Galactic globular clusters (GCs). This result is confirmed by a comparison between the adopted theoretical framework and empirical estimates of the $\Delta V_{\rm bump}$ parameter for both a large database of Galactic GCs and for four other dwarf spheroidal galaxies for which this estimate is available in the literature. Page 707

In order to understand the causes of the discrepancy existing for Galactic GCs, a detailed analysis of the possible observational biases (uncertainties) is mandatory, but this is beyond the scope of the present work. Page 714

The comparison between the observations and the theoretical predictions reveals that the well-known discrepancy between the observed and predicted brightness of the RGB bump seen in Galactic GCs is smaller, by more than a factor of 2 in our dSph sample. This evidence is supported by the inclusion of four additional dSph galaxies, for which the $\Delta V_{\rm bump}$ values are available in the literature. Page 715

Evidence For Mass-Dependent Evolution[135]
The discrepancy at the high-mass end is susceptible to uncertainties in the models and the data, but the discrepancy at the low-mass end may be more difficult to explain. Page 1765

While the discrepancies at the low-mass end are still present, the discrepancies at the high-mass end are significantly reduced. Page 1784

Convolving the model-predicted SMFs does not instead help at all to solve the discrepancies below the characteristic stellar mass. Page 1785

As already pointed out in Somerville et al. (2008), potentially serious discrepancies, common to all of the CDM-based semi analytic models, are connected with low-mass galaxies. This is indeed what we find, although the presence of a significant population of very massive galaxies out to red shift $z \sim 3$–4 and the little observed evolution in its number densities from $z = 4.0$ to $z = 1.3$ highlight other potential problems within the theoretical models. Page 1785

The discrepancy at the high-mass end is susceptible to uncertainties in the models and the data, but the discrepancy at the low mass end may be more difficult to explain. Page 1787

included in the error budget (bottom panels of Figure 18). However, the discrepancy at the low-mass end is still present and significant. Page 1791

This "discrepancy" thus indicates that they appear to be C-enhanced beyond what is expected from canonical stellar evolution (i.e., the level of the mixed stars). This would mean that the stars must have been born from material that was overabundant in carbon. Page 571

Extremely Metal-Poor Stars[136]
This agreement contrasts with the results of earlier studies of more metal-rich stars ($-2.5 <$ [Fe/H] < -1.0) in more luminous dwarf spheroidal galaxies, which found significant abundance discrepancies with respect to the MW halo data. Page 560

Vhb Parameter In Globular Clusters[137]
Evolutionary models that account either for α- and CNO-enhancement or for helium enhancement do not alleviate the discrepancy between theory and observations. The outcome is the same if we use the new solar heavy-element mixture. Page 527

This discrepancy does not depend on the adopted metallicity scale and becomes strongest in metal-poor ([M/H] < -1.5) GCs. Page 530

Such a discrepancy can hardly be explained as a spread in cluster age. Page 530

Given the limited changes between the current and previous predictions, the discrepancy between theory and observations in the metal-poor tail is confirmed and reinforced by the inclusion of new GCs in this metallicity regime. Page 531

The current discrepancy between theory and observations is little affected by the new solar heavy-element mixture provided by Asplund et al. (2005, hereinafter A05). Page 534

Evolutionary models that include either α- and CNO-enhancement or helium enhancement do not alleviate the discrepancy between theory and observations. Page 535

The above discrepancy between theory and observations is not affected by the new solar heavy-element mixture. Page 535

Heavy-Element Abundances[138]
We discuss the apparent discrepancy between abundance ratios N/O measured in BCGs and those in high-red shift damped Lya galaxies, which are up to 1 order of magnitude smaller. We argue that this large discrepancy may arise from the unknown physical conditions of the gas responsible for the metallic absorption lines in high-red shift damped Lya systems. Page 539

The discrepancy between theory and observation is much more important for N. The N yield inferred from observations is 1 to more than 2 orders of magnitude larger than the theoretical yields of models with subsolar metallicities (Table 7). Page 652

Si, Ti, And O Isotopic Ratios[139]
These discrepancies probably reflect errors in the supernova models used to calculate the GCE paths. Page 222

Apart from underestimating the fraction of dredged-up He-shell material, mixing of the normalized GCE models and He-shell material cannot explain several other features of the grain data. The steeper slope and non solar intercept of the mainstream Si isotope trend is the most obvious discrepancy. Page 228

Galactic Globular Cluster Stars[140]
In light of this serious discrepancy, which casts doubt on the adequacy of low-mass He-burning stellar models, we have re derived the initial He abundance for stars in two large samples of GGCs by employing theoretical models computed using new and more accurate determinations of the equation of state for the stellar matter. Page 862

This large discrepancy between the CMB and R parameter results casts doubt on the ability of stellar models to accurately predict the evolutionary times of these crucial phases of stellar evolution. Page 863

Color-Magnitude Diagram Age Discrepancy[141]
Using a new age indicator, Ha 130 which is particularly effective at breaking the degeneracy between age and metallicity, we confirm the discrepancy between the spectroscopic age and the CMD age of 47 Tuc, in that the spectroscopic age is much older. Page 274

This discrepancy shows clearly that current stellar population synthesis models used for interpreting the integrated light of stellar systems may have severe zero-point problems. Page 274

13. Many More Unsolved Mysteries

The formation of Blue Galaxies.
"These galaxies represent a highly evolving class that may play an important role in the decline of star formation since z = 1, but their exact nature and evolutionary pathways remain a mystery." [142]

"The explanation for the existence of an excess population of faint blue galaxies (FBGs) has been a mystery for nearly two decades and remains one of the grand astronomical issues to date. Existing models cannot explain all of the observational data, such as galaxy number counts in the optical and infrared pass bands and the red shift distributions of galaxies." [143]

Compact Galaxy Groups With Discordant Red Shifts.

"We consider the twin paradoxes posed by compact groups that involve: (1) gravitational instability of physically dense accordant groups and (2) a plethora of discordant red shift components." [144]

<u>The Origin Of Dwarf Galaxies</u>
"Early-type dwarfs are the most common galaxy in the local universe, yet their origin and evolution remain a mystery." [145]

<u>The Faint Sun Problem.</u>
"A moderately massive young Sun has been proposed to resolve the so-called faint young Sun paradox." [146]

<u>Neutron Star Retention In Globular Clusters</u>
"This retention problem is a long-standing mystery." [147]

<u>What Existed Before The Big Bang?</u>
This article has eight sections which are all admitted to be "unknown." [148]

What Existed Before The Big Bang?
"Although such theories, if they were to be proved true, may provide an explanation for what existed before the Big Bang, they do not solve an even more fundamental mystery: why is there something here at all, instead of nothingness?"

Why didn't the Universe Disappear as Soon as it Formed?
"The big bang theory suggests that when time began, matter and antimatter were generated in equal amounts. If that is true, the universe would have been transformed into pure energy—it should have perished in a profusion of radiation when matter and antimatter collided, but it exists."

How Did Galaxy Formation Start?
"What is unclear is why the gas that filled the universe gathered into galaxies."

What Makes up The Universe?
"Dark energy is more complicated, because there are no reliable theories about its composition."

How many dimensions are there?
"Experiments at the Large Hadron Collider have yet to yield results, so chances are we won't get an answer soon."

Are the laws of nature accidental?
"Trying to explain the laws of nature is an almost impossible task, but there have been at least three attempts."

What lies beyond the known universe?
"Further observations of this phenomenon, called dark flow, may yield new findings."

Did Life Originate In Other Places?
"If life is a natural consequence of the laws of nature, it is strange that we have not found signs of it in other places. If there are intelligent creatures in the universe, why haven't we heard from them?"

<u>An Emerald-Cut Diamond in the Rough</u>
"An Australian-led international team of astronomers has discovered a rare, rectangular galaxy that challenges current theories of galaxy evolution. Know by its catalogue designation as LEDA 074886, but now nicknamed the "Emerald-cut Galaxy" for its odd, rectangular shape, "it's one of those things that just makes you smile because it shouldn't exist, or rather, you don't expect it to exist;' says Alister Graham (Swinburne University of Technology), lead author of the study." [149]

<u>Bang Goes The Theory</u>
"PROBLEM: Once inflation starts it cannot stop Bits of the inflating universe themselves begin inflating oft info independent existences. This creates an infinite "multiverse" of universes, making cosmological predictions impossible." [150]

<u>The Existence Of Super Massive Black Holes</u>

“The existence of super massive black holes (SMBHs) as early as z = 7 is one of the great unsolved problems in cosmological structure formation.” [151]

Very Massive Population III Stars

“Super massive black holes (SMBHs; 105 –109 M) are now known to exist in the center of almost all galaxies (e.g., Kormendy & Richstone 1995; Bender 2005), but their formation processes are largely unknown.” [152]

Evolution of Super Massive Stars

“Such models, however, beg the question of how a super massive star might realistically form. Creating a 10^6 M⊙ star requires the very rapid accumulation of gas.” [153]

Evolution of Massive Black Holes

“While there is ample evidence that super massive black holes populate the nuclei of most large galaxies and that some black holes with masses exceeding 109 M⨀ formed as early as z . 6 (e.g., Fan 2001; Barth et al. 2003; Djorgovski et al. 2008; Willott et al. 2009; Jiang et al. 2009), there is little consensus as to the progenitors of these holes.**”** [154]

Supernova progenitor

“The identity of the progenitor systems of type-Ia supernovae (SNe Ia) is a major unsolved problem in astrophysics.” [155]

“Many aspects of type-Ia supernovae (SNe Ia) are still poorly understood (see, e.g., the recent review by Howell 2011, and elsewhere in this Special Issue). In particular, the identity of the progenitor systems of Sne Ia has not yet been established.”

“Both models, SD and DD, suffer from problems, theoretical and observational.”

Dark Matter Searches

“The existence of dark matter (DM) was first noticed by Zwicky in the 1930s, but its nature remains one of the great unsolved problems of physics.” [156]

Proto−Planetary Nebulae Shaping

“The shaping of the nebula is currently one of the outstanding unsolved problems in planetary nebula (PN) research. Several mechanisms have been proposed, most of which require a binary companion. However, direct evidence for a binary companion is lacking in most PNs.” [157]

Origin And Evolution Of Saturn’s Ring System

“The origin and long-term evolution of Saturn’s rings is still an unsolved problem in modern planetary science.” [158]

“The main problem here is how this material may have survived long enough for the subnebula to dissipate.”

“Esposito (1986) noted that most of the age problems involve Saturn’s A Ring. Perhaps the A and F Rings are more recent? This raises the problem of how the material that formed these (possibly more recent) rings had been preserved, perhaps as large, unconsolidated objects with competent solid cores encased in rubble.”

“Thus both the “destroyed satellite” scenario and the “tidally split comet” scenario (discussed below) face the same problem: the current cometary flux is not sufficient, by orders of magnitude, to provide enough large bodies passing close enough to Saturn.” “However, a problem with this scenario in which a moon is broken up so close to the completion of the satellite system is that it is unclear how much solid material may have been around at the tail end of planet and satellite formation.”

The Onset Of Star Formation

“Star formation remains an unsolved problem in astrophysics. Numerical studies of large-scale structure simulations cannot resolve the process and their approach usually assumes that only gas denser than a typical threshold can host and form stars.” [159]

How And When Do Planets Form?

“The formation of planets is one of the major unsolved problems in modern astrophysics.” [160]

A Realistic Cosmological Model

"Not surprisingly I shall show that there remain many unsolved problems, and previously unexpected observations, most of which are ignored or neglected by current observers and theorists, who believe that the hot big bang model must be correct." [161]

"The most difficult problem involving the QSOs was brought to light by Arp in 1987 (see Arp 1987) and others (Burbidge, Burbidge, Solomon and Strittmatter, 1971; Arp, H.C., et al, 2002) who found statistical evidence suggesting that many high red shift QSOs lie so close to low red shift galaxies that they must be physically associated, so the QSO red shifts are not due to the expanding universe."

"However, one of the major problems of cosmology is to understand the origin of galaxies."

"However to explain the existence of galaxies, many unproven assumptions have to be made."

"Also, in order to explain the abundance of the light isotopes and the flatness problem and so on we must invoke the presence of non-baryonic matter for which there is no direct evidence at all."

From Grains To Planetesimals

"This pedagogical review covers an unsolved problem in the theory of protoplanetary disks: the growth of dust grains into planetesimals, solids at least a kilometer in size." [162]

"These trapping mechanisms also slow the migration of solids, a serious problem in its own right."

"Planetesimal formation remains unsolved, despite considerable progress on several fronts. Laboratory studies of collisions place constraints on sticking assumptions (Blum and Wurm, 2008)."

Cosmology And Cosmogony

"An even harder problem is to explain how the massive black holes in galaxies were formed in the first place. Were they formed before the galaxies or later? In the standard model both scenarios have been tried, but no satisfactory answer has been found." [163]

"They present us with an unsolved problem, but one which must be closely connected to the creation process. A remarkable aspect of this problem is that the intrinsic red shifts show very clear peaks in their distribution"

"There are two challenges that still remain, namely understanding the origin of anomalous red shifts and the observed periodicities in the red shifts. Given the QSSC framework, one needs to find a scenario in which the hitherto classical interpretation of red shifts is enriched further with inputs of quantum theory. These are huge problems which we continue to wrestle with."

Models For The Formation Of Massive Stars

"The formation of massive stars is currently an unsolved problems in astrophysics. Understanding the formation of massive stars is essential because they dominate the luminous, kinematic, and chemical output of stars." [164]

"The difficulties in understanding massive star formation lie in that we are not able to fully ascertain the properties of a cloud in which massive stars form or to determine whether the properties we do observe are that of the pristine initial conditions or those due to subsequent evolution."

Critically Rotating Stars In Binaries

"In close binaries mass and angular momentum can be transferred from one star to the other during Roche-lobe overflow. The efficiency of this process is not well understood and constitutes one of the largest uncertainties in binary evolution. One of the problems lies in the transfer of angular momentum, which will spin up the accreting star." [165]

"We briefly discuss several such mechanisms below, noting that how effective most of these mechanisms are is very uncertain."

Rapid Planetesimal Formation

"The initial stages of planet formation in circumstellar gas discs proceed via dust grains that collide and build up larger and larger bodies. How this process continues from metre-sized boulders to kilometre-scale planetesimals is a major unsolved problem." [166]

Massive Stars In The Magellanic Clouds

"Accurate physical parameters of newborn massive stars are essential ingredients to shed light on their formation, which is still an unsolved problem." [167]

"Massive stars (> 8 $M_\odot$) play a key role in several fields of astrophysics. However their formation process is still an unsolved problem in spite of progress, both in theory and observation, in recent years."

"I have also tried to indicate the areas where our understanding remains incomplete, and to identify some of the most important unsolved problems."

Evolution Of Circumstellar Disks

"The mechanism for ultimately terminating the accretion, whether because of a limited mass supply or the effect of out flows from the YSO, remains an unsolved problem." [168]

The Evolution Of Cloud Complexes

"In fact, the maps of close complexes reveal clumps and irregularities on all observed scales and, inclusive, reveal some fractal nature, whose origin is an important unsolved problem." [169]

Implications For Galaxy Evolution

"A major unsolved problem concerns the origin of the stars seen in the metal-rich spheroid components of galaxies, which today includes one-half to two-thirds of all stars." [170]

The Formation Of Stellar Clusters

"The formation of stellar clusters is yet an unsolved problem of theoretical astrophysics." [171]

^{3}He In Planetary Nebulae

"The discrepancy between the observed abundances of ^{3}He in the interstellar medium and those predicted by stellar and Galactic chemical evolution remains largely unexplained." [172]

Evolution Of Interstellar Gas

"The final physical configuration of cooled gas in galactic and cluster cooling flows remains one of the most perplexing unsolved problems in galactic evolution." [173]

"Because of this as yet unsolved problem, we cannot be sure that we have treated the supernova energy correctly in our models, particularly for the high supernova rate solutions."

Neptune's Migration History

"The inclination distribution of the Kuiper Belt is not well matched in this or any model, leaving the source of the high-inclination population of the Kuiper Belt an important outstanding problem." [174]

Accretion In Protoplanetary Disks

"Therefore, an outstanding problem in cosmogony is to understand how, when objects can agglomerate to the critical ~meter scale by known low collisional velocity accretion processes (Dominik et al. 2007; Blum & Wurm 2008; Guttler et al. 2010), they are not then rapidly lost into the central star? Hence, it is sought to reveal the basic mechanisms through which matter can accrete sufficiently rapidly to slow their radial motion and thwart their demise." [175]

Low-Mass X-Ray Binaries

"The origin of millisecond pulsars (MSPs) remains an outstanding problem (see, e.g., & van den Heuvel Bhattacharya 1991). A number of channels of MSP formation have been discussed." [176]

White Dwarfs As Halo Dark Matter

"The nature of the dark matter in the halos of galaxies is an outstanding problem in astrophysics. Over the last several decades there has been great debate about whether this matter is baryonic or must be exotic." [177]

Fragmentation Of Rotating, Adiabatic Clouds

"A major problem in the theory of star formation is determining the forms a collapsing interstellar cloud passes through prior to forming a pre-main-sequence star. While dense interstellar clouds and pre-main-sequence stars have been extensively observed, the intermediate forms have not, because of the presumed rapid evolution in this phase and because of the inherent obscuration of the placental clouds within which stars form." [178]

Supermassive Black Holes And Galaxy Formation

"The formation of super massive black holes (SMBH) is intimately related to galaxy formation, although precisely how remains a mystery. I speculate that formation of, and feedback from, SMBH may alleviate problems that have arisen in our understanding of the cores of dark halos of galaxies. Galaxy formation theory is not in a very satisfactory state. This stems ultimately from our lack of any fundamental understanding of star formation. There is no robust theory for the detailed properties of galaxies." [179]

The First Cosmic Structures And Their Effects

"Despite much recent theoretical and observational progress in our knowledge of the early universe, many fundamental questions remain only partially answered. Here, we review the latest achievements and persisting problems in the understanding of first cosmic structure formation." [180] Page 625

1 The gap between the Big Bang nucleo-synthesis (BBN) metal abundances ($Z = 10^{-10}$ to 10^{-12}) and those observed in the lowest metallicity Pop II stars ($Z = 10^{-4}$ to 10^{-3});
2 The G-dwarf problem, i.e. the paucity of metal-poor stars in the solar neighbourhood relative to predictions from simple models of chemical evolution (van den Bergh, 1962);
3 The oxygen anomaly or enhancement of a-elements in galactic metal-poor stars (Sneden et al., 1979) and the existence of extremely metal-poor stars showing s-process elements in their envelopes (Truran, 1980);
4 The increasing observational evidence for metal-deficient stars populating the galactic halo (Norris et al., 1993; Primas et al., 1994; Sneden et al., 1994);
5 The missing mass in clusters of galaxies and galactic halos (White and Rees, 1978) formed by their dark remnants;
6 The re-ionization of the universe and the starting engine for the formation of the first galaxies;
7 The contaminants of the intergalactic medium as inferred from metallic absorption lines in the Lya forest seen in quasar light;
8 The cosmological helium abundance (Talbot and Arnett, 1971; Salvaterra and Ferrara, 2003b);
9 The formation of massive black holes. Page 643

"The nature of dark matter is likely to remain an extremely challenging problem, which may have intimate connections with the highly debated halo density profiles. Both problems affect the way in which galaxies build up and their observable properties; hence their importance extends beyond the realm of purely theoretical speculations." Page 693"

The Milky Way 3-Helium Abundance

"The ^{3}He abundances we derive have led to what has been called The ^{3}He Problem." [181] Page 53

"Yet Fig. 1 shows the magnitude of the3 He Problem: the abundances predicted by standard chemical evolution models lie far above the observations." Page 56

The First Stars In The Universe

"I have also tried to indicate the areas where our understanding remains incomplete, and to identify some of the most important unsolved problems." [182] Page 445

"Nevertheless, the problem remains a challenging one that involves processes occurring over a very wide range of length scales, from the cosmological to the protostellar." Page 446

"The simplest approach to this problem dispenses entirely with any attempt to accurately simulate the dynamical evolution of the protogalaxy." Page 456

"The biggest problem that we face when trying to simulate protogalactic collapse numerically is the wide range of length scales that we are required to resolve." Page 458

Galactic Evolution Of D And ^{3}He

“This has not yet led to a unique solution to the galactic evolution problem, but has at least reduced the range of possible values for the adjustable parameters.” [183] Page 207

“We haven’t been able to find models with higher D destruction which are able to satisfy all the other galactic constraints.” Page 216

Synthesis Of Heavy Elements

“A more serious problem for the r-process models presented here may arise from the total amount of r-process material which is expected to be produced over the age of the Galaxy.” [184] Page 684

The Origin Of The Solar System

“A persistent problem with the thermal condensation picture has been the presence of relatively volatile elements (e.g. Na, C1) in quite substantial amounts.” [185] Page 153

“The astrophysical justification of such an assumption has always been shaky. Star formation is observed to occur in cold dusty clouds rather than in hot ionized gas. Proponents of a hot-vapor model must call upon the gravitational energy released by the collapsing sun and the transfer of that energy to more distant parts of the nebula wherein the meteorites are forming. The problem is formidable, and it has seemed increasingly plausible in the past few years that the accretion disk at several AU from the center will never have been hotter than 1000 K, if that hot.” Page 155

“The basic problem is the lack of a ready supply of energy to heat the entire nebula or disk, so that one is left with schemes that instead concentrate what available energy there is in the attempt to heat and vaporize a selected fraction of the interstellar dust.” Page 156

“The fact that the observed ratio was 50 times smaller than continuous nucleosynthesis would be expected to maintain was a problem: on the one hand it was far too much to have survived from synthesis near the beginning of Galactic history, and on the other hand it suggested that nucleosynthesis was not continuous up to the time of formation of the meteorites.” Page 165

“The overall problem of star formation is too large and too unclear to be reviewed here.” Page 184

“The resulting spiral patterns are sobering to advocates of galactic density waves. Because the density-wave model has nagging problems of its own (e.g. Toomre, 1977) we can expect only a long and tortuous path to a clearly correct understanding of star formation.” Page 186

“A detailed model of how, where and when meteoritic solids formed must stand on its own feet, since the grave problems there involve specifically the chemical ontology of laboratory samples. What is still missing is an understanding of how isotopically anomalous meteoritic samples could have arisen as a result of the compression of a cold cloud by a surrounding supernova remnant.” Page 187

Saturn’s Rings

The general problem of ‘short timescales’ in planetary rings, and specifically in Saturn’s rings, was recently reviewed by Cuzzi (1995) and by Dones (1997), who differ on the robustness of the arguments for a recent origin of Saturn’s rings (see section 3.3).” [186] Page 226

“Answering the ‘big questions’ of, for instance, the origin and age of Saturn’s rings will require combining the observations from most of the instruments on the spacecraft.” Page 233

The Growth Of Planetesimals

“However, the diversity amongst extra-solar planets and some of their amazing characteristics have demonstrated that planet formation is still not fully understood. It is therefore not clear whether this collisional accumulation of dust to planets has really occurred as described.” [187] Page 279

“Hence, we believe that collisions between comparable sized rubble piles or fluffy planetesimals can not be the solution to the erosion problem found in solid body collisions.” Page 287

"We found that for 10 km-sized bodies, collisions occurring at velocities in excess 2:6 times escape velocity, lead to erosion rather than to accretion regardless of parent body structure. Scaling this result, implies that for 1 km radius solid planetesimals, growth is only possible if they collide at velocities less than 3.2 m/s. For smaller objects the critical velocity is reduced accordingly to reach 3.2 mm/s for 1 m radius objects! Rubble pile planetesimals require even lower relative velocities. Planetesimals are unlikely to collide with such small relative velocities and thus gravity cannot be responsible for growth in objects smaller than a few kilometers." Page 292

The Cosmological Constant Problem
"This gravitational vacuum field is analogous to the vacuum fields of the other interactions, and herein lies the problem: astrophysical data shows |Λ| to be small, whereas unified theories of the interactions predict a massive value. This discrepancy is a trifling 10^{120} or so." [188] Page 332

The Identity Of Dark Matter
"However, there is no clear consensus about what the dark matter may be. It could be astrophysical in nature, such as massive compact objects or brown-dwarf stars. Or it could be particles, which can be classified as 'hot' or 'cold' depending on their kinetic energies." Page 335

The Microwave Background Horizon Problem
"This arises because the microwave background is believed to have been produced in the fireball that followed the big bang, but the field today is too uniform in temperature to be compatible with standard cosmological models based on general relativity." Page 335

"However, while much has been written about the horizon problem for the photons of the microwave background, this problem is only part of a larger one to do with causality." Page 335

The Origin Of Galaxies And Other Structure
"In the gravitational instability picture, small statistical perturbations in the early universe grow through gravity in an expanding fluid. However, the growth rate is too slow to produce galaxies as observed in a reasonable time. This problem can be overcome in principle by assuming the presence of larger-than-random seed perturbations." Page 339

"It is clear from a more modern perspective that both of the above approaches contain ad hoc features and are simplistic." Page 339

The Origin Of The Spins Of Galaxies
"However, there is a consensus that for the Milky Way at least, the theoretical angular momentum is almost an order of magnitude smaller than that observed. This could be due to shortcomings in the astrophysical parameters of the model; but it could also be due to some more basic reason involving the laws of dynamics in the early universe."

"The spins of galaxies, while problematical in origin, provide a good data set for testing fundamental physics." Page 340

The Angular Momentum/Mass Relation
"Objects other than galaxies have spins, and it has been known for a long time that when the angular momenta J are plotted against the masses M in a log/log plot, the result is a straight line with a slope close to 2 (for a review see Wesson 1981). This holds for asteroids, planets, stars and galaxies. There have been many mechanisms proposed to account for this, but none has gained widespread acceptance." Page 340

14. Galaxy Formation Problems

Origin Of Angular Momenta In Galaxies
"One of the most important but unsolved until now problems in modern extragalactic astronomy and cosmology is the origin of large scale structures." [189]

The Origin Of Angular Momenta Of Galaxies
"The problem of the origin of large scale structures is till now one of the most enigmatic ones." [190]

"It could be accepted that gaining of angular momenta for galaxies in structure is a rather complicated problem, in which several mechanism played roles."

Stellar Feedback In Galaxies

"Feedback from massive stars is critical to the evolution of galaxies. In cosmological models of galaxy evolution without strong stellar feedback, gas rapidly cools and turns into stars, leading to galaxies with star formation rates much higher than observed, and ten times the stellar mass found in real galaxies (e.g. Katz et al. 1996; Somerville & Primack 1999; Cole et al. 2000; Springel & Hernquist 2003b; Kereš et al. 2009a, and references therein). Simply suppressing the rate of star formation does not solve the problem: the amount of baryons in real galactic disks is much lower than the amount of cool gas in disks found in cosmological simulations, especially in low-mass galaxies (White & Frenk 1991; for a recent review see Kereš et al. 2009b)." [191]

"Constraints from the mass-metallicity relation and enrichment of the IGM also imply that the baryons cannot simply be prevented from entering galaxy halos along with dark matter (Tremonti et al. 2004; Erb et al. 2006; Aguirre et al. 2001; Pettini et al. 2003; Songaila 2005). Some process must very efficiently remove baryons from galaxies."

"Related problems appear on smaller spatial and time scales. The Kennicutt-Schmidt (KS) law implies that star formation is very slow within galaxies, with a gas consumption time of 50 dynamical times (Kennicutt 1998). Moreover, the integrated fraction of mass turned into stars in GMCs over their lifetime is only a few to several percent (Zuckerman & Evans 1974; Williams & McKee 1997; Evans 1999; Evans et al. 2009). Without strong stellar feedback, however, self-gravitating collapse leads to most of the gas turning into stars in just a few dynamical times."

"The problem, then, on both galactic and sub-galactic scales, is twofold. First, star formation must be "slowed down" at a given global/local gas surface density. But this alone would still violate integral constraints, producing galaxies and star clusters more massive than observed by an order of magnitude. Thus the second problem: on small scales gas must be expelled from GMCs, and on galactic scales either prevented from entering, or, more likely in our judgment, removed from, the host galaxy. In other words, local outflows and global super-winds must be generated that can remove gas at a rate rapid compared to the star formation rate."

Understanding Galaxy Formation And Evolution

"Our understanding of galaxy formation and evolution is in its infancy. So far, only the first steps were given in the direction of consolidating a theory in this field. The process is apparently so complex and non–linear that several specialists do not expect the emergence of a theory in the sense that a few driving parameters and factors might explain the main body of observations." [192]

"However, there are still unsolved issues at the intermediate level: for example, the central halo density profile of galaxies is inferred from observations of inner rotation curves under several assumptions that could be incorrect."

Galaxy Formation

"I also discuss five key unsolved problems in galaxy formation and prognosticate advances that the near future will bring."

1. What does a proto galaxy look like?
2. When/how did each component of the Galaxy form?
3. When/how did galaxy sequences evolve?
4. What role did feedback play?
5. When/how was the universe re-ionized? [193]

Dark Energy, Curvature, And Cosmic Coincidence

"The fact that the energy densities of dark energy and matter are similar currently, known as the coincidence problem, is one of the main unsolved problems of cosmology." [194]

"This recipe for the universe gives rise to what became known as the cosmic coincidence problem: why are dark energy and dark matter energy densities of the same order of magnitude in the present epoch? This problem arises because dark energy must have a negative pressure to accelerate the universe, and cold dark matter (as well as baryons) has vanishing pressure."`

Reconstructing Galaxy Histories

"Nearly a century after the true nature of galaxies as distant "island universes" was established, their origin and evolution remain great unsolved problems of modern astrophysics." [195]

Smoothed Particle Hydrodynamics

"There are only a handful of known cases of massive counter rotating disks in spiral galaxies to date, and yet counter rotation in spirals cannot be deemed a rare phenomenon by any standards. There are hints that it may be quite common, in fact, in early-type spirals, particularly S0s (Kuijken, Fisher, & Merrifield 1996). The origin of any, counter rotating mass (gas or stars) within a spiral disk is an important unsolved problem with profound implications for the formation and evolution of all spiral galaxies, but the existence of a significant retrograde mass component (comprising anywhere from 10% to 50% of the total mass of the disk system) is a particularly intriguing question that threatens to radically alter our view of the evolution of spiral galaxies." [196]

"It is very unlikely that counter rotating systems can be produced indigenously or as a by-product of the galaxy formation process. The theory of formation of a spiral galaxy from a spinning proto galactic cloud does not admit the possibility of bidirectional spin being imparted to the disk system."

Bulges Of Spiral And Lenticular Galaxies

"The galaxy consists of two distinct components, disks and bulges, and how they formed is an outstanding problem in the galaxy formation." [197]

Feedback In Galaxy Clusters

"The requirements to solve the outstanding problems in cluster feedback posed by Chandra should be one of the benchmarks for future large X-ray missions, such as the International X-ray Observatory (IXO)." [198]

The Nature Of Red Dwarf Galaxies

"An outstanding problem for all galaxy formation models concerns the low-mass slope of the galaxy mass function. CDM models in general predict too many low-mass dark matter halos compared to the number of low-mass galaxies." [199]

The Nature Of Weak Emission-Line Quasars

"However, such observations will not resolve the missing parent population of 'typical' (i.e., X-ray- and radio-bright) BL Lacs at high redshift, which remains an outstanding problem for any model attempting to unify WLQs and BL Lacs." [200]

Tidal Imprints Of A Dark Sub-Halo

"The detection and characterization of the ubiquitous dark matter in the universe is an outstanding problem in modern astrophysics." [201]

Dynamical Mechanisms For Cluster Galaxy Evolution

"The determination of the dynamical causes of the morphological Butcher-Oemler (BO) e.ect, or the rapid transformation of a large population of late-type galaxies to earlier Hubble types in the rich cluster environment between intermediate red shifts and the local universe, has been an important unsolved problem which is central to our understanding of the general problems of galaxy formation and evolution." [202] Page 2

"However, an obvious problem with this proposed explanation is why mergers in cluster outskirts would selectively eliminate only the high-density spirals but not the low-density spirals." Page 22

"The rotationally-supported S0 disk, which is the end product of the majority of BO transformation in clusters, is also problematic for a merger-based morphological transformation process." Page 27

"Even though the CDM paradigm has been successful in explaining many features of the large-scale structure observations (though by no means this is the only possible way to explain it, as our above references had shown), the observations on galaxy-scaled phenomena is the area that the CDM paradigm has run into the most serious problems, both in terms of the mass profiles of galaxies along the Hubble sequence, for which it predicted the progressively-later Hubble types to have a more cuspy mass density, exactly opposite to what was observed, which shows that it is the early types that possess the cuspy surface density; as well as in terms of the mass assembly history, which is currently found to be anti-hierarchical (Cimatti et al. 2006). Secular evolution cannot be simply inserted into the CDM paradigm to help solve its many problems on the galaxy level, as many had hoped, because as an initial condition secular evolution assumes a physical low surface brightness (LSB) galaxy surface density profile, which is flat across the disk, not the cuspy type predicted by the CDM as a result of cold dark matter quickly sinking into the center of a galaxy." Page 30, 31

Co Spatial Counter Rotating Stellar Disks
"There are several possibilities for the origin of the curious kinematics in NGC 4550, virtually all of which require the acquisition of secondary material after the initial stellar disk of NGC 4550 was in place." [203]

Counter Rotating Stars In The Disk
"NGC 7217 is only the second disk galaxy known to contain counter rotating stars, but we argue that similar components in other regular disk systems would not have been detected by traditional techniques, and so there could exist many such systems." [204]

"It is quite possible that many galaxies contain similar dynamical oddities which would not have been uncovered by the analysis of lower signal-to-noise data or by a traditional single-Gaussian fit to the LOSVD parameters."

"The obvious remaining question that the peculiar dynamics of NGC 7217 raises is how such a counter rotating system could form."

Counter Rotating Stellar Disks
"We report the discovery of two counter rotating stellar disks in the early-type spiral galaxy NGC 3593." [205]

A Counter-Rotating Disk
"The discovery of counter-rotating disks and their possible common origin with such well-recognized phenomena as polar rings and warps, raises more general questions about the frequency with which such kinematic peculiarities occur and their importance in tracing events influential to a galaxy's evolutionary history." [206]

"The gas infall scenario avoids this problem, but the possible origin of such gas, and how its spin velocity has managed to be oriented opposite that of the primary galaxy has yet to be resolved. Future observations are planned which may give us further clues to the origin of the counter-rotating disk and will allow us to investigate statistically whether such kinematic peculiarities are common in other normal-looking Sa galaxies."

The Formation And Evolution Of Disk Galaxies
"The question of whether or not they are the result of the primordial cosmological conditions is still an unsolved problem." [207]

"As we shall see, more direct observations of the internal structure of galactic halos seem to confirm the acuteness of this problem."

Conclusion

I am sure there are lots more problems the Big Bang cannot explain. The creationist who accepts the Genesis creation account has no problem with the Universe being crated just the way it is.

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