Problems In Evolutionary Astronomy

Age Anomaly, Magnetars

"This matches with the scenario sketched out in Leahy & Ouyed (2007). They find that the spin-down ages of magnetars in their study are *systematically* smaller than the ages of the associated SNRs. While the spin-down ages of their sample vary between 1000 and 5000 yr, the mismatch with the corresponding SNR ages is systematically of the order of 104 yr (see fig. 1 of Leahy & Ouyed 2007). Besides, Dar and De Rujula and Marsden et al. have pointed out that the dynamo model of SGRs cannot explain their ages (Dar 1999; Marsden et al. 1999; Dar & De Rujula 2000). They also find that the spin-down ages are much smaller than the ages of their SNRs."

Binary Star Systems

"The formation process of binary stars and multiple systems is poorly understood." **Astronomy And Astrophysics, 2010, Volume, 512, Pages A40**

"These fascinating processes are very poorly understood, as is the speed with which the system evolves and why it remains in contact." **Astronomy And Astrophysics, 2003, Volume, 412, Pages 465-471**

"Binary star formation mechanisms represent an important but still poorly understood part of star formation. A concerted effort is therefore necessary to fill this gap from both theoretical and observational sides." **Astronomy And Astrophysics, 2002, Volume 382, Pages 92-103**

"Recently, the internal structure and evolution of contact W UMa systems are not well-known or else are poorly understood. The evolution theories of these binary stars yield secular as well as shorter time scale quasi-cyclical orbital period variations. Although these theories suffer from a lot of problems." **Astronomy And Astrophysics, 2005, Volume 441, Pages 1087–1097**

"The formation process of binary stars is still poorly understood, and various mechanisms could intervene." **Astronomy And Astrophysics, 2003, Volume 397, Pages 159–175**

"Their existence cannot be explained by the process of star formation or by dynamical interactions in the field, and their origin has long been a mystery." **MNRAS, 2010, Volume 404, Pages 1835–1848**

"Hierarchical triple systems are common among field stars yet their long-term evolution is poorly understood theoretically." **MNRAS, 2013, Volume 430, Pages 2262–2280**

"We derive for the first time the orbital parameters of *B* Cen and find a very eccentric orbit ($e = 0{:}81$) and similar component masses with a mass ratio $M1 = M2 = 1{:}02$. *B* Cen forms a challenge for current evolution scenarios in close binaries and it is also a puzzle how a massive binary with such a large eccentricity could have formed in the first place." **Astronomy And Astrophysics, 2002, Volume 384, Pages 209-214**

Bizarre Quasars

"Regardless of the physical reason for these mysterious spectra, they almost certainly represent quasar types that are extremely rare in presently available samples." **Astronomy And Astrophysics, 2012, Volume 541, Pages, A77**

Carbon Star Formation

"We did not find a theoretical scheme that is able to satisfactorily reproduce the chemical abundance pattern in NGC1978. By claiming the existence of a non-standard mixing mechanism, we postulated some possible solutions. However, we are aware that too many ad hoc assumptions make our analysis objectionable, taking into account that some of them are strongly limited by observational constraints." **Astronomy And Astrophysics, 2009, Volume 502, Pages, 913-927**

"While the presence of a circumbinary disk or a disk around an unseen, low-luminosity companion has been suggested to explain the peculiar dust chemistry, the origin of silicate carbon stars is still a puzzle to date." **Astronomy And Astrophysics, 2008, Volume 478, Pages, 809-814**

"On the other hand, optical spectroscopic studies show that 12C/13C ratios in silicate carbon stars are as low as 4–5 and thus they are classified as "J-type" carbon stars (e.g., Ohnaka & Tsuji 1999), which is difficult to explain by the standard stellar evolution theory.**" Astronomy And Astrophysics, 2008, Volume 478, Pages, 809-814**

"The mixing of carbon during an anomalous He-flash is favoured, although no physical mechanism able to trigger that mixing has been found yet. The origin of these stars still remains a mystery." **Astronomy And Astrophysics, 2009, Volume 508, Pages, 909-922**

"However, the formation mechanisms of these disks are poorly understood, and the possible link between disk formation and the anomalously low 12C/13C ratios is by no means clear**." Astronomy And Astrophysics, 2008, Volume 490, Pages 173-178**

"The origins of carbon-enhanced groups are an intriguing open question among the many mysteries of EMP stars." **MNRAS, 2011, Volume 412, Pages 843–874**

"In any case, the existence of stars with peculiar α-element abundances only at low metallicity poses a mystery in the sense that the majority of stars in the sample show no deviation from the average value irrespective of metallicity." **MNRAS, 2011, Volume 412, Pages 843–874**

Chemically Peculiar Stars

"Theoretical evolutionary tracks of the upper main sequence stars are available for different metal abundance of the stellar envelope (see Schaller et al. 1992; and Schaerer et al. 1993). Large deviations of the chemical composition of CP stars from the normal solar abundance table are believed to be limited to the surface layers." **Astronomy And Astrophysics, 2006, Volume 450, Pages 763–775**

Clustered Star Formation

"Most of the stars of all masses in the Galaxy form in rich clusters. Despite this, the details of the clustered star formation process are still poorly understood**." MNRAS, 2012, Volume 423, Pages 1691–1706**

Dark Matter

"However, this success comes at an expensive cost as two poorly-understood components are required in the theory to provide the concordance of the cosmological model to the observations. These components are dark matter, whose density is estimated to be around ∼20% of the critical density, and dark energy, which accounts for as much as ∼75% of the energy content of the Universe. The physical nature of dark energy remains to be elucidated." **Astronomy And Astrophysics, 2012, Volume 537, Pages A78**

"While data on large-scale structures point toward a Universe dominated by dark matter and dark energy (e.g. Komatsu et al. 2011), the nature of these remains a deep mystery**." Astronomy And Astrophysics, 2011, Volume 531, Pages A100**

Dust Formation

"Despite the included detailed treatment of the dust contribution from stellar sources in the developed model, the poorly understood dust production by SNe, but also dust destruction by SN shock interactions, very likely constitute the largest uncertainties in the evolution of dust." **Astronomy And Astrophysics, 2011, Volume 528, Pages A13**

"Observations have revealed unexpectedly large amounts of dust in high-redshift galaxies and its origin is still much debated." **MNRAS, 2011, Volume 414, Pages 781-791**

Extraplanar Gas In Spiral Galaxies

"The origin of the extraplanar gas in spiral galaxies is still poorly understood." **Astronomy And Astrophysics, 2004, Volume 424, Pages 485-495**

Galaxy Disc Formation

"In the paradigm of a dark energy and dark matter dominated Universe, the process of disc galaxy formation is still very poorly understood. For instance, the creation of the Galactic thick disc still remains a riddle." **Astronomy And Astrophysics, 2011, Volume 535, Pages A107**

"The details of how the gas inside dark matter haloes is transformed into a luminous disc, however, depend strongly on the physics of star formation, feedback and cooling, which are poorly understood." **MNRAS, 2002, Volume 332, Pages 456-472**

"The development of bulges and inner discs is, however, poorly understood observationally due to the small number of studies focusing on the stellar populations of these systems**." MNRAS, 2013, Volume 431, Pages 2397-2418**

Galaxy Formation

"In the model, we are going to consider the effects of major mergers on the galaxy populations, but not those of minor mergers. Although their role on the galaxy evolution is poorly understood at present." **Astronomy And Astrophysics, 2010, Volume 519, Pages A55**

"The feedback between massive stars and the interstellar medium is one of the most important processes in the evolution of dwarf galaxies. This interaction results in numerous neutral and ionized gas structures that have been found both in the disc and in the halo of these galaxies. However, their origin and fate are still poorly understood." **MNRAS, 2010, Volume 407, Pages 113-132**

"We conclude that the angular momentum build-up of galactic discs remains poorly understood." **MNRAS, 2012, Volume 421, Pages 608-620**

"The knowledge of the second stage of galaxy formation is far less well established, mainly because the baryonic processes involved (cooling, star formation and feedback) are poorly understood. Additional physical processes whose importance is not fully understood include dynamical friction, tidal stripping, black hole formation and accretion, and adiabatic contraction." **MNRAS, 2011, Volume 416, Pages 1949-1964**

"One of the most dramatic but poorly understood stages in the evolution of galaxies is the formation of an active galactic nucleus." **MNRAS, 2013, Volume 431, Pages 3269-3281**

"Although this hierarchical scenario of galaxy formation and evolution has been very successful in explaining many observational phenomena, in general, there are still some phenomena, such as the role of active galactic nucleus (AGN) feedback, star formation, morphological evolution, etc., that are poorly understood. Details can be found in the recent review by Silk & Mamon (2012)." **MNRAS, 2013, Volume 431, Pages 2080-2105**

"The bimodality in observed present-day galaxy colours has long been a challenge for hierarchical galaxy formation models, as it requires some physical process to quench (and keep quenched) star formation in massive galaxies." **MNRAS, 2010, Volume 407, Pages 749-771**

"Despite the accumulating wealth of data, the physical origin of the bimodality in galaxy properties remains poorly understood. Red passive galaxies evolve from blue star-forming ones, in the sense that galaxies dominated by old stars today must have built up their stellar mass through star formation at early epochs." **MNRAS, 2010, Volume 407, Pages 749-771**

"Galaxies are abundant and visible to high redshifts, making them, in principle, excellent tracers of the mass distribution in the Universe over cosmological scales. The problem, however, is that galaxies are biased tracers, and that this bias is a complicated function of scale, luminosity, morphological type, etc. It is an imprint of the poorly understood physics related to galaxy formation." **MNRAS, 2013, Volume 430, Pages 725-746**

"The connection between molecular gas and star formation (SF) is a fundamental but poorly understood problem in galaxy formation." **MNRAS, 2012, Volume 426, Pages 2142-2165**

"In particular, predictions about Stellar Populations of galaxies, particularly those of multiple component (bulge, disc, bar), are still in their infancy and must currently resort to semi-analytical recipes to describe many of the

complicated gastro physical processes that remain poorly understood and too difficult to model explicitly." **MNRAS, 2009, Volume 395, Pages 28-63**

"While this model has been very successful at reproducing observations on large scales, a number of issues remain to be resolved at the galaxy-scale regime (Moore et al. 1999; Navarro & Steinmetz 2000; Primack 2007, and references therein). In particular, the formation of disc galaxies is not well represented in current implementations of simulations based on □CDM (e.g. Bell et al. 2003; Dutton et al. 2007; Kaufmann et al. 2007). The discrepancies do not necessarily indicate a failure in the _CDM model, but rather point to physical regimes and processes that are either not well understood or difficult to implement in large simulations." **MNRAS, 2009, Volume 395, Pages 28-63**

"The formation of the supermassive galaxies at the centres of galaxy clusters, called brightest cluster galaxies (BCGs), is still one of the most challenging problems in galaxy formation studies." **MNRAS, 2012, Volume 425, Pages 841-861**

"However, the mechanisms behind their growth are still poorly understood." **MNRAS, 2012, Volume 425, Pages 841-861**

"More than half of the stellar mass in the local Universe is observed to reside in disc galaxies (Driver et al. 2007; Weinzirl et al. 2009), yet the evolutionary history of these systems remains poorly understood." **MNRAS, 2012, Volume 423, Pages 2726-2735**

"An even more uncertain ingredient of galaxy formation simulations is the descriptions of poorly understood physical processes such as star formation and feedback." **MNRAS, 2012, Volume 423, Pages 1726-1749**

"The evolution of galaxies in different environments is still poorly understood, as is the relative importance of the different processes involved." **MNRAS, 2012, Volume 422, Pages 2590-2599**

"Since a variety of the physical processes that affect galaxy formation and evolution are still poorly understood (e.g. Mo, van den Bosch & White 2010), one must quantitatively characterize the model constraints implied by the existing data sets as well as explore a wide range of models." **MNRAS, 2012, Volume 421, Pages 1779-1796**

"However, complex baryonic physics relevant to the formation of galaxies is still poorly understood, and cannot be implemented unambiguously in hydro simulations." **Astronomy And Astrophysics, 2010, Volume 510, Pages A60**

"Understanding how early-type galaxies (ETGs) formed and evolved along the Hubble time is still a formidable challenge." **MNRAS, 2012, Volume 427, Pages 1530-1554**

"However, it is not yet clear how the paradigm cold dark matter (CDM) cosmological model (which prescribes a hierarchical, bottom–top formation of structures, implying that massive systems assemble their mass later than the smaller ones) could be reconciled with the observational evidence for large, and red, galaxies already in place at very high redshifts (see e.g. Marchesini et al. 2010; Mortlock et al. 2011). The problem is twofold: on the one hand, it must be explained how and when star formation is quenched in both massive and small haloes, which is necessary to reconcile the theoretical prediction with the observed galaxy mass function (see e.g. Bundy et al. 2006); on the other hand, it should be also clarified how such massive systems can form at very high redshifts." **MNRAS, 2012, Volume 427, Pages 1530-1554**

"Given our conclusions, we must stress that a clearer picture on the core formation problem has still to be drawn. The problem needs to be studied within a larger class of haloes with different merger histories and masses, and idealized simulations are probably required to shed more light on the core formation process in clusters." **MNRAS, 2012, Volume 422, Pages 3081-3091**

Elliptical Galaxy Star Formation

"A long-standing problem in the study of elliptical galaxies is the far ultraviolet (FUV) excess in their spectra. Traditionally, elliptical galaxies were supposed to be passively evolving and not contain any young stars that radiate in the FUV." **MNRAS, 2007, Volume 380, Pages 1098-1118**

"The origin of those hot, blue stars, as the major source of the FUV radiation, has remained an enigma in evolutionary population synthesis (EPS) studies of elliptical galaxies. Two models, both involving single-star evolution, have previously been proposed to explain the UV-upturn: a metal-poor model (Lee 1994; Park & Lee 1997) and a metal-rich model (Bressan, Chiosi & Fagotto 1994; Bressan et al. 1996; Yi et al. 1995; Tantalo et al. 1996; Yi, Demarque & Kim 1997a; Yi, Demarque & Oemler 1997b; Yi et al. 1998)." **MNRAS, 2007, Volume 380, Pages 1098-1118**

"Both of these models are quite ad hoc: there is neither observational evidence for a very old, low-metallicity subpopulation in elliptical galaxies, nor a physical explanation for the very high mass loss required for just a small subset of stars. Furthermore, the onset of the formation of the hot sub dwarfs is very sudden as the stellar population evolves, and both models require a large age for the production of the hot stars. As a consequence, the models predict that the UV-upturn of elliptical galaxies declines rapidly with redshift. However, this does not appear to be consistent with recent observations with the *Hubble Space Telescope* (*HST*) (Brown et al. 1998, 2000a, 2003)." **MNRAS, 2007, Volume 380, Pages 1098-1118**

Gas Haloes Around Elliptical Galaxies

"The existence of hot gas haloes around many elliptical galaxies presents something of an enigma. How were they created and why do they not exist in all cases?" **MNRAS, 2006, Volume 370, Pages 1541-1555**

Globular Cluster Formation

"The exact formation mechanism of GCs has been the subject of much recent debate. Many models for GC formation have been proposed including gaseous mergers (Ashman & Zepf 1992), in situ formation (e.g. Harris et al. 1995), multiphase collapse (Forbes et al. 1997), dissipationless hierarchical merging (e.g. Côté et al. 1998, 2000, 2002) and hierarchical clustering (Beasley et al. 2003)." **Astronomy And Astrophysics, 2005, Volume, 439, Pages 913-919**

"An elegant review of the GC formation models mentioned above can be found in West et al. (2004)." **Astronomy And Astrophysics, 2005, Volume, 439, Pages 913-919**

"However, we show that for any reasonable choice of the initial mass function the helium-to-metal enrichment of the integrated stellar population is unavoidably much lower than 70 and conclude that the issue of the helium enhancement in *Omega* Centauri still waits for a satisfactory explanation. We briefly speculate upon possible solutions." **MNRAS, 2007, Volume 376, Pages 405-415**

"This could also explain why dwarf galaxies have larger GCs due to the weaker tidal forces in less massive galaxies. Alternatively, the larger sizes at larger radii could be an effect of the initial sizes being larger, as GC formation is still poorly understood." **MNRAS (2013), doi:10.1093/mnras/stt1637**

"Now we study the Galactic globular clusters, which are all old objects and cover a large range in Galactocentric radius. The formation process of the globular clusters remains poorly understood (for a review, see Gratton, Sneden & Carretta 2004), and we are interested to know what can be learned from their C-space properties." **MNRAS, 2012, Volume 421, Pages 1231-1255**

"It is difficult to know whether this result should be expected, because we do not yet have a good perspective on what globular clusters are and how (and where) their chemical evolution took place." **MNRAS, 2012, Volume 421, Pages 1231-1255**

Intergalactic Magnetic Fields

"The origin of intergalactic magnetic fields is still a mystery and several scenarios have been proposed so far: among them, primordial phase transitions, structure-formation shocks and galactic outflows." **MNRAS, 2006, Volume 370, Pages 319-330**

Massive Star Formation

"The origin of massive field stars in the Large Magellanic Cloud (LMC) has long been an enigma." **Astronomy And Astrophysics, 2010, Volume, 519, Pages A33**

"Despite its major role in the evolution of the interstellar medium, the formation of high-mass stars ($M \geq 10\ M\_$) remains poorly understood. Two types of massive star cluster precursors, the so-called massive dense cores (MDCs), have been observed, which differ in terms of their mid-infrared brightness. The origin of this difference has not yet been established and may be the result of evolution, density, geometry differences, or a combination of these." **Astronomy And Astrophysics, 2010, Volume, 522, Pages A40**

"High-mass stars play a significant role in shaping their host galaxies, because of their high UV luminosity and mechanical input (wind shocks and supernovæ), but their formation remains poorly understood." **Astronomy And Astrophysics, 2010, Volume, 522, Pages A40**

"High-mass stars play a prominent role in Galactic evolution, but their formation mechanism is still poorly understood." **Astronomy And Astrophysics, 2011, Volume, 536, Pages A38**

"The earliest phases of massive star formation in clusters are still poorly understood." **Astronomy And Astrophysics, 2007, Volume, 464, Pages 983-994**

"In studies of star formation, massive young stars remain poorly understood." **Astronomy And Astrophysics, 2007, Volume, 462, Pages L37-L40**

"The earliest phases of massive star formation (MSF) are still poorly understood." **Astronomy And Astrophysics, 2012, Volume, 542, Pages L15**

"Despite their importance, the lives and deaths of massive stars are poorly understood; in particular, it is not known with any degree of certainty which massive stars produce which SNe." **Astronomy And Astrophysics, 2006, Volume, 460, Pages L5-L8**

"The evolution of very high mass stars (Mass initial > 25 M_o) is intriguing and has been poorly understood for a long time." **Astronomy And Astrophysics, 2001, Volume, 366, Pages 817-826**

"Massive stars play a crucial role in the evolution of galaxies, but the processes leading to massive star formation are poorly understood, e.g. Garay & Lizano (1999), McKee & Tan (2003)." **Astronomy And Astrophysics, 2008, Volume, 480, Pages 767-773**

2003, Astrophysical Journal, Volume 585, Page 850

"Owing to their occurrence in more distant crowded stellar clusters, shorter formation timescales and formation in regions of high visual extinction, the formation of massive stars is still poorly understood." **Astronomy And Astrophysics, 2004, Volume, 426, Pages 119-129**

"This is especially crucial for the still poorly understood formation of the most massive stars." **Astronomy And Astrophysics, 2004, Volume 421, Pages 693-702**

"Furthermore, in contrast to the birth of low-mass stars, the formation mechanism of high-mass stars is still poorly understood." **Astronomy And Astrophysics, 2007, Volume 466, Pages 649-659**

"On the other hand, the theoretical evolution of these massive stars is still poorly understood." **Astronomy And Astrophysics, 2010, Volume 520, Pages A51**

"Presently, high mass star formation is still poorly understood." **Astronomy And Astrophysics, 2005, Volume 440, Pages 261-286**

"While the process of low-mass star-formation has been well studied, high-mass star-formation is still poorly understood." **Astronomy And Astrophysics, 2006, Volume 448, Pages 597-611**

"Relative to the low-mass star formation processes, the high-mass star formation mechanism is poorly understood. Some of the reasons for the paucity of studies in this area are as follows: high-mass stars have a short pre-main sequence time-scale; most of the high mass star forming regions are distant; it is difficult to observe the earliest stages of high-mass star forming processes; it is difficult to obtain a bona fide sample of high-mass stars; and the highly embedded nature of massive star forming sites makes it difficult to resolve and locate them. Hence, it has

been difficult to characterize high mass (≥ 8 Mo) star forming processes." **MNRAS, 2013, Volume 435, Pages 663-678**

"Despite the key role they play in the evolution of galaxies, their formation mechanism is still poorly understood." **Astronomy And Astrophysics, 2010, Volume 517, Pages A66**

"The earliest phases of massive star formation are still poorly understood." **Astronomy And Astrophysics, 2006, Volume 454, Pages L95-L98**

Molecule Formation

"Despite this fame, water is still mostly a mystery for astrochemists: its formation pathways are not very well constrained.**" Astronomy And Astrophysics, 2012, Volume 542, Pages, L5**

"But the details of these processes are mostly unknown.**" Astronomy And Astrophysics, 2012, Volume 542, Pages, L5**

"One common, surprising result of *all* the above studies is the exceedingly high NH3 abundances they report. Most of them cite values of several times 10^{-7} or even 10^{-6} relative to molecular hydrogen. These numbers are in stark contrast to the results of thermodynamical equilibrium calculations for the atmospheres of cool stars, which predict the production of only negligible amounts of NH3, of order 10^{-12}." **Astronomy And Astrophysics, 2010, Volume, 521, Pages L7**

"However, the remarkably high abundances we determine for all our objects confirm and significantly strengthen the finding that this molecule exists in a variety of CSEs at levels not explained by current chemical models." **Astronomy And Astrophysics, 2010, Volume, 521, Pages L7**

"The formation of refractory molecules in a cold, tenuous medium is poorly understood: it may be the result of gas-phase reactions between molecules and radicals or ions, or of reactions on dust grains." **Astronomy And Astrophysics, 2004, Volume, 426, Pages L49-L52**

"The real underlying mysteries are the working of the poorly-understood polyatomic chemistry which forms the CO and other species at such modest densities (Liszt et al. 2006), and the origin of the turbulent flows which may power the chemistry.**" Astronomy And Astrophysics, 2009, Volume, 499, Pages 503-513**

"Indeed, the HCN abundance does not change considerably between cold and warm clouds, but the HNC abundance decreases. This is puzzling since both isomers are mainly formed from the dissociative recombination of HCNH+.**" Astronomy And Astrophysics, 2010, Volume 516, Pages A105**

"In summary, much of the chemistry is still poorly understood, and it is not clear in particular why HCNO is so under abundant with respect to HOCN in the warm sources but not in the cold ones.**" Astronomy And Astrophysics, 2010, Volume 516, Pages A105**

"Although the abundances of the simplest COMs, such as formaldehyde (H2CO) or methanol (CH3OH), are now quite well predicted, astrochemical models still fail to reproduce the abundance of more complex ones, such as methyl formate (HCOOCH3), for example.**" Astronomy And Astrophysics, 2012, Volume 538, Pages A42**

"Sulphur chemistry is particularly poorly understood, for various reasons.**" MNRAS, 2012, Volume 421, Pages 1476-1484, http://kida.obs.u-bordeaux1.fr**

"The origin and chemical properties of the Galactic bulge are poorly understood, see, for instance, the reviews by Wyse et al. (1997) and Kormendy & Kennicutt (2004). These properties are critical for our understanding of the formation and evolution of the Milky Way, but also of galaxies in general (Renzini 2006).**" Astronomy And Astrophysics, 2009, Volume 496, Pages 701-712**

"The origin of the HCO+ is something of a mystery but the CO formation problem, per se, is not.**" Astronomy And Astrophysics, 2011, Volume 527, Pages A45**

"The measured [CH2DOH]/[CH3OD] ratios are inconsistent with the current theory of methanol deuteration, independently of the mass of the source. While the large ratios measured in low- and intermediate-mass sources

can be explained qualitatively by various selective depletion mechanisms, the small ratios (<2) measured toward massive hot cores are puzzling. A revision of the deuterium chemistry in hot cores is suggested.**" Astronomy And Astrophysics, 2011, Volume 528, Pages L13**

"Surprisingly, however, the other form of singly deuterated methanol, CH3OD, is much less abundant, by more than a factor of 10. According to the grain chemistry statistical model of Charnley et al. (1997), if the deuterated isotopologues of methanol are formed by H/D atoms addition to CO on the grain surfaces, the abundance of CH2DOH should always be only a factor of ∼3 larger than the CH3OD one. To make the situation even more puzzling, the same [CH2DOH]/[CH3OD] ratio is close to 1 in the high-mass protostar Orion IRc2.**" Astronomy And Astrophysics, 2011, Volume 528, Pages L13**

"We are thus compelled to conclude that the deuteration of methanol in massive hot cores, where the abundance of CH_2DOH is at most similar to that of CH_3OD, remains enigmatic.**" Astronomy And Astrophysics, 2011, Volume 528, Pages L13**

Origin Of Open Clusters

"Despite recent advances in the field of star formation, the origin of open clusters remains a mystery." **MNRAS, 2010, Volume 405, Pages 666-680**

Origin Of Sub Dwarf B Star

"Their origin remains a mystery, because mass loss on the first-ascent giant branch must remove all but $<10^{-2}$ *M*o of the hydrogen envelope, yet produce a core of the same mass (to within a few percent) every time (D'Cruz et al. 1996; Han et al. 2002, 2003)." **Astronomy And Astrophysics, 2009, Volume 493, Pages, 175-183**

"These companions are thought to play an important role in the poorly understood formation of sub dwarf B stars." **Astronomy And Astrophysics, 2011, Volume, 531, Pages A125**

"However, the details of how stars evolve to become hot sub dwarfs, and particularly how such a wide variety of atmospheric chemistries is produced, are very poorly understood." **Astronomy And Astrophysics, 2012, Volume, 541, Pages A100**

"Low mass dwarf stars are very common, but the way in which they evolve in close binary systems is poorly understood." **Astronomy And Astrophysics, 2011, Volume, 528, Pages A90**

"Even though the models describing the future evolution of the sdB stars are generally accepted (e.g. those of Dorman et al. 1993), the current evolutionary state of the sdB stars is still poorly understood. The fact that sdB stars must have lost almost all of their hydrogen layer at *exactly* the same time when the helium core has attained the minimum mass required for the helium flash to occur, makes them enigmatic from an evolutionary point of view. To loose such an amount of mass, they must suffer considerable mass loss during the red giant branch (RGB) phase, and most probably also during the helium core flash. The most fundamental missing piece to our understanding of the evolution of the sdB stars, apart from the physics during the helium core flash, is the nature and physics behind this mass loss (Fusi-Pecci & Renzini 1976)." **Astronomy And Astrophysics, 2007, Volume 471, Pages 605-615**

"An open question is the way brown dwarfs form. Although it is commonly accepted that they originate, like low-mass stars, from the gravitational collapse of molecular cloud cores, their formation process is still poorly understood." **Astronomy And Astrophysics, 2004, Volume 416, Pages 555-576**

Planet Formation

"But how the dust disk evolves to a planetary system is poorly understood as yet (Williams & Cieza 2011)." **Astronomy And Astrophysics, 2013, Volume, 553, Pages L1**

"Fragmentation of aggregates is a major obstacle in planet formation theory. Dust cannot grow all the way to form planetesimals because it gets destroyed once relative velocities become violent enough to disrupt aggregates. Similarly, radial drift may prevent growth by removing particles from the disk once they grow to a certain size and spiral towards the central star." **Astronomy And Astrophysics, 2009, Volume 507, Pages 1023-1040**

"The question of how planets form is one of the key questions in modern astronomy today. While it has been studied for centuries, the problem is still far from being solved." **Astronomy And Astrophysics, 2010, Volume 513, Pages A79**

"It was concluded that the barrier is indeed a very strong limiting factor in the formation of planetesimals from dust, and that special particle trapping mechanisms are likely necessary to overcome the barrier." **Astronomy And Astrophysics, 2010, Volume 513, Pages A79**

"This model includes also the initial build-up phase of the disk, which is still a very poorly understood phase of disk evolution." **Astronomy And Astrophysics, 2010, Volume 513, Pages A79**

"One of the more poorly understood stages is the evolution of μmeter sized dust grains into km-sized objects, called planetesimals." **MNRAS, 2013, Volume 433, Pages 98-116**

"The evolution of compact multi planet systems in star clusters, however, remains poorly understood, although previous studies have already indicated that the effect of planet–planet interactions may be at least as important as the effect of stellar flybys." **MNRAS, 2013, Volume 433, Pages 867-877**

"The multitude of poorly understood processes associated with planet formation renders this a formidable task." **MNRAS, 2013, Volume 432, Pages 2562-2572**

"I report a novel theory that *non uniform* viscous frictional force in the solar nebula accounts for the largest mass of Jupiter and Saturn and their largest amount of H and He among the planets, two outstanding facts that are unsolved puzzles in our understanding of origin of the Solar System. It is shown that the nebula model of uniform viscosity does not match the present planet masses." **Astronomy And Astrophysics, 2004, Volume 423, Pages, L5-L8**

Planetary Nebulae Formation

"The reason why more than 80% of the known planetary nebulae (PNe) are mostly bipolar and not spherically symmetric (Zuckerman & Aller 1986; Stanghellini et al. 1993) is barely understood." **Astronomy And Astrophysics, 2005, Volume 432, Pages, 273-279**

"Despite numerous efforts, the transition from Asymptotic Giant Branch (AGB) stars to Planetary Nebulae (PN) is a poorly understood phase of stellar evolution." **Astronomy And Astrophysics, 2004, Volume, 428, Pages 121-129**

"The formation and early evolution of Planetary Nebulae (PNe) is a quite obscure phase of stellar evolution." **Astronomy And Astrophysics, 2004, Volume, 428, Pages 121-129**

"Many aspects of the evolutionary phase in which asymptotic giant branch stars (AGB stars) are in transition to become planetary nebulae (PNe) remain poorly understood." **Astronomy And Astrophysics, 2012, Volume, 542, Pages A15**

"The short transition phase between the end of the asymptotic giant branch (AGB) and the formation of a new planetary nebula (PN) is still poorly understood." **Astronomy And Astrophysics, 2002, Volume, 387, Pages 955-968**

"Because of the huge amount of processed material returned to the ISM, this evolutionary phase is very important for the chemical evolution of the Galaxy; and yet the short transition phase between the end of the AGB and the formation of a new PN is still poorly understood. In particular, it is quite challenging to understand how the almost symmetric CSE observed around AGB stars transform themselves in to the highly structured morphologies observed in high-dynamical range optical images of PNs." **Astronomy And Astrophysics, 2007, Volume 462, Pages 637-644**

Star Formation

"In a volume-limited sample, dwarf galaxies constitute the vast majority of the total galaxy population. Yet, their star formation histories remain poorly understood." **Astronomy And Astrophysics, 2005, Volume, 434, Pages 935-938**

"The very early phase of star formation is still poorly understood because most stars form in dense clusters embedded within giant molecular clouds." **Astronomy And Astrophysics, 2009, Volume, 498, Pages L37-L40**

"The mechanisms that govern star formation in galaxies are poorly understood." **Astronomy And Astrophysics, 2010, Volume, 518, Pages L29**

"The nature of the processes regulating star formation in irregular galaxies is poorly understood." **Astronomy And Astrophysics, 2004, Volume, 422, Pages 55-64**

"However, it is still poorly understood how the first stars and black holes in galaxies were formed and the way that in less than a billon year these pristine objects re-ionized and re-heated most of the matter in the universe over large volumes of space. The apparent disparity between the number of dwarf galaxies predicted by the cold dark matter model of the universe and the number of small galaxies observed so far in the halo of the Galaxy is a subject of topical interest in cosmology." **Astronomy And Astrophysics, 2011, Volume, 528, Pages A149**

"The mechanisms that trigger strong bursts of star formation in galaxies are poorly understood." **Astronomy And Astrophysics, 2012, Volume 544, Pages A145**

"The theory of star formation in the original and holistic sense, which treats the forming protostar as a real and structured object, remains poorly understood." **Astronomy And Astrophysics, 2011, Volume 526, Pages A139**

"Most stars form in clusters in the densest portions of giant molecular clouds, but the initial conditions of the star formation process in clusters are still poorly understood." **Astronomy And Astrophysics, 2012, Volume 541, Pages A32**

"There is also vigorous theoretical debate on how star formation proceeds in clustered regions." **Astronomy And Astrophysics, 2012, Volume 541, Pages A32**

"The initial conditions of the star formation process are still poorly understood." **Astronomy And Astrophysics, 2006, Volume 460, Pages 709-720**

"Complex and poorly understood star formation processes are implemented using the phenomenological prescription proposed by Katz." **Astronomy And Astrophysics, 2012, Volume 538, Pages A82**

"The origin of the stellar initial mass function (IMF) is a question of fundamental importance for the study of star formation, stellar evolution and feedback, and galaxy formation. It is an input into a huge range of models of all of these phenomena, and a necessary assumption when deriving physical parameters from many observations. However, despite decades of theoretical study, it remains poorly understood." **MNRAS, 2012, Volume 423, Pages 2037-2044**

"Despite recent surveys that have dramatically increased the number of central stars that belong to the sequence, their origin and evolution remain poorly understood." **MNRAS, 2012, Volume 423, Pages 934-947**

Stellar Magnetic Fields

"The origin of magnetic fields in intermediate- and high-mass stars is fundamentally a mystery." **MNRAS, 2007, Volume 376, Pages 1145-1161**

"Remarkably, very little is known about the formation and evolution of these magnetic fields." **MNRAS, 2007, Volume 376, Pages 1145-1161**

Stellar Nucleo Synthesis

"The astrophysical nature of r-process sites is a long-standing mystery and many probable sources have been suggested, among them lower-mass core-collapse supernovae (in the range 8–10 Mo), higher-mass core-collapse supernovae (with masses ≥20 M) and neutron star mergers." **Astronomy And Astrophysics, 2004, Volume 416, Pages, 997-1011**

"Thus, we conclude, that the *exact* astrophysical nature of r-process sites still remains a mystery, since it is not possible to clearly distinguish between neutron capture element abundance patterns resulting from lower-mass

SNe II (8–10 *M*o) and the ones from higher-mass SNe II (≥20 *M*o) in the framework of inhomogeneous chemical evolution." **Astronomy And Astrophysics, 2004, Volume 416, Pages, 997-1011**

"Yet, it remains to be seen how SNe II can actually produce the required r-process yields." **Astronomy And Astrophysics, 2004, Volume 416, Pages, 997-1011**

"Serious discrepancies have recently been observed between predictions of stellar evolution models in the 0.7–1.1 $M_{\odot}$ mass range and accurately measured properties of binary stars with components in this mass range." **Astronomy And Astrophysics, 2003, Volume, 409, Pages 611-618**

"There are many well-studied systems with components in this mass range which present puzzling discrepancies with the predictions of stellar evolution theory." **Astronomy And Astrophysics, 2003, Volume, 409, Pages 611-618**

"One of the main questions concerns the possible link between chemical signature and dynamical evolution of different stellar generations in GCs. This issue is puzzling and still poorly explored in a systematic way by theoretical models." **Astronomy And Astrophysics, 2010, Volume, 519, Pages A71**

"The recent downward revision of the solar photospheric abundances now leads to severe inconsistencies between the theoretical predictions for the internal structure of the Sun and the results of helioseismology. There have been claims that the solar neon abundance may be underestimated and that an increase in this poorly-known quantity could alleviate (or even completely solve) this problem." **Astronomy And Astrophysics, 2008, Volume 487, Pages 307-315**

"The abundance patterns observed in stellar coronae appear at odds with the solar mixture, in particular, with neon being strongly enhanced in active stars by some still poorly-understood mechanisms (e.g. Drake et al. 2001)." **Astronomy And Astrophysics, 2008, Volume 487, Pages 307-315**

"This discrepancy may be related to missing physics or unaccounted systematic errors in the B star analyses, and may question the assumption that the neon abundance derived from hot stars is directly transposable to the Sun." **Astronomy And Astrophysics, 2008, Volume 487, Pages 307-315**

"It is, therefore, evident that observing how metals are distributed in a galaxy should tightly constrain its evolution. However, the detailed dynamical processes responsible for the modification of the metallicity distribution and their importance remains poorly understood. In particular, it is unknown, from the observational point of view, the importance that bars might have in producing the metallicity radial mixing." **Astronomy And Astrophysics, 2012, Volume 543, Pages A150**

"We find that, except for a handful of elements whose nucleosynthesis in stars is well understood by now, large uncertainties still affect model predictions. This is especially true for the majority of the iron-peak elements, but also for much more abundant species such as carbon and nitrogen. The main causes of the mismatch we find among the outputs of different models assuming different stellar yields and among model predictions and observations are (1) the adopted location of the mass cut in models of type II supernova explosions; (2) the adopted strength and extent of hot bottom burning in models of asymptotic giant branch stars; (3) the neglection of the effects of rotation on the chemical composition of the stellar surfaces; (4) the adopted rates of mass loss and of (5) nuclear reactions; and (6) the different treatments of convection." **Astronomy And Astrophysics, 2010, Volume 522, Pages A32**

"Despite several considerable improvements in the field of stellar evolution and nucleo synthesis in recent years, no single combination of stellar yields is found which is able to reproduce at once all the available measurements of chemical abundances and abundance ratios in the Milky Way." **Astronomy And Astrophysics, 2010, Volume 522, Pages A32**

"None of the models is able to explain the Co data in the Galaxy." **Astronomy And Astrophysics, 2010, Volume 522, Pages A32**

"Neither model can explain the behaviour of Mn in the Galactic disc." **Astronomy And Astrophysics, 2010, Volume 522, Pages A32**

"This issue is particularly important because the astrophysical origin of *r*-process nuclei remains a mystery (Qian & Wasserburg 2007)**." MNRAS, 2013, Volume 435, Pages 502-517**

"HgMn stars are chemically peculiar late B stars, characterized by strong overabundances of Mn, by up to a thousand times solar, and strong overabundances of Hg, by up to a hundred thousand times solar. Strong overabundances of Xe, iron-peak elements, Ga and under abundances of He are also often seen in these stars. These chemical anomalies are believed to be produced by the selective radiative levitation and gravitational settling of chemical elements in the outer stellar layers (e.g. Michaud, Reeves & Charland 1974). However, despite a significant number of observational and theoretical studies, the physical processes responsible for these strong chemical peculiarities remain poorly understood." **MNRAS, 2010, Volume 407, Pages 2383-2392**

Super Massive Black Holes

"There is no doubt about the existence of supermassive black holes (SMBHs) at the center of most galaxies. However, the formation and growth of SMBHs is poorly understood." **Astronomy And Astrophysics, 2012, Volume 538, Pages A19**

"Supermassive black holes with up to a 10^9 Mo dwell in the centres of present-day galaxies, and their presence has been confirmed at $z \geq 6$. Their formation at such early epochs is still an enigma." **MNRAS, 2013, Volume 433, Pages 1607-1618**

"It is however not very well understood how these quasars observed in the Sloan Digital Sky Survey could attain such high masses in such short span of time after the big bang." **MNRAS, 2013, Volume 433, Pages 1607-1618**

"It is still a mystery how these supermassive black holes (SMBHs) accumulated so much mass in such a short time (see reviews by Volonteri 2010 and Haiman 2013)." **MNRAS, 2013, DOI: 10.1093/mnras/stt1553**

"This important but poorly understood accretion state may be responsible for much of the SMBH mass growth in the Universe; for instance, it might explain the paradox of having 10^9 Mo BHs already at $z > 6$, when the Universe was less than 1 Gyr old (Barth et al. 2003; Willott et al. 2005, 2010; Fan et al. 2006; Mortlock et al. 2011)." **MNRAS, 2013, Volume 429, Pages 3533-3550**

The Milky Way Bulge

"The evolution of the Milky Way bulge and its relationship with the other Galactic populations is still poorly understood." **Astronomy And Astrophysics, 2008, Volume, 484, Pages L21-L25**

"Despite its prominent role in the formation and evolution of the Galaxy, the bulge is the least well-understood stellar population in the Milky Way. Two main formation scenarios have been proposed to explain bulges of spiral galaxies." **Astronomy And Astrophysics, 2008, Volume, 484, Pages L21-L25**

"The formation and evolution of the Galactic bulge and its relationship with the other Galactic populations is still poorly understood." **Astronomy And Astrophysics, 2010, Volume, 513, Pages A35**

"Although the Milky Way bulge is our closest opportunity to study in detail such a complex chemo-dynamical system, its formation and evolution is still poorly understood." **Astronomy And Astrophysics, 2010, Volume 519, Pages A77**

The Origin Of Fluorine

"These authors found F abundance enhancements of up to a factor of 30 over the solar value, and interpreted this as evidence of 19F stellar nucleosynthesis in AGB stars. The formation of fluorine remains poorly understood with three different proposed sources: low-metallicity low-mass AGB stars, Wolf-Rayet stars, and neutrino spallation in core-collapse supernovae (see e.g. Lucatello et al. 2011)." **Astronomy And Astrophysics, 2011, Volume, 533, Pages L6**

The Origin Of Nitrogen

"For more than 20 years, the nucleosynthetic origin of primary nitrogen, which is one of the most abundant and important elements in the Universe, for life in particular, has remained a deep mystery in astrophysics (Edmunds & Pagel 1978; Barbuy 1983; Carbon et al. 1987; Thuan et al. 1995; Izotov & Thuan 1999; Henry et al. 2000)."

Astronomy And Astrophysics, 2002, Volume 381, Pages, L25-L28

"We have investigated the poorly-understood origin of nitrogen in the early Galaxy by determining N abundances from the NH band at 336 nm in 35 extremely metal-poor halo giants, with carbon and oxygen abundances from Cayrel et al." **Astronomy And Astrophysics, 2005, Volume, 430, Pages 655-668**

Warped Galaxies

"The origin of warps is still poorly understood. Different models have been proposed, for instance: the precession of a disk embedded in a flattened dark halo, misaligned with the disk itself (e.g. Toomre 1983), or the accretion of gas with angular momentum different from that of the disk (e.g. Ostriker & Binney 1989), but none is completely satisfactory." **Astronomy And Astrophysics, 2003, Volume, 405, Pages 969-973**

"Warps are still poorly understood phenomena. They are very common and ubiquitous (e.g. Garcia-Ruiz et al. 2002, and references therein), but it is not clear yet whether this means that they are easily excited or that there is a mechanism capable of maintaining them. Several different possibilities have been proposed to explain their origin such as: tidal interactions (Burke 1957; Kerr 1957; Hunter & Toomre 1969), misalignment between disk and halo (Debattista & Sellwood 1999), discrete bending modes due to a tilted oblate dark matter halo (Sparke & Casertano 1988), effects of the intergalactic medium and accretion (Kahn & Woltjer 1959; Jiang & Binney 1999). In particular, the possible role of dark matter halos has been widely considered. However, none of these explanations has been completely accepted." **Astronomy And Astrophysics, 2006, Volume 447, Pages 49-62**

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