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Origin and evolution of magnetars

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Up to now it is unclear how magnetars obtain their large magnetic fields. In the standard model it is proposed that fields are enhanced via a dynamo mechanism. This scenario requires that the neutron star has very rapid initial rotation. Such assumption, on one hand, requires rapid rotation of the progenitor, and so a specific evolution; on another hand, this assumption leads us to potentially testable predictions.

At first we study evolutionary channels in binary evolution which can produce rapidly rotating massive stellar cores prior to collapse. It is demonstrated that in an optimistic scenario one can easily explain the fraction of magnetars among all NSs and the fact that all known sources of this kind are isolated. In a very conservative approach the fraction of magnetars is also reproduced, but it is necessary to assume correlation between initial spin and kick velocity to explain the absence of companions for known magnetars.

Then we study evolution of magnetars in close binary systems, and demonstrate that the observational data is in correspondence with the standard magnetic field decay scenario.

Finally, we discuss the possibility that some of CCOs are magnetars which experienced very strong fall-back, in particular we look at the case of Kes 79 where a NS has relatively long spin period (in comparison with what is necessary for effective dynamo). A discovery of an anti-magnetar with a millisecond period and strong crustal field identifiable, for example, due to large pulse fraction, would be the proof of the dynamo field origin. Existence of such sources is in correspondence with the present standard picture of neutron star unification. However, the fraction of magnetars with submerged fields can be small — few percent of the total number of CCOs.

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