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From Quarks to Cosmos

HUAZHONG NORMAL UNIVERSITY

Prof. Yun-Wei Yu
Institute of Astrophysics, Central China Normal University, Wuhan, China
yuyw@mail.ccnu.edu.cn

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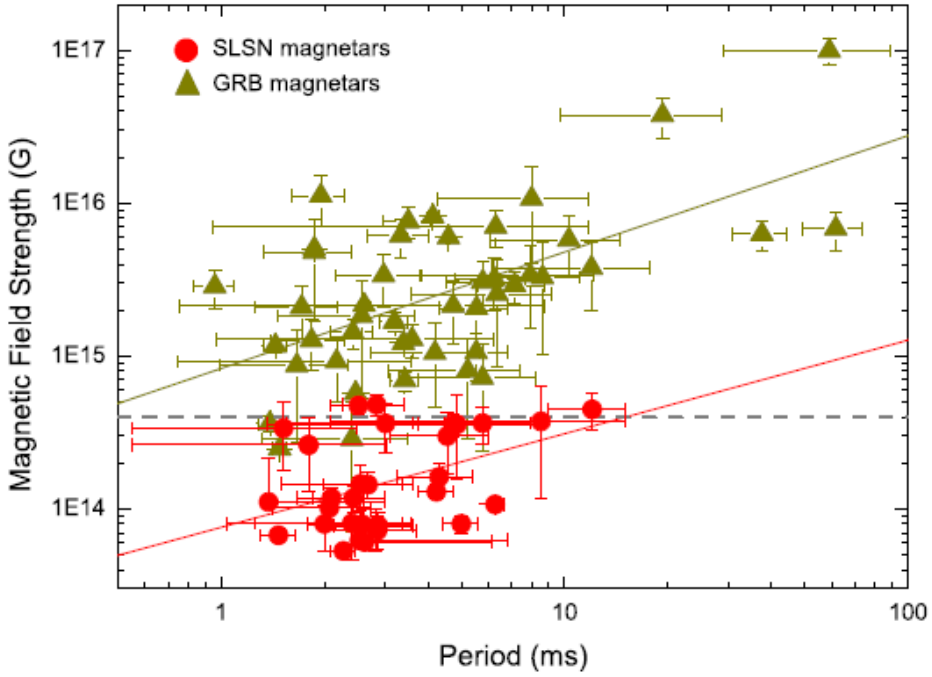
TITLE: STUDYING NEWBORN NEUTRON STARS BY USING TRANSIENT OBSERVATIONS

ABSTRACT: Both the collapses of massive stars and mergers of compact objects could lead to the formation of a rapidly rotating neutron star (NS), which can power the explosively-ejected material to generate a bright transient emission such as superluminous supernovae (SLSNe), gamma-ray burst (GRB) afterglows, enhanced kilonovae (mergernovae), etc. These transients enable us to probe the properties of those newborn neutron stars. My talk will give a brief review on this topic.

Neutron stars from the collapses of massive stars: SLSNe and long GRBs

- The plateau and flare afterglow features of GRBs indicate that their central engines could be millisecond magnetars.
- It is also widely suggested that a remarkable fraction of SLSNe are powered by a millisecond magnetar, rather than by the traditional radioactivities.
- These two different phenomena could have an unified origin. The key factor leading to the difference is the strength of the magnetic field of the magnetar.

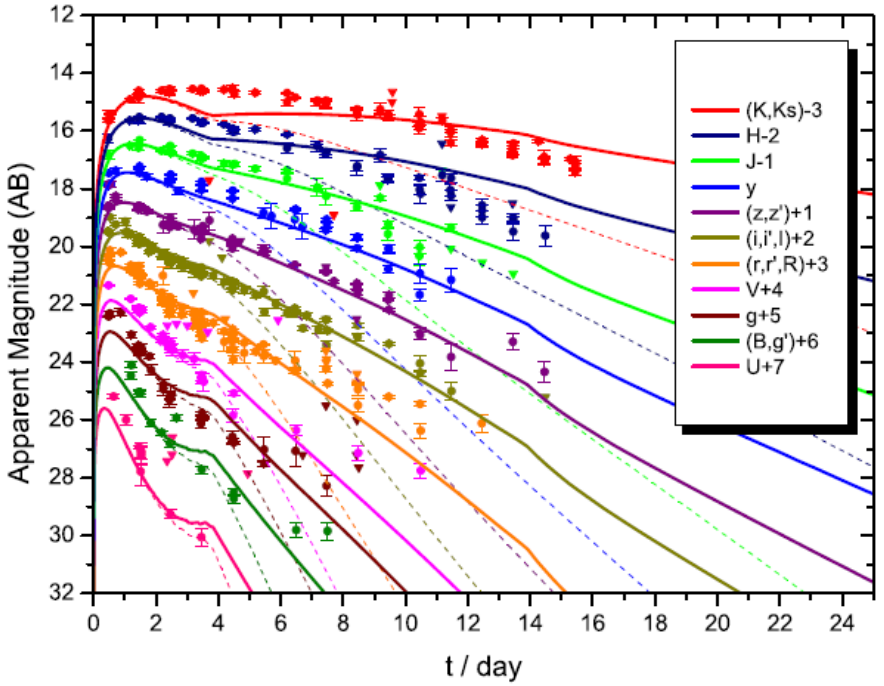


- An ultra-high magnetic field could play a crucial role in driving a relativistic jet to produce the GRB emission.

YWY, Cheng, Cao, 2010, ApJ, 715, 477; **YWY**, Zhu, Li et al. 2017, ApJ, 840, 12

Neutron stars from the mergers of neutron stars (short GRBs) and the accretion-induced collapses (AICs) of white dwarfs

- The afterglow emission of short GRBs hints their remnant objects could also be millisecond magnetars. Such a magnetar can also power the merger ejecta to produce an enhanced kilonova emission (i.e., mergernova).
- This model can provide a reasonable explanation for the AT2017fgo optical emission in the GW170817 event. Then, it is suggested that the remnant of this merger event can be a massive NS of a mass higher than ~2.5 solar masses.



- The accretion-induced collapses (AICs) of massive white dwarfs could also lead to the formation of a millisecond magnetar and, then, result in a rapidly evolving luminous optical transient that resembles mergernova emission.

YWY, Zhang, Gao, 2013, ApJL, 776, L40; **YWY**, Liu, Dai, 2018, ApJ, 861, 114; **YWY**, Chen, Li, 2019, ApJL, 877, L21