Fast Radio Bursts and their Possible Neutron Star Origin

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I will review our current observational understanding of the Fast Radio Bursts (FRBs), which are millisecond-duration radio pulses originating at extragalactic distances [2, 4, 7, 10]. Many theories for the physical nature of the FRBs have been proposed — including both cataclysmic events involving neutron star collision (or collapse), along with non-cataclysmic scenarios involving a young and/or highly magnetized neutron star. While some FRBs appear to be one-off events — arguably supporting a cataclysmic origin — a sporadically repeating FRB has also recently been discovered [8]. It is thus currently unclear whether there is a single type of FRB, or whether we are seeing multiple source populations [6]. In any case, it seems very likely that exotic manifestations of neutron stars are at least part of the puzzle. Most recently, our group has achieved a precise localization for the repeating FRB 121102, which shows that it is hosted by a dwarf galaxy at a distance of $\sim 1\,\mathrm{Gpc}$ [1, 9]. FRB 121102 is also physically associated with a persistent source of radio waves, which is offset from the center of light of the host galaxy [3]. Together, these findings suggest that FRB 121102 may be an extremely young and highly magnetized neutron star, and since superluminous supernovae and long gamma-ray bursts are also preferentially found in dwarf galaxies similar to FRB 121102's host, there is the possibility that it was created during such an event [3, 5, 9].

References

[1] Chatterjee, S., Law, C. J., Wharton, R. S., et al., 2017, *Nature*, 541, 58
[2] Lorimer, D. R., Bailes, M., McLaughlin, M. A., et al., 2007, *Science*, 318, 777
[3] Marcote, B., Paragi, Z., Hessels, J. W. T., et al., 2017, *ApJ*, 834, L8
[4] Masui, K., Lin, H.-H., Sievers, J., et al., 2015, *Nature*, 528, 523
[5] Metzger, B. D., Berger, E., & Margalit, B., 2017, arXiv:1701.02370
[6] Scholz, P., Spitler, L. G., Hessels, J. W. T., et al., 2016, *ApJ*, 833, 177
[7] Spitler, L. G., Cordes, J. M., Hessels, J. W. T., et al., 2014, *ApJ*, 790, 101
[8] Spitler, L. G., Scholz, P., Hessels, J. W. T., et al., 2016, *Nature*, 531, 202
[9] Tendulkar, S. P., Bassa, C. G., Cordes, J. M., et al., 2017, *ApJ*, 834, L7
[10] Thornton, D., Stappers, B., Bailes, M., et al., 2013, *Science*, 341, 53

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