



Odd Radio Circles – New mysterious radio sources in the sky

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Odd Radio Circles or ORCs are low surface brightness circular radio sources discovered recently from the most sensitive international radio telescopes, namely the Square Kilometer Array (SKA), the Giant Metrewave Radio Telescope (GMRT) and the Low Frequency Array (LOFAR) [1]. Some of these objects may be 1 million light-year across, about 10 times larger than our Milky Way [2]. The progenitors and astrophysical processes responsible for their origins are presently debated. Some of these ORCs may be the remnants of thermonuclear supernova outside the Milky Way and lurking in the vast intergalactic space between its neighboring galaxies [3]. The intergalactic supernova events, taking place outside galaxies, were already known from the optical surveys. Their remnants become bright in radio several thousands of years after the explosion and may be detected anywhere in the intergalactic space with the right sensitivity of the radio observations. As the sensitivity of the modern radio telescope arrays has increased many-fold, astronomers are now able to detect these objects. This explanation fits well for those ORCs, which do not have any known optical object at their centers. Some ORCs are most likely associated with distant galaxies as their centers have a known optical galaxy and hence all of the ORCs cannot be considered intergalactic supernovae. A widely known mechanism of disruption of a star by extreme tidal forces exerted by a massive black hole as the star comes in the close proximity of the central massive black hole in a galaxy can explain creation of ORCs in some galaxies in terms of the energetics [4]. In this process, the star is destroyed and about half of its mass is thrown at very high speeds away from the black hole. This disruption process releases huge amount of energy, similar to that produced in a supernova explosion. An occasional merger of two galaxies can cause millions of stars to get tidally disrupted by a black hole in a few million years, a cosmologically short period of time. The sudden release of huge energy creates shocks, which can traverse up to a million light-year in the intergalactic space. These shocks energize omnipresent cosmic free electrons to the extent that the synchrotron radio emission is produced in the weakly magnetized intergalactic space. This explanation fits within the framework of the known astrophysical phenomena.

1. A. Omar, “Yet Another Odd Radio Circle?,” *Research Notes of American Astronomical Society*, **6**, May 2022, p. 100, doi: <https://iopscience.iop.org/article/10.3847/2515-5172/ac7044>.
2. R. P. Norris et al., “Unexpected circular radio objects at high Galactic latitude,” *Publications of the Astronomical Society of Australia*, **38**, January 2021, p. e003, doi: <https://doi.org/10.1017/pasa.2020.52>.
3. A. Omar, “Odd Radio Circles as supernovae remnants in the intragroup medium,” *Monthly Notices of the Royal Astronomical Society (Letters)*, **513**, April 2022, pp. L101-L105, doi: <https://doi.org/10.1093/mnrasl/slac038>.
4. A. Omar, “On energetics and progenitors of Odd Radio Circles: A causal connection with tidal disruption of stars?,” *Monthly Notices of the Royal Astronomical Society (Letters)*, **516**, July 2022, pp. L43-L47, doi: <https://doi.org/10.1093/mnrasl/slac081>.