GALAXIES

The ring

It is not often that one finds rings in the sky, let alone rings shining in X-rays, like the ones revealed by Anna Wolter, Antonella Fruscione and Michela Mapelli (*Astrophys. J.*, in the press; preprint available at https://arxiv.org/abs/1806.02746) when they looked at data from the Chandra X-ray telescope of seven ring galaxies. Their findings indicate that these rings are rich in ultra-luminous X-ray sources (ULXs), which appear to have formed as the result of the catastrophic event that gave these galaxies their distinctive shape.

While relatively rare (<0.5% of all spiral galaxies), ring galaxies have been known to exist for a long time — Hoag's object, one of the first reported ring galaxies, was discovered in 1950. Their morphology is characterized by a bright nucleus of old stars, a gap containing almost no luminous matter and then a ring of luminous young stars. A composite image (made up of optical images from the Hubble Space Telescope in blue, green and red, and an X-ray image from the Chandra X-ray telescope in purple) of the ring galaxy AM 0644-771, a spectacular example from the work by Wolter et al., is pictured. One of the main theories to explain these peculiar systems involves an almost head-on collision between two galaxies that triggers a star formation wave, which together with the gravitational torques exerted on the impacted galaxy leads to an 'excavated' inner part of the galaxy and a ring of newly formed stars.

Credit: X-ray, NASA/CXC/INAF/A. Wolter et al; optical, NASA/STScI

The study by Wolter et al. now shows that these rings are abundant in compact objects. Interestingly, 50 out of the 63 X-ray sources found in the seven ring galaxies are classified as ultra-luminous, implying that they are powered by either stellar-mass black holes or neutron stars accreting matter at super-Eddington rates or, more intriguingly, that they are hosting accreting intermediate-mass black holes. Given the faintness of these sources and the absence of multi-epoch observations, distinguishing between these scenarios is not possible with this dataset.

Nonetheless, this sample is one of the cleanest ULX samples, the ULXs having been created in a single burst of recent star formation. Confirming previous results, the authors find a positive correlation between the number of ULXs in a galaxy and the rate with which it is forming stars. This correlation could be interpreted as evidence for an association between high-mass X-ray binaries and ULXs.

The authors also hint at a potential anti-correlation between the number of ULXs in a galaxy and the galaxy's metallicity. Unfortunately, uncertain metallicity and star formation rate measurements do not allow the authors to draw robust conclusions. ❐

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