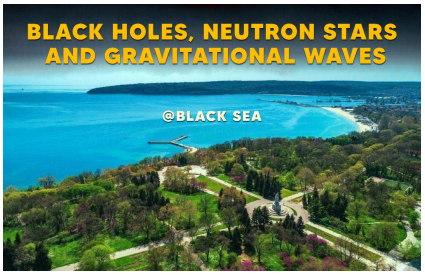

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Impact of magnetic field gradients on the development of the MRI in binary neutron star mergers

Wednesday 18 June 2025 17:00 (15 minutes)

The magneto-rotational instability (MRI) is a cornerstone of accretion disk theory, and it is often invoked to explain the generation of large-scale, poloidal magnetic fields in binary neutron star mergers. However, simulations that begin with weak seed fields and follow their amplification to saturation lack convincing evidence of MRI activity, casting doubts on its role in this setting. In this talk, I will discuss how the classical MRI extends under more realistic post-merger conditions, where magnetic fields present complex topologies and field gradients are significant. In particular, I will present modified expressions for the timescale and wavelength of the fastest growing mode, along with a generalised instability criterion that captures the influence of magnetic field inhomogeneities. Finally, I will show the results of applying the extended MRI to a high-resolution simulation of a long-lived merger remnant. Our results indicate that the MRI is significantly hindered in the early post-merger phase, with favourable conditions—where the instability condition is met and the growth rate is sufficiently fast—emerging only at later stages, of the order of 100 milliseconds after merger.

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