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Binary Coalescences as Sources of Ultrahigh-Energy Cosmic Rays

Binary coalescences are well-known sources of gravitational waves (GWs) and include combinations of black holes (BHs) and neutron stars (NSs). I will show that when BHs are immersed in magnetic fields (Bs) stronger than approximately 10^{10} G, charged particles colliding near their event horizons can easily reach very high energies (
$gtrsim 10^{18}$ eV) and become more likely to escape. Such a configuration involving B fields and high-energy particles may occur in BH–NS binaries, or even in BH–BH binaries where one of the BHs is charged (with charge-to-mass ratios as small as 10^{-5}, which do not affect the GW waveforms) and has a residual accretion disk. The number of collisions resulting in ultrahigh-energy particles is estimated to range from a few up to millions before the merger of compact binary systems. Thus, binary coalescences may also be efficient sources of ultrahigh-energy cosmic rays (UHECRs), and constraints on binary parameters would be possible if UHECRs are detected in coincidence with GWs. Furthermore, in this case, we would for the first time have certainty about a source of ultrahigh-energy cosmic rays.

Author: PEREIRA, Jonas P. (University of Brasilia)

Co-authors: Dr COIMBRA-ARAÚJO, Carlos H. (UFPR); Dr DOS ANJOS, Rita C. (UFPR); Dr COELHO, Jaziel G. (UFES)

Presenter: PEREIRA, Jonas P. (University of Brasilia)