Shadows and lensing of black holes immersed in strong magnetic fields

Haroldo C. D. Lima Junior
Universidade Federal do Maranhão, Brazil

Pedro V. P. Cunha
Universidade de Aveiro, Portugal

Carlos A. R. Herdeiro
Universidade de Aveiro, Portugal

Luís C. B. Crispino
Universidade Federal do Pará, Brazil

In astrophysically realistic environments, BHs are not isolated. Instead, they are surrounded by matter and fields that can interact with the central BH, giving rise to interesting phenomena. We investigate the null geodesic flow and in particular the light rings (LRs), fundamental photon orbits (FPOs) and shadows of a black hole (BH) immersed in a strong, uniform magnetic field, described by the Schwarzschilld-Melvin electrovacuum solution. For weak magnetic fields, the shadow becomes oblate, whereas the intrinsic horizon geometry becomes prolate. For strong magnetic fields (overcritical solutions), there are no LRs outside the BH horizon, a result explained using topological arguments. This feature, together with the light confining structure of the Melvin universe yields panoramic shadows, seen (almost) all around the equator of the observer's sky. Despite the lack of LRs, there are FPOs, including polar planar ones, which define the shadow edge. We also observe and discuss chaotic lensing and multiple disconnected shadows**.**