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Generic equilibrium black holes (BHs) and ultra-compact horizonless objects can admit a special set of planar and circular bound null orbits: Light Rings (LRs). These orbits are deeply connected to strong gravitational lensing. For instance, in spherical symmetry, LR completely determines the photon spheres and the BH shadow image.

In generic equilibrium spacetimes, non-planar bound photon orbits may also exist, dubbed Fundamental Photon Orbits (FPOs), regardless of having full geodesic integrability of the photon motion. FPOs are a natural generalization of the LR orbits.

Recent results in Arxiv:2207.13713 have indicated that horizonless ultracompact objects with LRs, that could potentially mimic BHs, can be effectively destroyed by a LR instability, triggered by the existence of a stable LR inside these objects.

In this talk we remark that stable FPOs can exist within generic spacetimes, even when all LRs are unstable or even in scenarios where no LR exists at all. We illustrate such scenarios in two concrete models: two boson stars in equilibrium and Kerr BHs with Proca hair. The existence of stable FPOs can be conjectured to also trigger new instabilities on the spacetime, similarly to the LR instability. However, a conjectured FPO instability would be much harder to anticipate or diagnose.

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