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Probing astrophysical black holes via gravitational lensing

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Black holes (BHs) represent the most extreme objects in the universe and play an important role in astrophysics. We have been exploring various ideas of using gravitational lensing to probe the population and astrophysics of BHs. Supermassive BHs of million solar masses or greater are usually detected as active galactic nuclei (AGN). We show that the innermost X-ray-emitting structure of AGN can be greatly amplified and hence effectively probed by microlensing of nearby foreground stars. For stellar mass BHs in our Galaxy, we may estimate their overall population via their astrometric microlensing effect on background sources. This capability is within the reach of available near-IR/radio interferometry facilities. Particularly interesting is the possibility to detect a concentration of stellar mass BHs (including ones of ~30 solar masses, similar to those discovered recently via gravitational waves) around the very center of our Galaxy. Furthermore, we can effectively study the formation and evolution of both stellar mass and supermassive BHs at high redshifts via strong gravitational lensing by foreground massive galaxies or galaxy clusters.

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