

Probing Astrophysical Black Holes through 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.

Q. Daniel Wang is a professor in the Astronomy Department at University of Massachusetts Amherst. He received his Ph.D. in astronomy in 1990 from Columbia University and was awarded the 1992 ASP Trumpler Award for Outstanding North American Ph.D Dissertation Research in Astronomy. He was then a NASA Hubble Fellow at University of Colorado and later a Lindheimer Fellow at Northwestern University. He was also a member of the Institute for Advanced Study at Princeton and a Raymond and Beverley Sackler Distinguished Visiting Astronomer at University of Cambridge. He was honored as the Siyuan Visiting Professor, then the Yixing Visiting Chair Professor in the School of Astronomy and Space Science at Nanjing University, and most recently as a visiting professor at Pontificia Universidad Católica de Chile. He was a Frontier Science Panel member for the US 2010 Decadal Survey on Astronomy and Astrophysics and served on the executive committee of the High Energy Division of the American Astronomical Society.

His research is primarily on high energy astrophysics. He is recognized for his pioneering work on X-ray mapping and spectroscopy of diffuse hot plasma in and around galaxies and for leading several major surveys of the Milky Way Galaxy center, using state-of-art telescopes. He was the principle investigator of numerous national and international research projects (with multi-million US dollar funding), including several large observing projects with the Hubble Space Telescope, Chandra X-ray Observatory, and XMM-Newton X-ray Observatory. He has (co-)authored about 190 research papers published in refereed journals (including four in Nature and one in Science as the lead author and one single author review paper in Proceedings of the National Academy of Sciences).

His publication covers a broad range of topics: compact stars, supernova remnants, superbubbles, and hot circumgalactic and intergalactic media, as well as galactic nuclei and their environments. His current research focuses on the feedback and ecosystem of galaxies and galactic nuclear regions. He mainly uses radio, infrared, ultraviolet, and X-ray observations to conduct these studies. He also carries out theoretical and computational studies with his students and collaborators.