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Dear Colleague,

I have several projects in observations of galaxies (active or not) and/or new probes of black holes. The ultimate goal is to understand the origin and evolution of massive black holes, in the context of cosmology, galaxy formation, and gravitational wave astronomy. Most projects require data analysis and designing clever algorithms to extract physics from large surveys. Many projects will lead to interesting targets for extensive follow-up studies - perfect for turning into theses.   If any of these interests you, let's talk.   –Xin

1) A project using the SDSS to search for sub-pc binary black hole candidates based on radial velocity drifts (similar to radial velocity exoplanet searches). The goal is to provide direct observational constraints on the abundance of sub-pc binaries that are supposed to be common from galaxy mergers, but are yet to be found.

2) A project using the DES to search for very close binary black holes based on periodic quasar light curves. By selection this probes a virtually untouched parameter space, potentially in the gravitational wave regime.

3) A project using both real and simulated quasar light curves to critically compare the different techniques to quantify periodic variability (e.g., wavelet, auto-correlation function, Fourier-transform based methods). The goal is to identify the best approach(es) for periodic features in inhomogeneous data sets with application in BBH searches.

4) A project using distinct features in the spectral energy distribution of quasars to search for very close binary black hole candidates based on binary-gap-opening models. The idea is that a secondary BH opens a gap in the circumbinary accretion disk (again, akin to planetary systems) resulting in a UV deficit. A candidate was recently proposed in Mrk231 (although unverified), but systematic searches are needed.

5) A project using the DES to find offset nuclei in galaxies based on difference imaging.

6) A project using Chandra to study the X-ray properties of galactic and sub-galactic scale binary AGN. Data already collected with our Chandra programs and will also involve searches in the archive. The goal is to understand the accretion properties of black holes in mergers. Another goal is to compare the effectiveness/limitations of optical versus X-ray selection of binary AGN.

7) A project using HST data to study the ionized gas properties of kpc/sub-kpc binary AGN and/or AGN with outflows. The goal is to critically assess the efficiency of the kinematics approach to select binary AGN. Another goal is to systematically constrain the energy output of outflows with implications for AGN feedback.

8) A project using the SDSS DR12 spectroscopic database to identify interesting new variable sources, both extragalactic and galactic. The technique developed will also be of unique value for future large multi-object spectroscopic and time-domain surveys.