Research Interests

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My current research goal is to better our understanding of the connection between QSO formation and galaxy formation. In particular, I study the relationships between QSO nuclear and host galaxy properties and how the hosts compare to normal galaxies. I have used images from the Hubble Space Telescope's Wide Field Planetary Camera 2 to study a large sample of 75 nearby ($0.06 \leq z \leq 0.46$) QSOs and have combined these observations with published data in other wavebands: x-ray (ROSAT, ASCA, Einstein), UV (HST's Faint Object Spectrograph), optical spectra (various observatories), IR (IRAS), and radio (various observatories).

Observing QSO hosts involves a detailed procedure of removing the nuclear light, and to that end I have written an extensive set of my own image analysis programs in IDL. Observed point-spread functions (PSFs) vary both spatially (field dependence) and temporally (breathing of the HST Optical Telescope Assembly). Using an artificial PSF, my software allows me to fit both of these effects. I have been using an artificial PSF because the archival images I have generally do not have an observed, stellar PSF taken at the same time as the QSO image. However, the technique could be applied to a large library of observed PSFs. My software then performs a simultaneous, 2-D fit to the nucleus and host, determining the host morphology and permitting a smooth subtraction of the QSO light, revealing the host image underneath. I can easily deal with saturation by using the host model to fill in saturated pixels. However, I measure the host luminosity not from the model but from the PSF-subtracted image, thus accounting for any differences between the model and the actual galaxy.

The luminosity function of QSO hosts is of particular interest in answering questions on galaxy evolution and why some galaxies are active while others are not. I have found that galaxies which host QSOs span a narrow range of luminosities and are more luminous than normal galaxies. They average one magnitude brighter than M_V^* ($M_V^* = -22.35$, with a cosmology of $H_0 = 50$ km/s/Mpc, $q_0 = 0.5$), so only the very brightest of galaxies can host a QSO. By comparing the host luminosity function to that of normal galaxies, I have also calculated the fraction of galaxies of a given luminosity that will host a QSO. For nearby QSOs, this fraction increases with galaxy luminosity, up to 100% for $M_V \leq -24.5$, subject to the uncertainty in the luminosity function for bright galaxies.

I plan to extend my QSO study to explore the recently discovered relationship between black hole mass and bulge luminosity in host galaxies. The large sample I have already gathered and the techniques I have developed will provide an excellent starting point to expand our knowledge of how these black holes are fueled and grow. I plan to complement my existing sample with new HST data, such as will be produced by the Advanced Camera for Surveys, and using the finer sampling of ACS to go to higher redshifts with good image quality.