

## Exploring the Center of M31

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### Abstract

Supermassive black holes (BHs) in the centers of galaxies interact with nearby stars, e.g., stripping giants of their gaseous envelopes. High nuclear stellar densities can foster interactions among stars. These processes lead to the creation of X-ray sources (XRSs), such as the hot cores of stripped giants, or X-ray binaries. Chandra has identified more than 100 XRSs in the central  $8' \times 8'$  of M31. This region has also been the subject of numerous HST observations. We propose to use archival HST data to study correlations between the XRSs and both nearby stars and ionization features. We will find counterparts or to place significant limits on the flux of possible counterparts for a significant fraction (1/3-1/2) of the XRSs in these fields. We will estimate the ages of the X-ray active systems, search for differences between them and stars in their immediate neighborhood, study the results as a function of distance from the nucleus, and compare the bulge and disk populations. This detailed work, possible only in M31, will shed light on the interactions that occur in the centers of galaxies. XRSs created near the center emit copious amounts of X-ray and UV radiation, with a reasonably steady average greater than  $10^{39}$ - $10^{40}$  erg  $s^{-1}$ , independent of direct emission from the BH. This is a form of feedback that has not yet been well studied, and which can be better understood through the work we propose. A second important focus of the archival work is to illuminate the nature of the still poorly understood classes of supersoft sources (SSSs) and quasisoft sources (QSSs). Some SSSs may be progenitors of Type Ia supernovae; some may be accreting intermediate-mass BHs. Appropriate models for QSSs have not yet been developed. The bulge of M31 has a high density of these sources. Work with the HST archive will provide unique insight into the possible natures of these enigmatic and potentially important sources.

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