Chandra Studies of Nearby Radio and Seyfert Galaxies

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[Contributed talk, 15min.]

Abstract

I shall describe some of the results of a Chandra ACIS program on the extended, universally bi-polar, X-ray emission of nearby radio galaxies and Seyfert galaxies, with emphasis on the diversity of the radiation mechanisms involved and the implications for our understanding of the AGN phenomenon.

a) Radio galaxies. The X-ray emission from the hot spots of **Cygnus A** are synchrotron self-Compton emission from the synchrotron radio emitting electrons in a magnetic field which is close to equipartition (the papers by Young et al. and Smith et al. describe our Chandra results on the nucleus and cluster gas of Cygnus A, respectively). The X-ray knots of the **M87** jet are almost certainly synchrotron radiation, as judged by their steep spectra. Preliminary results of a long integration on the Virgo cluster ICM will be presented. The X-ray radiation mechanism of the jet and western hot spot of **Pictor A** remains uncertain, with evidence favoring synchrotron radiation and bulk relativistic outflow of the jet and, remarkably, the western hot spot.

b) Seyfert galaxies. For the **Circinus galaxy, NGC 1068 and NGC 4151**, the bulk of the X-ray emitting gas is photoionized by the nucleus. There is some evidence for thermal plasma emission powered by the starburst in Circinus and by the jet-driven outflows in NGC 1068. In **M51**, the bi-polar nuclear lobes previously found in radio continuum and optical line emission show up in X-rays as thermal plasma emission from shocked gas with kT $\sim$ 0.5 keV. The nucleus is obscured by a column density in excess of 10^{24} cm^{-2} (see paper by Terashima et al.). In **NGC 4258**, the X-rays (which are thermal plasma emission from gas with kT $\sim$ 0.3 - 0.6 keV) are dominated by the "anomalous arms". These arms represent dense gas in the galaxy disk shocked by mass motions driven into the low density halo gas (which then collides with the disk) by the out-of-disk radio jet.

The extended X-ray emission powered by active galaxies thus depends on the relative contributions of i) relativistic jets (dominant in radio galaxies), which radiate non-thermal X-rays; ii) bi-polar ionizing radiation (dominant in high luminosity, radio-quiet [Seyfert] galaxies), which photoionizes an extended nebulosity, and iii) non-relativistic, bi-polar mass ejections and radio jets (dominant in low luminosity AGN).

CATEGORY: ACTIVE GALAXIES AND QUASARS