Q4 ISM of elliptical vs. spiral galaxies. Mo, van den Bosch & White §2.3

(f) Gas Content Although it was once believed that elliptical galaxies contain neither gas nor dust, it has become clear over the years that they actually contain a significant amount of interstellar medium which is quite different in character from that in spiral galaxies (e.g. Roberts et al., 1991; Buson et al., 1993). Hot ($\sim 10^7$ K) X-ray emitting gas usually dominates the interstellar medium (ISM) in luminous ellipticals, where it can contribute up to $\sim 10^{10}\,M_\odot$ to the total mass of the system. This hot gas is distributed in extended X-ray emitting atmospheres (Fabbiano, 1989; Mathews & Brighenti, 2003), and serves as an ideal tracer of the gravitational potential in which the galaxy resides (see §8.2).

In addition, many ellipticals also contain small amounts of warm ionized (10^4 K) gas as well as cold (< 100 K) gas and dust. Typical masses are 10^2–$10^4\,M_\odot$ in ionized gas and 10^6–$10^8\,M_\odot$ in the cold component. Contrary to the case for spirals, the amounts of dust and of atomic and molecular gas are not correlated with the luminosity of the elliptical. In many cases, the dust and/or ionized gas is located in the center of the galaxy in a small disk component, while other ellipticals reveal more complex, filamentary or patchy dust morphologies (e.g. van Dokkum & Franx, 1995; Tran et al., 2001). This gas and dust either results from accumulated mass loss from stars within the galaxy or has been accreted from external systems. The latter is supported by the fact that the dust and gas disks are often found to have kinematics decoupled from that of the stellar body (e.g. Bertola et al., 1992).

(f) Gas Content Unlike elliptical galaxies which contain gas predominantly in a hot and highly ionized state, the gas component in spiral galaxies is mainly in neutral hydrogen (HI) and molecular hydrogen (H_2). Observations in the 21-cm lines of HI and in the mm-lines of CO have produced maps of the distribution of these components in many nearby spirals (e.g. Young & Scoville, 1991). The gas mass fraction increases from about 5% in massive, early-type spirals (Sa/SBa) to as much as 80% in low mass, low surface brightness disk galaxies (McGaugh & de Blok, 1997). In general, while the distribution of molecular gas typically traces that of the stars, the distribution of HI is much more extended and can often be traced to several Holmberg radii. Analysis of emission from HII regions in spirals provides the primary means for determining their metal abundance (in this case the abundance of interstellar gas rather than of stars). Metallicity is found to decrease with radius. As a rule of thumb, the metal abundance decreases by an order of magnitude for a hundred-fold decrease in surface density. The mean metallicity also correlates with luminosity (or stellar mass), with the metal abundance increasing roughly as the square root of stellar mass (see §2.4.4).