EARLY RESULTS FROM AN HST IMAGING SURVEY OF THE ULTRALUMINOUS IR GALAXIES

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1. Why Study the Ultraluminous IR Galaxies?

The intense study of interacting galaxies originated in large part with the discovery by IRAS that the most IR-luminous galaxies are nearly all products of collisions and may be the missing link in the chain of evolution from quasars to normal quiescent galaxies (Sanders *et al.* 1988a,b). These galaxies (with $L_{\rm IR} > 10^{12} L_{\odot}$) are considered to be the most strongly starbursting of all galaxies in the local universe, have a higher space density than quasars, emit >90% of their power in the IR, are rich in the raw materials of star formation, and to a large extent owe their peculiar morphologies to encounters with other galaxies. The particular importance of IR-luminous galaxies in the grand scheme of cosmology and galaxy evolution has been underscored by the luminosity function studies of Soifer *et al.* (1986), which indicated that most galaxies have gone through a high-IR luminosity stage. We are using the Hubble Space Telescope to survey the fine-scale features that are associated with the interaction- and activity-related processes that are at work within the Ultraluminous IR Galaxy Sample. It is widely believed that these galaxies are undergoing star formation at a prodigious rate and are abnormally dust-enshrouded. An alternative to the starburst hypothesis is that these galaxies' IR luminosity is powered by a dust-hidden quasar at its center (Sanders *et al.* 1988a). *It is important for our understanding of the evolution of galaxies and quasars to determine which of these two hypotheses is valid, or in which objects they are separately valid.*

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2. The Ultraluminous IR Galaxy Sample: $L_{\rm IR} > 10^{12} L_{\odot}$

We have created our survey sample from a combination of sources. The first "bright" sample of 10 galaxies that satisfied the $L_{\rm IR} > 10^{12} L_{\odot}$ constraint was compiled by Sanders *et al.* (1988a). A second, partially overlapping, "warm" sample of 12 galaxies (9 new ones) was also identified at that time by Sanders *et al.* (1988b). An additional, partially overlapping, "bright" sample of 17 galaxies in the south was later compiled by Melnick & Mirabel (1990). Lawrence *et al.* (1996) found another 126 low-flux objects in the QDOT all-sky redshift survey of IRAS galaxies, while Kim *et al.* (1995) and Clements *et al.* (1996) have added to the numbers at low flux levels.

3. Early Results from the HST Survey

To date, we have received HST WFPC2 I-band (F814W) images for about 40 galaxies from our total combined sample of 160 ultraluminous IR galaxies. With the help of such high-resolution imaging, the properties of this class of objects are now being better defined, including a clarification of the nature of the energy source. *Fine structure is seen within a radius* $< 2''$ *for each galaxy.* In $\sim$20% of the galaxies, the structure is smooth and centrally concentrated, suggestive of a bright nuclear energy source (AGN?). *In the other cases, the sub-arcsecond morphology is chaotic and extended, suggestive of strong starburst activity.* The peculiar, disturbed morphologies that are seen on large (kiloparsec) scales among this sample of galaxies are continued down to the smallest scales in the cores of these strongly starbursting systems (Figure 1). A rich variety of morphological features are seen; these are probably related to the recent interaction-induced starburst episode. These starburst-related features, (*e.g.*, numerous bright clumps of star formation, shells, and bubbles) are similar to those seen in previous HST imaging observations of strongly interacting and merging galaxies.

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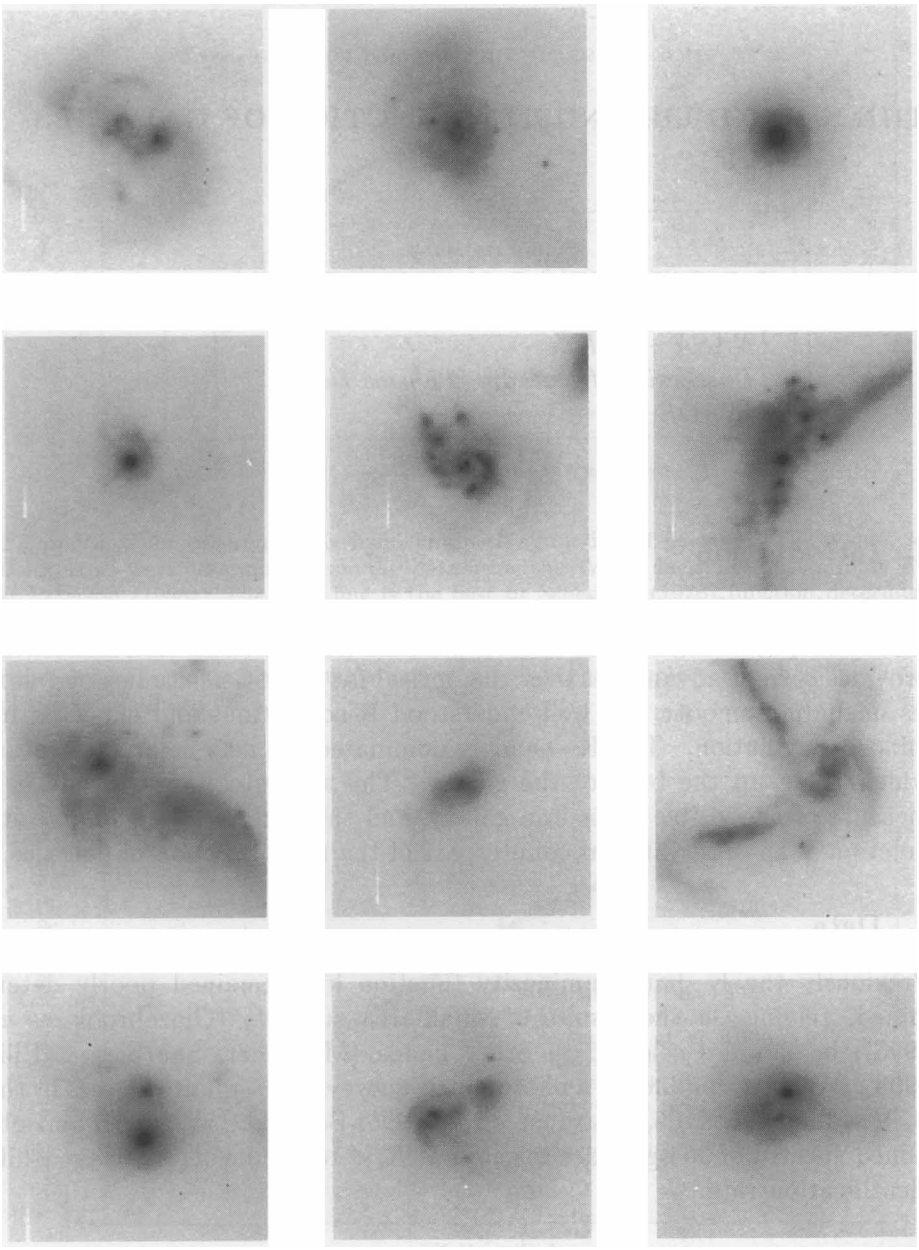

Figure 1. Selected HST WFPC2 I-band images (10″ square) for 12 ultraluminous IRAS galaxies. Note the clear interaction/merger morphology for many of the galaxies, but also note the AGN-like appearance of at least 2 of them.

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