

*Our Galaxy, its structure, interstellar matter*

1. Survey of Galactic regions, its gaseous nebulae and clusters, with high-resolution diffraction-limited optics. Fainter objects and more detail. Detailed observations in all wavelengths are of great interest. IR studies of central regions, for extinction and distribution of hydrogen. Abundances of other elements relative to H; e.g., C, N, O. Also emission in UV, especially in Lyman alpha. How much emission is thermal and how much non-thermal. IR for total extinction, UV for size distribution.

2. Special attention to Galactic center, photos of filamentary structure, determination of motions of gasses—turbulent and systematic.

3. Distribution of *gas and dust*. Magnetic fields (from polarization measures) associated with interstellar material, because of theoretical implications with regard to cosmic ray accelerations. Observations of interstellar absorption lines in ultra spectra of distant stars. Primary source of excitation of emission nebulae thought to be Lyman alpha and other lines in series.

4. *Supernovae* and their remnants, include X-ray observations, and UV observations, and gamma ray observations if latter sensors can be pointed with sufficient accuracy.

5. A sky survey in X-radiation and gamma-radiation at many wavelengths is needed to determine sky background and discrete sources, and their diameters. Until now, the gamma radiation appears to be all due to background. Only about 10 X-ray sources are known, and only one of these (Crab Nebula) has identified with an optical object and is not a point source. Only imaging has been done on Sun: first with a pin-hole device, later with grazing incidence optics. For objects fainter than the Sun, collimating systems may be required in order that very large collecting areas are possible.

6. Large orbiting radio antennas may be needed for exploring the Galactic center and arms of the Galaxy, in wavelengths on either side of the radio window. The longer wavelengths (longer than optical) penetrate absorbing features more easily than shorter wavelengths.

*Galaxies and Intergalactic Space*

1. Direct high-resolution photographs and spectrophotometric observations of the nearer galaxies, together with polarization measures will give improved knowledge of the largest groupings of stars and gas clouds. This will include radio observations and X-ray source observations. Galactic nuclei deserve special attention since there is evidence of ejection of large gaseous masses. With high resolution (e.g., 0".1, 0".01' or better) it will be possible to identify much smaller components of galaxies, including brighter stars, star clusters, gaseous nebulae, and filaments for many more nearby galaxies than the dozen or so now studied in detail from ground observations. Some of these special features should be easier to detect against a blacker sky—beyond the airglow of the atmosphere.

2. Distance criteria for nearer and more distant galaxies will improve the Hubble velocity-distance relation (or redshift versus magnitude). This in turn should lead to the selection of cosmological model(s) of the universe, and more reasonable explanations of the apparent expansion of the universe of galaxies. Is there a relation between a "neutron star" as proposed by theory, and an "X-ray star" (also theoretical, and perhaps yet observable), and the QUASAR (observed as a "radio star" and photographed as a bright star-like object)? Observations of these objects outside the Earth's atmosphere, together with the efforts of the theorists may shed light on this question.

3. Observations of the most distant objects, such as the galaxies themselves, and the QUASARS (quasi stellar radio sources) may indicate important differences between the universe as it is now, and as it was, say, 5 to 10 billion years ago. It is important to correlate energy received from the galaxies in wavelengths observable outside the atmosphere with energy received at the Earth's surface through the optical and radio windows. Will there be found good evidence of aging of galaxies the farther out one observes? (i.e., Are distant galaxies appreciably younger, or at least, different from nearer galaxies?)

4. Quasi stellar galaxies (QSG) emit excessive amounts of light in the ultra-violet range and not radio detectable as sources. Although only a few of them have been studied, they appear to be much more plentiful than quasars. Further discovery and study of these QSG's will provide much more information for studying the outer limits of the universe.