

Search for Obscured *IRAS* Galaxies

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Abstract. We have discovered a number of sources still remaining in the *IRAS* catalogs with no convincing optical identification. Their IR colors and high galactic latitudes indicate faint galaxies (fainter the DSS limit). These empty fields have been observed with the Byurakan Obs. 2.6m telescope in VRI. 22^m - 23^m faint formations have been revealed.

1. Obscured *IRAS* galaxies

One of the major objectives of infrared, submillimeter and X-ray astronomy is to determine if there exists an extragalactic population so obscured as to be spectroscopically unidentifiable from optical observations. Such objects have been discovered recently by SCUBA, ISO far-infrared, and Chandra X-ray surveys providing evidence that an obscured population exists (e.g. Barger et al. 2000). Such objects may be revealed from *IRAS* sources, too. Half of them remain without any identification yet and their physical nature is unknown. The Byurakan-*IRAS* Galaxies (BIG) sample has been constructed on the basis of optical identifications of *IRAS* PSC sources (*IRAS* 1988) in the region $+61^\circ < \delta < +90^\circ$ ($|b| > 15^\circ$) of the First Byurakan Survey (FBS). A brief description of the sample is given in these Proceedings (Mickaelian et al. 2002). The sample contains objects in the range 12^m - 21^m : most of them are emission-line galaxies, some having AGN properties (Sy2, LINERs, composite spectrum objects). A number of observed galaxies revealed high IR luminosity ($L_{fir} > 10^{11} L_\odot$), so that they are LIGs and ULIGs (Sanders & Mirabel 1996).

2. High-Luminosity *IRAS* Galaxies in the *BIG* Sample

The ultraluminous infrared galaxies (ULIGs) are defined as having $L_{fir} > 10^{12} L_\odot$ (for $H_0=50$ and $q_0=0.5$). QSOs with $M_b=-24.0$ have this luminosity between 1 micron and 1 keV.

It is interesting that the *IRAS* PSC sources with colors typical of galaxies (except for the brightest objects) have approximately the same IR fluxes at $60\mu\text{m}$ and $100\mu\text{m}$ (0.4-1.5Jy and 1-3Jy, respectively), while their optical magnitudes fall in a large range, as mentioned above. Moreover, we can assume that 21^m is not the limit for such objects. Fainter galaxies in our *BIG* sample should appear to be LIGs and ULIGs. They are much fainter in the optical range and much farther on the average, hence their IR luminosities will be much larger.

The far-infrared sky is characterized by extended, filamentary structure, particularly at $100\mu\text{m}$. For sources only detected at $100\mu\text{m}$, the sum of the two cirrus flags CIRR1+CIRR2 has to be less than 10 in order to discriminate against knots of the IR cirrus (Klaas & Elsässer 1993); 436 sources in our region have been eliminated for this reason (to be checked later?). However, we are left with 30 good sources which still have no optical counterparts, and which may be very distant hyperluminous IR galaxies (HyLIGs).

The BIG Redshift Survey (Mickaelian et al. 2002) revealed 30 new LIGs and two ULIGs (IRAS 07479+7832a and IRAS 10252+7013) even at 17^m – 18^m . The total number of LIGs and ULIGs in the BIG sample is estimated to be about 300 (15%).

3. Search for Obscured IRAS Galaxies

25% of our sources are associated with galaxies fainter than 20^m . 30 IRAS sources (having colors typical of galaxies) seeming to be real extragalactic objects (not cirrus) have no optical counterparts at the IR coordinate positions. The corresponding optical objects must be beyond the DSS limit.

These empty fields are to be studied by deep imaging to reveal the faint objects responsible for the IR. Taking into account their IR colors typical of galaxies, they must be very faint galaxies in optical wavelengths. Taking into account that 12 of them also have radio counterparts (association with NVSS sources), it may be believed that there exist real objects at these positions. The radio objects may be both AGNs and ULIGs, a very important combination for study of the AGN/starburst phenomena.

The Byurakan Astrophysical Observatory (BAO) 2.6m telescope with the ByuFOSC focal reducer and the TM 1060×514 CCD has been used for deep imaging of the candidate “obscured” IRAS galaxies from our lists. Five objects (empty fields): IRAS 08596+6741, 09246+6956, 09247+6541, 09509+7641, and 09531+6955 were observed in November, 2000, in VRI colors (5 min exposures). A few faint formations have been revealed at the positions of the IRAS sources for all of them, 3-4 objects for each field, most probably distant galaxies. Their magnitude estimates give 22^m – 23^m in V.

This program will reveal objects which must be studied in detail with larger telescopes and SIRTf in 2002 (in collaboration with J.Houck and B.Brandl, Cornell Univ., USA). We plan to take IRS spectra for these fields to confirm the IRAS sources, measure accurate IR fluxes, and measure their redshifts.

References

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