Large IR galaxy sample for studies of nuclear and starburst activity

Areg Mickaelian, Hayk Abrahamyan, Gurgen Paronyan
Byurakan Astrophysical Observatory (BAO)

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Overview

- Byurakan-IRAS Galaxy (BIG) sample
- Studies of BIG objects
- Star-Formation Rates of BIG objects
- IRAS PSC/FSC Combined Catalogue
- IRAS PSC/FSC ExtraGalactic sample (IRAS-EG)
- Studies of IRAS-EG, pilot subsamples

Optical identification of IR sources

Optical identification of **all** non-identified *IRAS PSC* sources (1577) in the *FBS* area with $\delta>+61°$, $|b|>15°$, 1487 deg^2; using FBS/DFBS, POSS/DSS, and SDSS

Cross-identifications with X-ray, UV, other optical data, IR, and radio catalogs; 770 coincidences with NVSS

Byurakan-*IRAS* Galaxy (BIG) sample: 1967 objects, including 789 previously known galaxies in this area and **1278** newly identified ones

Byurakan-*IRAS* Star (BIS) sample: **287** late-type stars *(catalog is available at CDS, Vizier)*

Only 12 non-identified IR sources

Studies of BIG sample and subsamples

- *spectroscopic follow-up (redshift survey) for bright ($V<18^m$) objs:* ***z/classification/L_{fir}***
- *discovery and study of new* ***AGNs and ULIRGs***
- *morphological study & 2D spectroscopy for* ***interacting/merging systems*** *and others*
- *deep observations for search for optical counterparts of* ***obscured IRAS galaxies***
- *SST (SIRTF) observations of* ***obscured IRAS galaxies***
- *study of* ***starburst / AGN / interaction phenomena*** *and their interrelationship*

Starburst activity

Many SB galaxies in our sample:

The fraction of SB [SB/(SB+AGN)]: 0.07-0.98

IR and FIR luminosities:

$F_{IR} = 1.8 \times 10^{-11} (13.38 f_{12} + 5.15 f_{25} + 2.58 f_{60} + f_{100})$ erg cm^{-2} s^{-1}

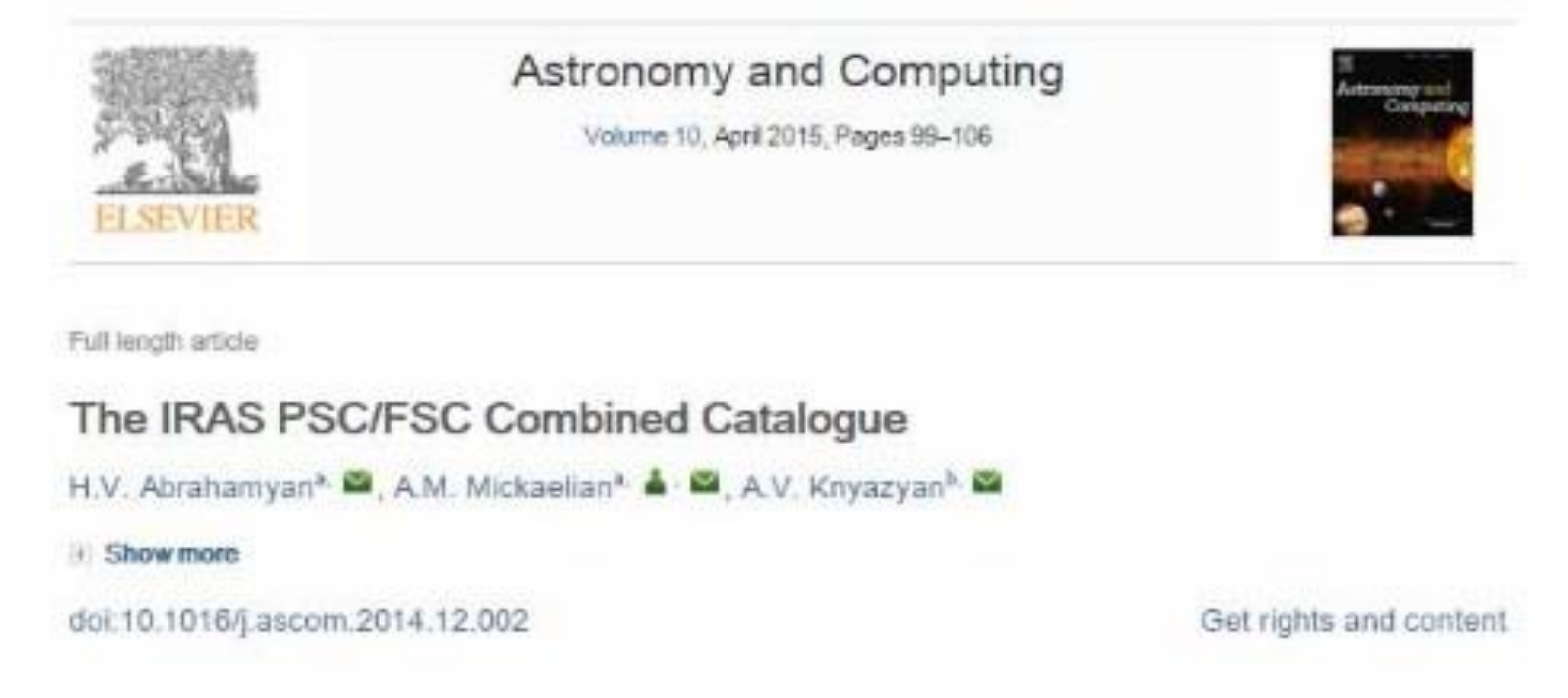
$F_{FIR} = 1.26 \times 10^{-11} (2.58 f_{60} + f_{100})$ erg cm^{-2} s^{-1}

$L_{IR}(L_\odot) = 5.6 \cdot 10^5 \cdot R^2 \cdot (13.56 f_{12} + 5.26 f_{25} + 2.54 f_{60} + f_{100})$

$L_{FIR}(L_\odot) = 5.6 \cdot 10^5 \cdot R^2 (2.58 f_{60} + f_{100})$

Highest IR luminosity for a single spiral galaxy: 10^{12} $L_\odot$

IRAS PSC/FSC Combined Catalogue



Abrahamyan, H. V.; Mickaelian, A. M.; Knyazyan, A. V.

The IRAS PSC/FSC Combined Catalogue

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Vizier Online Data Catalogue # II/338.

IRAS PSC/FSC Combined Catalogue

- a new tool for cross-matching astronomical catalogues
- identifications with a search radius corresponding to 3σ of errors for each source individually
- **73,770 associations** (common sources)
- cross-correlations: AKARI-IRC, AKARI-FIS, WISE (+2MASS)

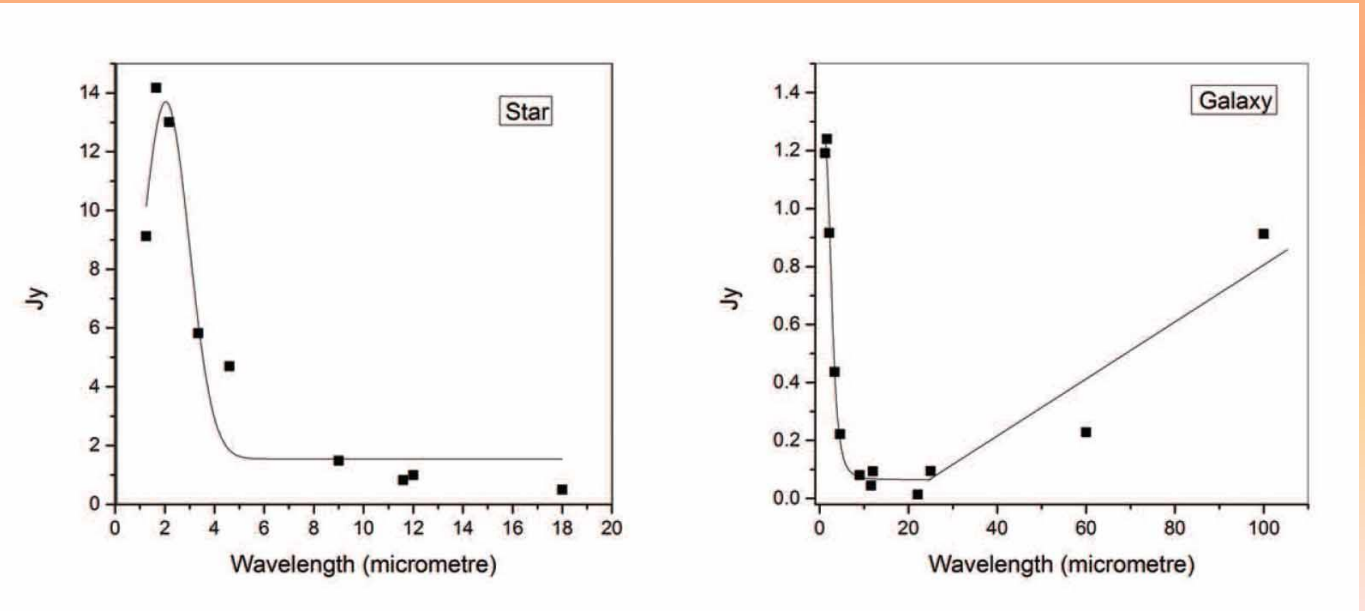
Table 1. Main characteristics of IRAS-PSC, IRAS-FSC, AKARI-IRC, AKARI-FIS and WISE catalogues.

Catalogues	IRAS-PSC	IRAS-FSC	AKARI-IRC	AKARI-FIS	WISE
Year	1986	1989	2010	2010	2012
Wavebands (μm)	12, 25, 60, 100	12, 25, 60, 100	9, 18	65, 90, 140, 160	3.4, 4.6, 11.6, 22.6 1.25, 1.65, 2.17
Wavelengths (μm)	8–120	8–120	6.7–25.6	50–180	2.6–28
Resolution (")	40	20	0.3	0.8	0.5
Sensitivity (Jy)	0.25, 0.25, 0.4, 1.0	0.1–0.5	0.05, 0.12	~ 0.55	0.00008–0.006
Sky area	all-sky	$\|b\| > 10°$	all-sky	all-sky	all-sky
Coverage (%)	96	83	94	98	99
Source number	245,889	173,044	870,973	427,071	563,921,584

IRAS-PSC 1988	IRAS-FSC 1989	IRAS PSC/FSC 2014	AKARI-IRC 2010	AKARI-FIS 2010	WISE 2012
245,889	173,044	345,163	225,165	90,946	344,923

IRAS PSC/FSC Combined Catalogue

- Combined Catalogue of **345,163 IRAS point sources**
- high positional accuracy and **17 photometric measurements** from 1.25 to 160 μm range
- increasing the efficiency of using PSC and FSC
- improving data based on both catalogues
- facilitate new optical identifications
- many new QSOs and active galactic nuclei, late-type stars, planetary nebulae, variables, etc.



Galaxies in IRAS PSC/FSC

Pre-selection of sources (stars / galaxies / unknown)

- IRAS and WISE colours
- Quality flags
- Extension
- Detection in AKARI-IRC or AKARI-FIS

Cross-correlations

- Catalogs of bright galaxies
- Catalogs of QSO/AGN (VCV-13, BZCAT, SDSS DR9 QSOs)
- SDSS DR10 (star / galaxy / QSO)
- APM / MAPS (ellipticity / extension)
- Genuine identifications (1σ and no other counterpart within 3σ)

IRAS PSC/FSC Galaxy Sample

Total number: **78,240 objects** (genuine galaxies)

Available data from IRAS PSC/FSC: 2MASS JHK, WISE w1w2w3w4, AKARI-IRC 9,18, IRAS 12,25,60,100, AKARI-FIS 65,90,140,160

18,567 active galaxies (VCV-13, BZCAT v5, SDSS QSOs)

Fraction of active galaxies: **23.7%**

Cross-correlations with **X-ray and radio**; more AGN candidates

Redshifts available for 22,970 objects

MW flux ratios

Interrelationship between SB, nuclear activity and interactions / merging phenomena for some 17,500 interacting/merging pairs and multiples in IRAS-EG

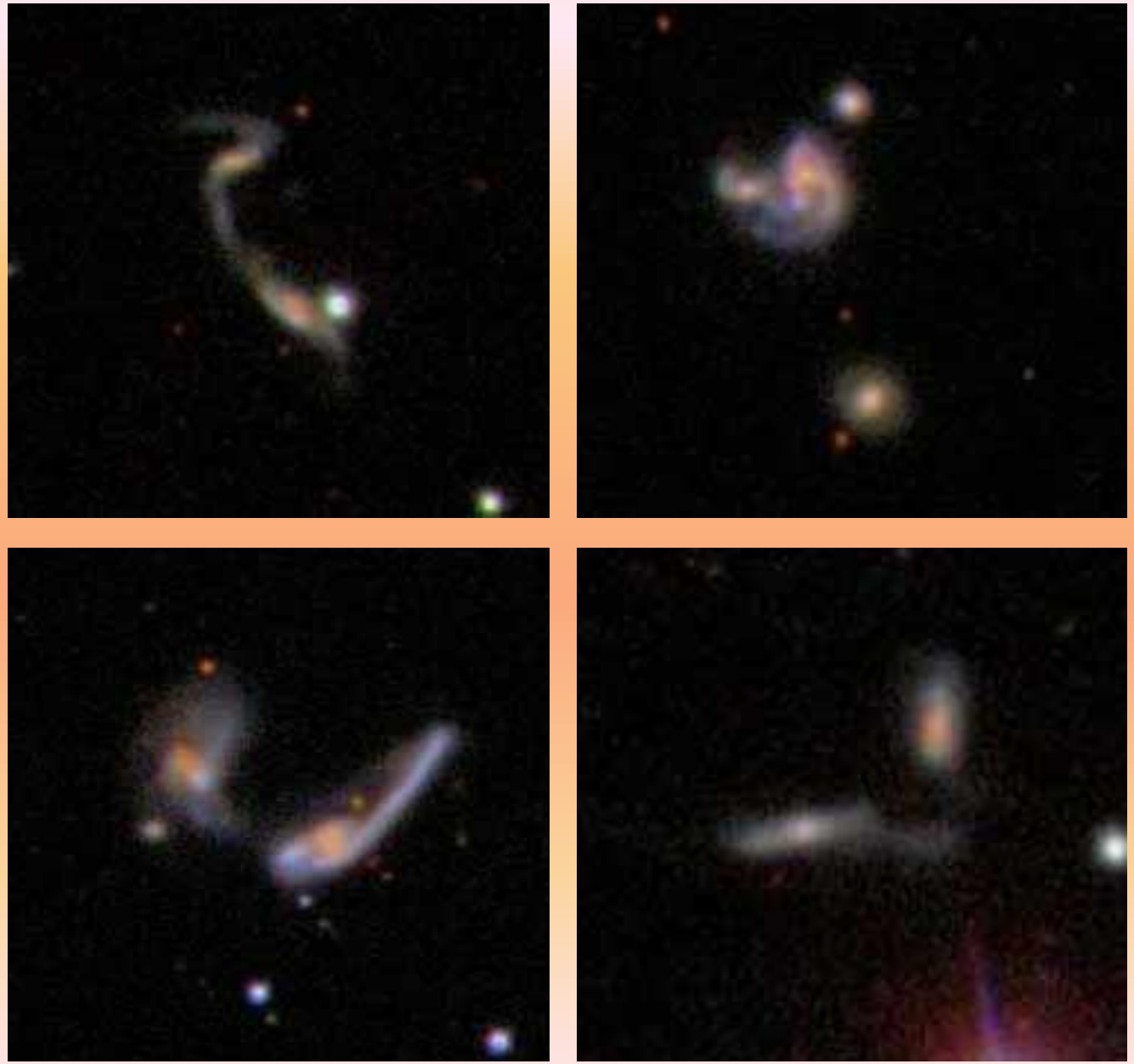
Studies of Pilot Subsamples

Pilot subsamples

- AGN (+ Composites); AGN content, fraction of AGN types, etc.
- LIRGs / ULIRGs / HLIRGs
- Interacting/merging galaxies (SB/AGN/interactions interrelationship)
- Obscured galaxies (very high IR/opt flux ratios: >100)

Full subsamples for further studies

Interacting/merging galaxies in IRAS-EG



Summary

- **BIG sample** of 1278 galaxies
- AGN & SB by spectroscopic observations, a number of ULIRGs (AGN/SB fraction among IR sources and ULIRGs)
- Cross-correlations with 2MASS, WISE, AKARI, GB6, NVSS, FIRST; ROSAT, GALEX (for MW flux ratios and overall understanding)
- Highest IR luminosity for a single spiral galaxy is 10^{12} $L_{\odot}$
- Interrelationship between SB, nuclear activity and interactions / merging phenomena for interacting/merging pairs and multiples from BIG sample (1278 IRAS sources, incl. 150 components)
- IRAS PSC/FSC Combined Catalogue of **345,163 point sources**
- Star / Galaxy separation (pre-selection)
- Cross-correlations with catalogs of bright galaxies and AGN
- Large sample of **IRAS selected galaxies** (78,240)
- Studies of IRAS-EG **pilot subsamples**