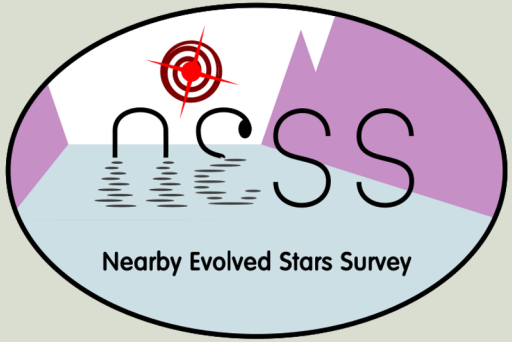

The Nearby Evolved Stars Survey

Overview and first results

Alfonso Trejo Cruz
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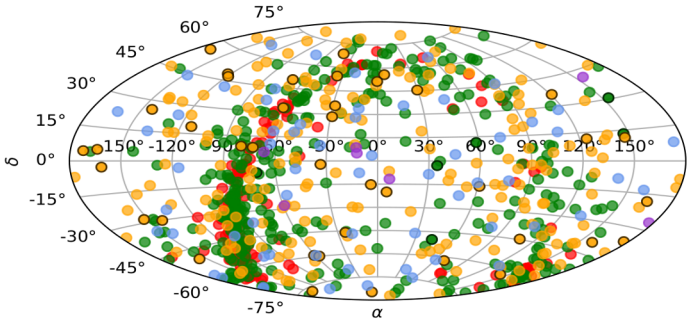
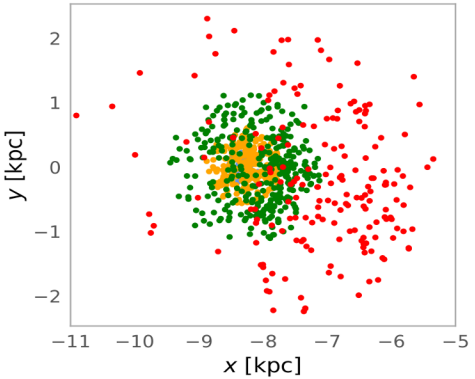
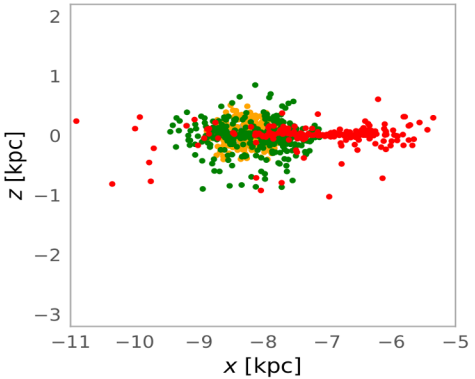
Overview paper: Scicluna+2021 (arxiv.org/abs/2110.12562)

Sky distribution

- 852 stars within 3 kpc
- A large fraction of sources in the Galactic plane
- Aim to be as reproducible and open source as possible

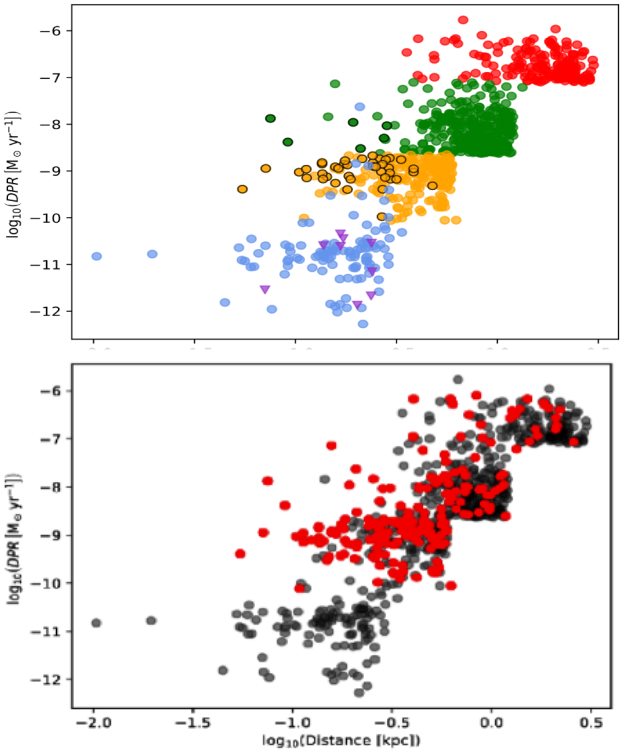






Sample

- Wedding cake selection in distance and dust-production rate
- Observations in CO and sub-mm continuum
- Lowest tier mostly objects missing from previous studies
- 4-5x improvement in statistics at high DPRs and D > 600 pc

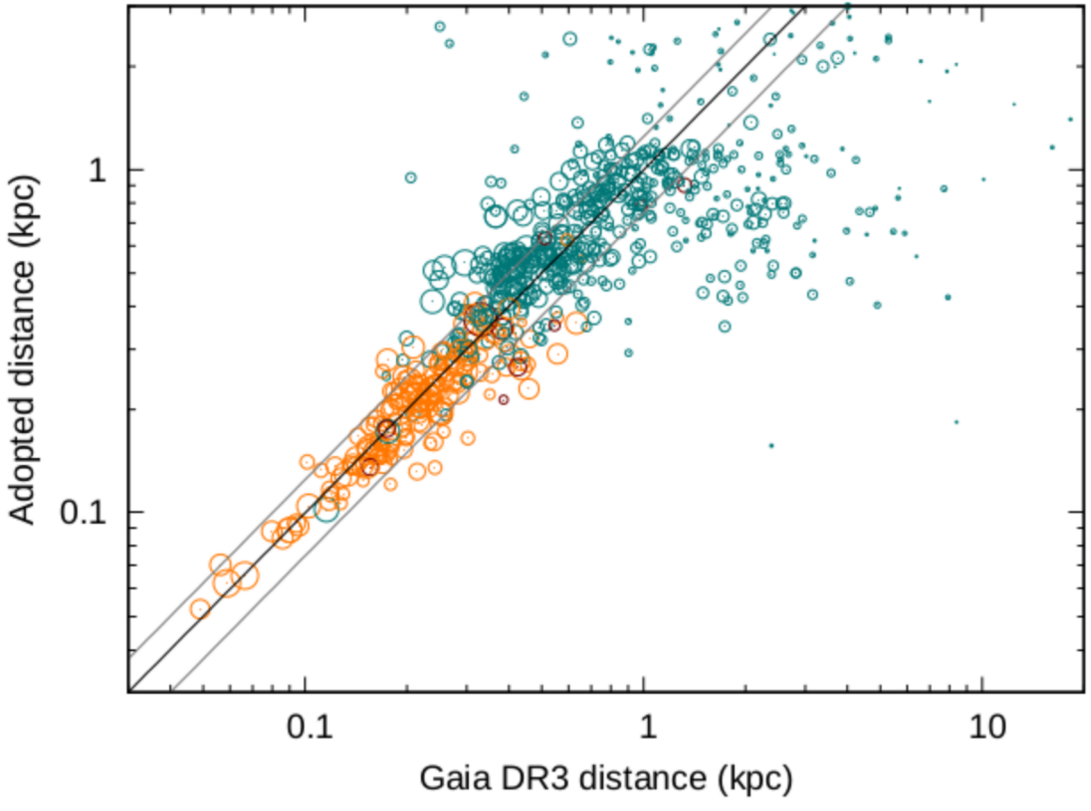


Sample Selection

- Start from IRAS PSC
- Distances have long been a problem
  - Parallax contaminated by convection, variability, dust
- Derive distances assuming local luminosity function matches LMC (Riebel+ 2012)
- Use Hipparcos, TGAS or maser parallaxes if possible
- DPRs from SEDs with GRAMS models (Sargent+ 2011, Srinivasan+ 2011)

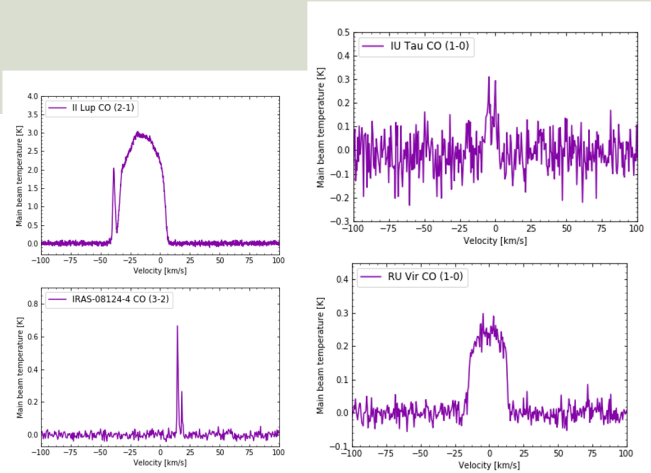
Distances: comparison with Gaia EDR3

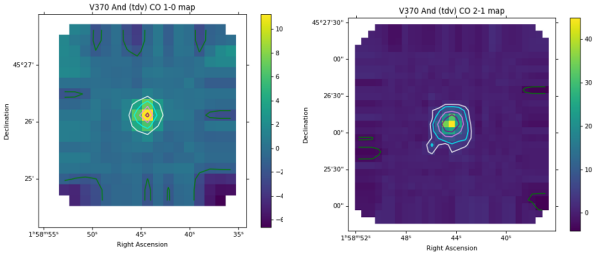
- Distance determination:
  - Maser
  - Hipparcos/TGAS
  - Luminosity
- Size of circle indicates precision - bigger = better
- Dashed lines indicate ±25% uncertainty
- As expected, methods roughly in agreement.

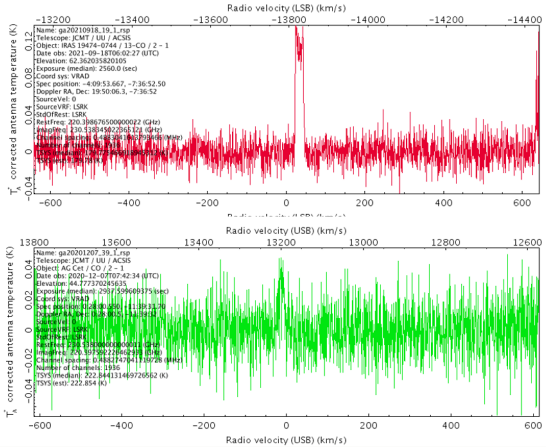


NESS observations

- JCMT: 1400 hours, CO(2-1), (3-2), 450/850 continuum
- APEX: 200 hours, CO(2-1), (3-2)
- Nobeyama 45m: 450 hours, CO(1-0)
- IRAM 30m: 80 hours CO(1-0), (2-1)
- ALMA/ACA: 97 hours, higher resolution B6 & B7
- Observations over 50% complete
- ***Lots*** of archival data

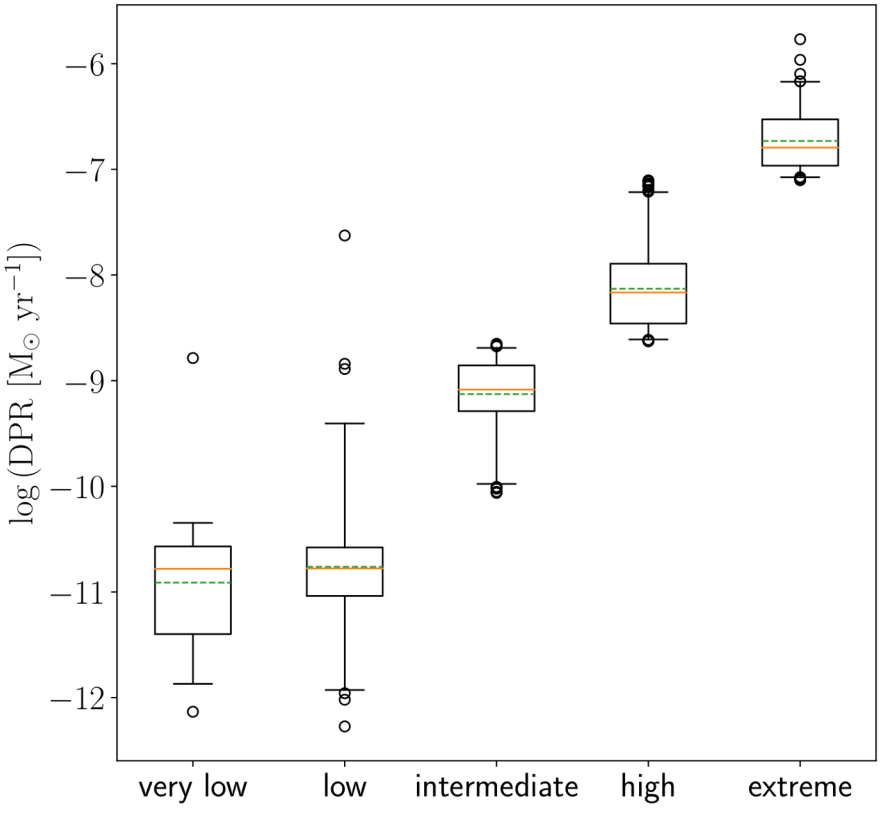




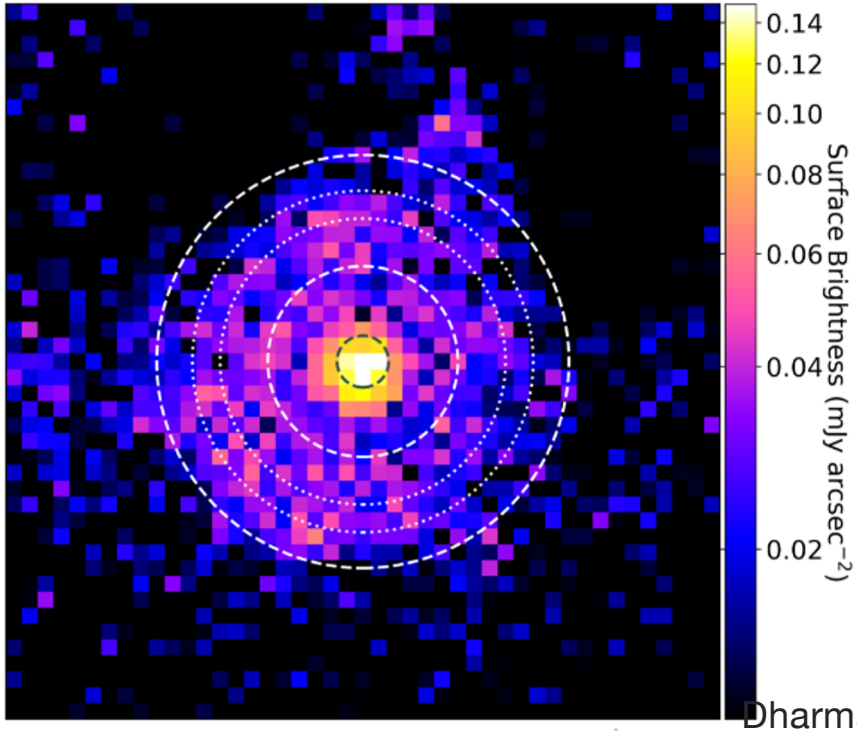


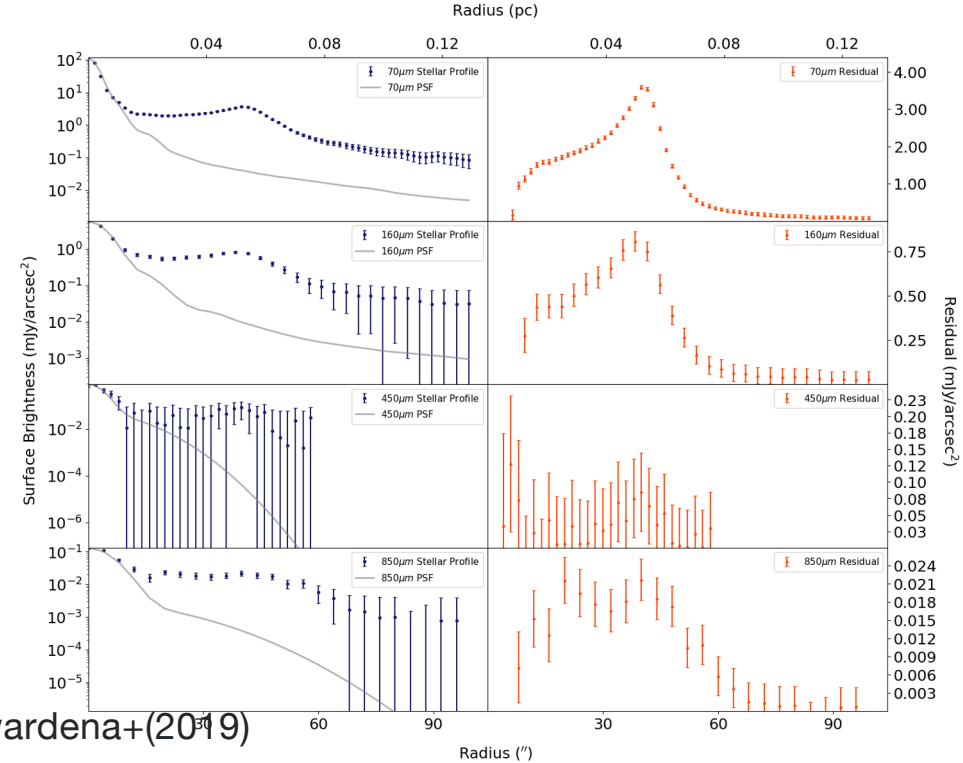
Dust production rate in Solar Neighbourhood

- Unsurprisingly, dominated by highest DPRs sources
- Consistent with previous estimates (e.g. 8×10^{-6} $M_{\odot}$ yr^{-1} kpc^{-2}; Tielens 2010)



Extended Continuum Emission

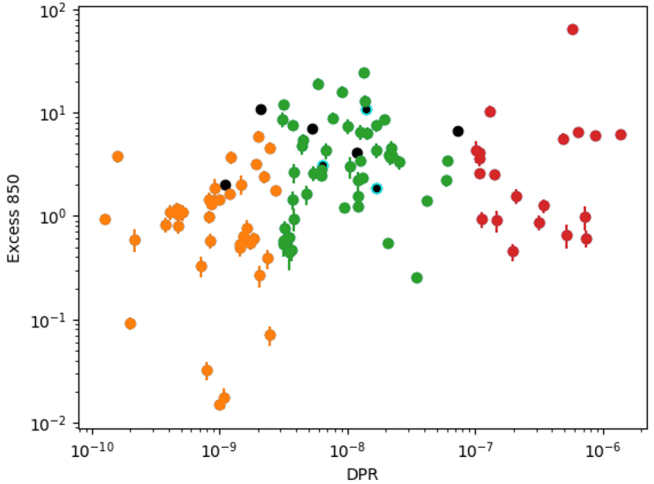


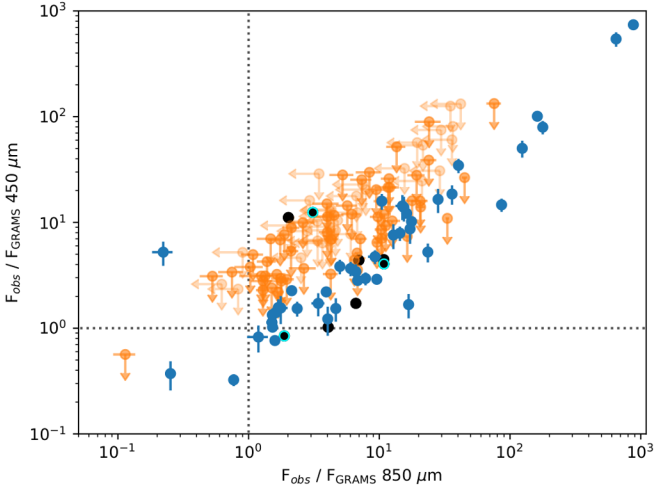


Dharmawardena+(2019)

Excess sub-mm emission

- GRAMS models underestimate sub-mm flux by a factor of 3 - 10.
  - Not too surprising as GRAMS is tuned for mid-IR

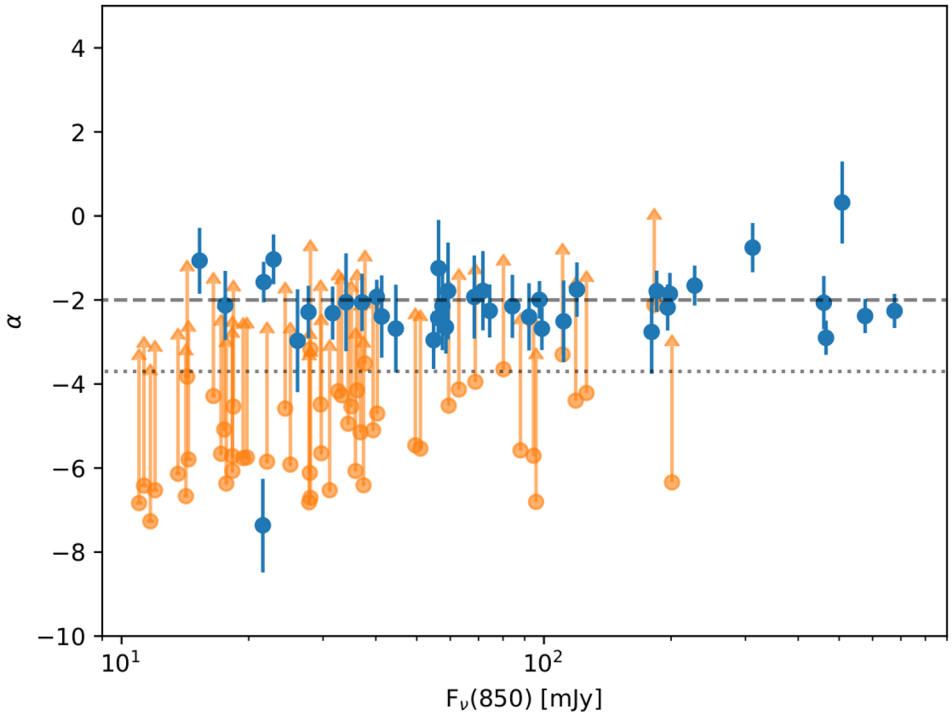




- Possible link between extended emission and excess
  - Extended sources from Dharmawardena+(2018): big excess
  - Higher DPR, more cold dust (?) ⇒ more excess emission?

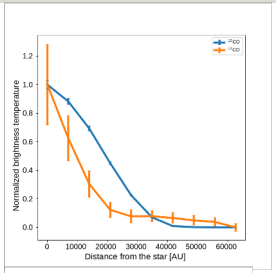
Sub-mm spectral indices

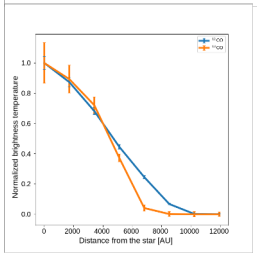
- Observed spectral indices very low
- Consistent with blackbody, rather than ISM dust.
  - Also due to cold dust?
  - Or we don't understand dust properties well at all.

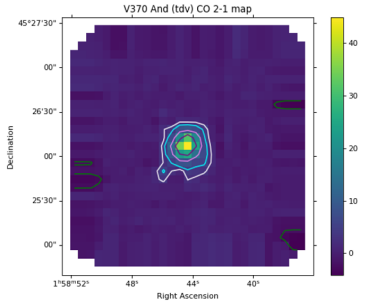


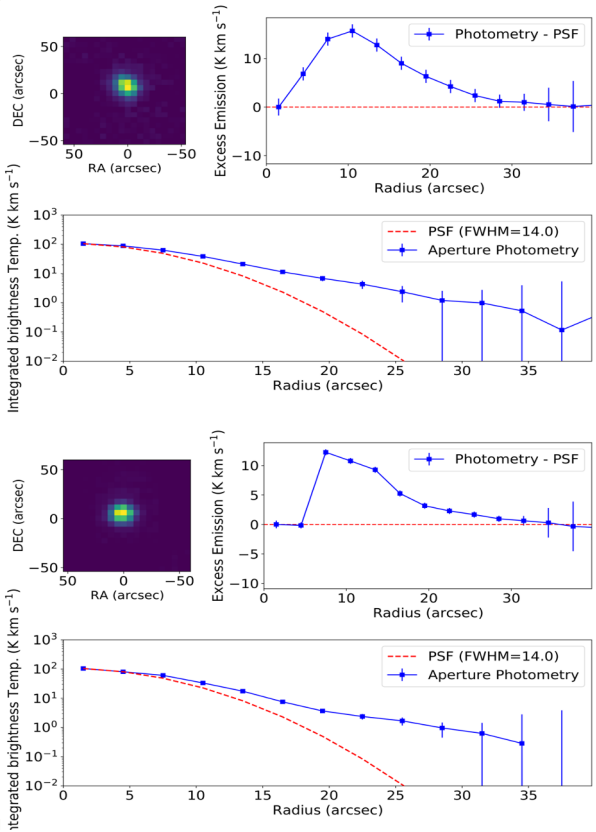
Extended CO Emission

- Nearby intermediate/high DPR stars well resolved even in CO(3-2)
  - Initially 18/25 JCMT mapping sources extended (Scicluna+ 2021)
- Some have radii exceeding 30”
- Also see large extensions in NRO and IRAM data (Amada+, Jeste+, in prep)
- Also resolve 13CO with NRO (Amada+, in prep)



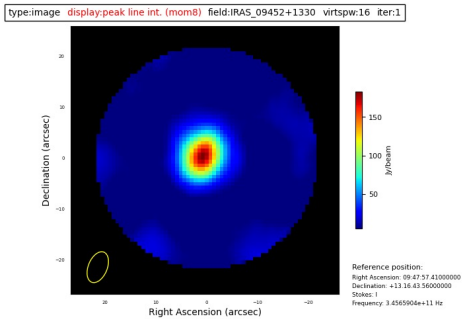


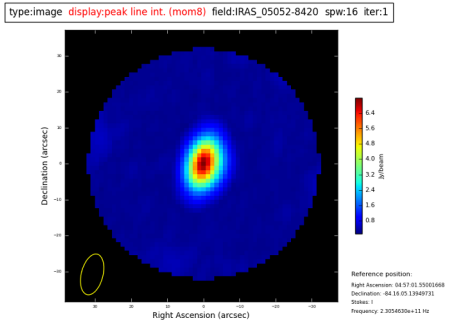


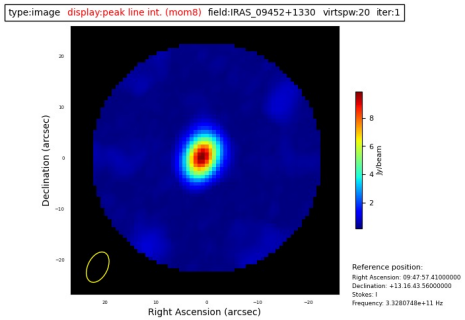


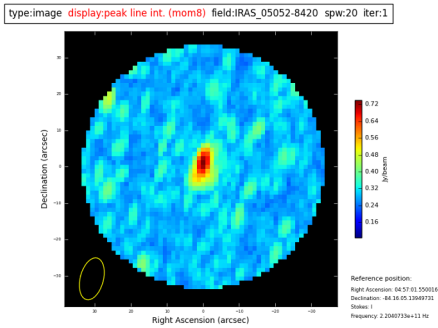
Synergyes with ALMA ACA

- ~ 270 sources in $^{12\text{-}13}$CO (2-1) and $^{12\text{-}13}$CO (3-2) and continuum, with DPR > 10^{-10} M yr^{-1}
- Archival data also available
- Aiming to resolve envelopes
- Combine with JCMT to obtain morphology from 3 to 20 arcsec









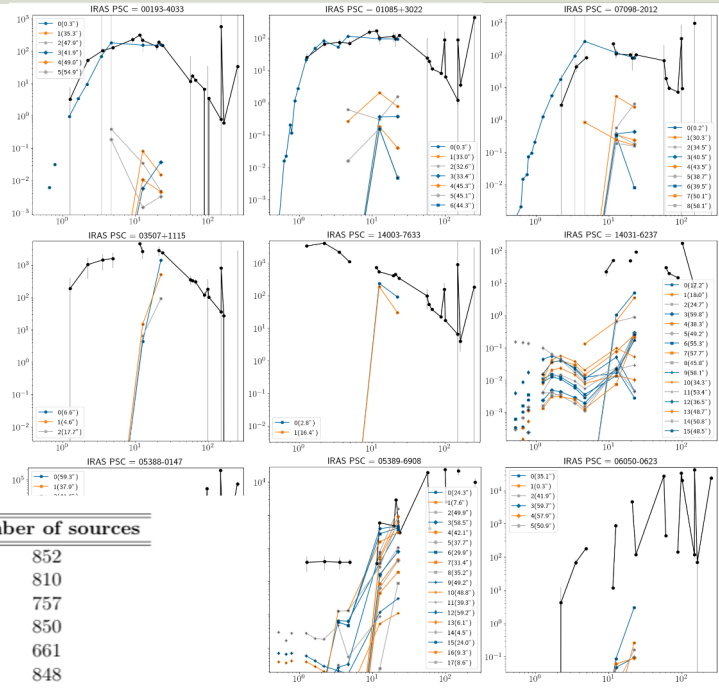
Machine-learning classification

- Well-understood sample
  - Good for training ML
- But sample is unbalanced
  - E.g. many more M-stars than C-stars
  - Use *Imbalanced classification*
  - Otherwise almost everything gets classified as an M-star
- Train on spectroscopic classes, predict on photometry

Emir Hernandez (IRyA-UNAM)

Collating literature results

- Many well-studied sources in sample
- Collating as much literature data on sample as possible (McDonald+in prep):
  - Automatically gathering photometry from all-sky surveys (Antonio Perez, VIU)
  - And extracting properties from various databases e.g. Vizier - see also talk by Iain McDonald.
  - Also automatically identifying papers with SIMBAD
    - Explore papers with most hits for tables
- Use TAP queries wherever possible for maximal reproducibility
  - Release queries for reconstructing data if possible

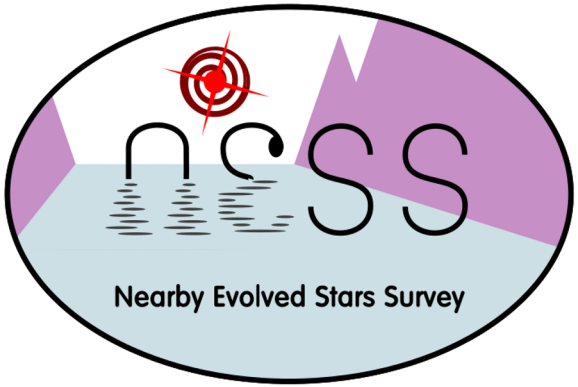


Survey	Number of sources
IRAS PSC	852
Akari IRC	810
Akari FIS	757
WISE All-Sky	850
COBE/DIRBE	661
AllWISE	848
2MASS	334
UnWISE	414
Gaia DR2	282
PanSTARRS-1	59

Table 4.1: *Table with the number of counterparts obtained from each survey.*

Summary

- Objectives:
  - Total mass return to Solar Neighbourhood
  - Statistically-robust studies of evolved-star physics
  - Go-to database for nearby evolved stars
- Data collection and analysis ongoing, still lots to do!
  - Overview paper accepted,
  - catalogue, heterodyne data, and CO 1-0 papers in prep
- General information and catalogue at NESS website
  - If interested, you can fill in a form or contact P. Scicluna



http://evolvedstars.space