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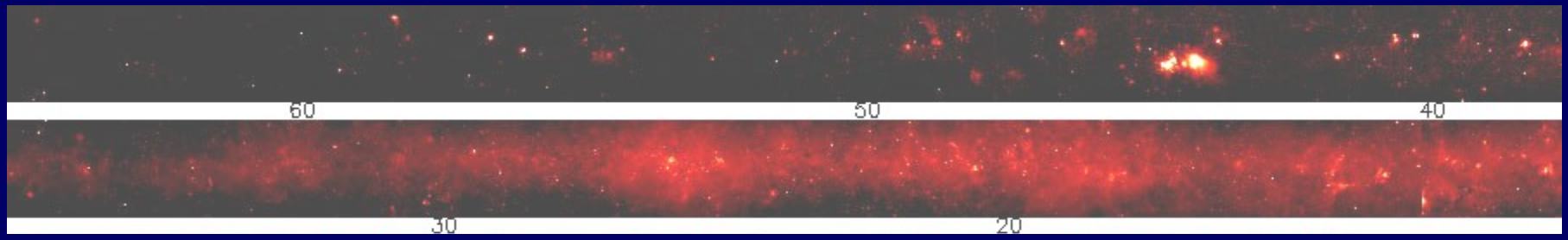
Finding Massive YSOs

Stuart Lumsden



RMS Team:
Melvin Hoare, Rene Oudmaijer, Heather Cooper, Nichol Cunningham, Luke Maud (Leeds), James Urquhart, Hugh Wheelwright (MPIfR), Ben Davies (Cambridge), Joe Mottram (Exeter), Toby Moore (Liverpool JMU), Cormac Purcell (Sydney), Michael Burton (UNSW)
CORNISH:
Cast of millions, but the bulk of the work done by Cormac Purcell

Massive Young Stellar Objects

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- Luminous (>10^4 $L_\odot$), embedded IR source (mostly still accreting?). Mostly HMCs?
- Also frequently:
  - Compact, ionised "wind" (emission lines have v~100 km/s) – radio "weak".
  - Supersonic molecular outflow
  - Maser emission

GL2591

Gemini JHK

Evolutionary Outline

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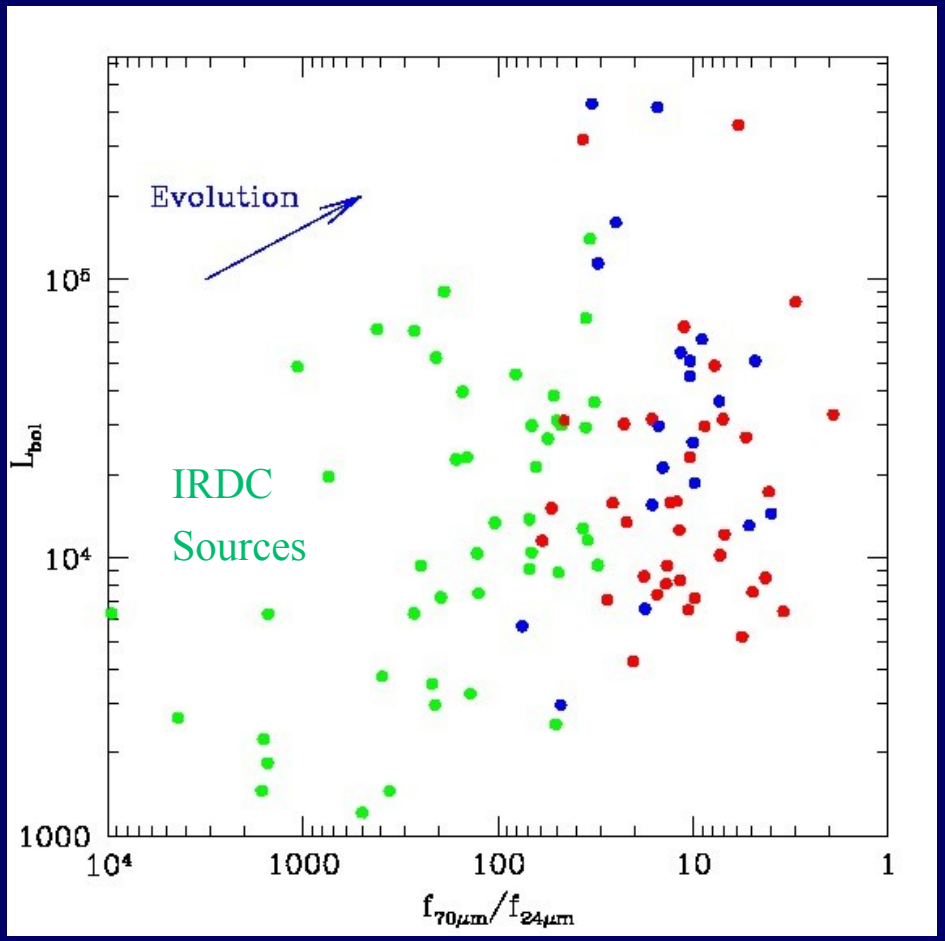

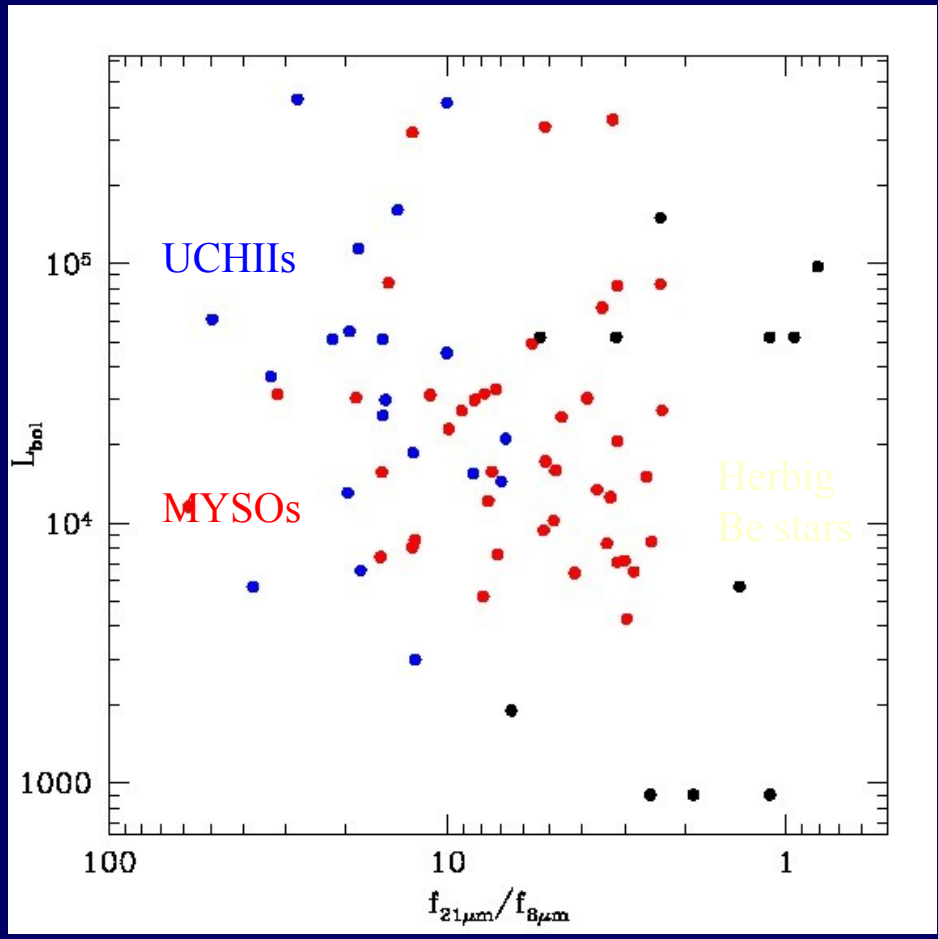

The Red MSX Source (RMS) Survey

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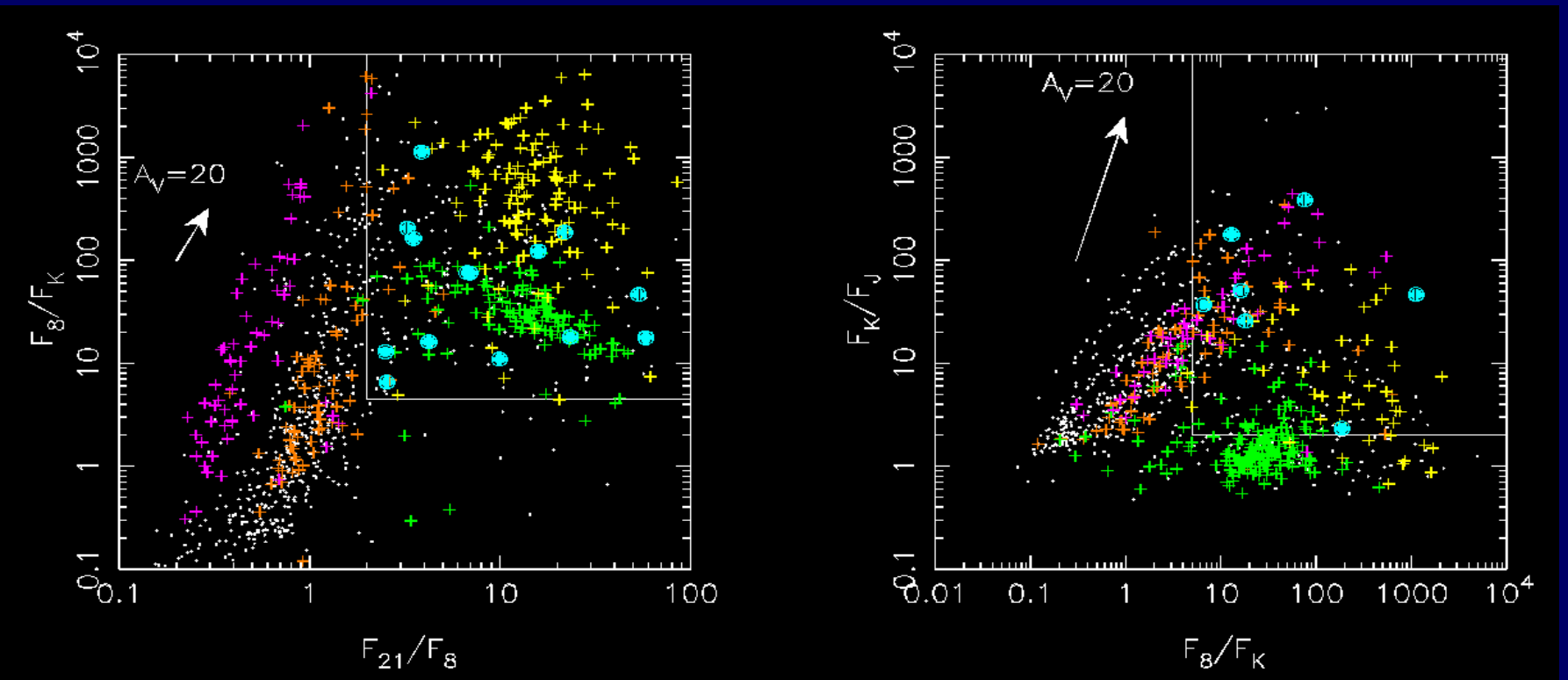
MSX survey: 8, 12, 14 and 21μm, 18″ resolution, $|b|<5^{o}$

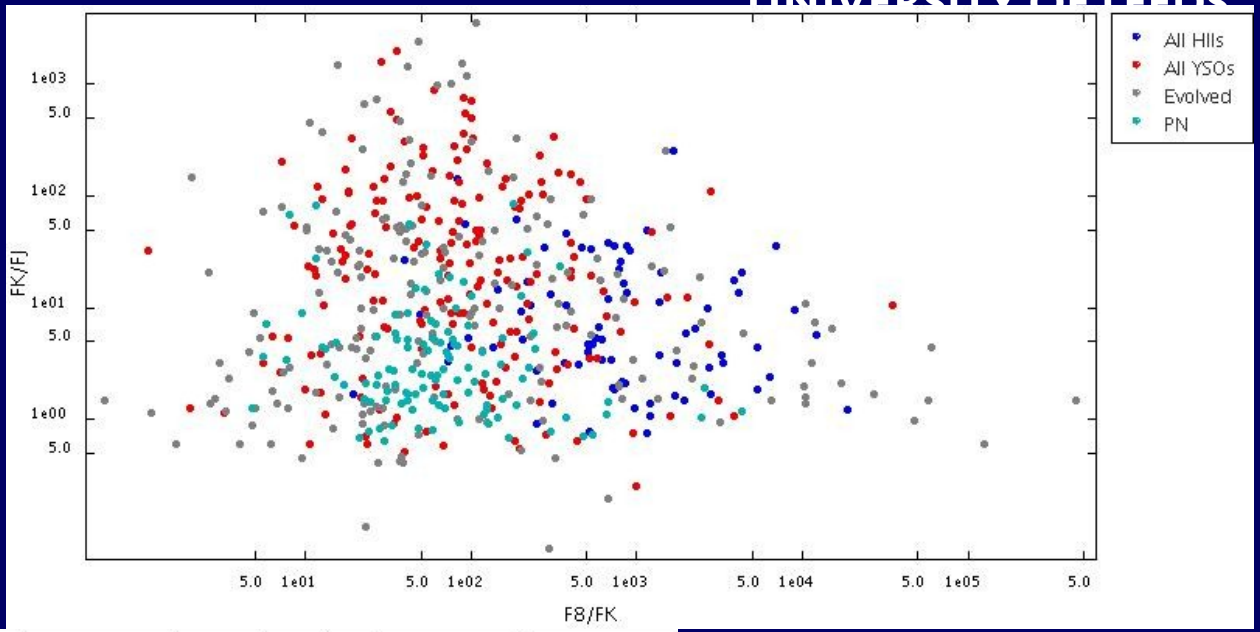
Colour-select from the MSX PSC and 2MASS

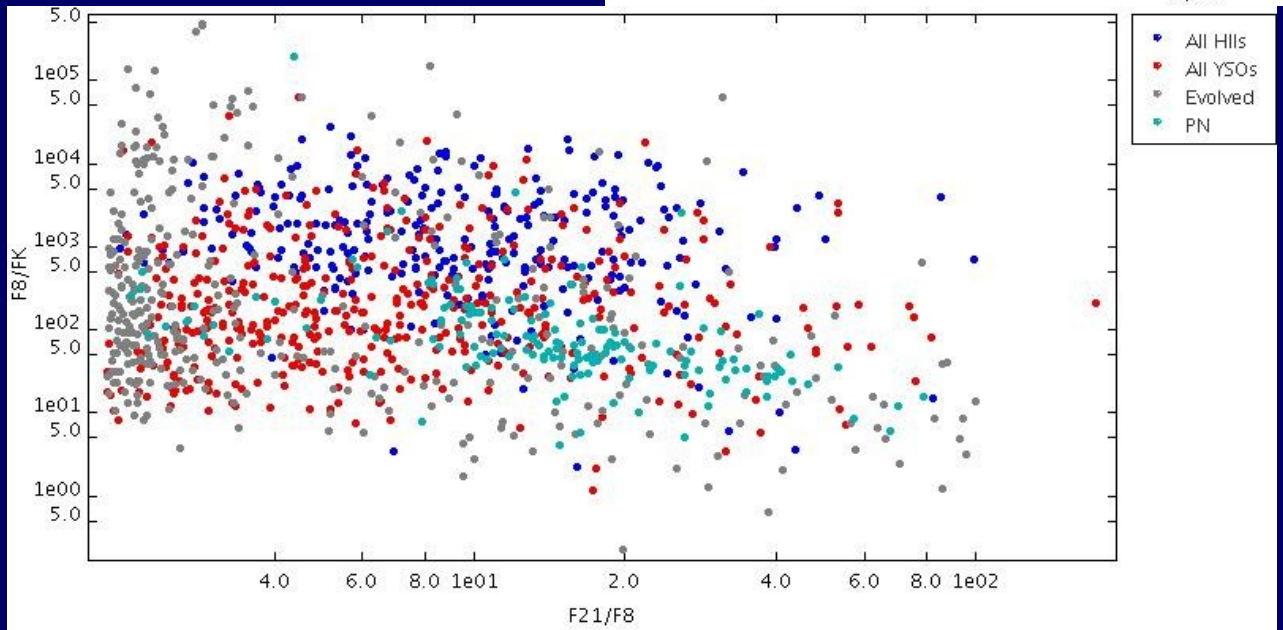
Delivers ~2000 candidates: http://www.ast.leeds.ac.uk/RMS

- Massive YSOs + UCHII regions + PN + C stars + OH/IR stars



What happens when we add GPS?





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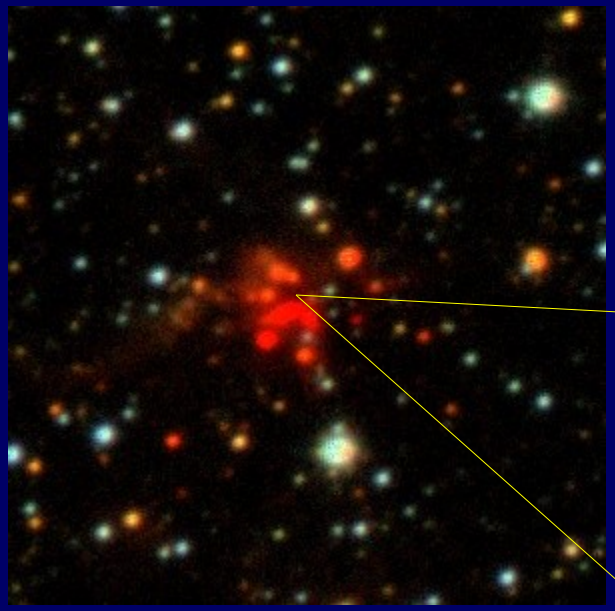

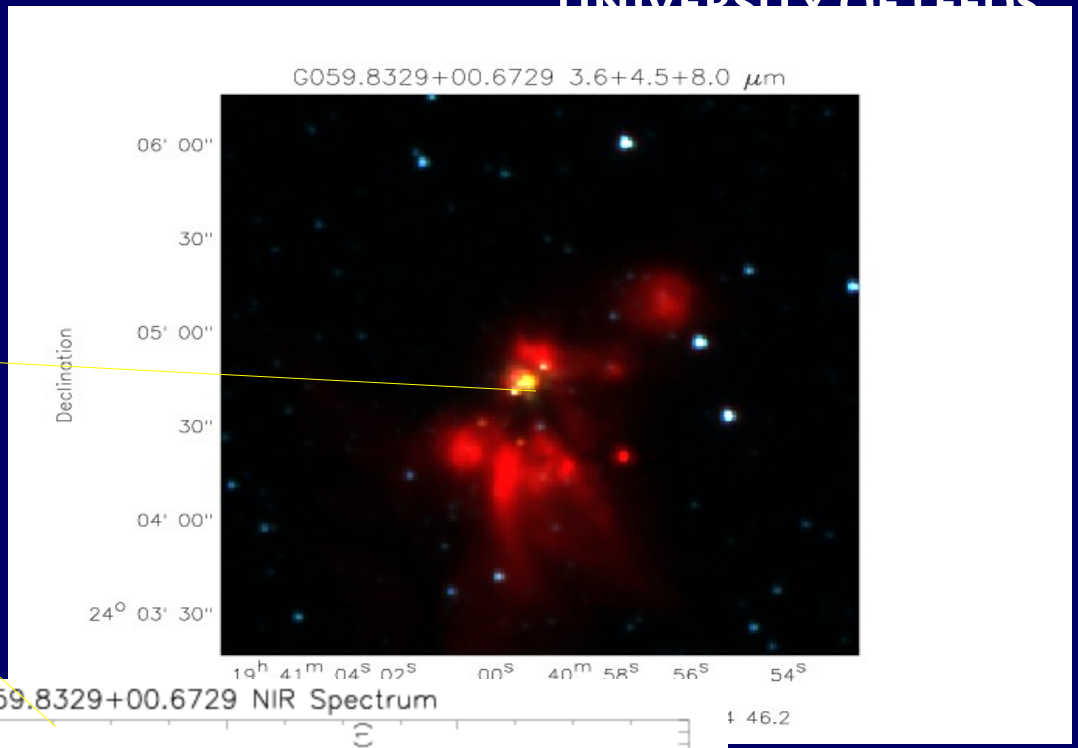

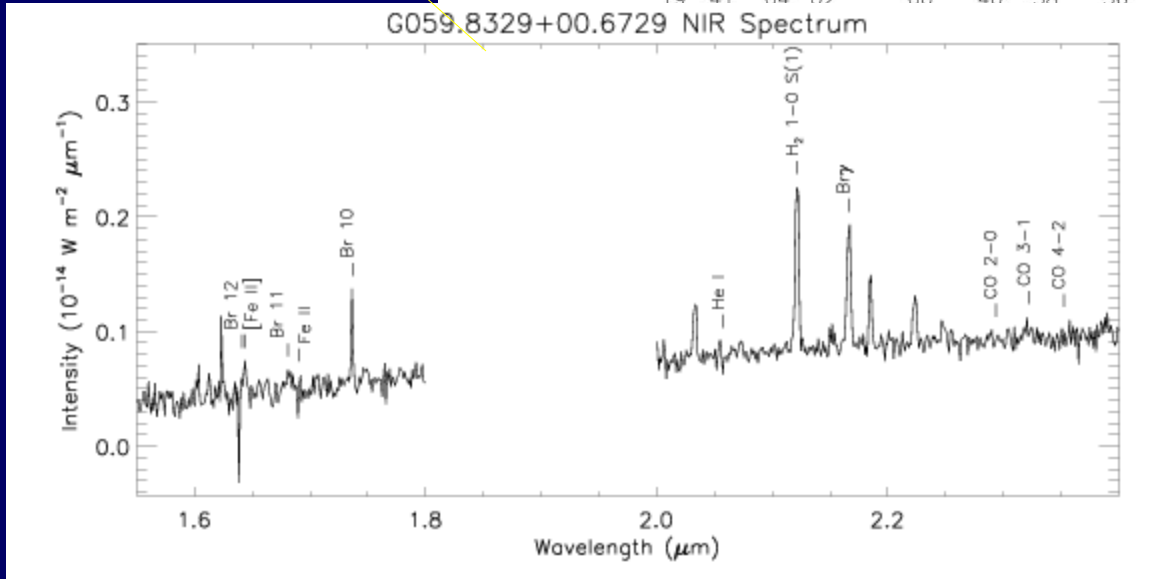

All sorted then??

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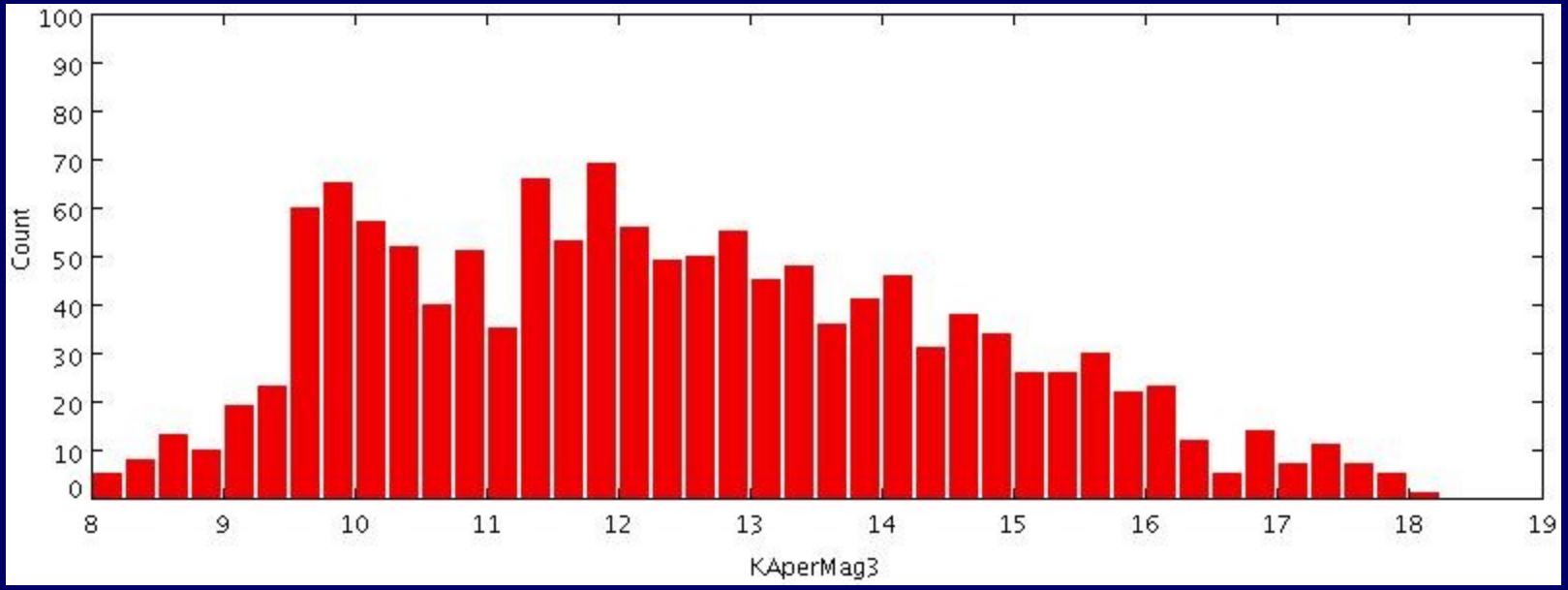

Most of the mid-IR bright sources are also easily detected by WFCAM – but there is a clear tail of sources near the limit of the survey

All sorted then??

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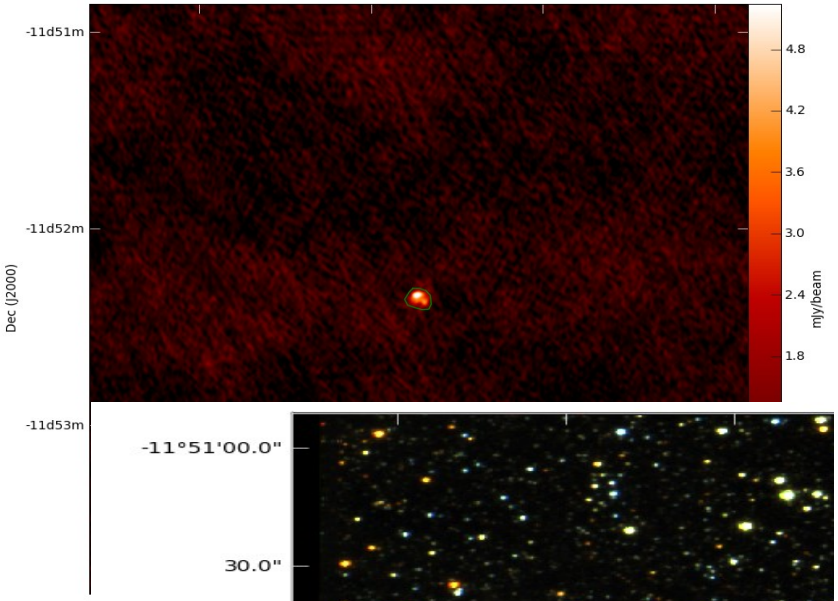

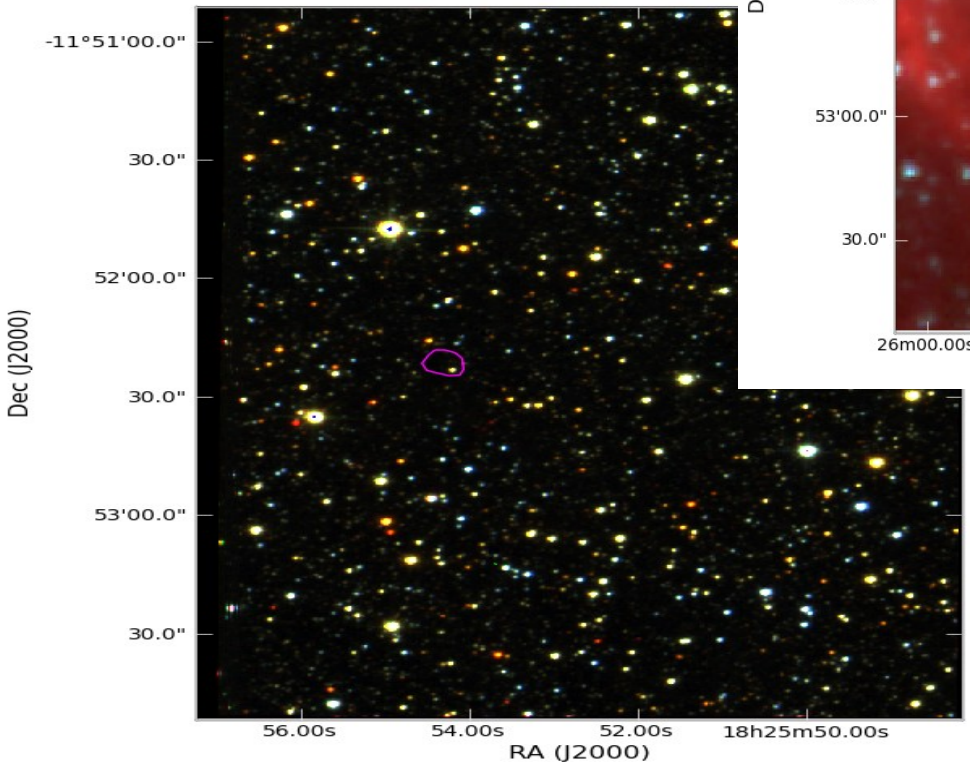

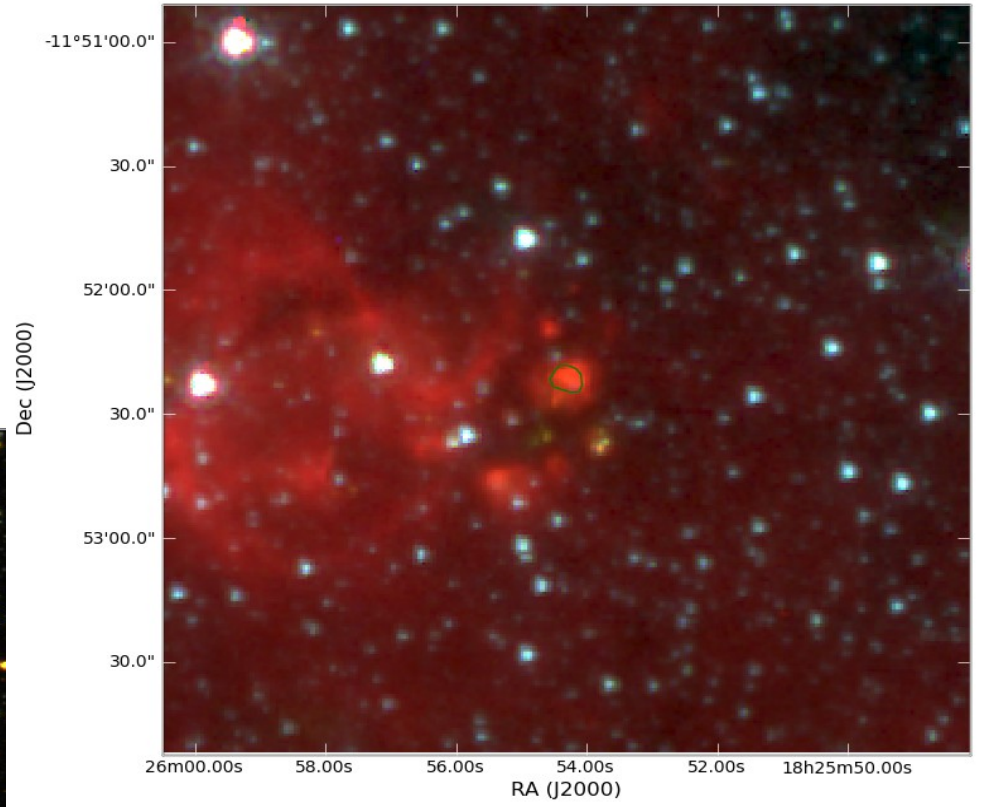

Random UCHIIs from the CORNISH survey – not seen in GPS

All sorted then??

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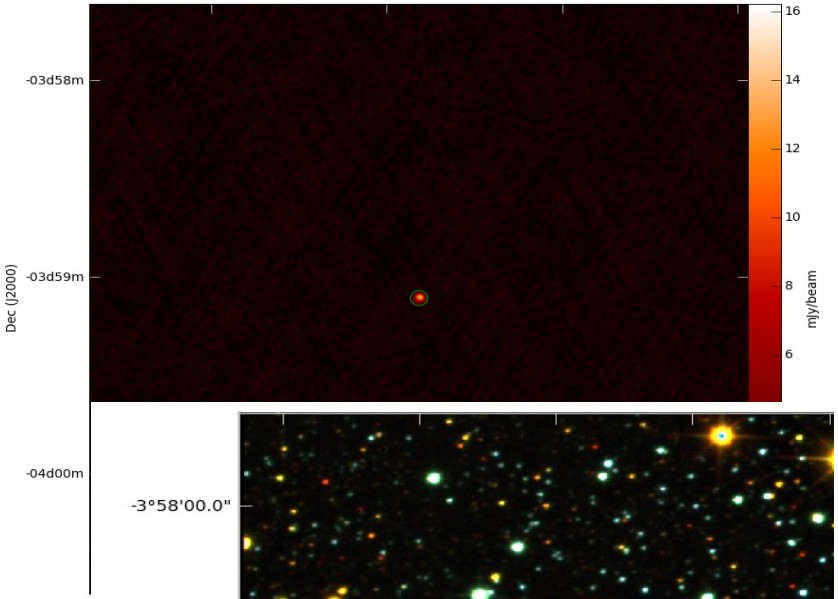

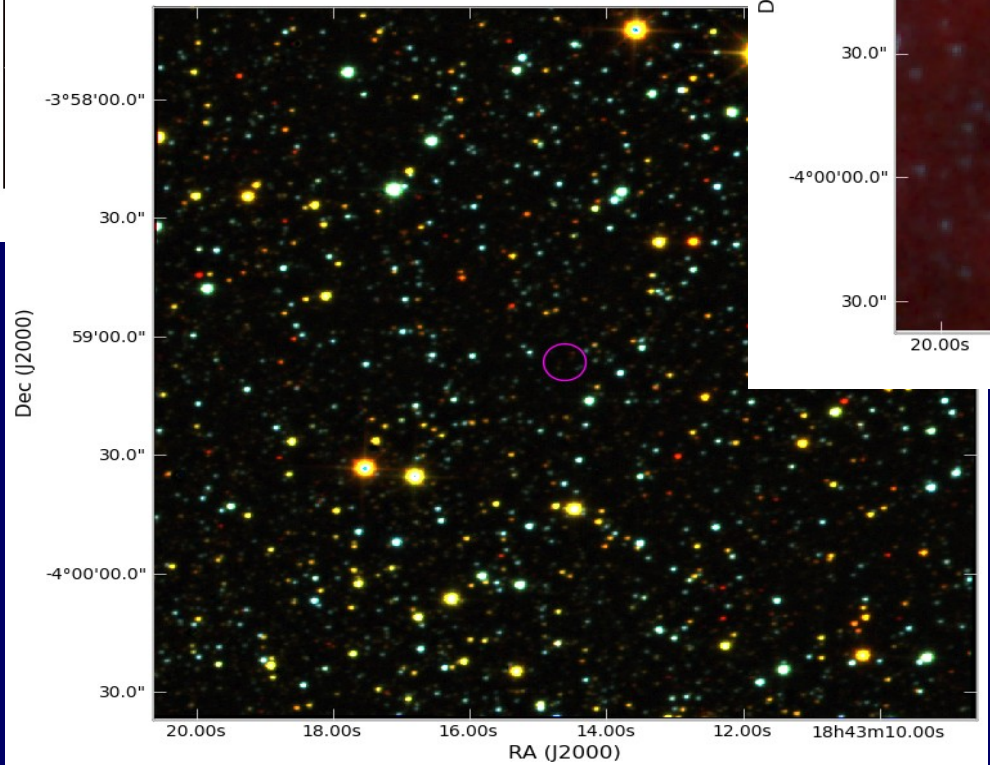

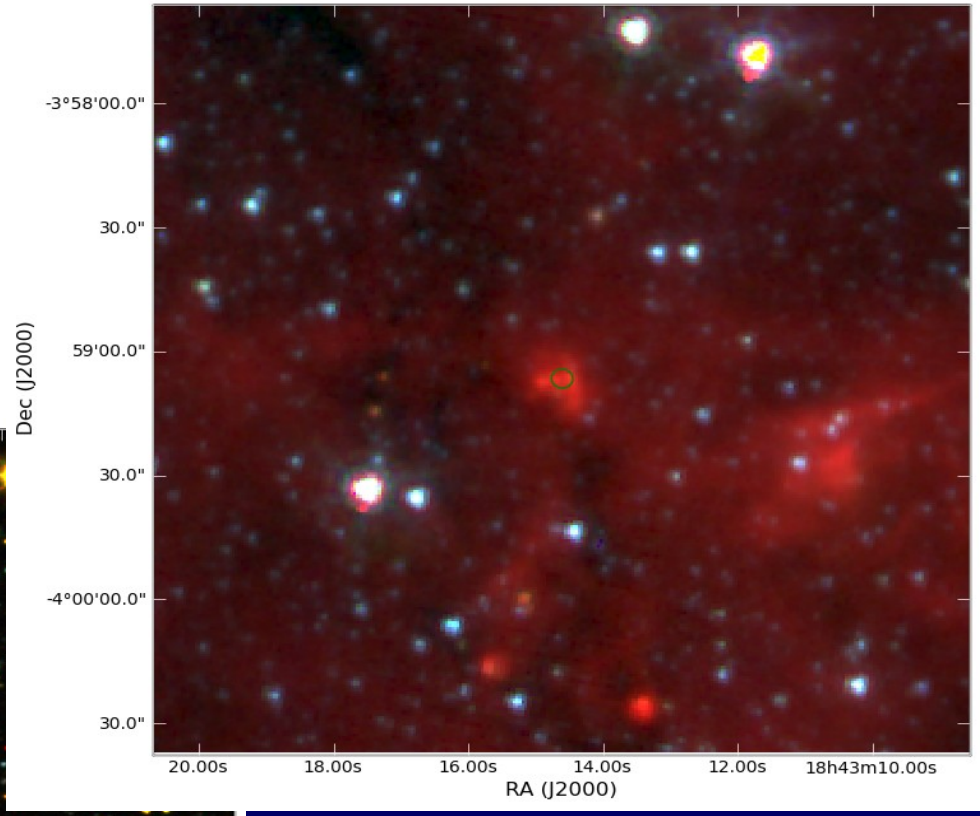

All sorted then??

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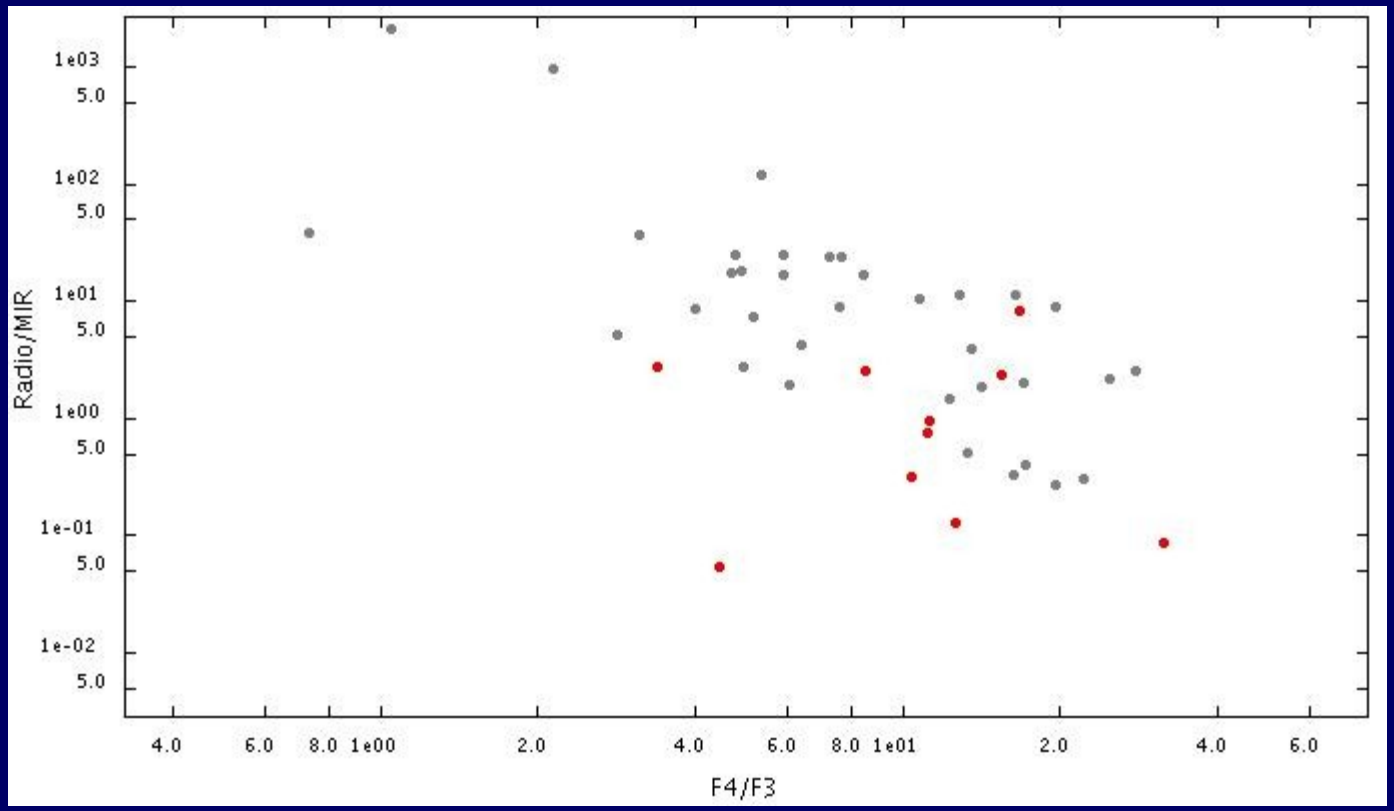

Using WISE data can see most embedded are weakest radio – most optically thick?? Consistent with being youngest – GPS can't find youngest highest mass stars

Can we use just K from GPS?

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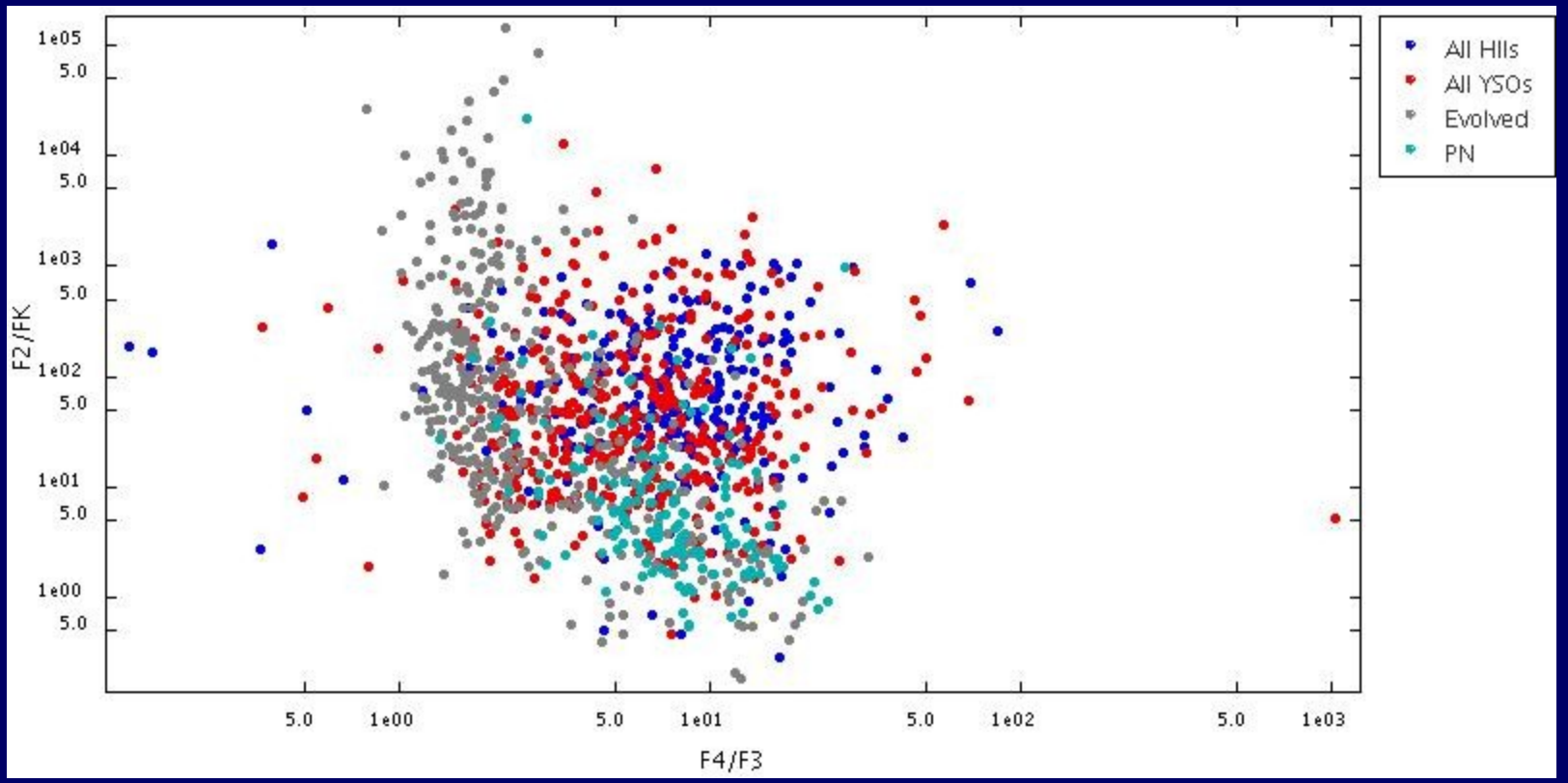

Using WISE data to probe silicate feature, and 4.5um/2.2um to separate out dust shells seems to work well: but will still have sources where GPS only gives limits.

RMS Spectroscopic Results

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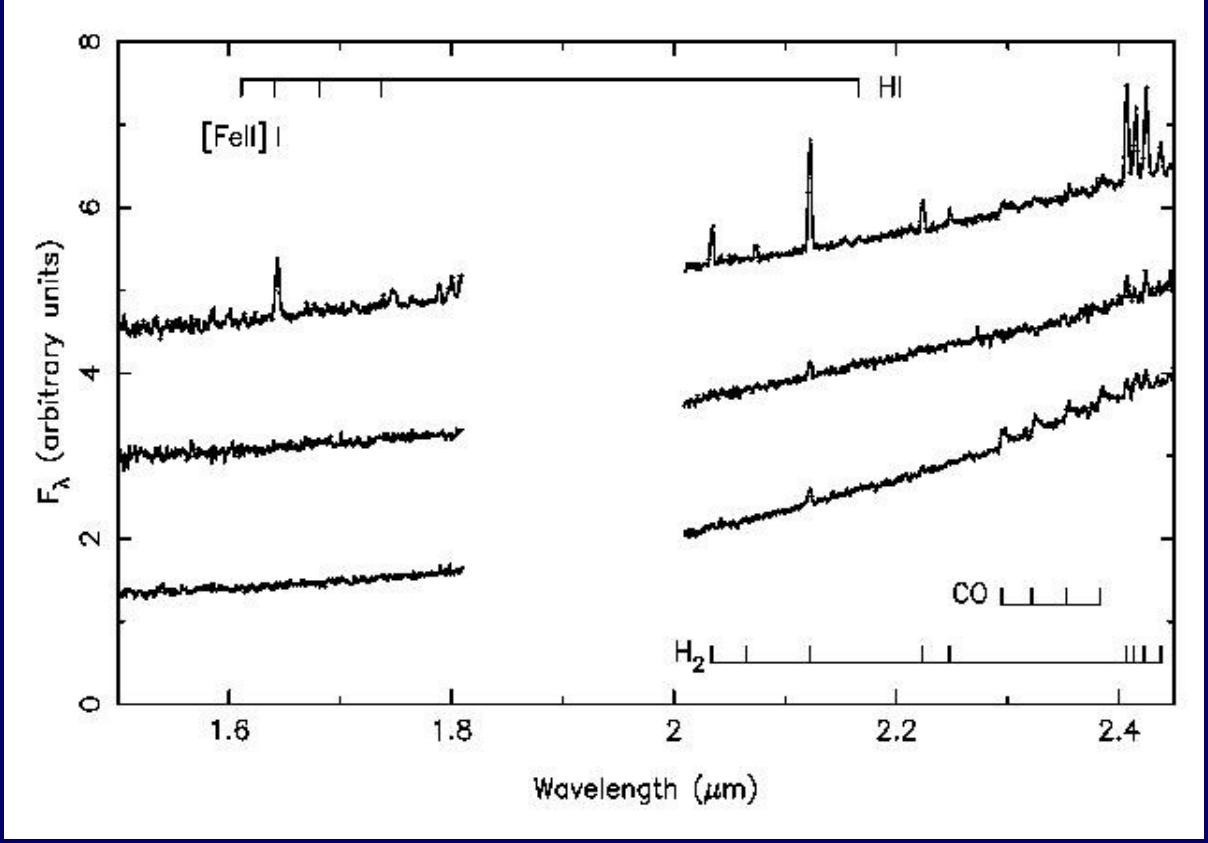
Largest homogeneous MYSO sample ever studied (Cooper et al in prep)

- Youngest (molecular hydrogen,sometimes shocked [FeII], no ionised gas, sometimes CO) – type I



Spectroscopic Results

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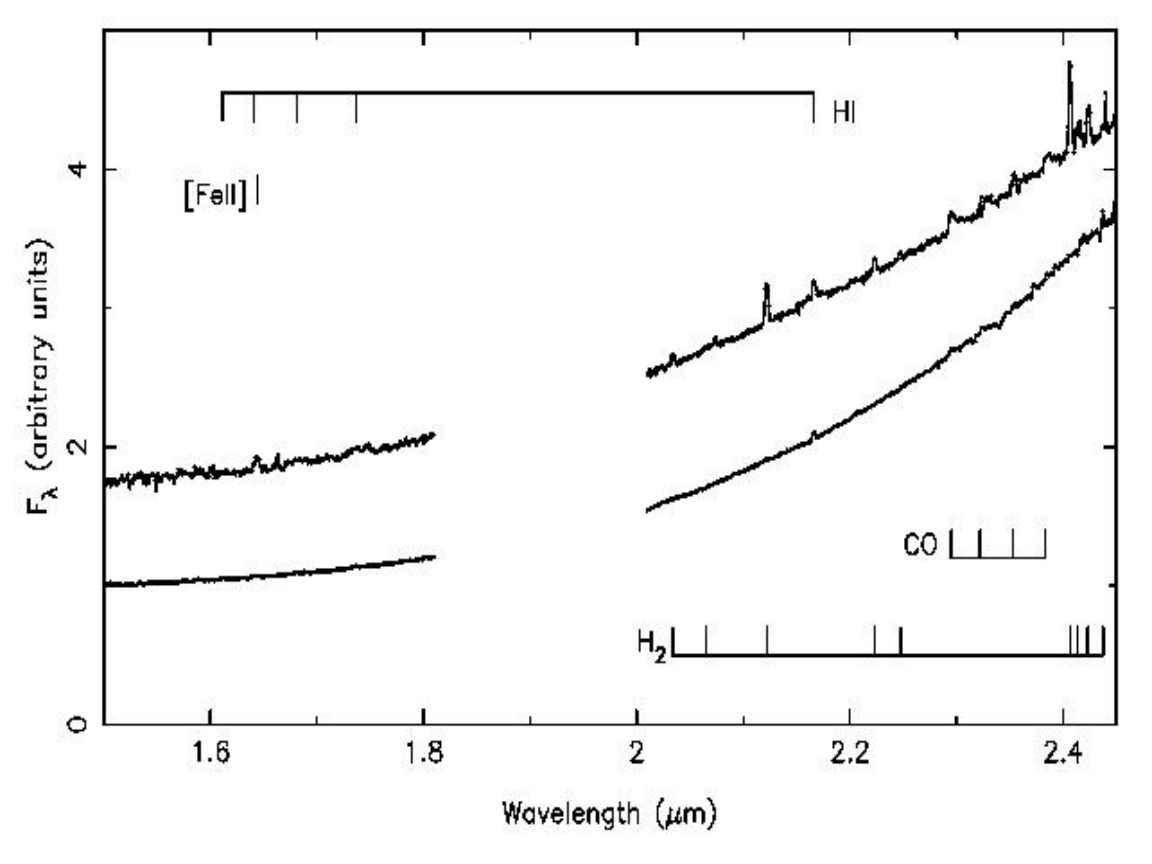
- Mid-stage (sometimes molecular hydrogen and shocked [FeII], weak ionised gas, sometimes CO) – type II



Spectroscopic Results

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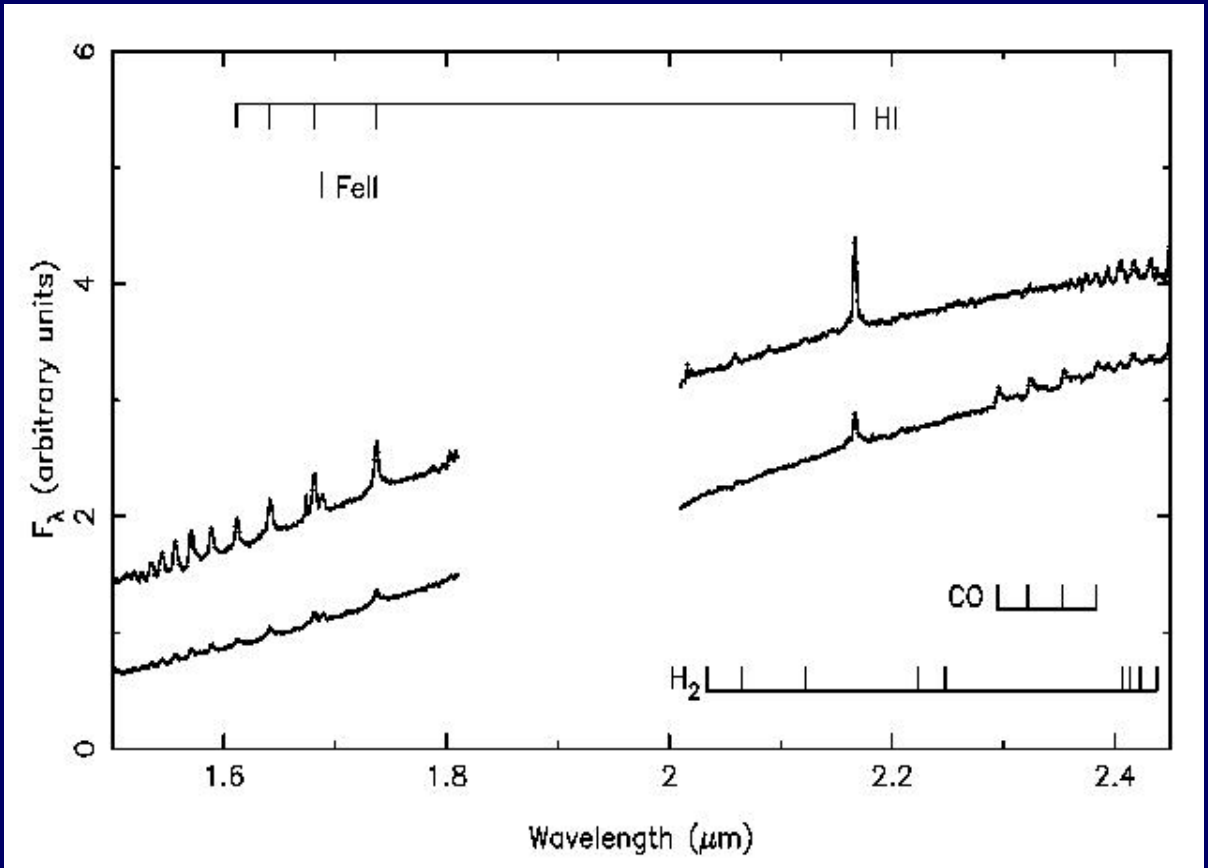
- Oldest (weak/no molecular hydrogen, strong Br lines, occasional CO, fluorescent FeII common) – type III



Spectroscopic Results

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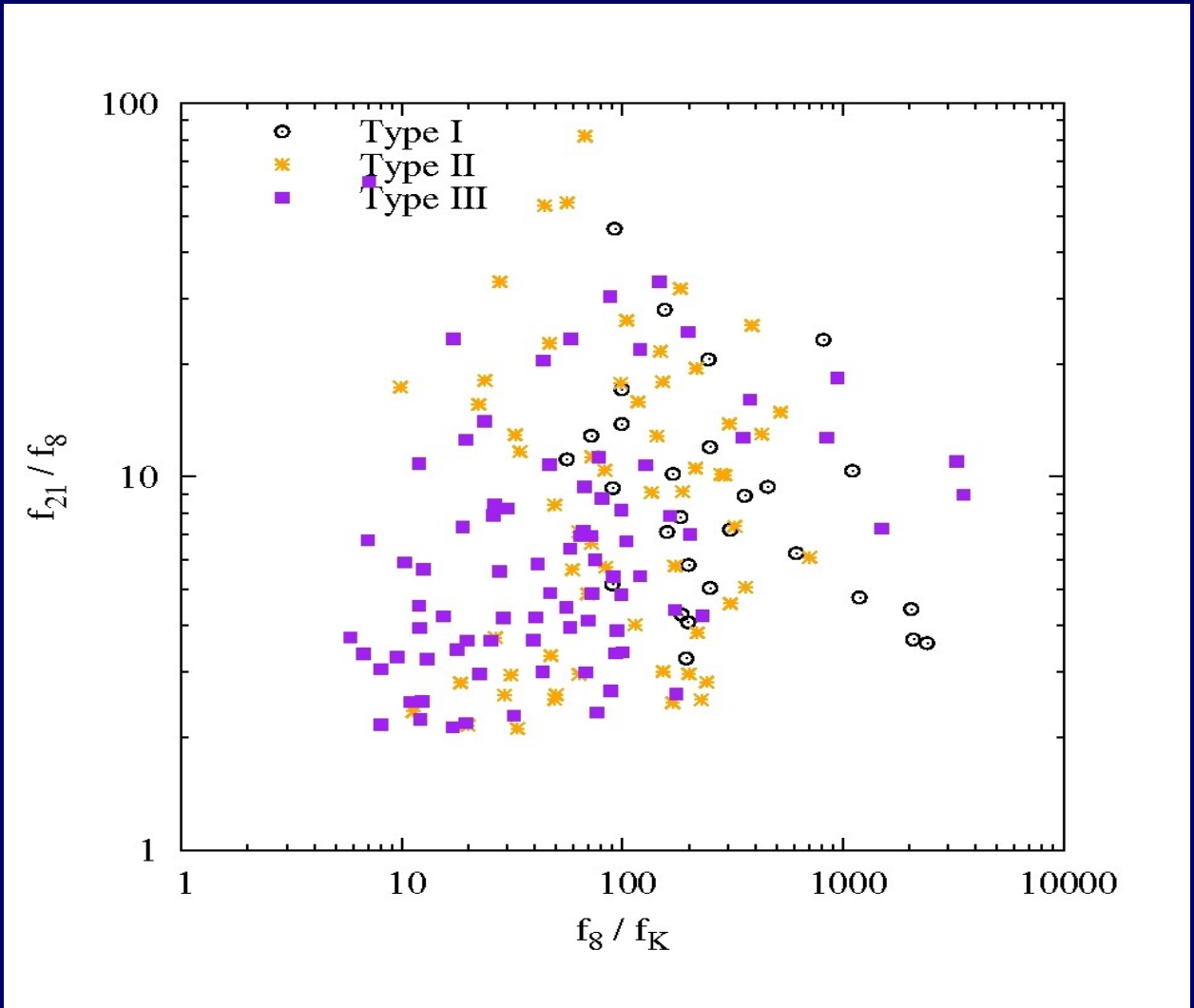
- Colours largely consistent with this



Summary

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RMS survey has delivered ~500 MYSOs and a similar number of compact HII regions across the galaxy.

Relied originally on 2MASS (including limits) – much easier to identify real counterparts with GPS

But there are still many massive YSOs and UCHII regions not directly visible at K – even GPS may

Near IR spectroscopy suggests there is a correlation between YSO "type" and the extinction inferred from GPS – evidence for an evolutionary sequence