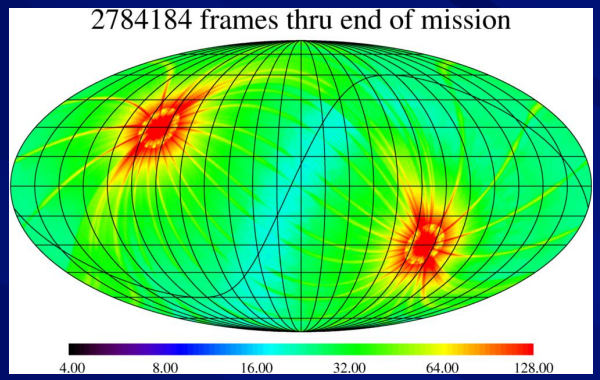
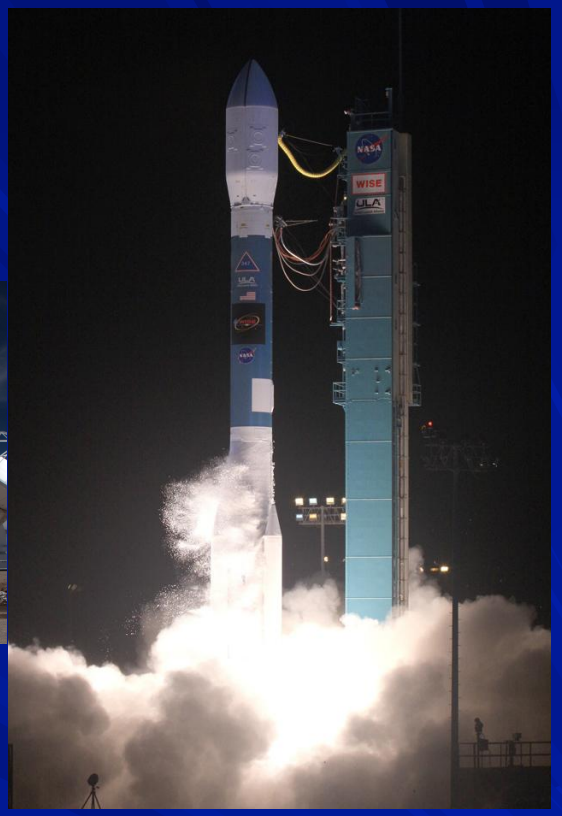




Finding WISE AGN

Andrew Blain (and others noted….)

3 October 2011

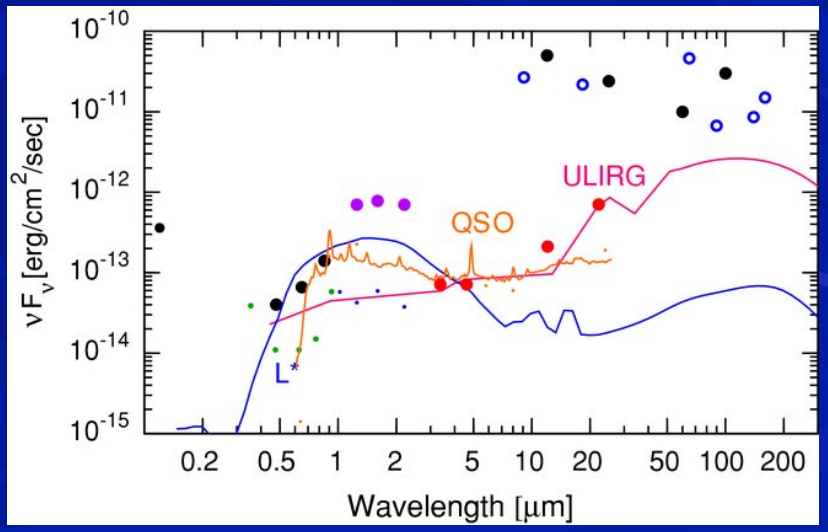
Looking Glass meeting

Introduction

- WISE has mapped the whole sky from 3-5-12-22μm
- Uncovering new populations – need large-area survey matches, but also quite deep data to detect
  - 100-1000x deeper than IRAS, reach z>>0.1
  - Excellent positions ~ few arcsec. Whole sky now available.
  - NVSS/FIRST/SUMSS (Lonsdale & Condon). Cf Glikman here.
  - ROSAT not very deep, help improve IRAS-ROSAT matches.
  - Spectroscopy: SDSS, 2dF, 6dF; GAMA
- Want to find things too rare for Spitzer; but with existing spectroscopic data.
  - Exploit 2XMM (Watson et al. 2010), reprocessed data-center ancillary product, parallel to QA; ~500k sources, 0.2-12keV.
  - BUXS ultrahard sample (Silvia Mateos Ibanez)
  - z>6 QSOs from SDSS, CFHT-LS, UKIDSS and others.
  - Parallel WISE spectral follow up – see Lake, Bridge, Stern…

WISE-based AGN searches

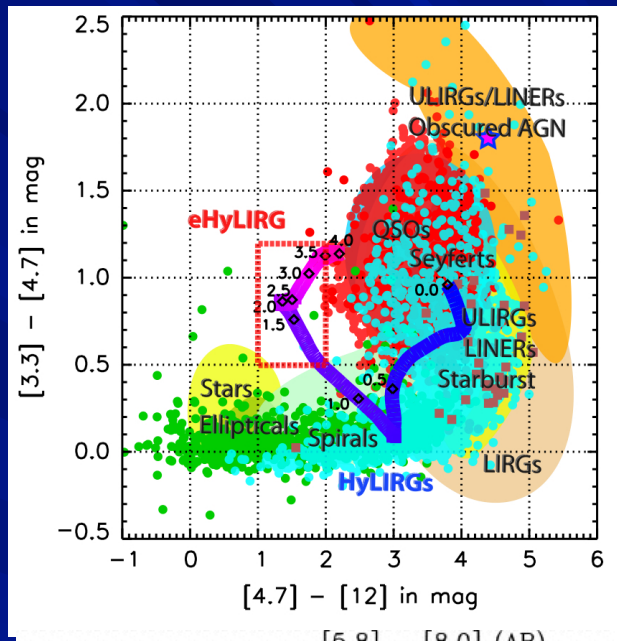
- WISE bands – AGN have power-law SEDs
  - Expect low PAH effects in W3/4
  - Starlight has very different properties in W1/2
  - Uniquely enshrouded objects - Assef
  - Take interesting samples & find WISE properties.
- 2dF/SDSS/6dF/deep
- 2XMM
- BUXS
- Z>6 QSOs



Wright et al. 2010

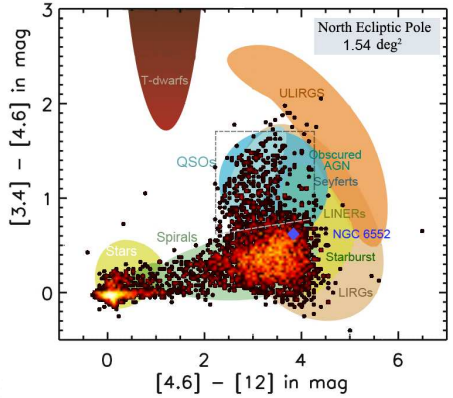
WISE colors

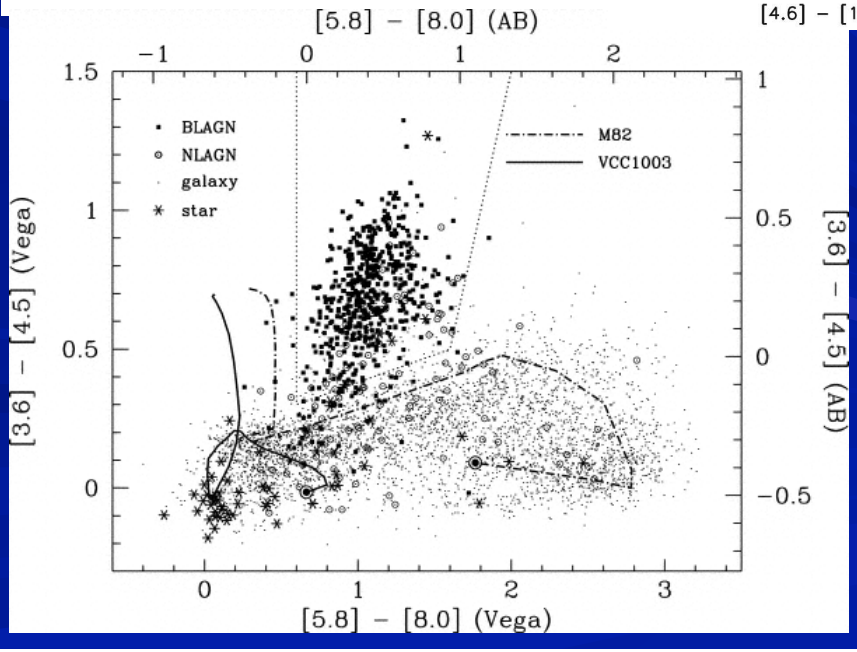
- 23μm W4 band is not as sensitive
- W1, W2, W3 provide best insight into galaxy and stellar populations
- Note that AGB stars scatter over the same region as ‘eHyLIRGs’, but they tend to be bluer in [3.3]-[4.7] and to have 2MASS/SDSS/DPOSS counterparts. Follow-up spectroscopy rate is <2% for stars.



SDSS comparison by Lin Yan

Jarrett et al. NEP

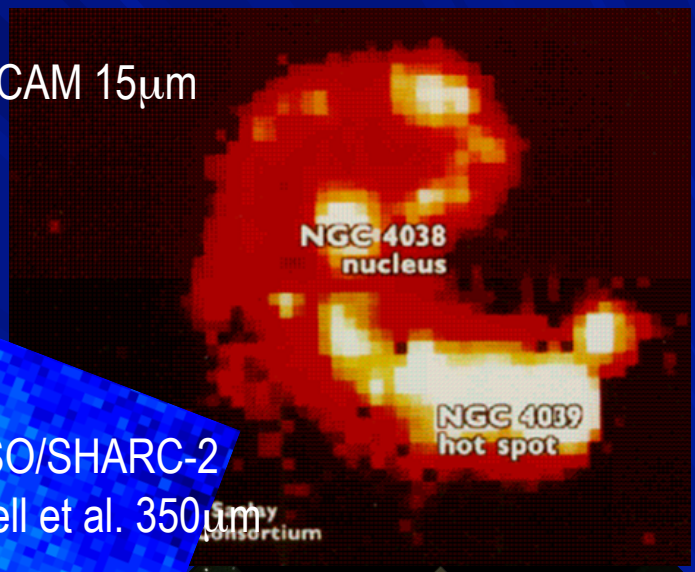


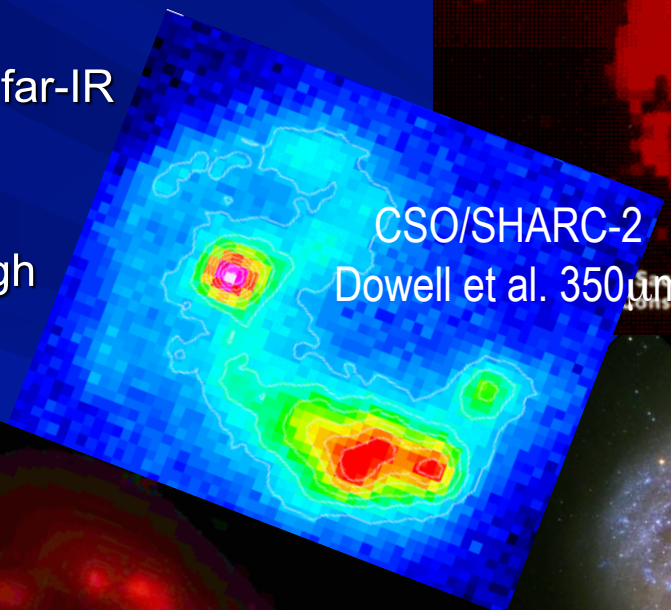


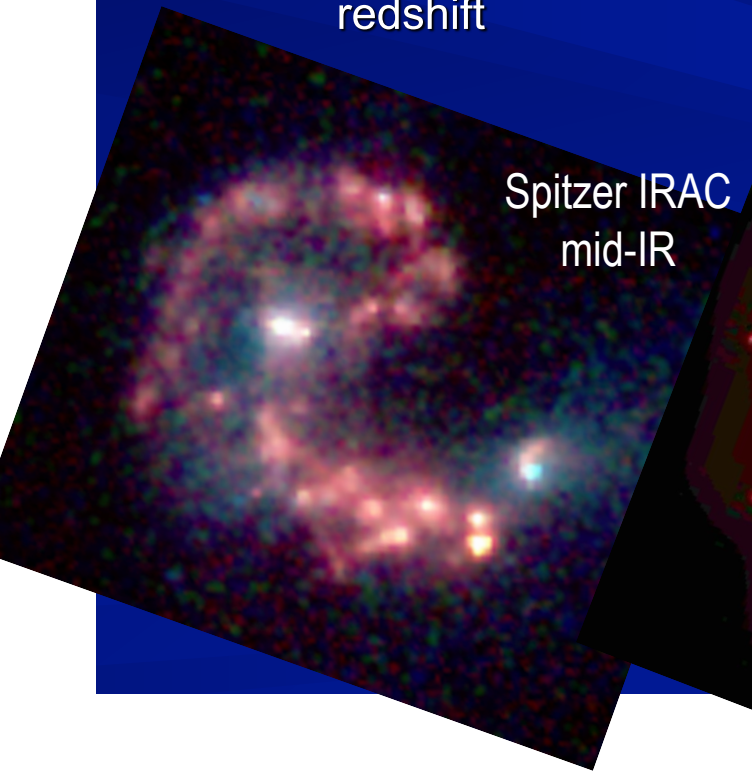
Stern & Eisenhardt

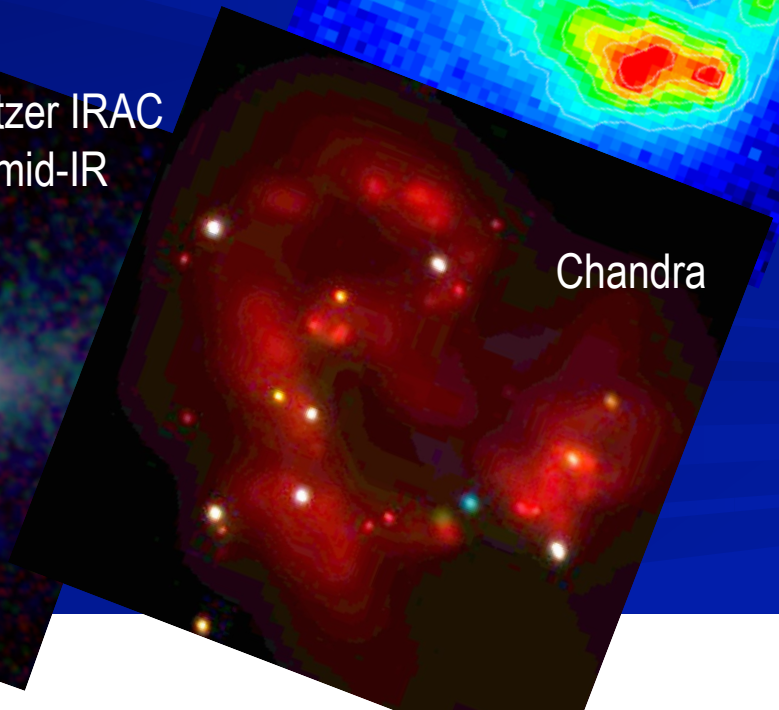
Perennial caveat: the Antennae

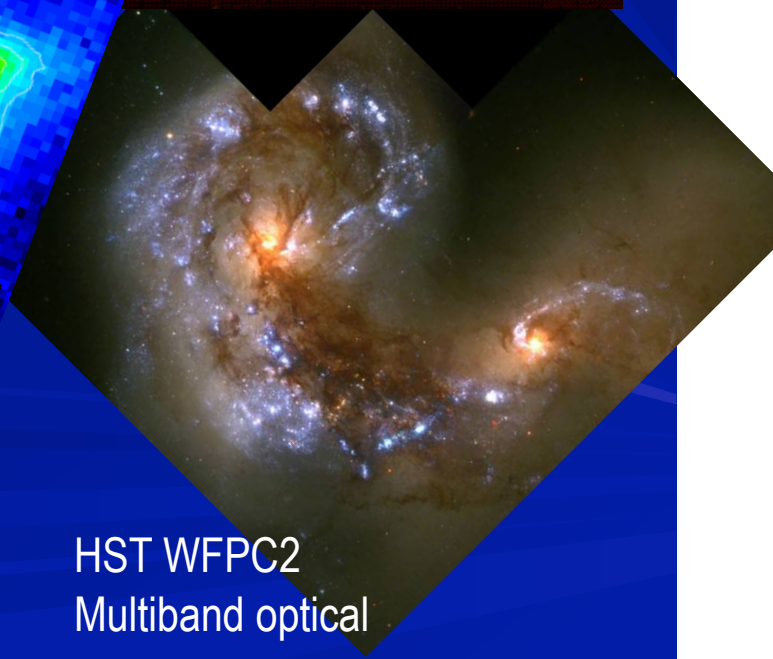
- Excellent example of distinct opt/UV and IR luminosity; BUT modest luminosity
- Interaction long known, but great IRAS luminosity unexpected
  - ~90% energy escapes at far-IR wavelengths
- Resolved images important
  - Relevant scales ~1” at high redshift











AGN identification via WISE

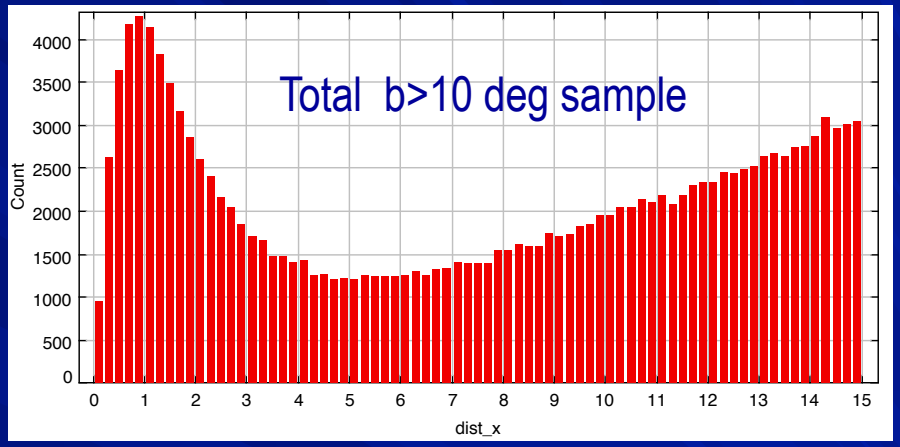
- Stern color red power-law SED region
- Broad optical line in spectroscopic `W12drop' & other surveys. Keck/Palomar/Gemini/LBT
  - 10-20% level in single-target follow up
- Matching other catalogs – ROSAT-2XMM, optical QSO surveys (Yan), radio (Lonsdale)
- Comparison with COSMOS / GOODS / CFHT-LS possible
  - There can be excellent multiwavelength data, but make a much much wider search with WISE

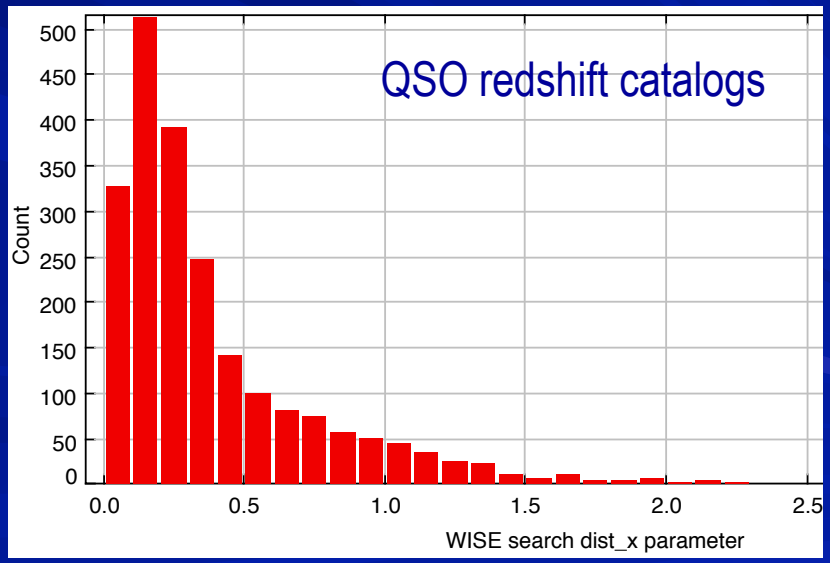
2XMM survey

- XMM-Newton data center effort
  - X-ray flux & energy index (B2-B1)/(B1+B2), hardest spectra objects – BUXS
  - All XMM pointings – varying depth, many fields galactic, some of time in regular deep fields. Includes real PI's targets too.
  - Some multi epochs.
- Also Slew survey, reading imagers during inter-target slews (Read et al.). This is very very shallow.

WISE-2XMM connection

- ~262k 2XMM objects.
  - WISE finds >180k, expected separation distribution. ¼ `real'
  - Very non-uniform
  - Mix with SDSS/2dFQ get ~2500
  - 6dF also adds some in South
- New student Suzy Jones just started



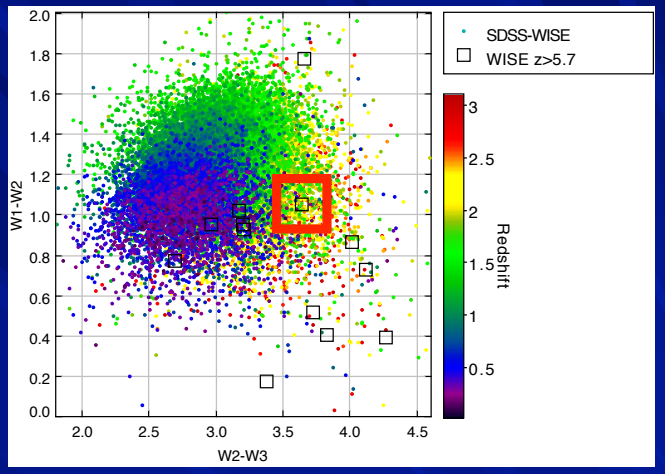


BUXS – hard X-ray selected

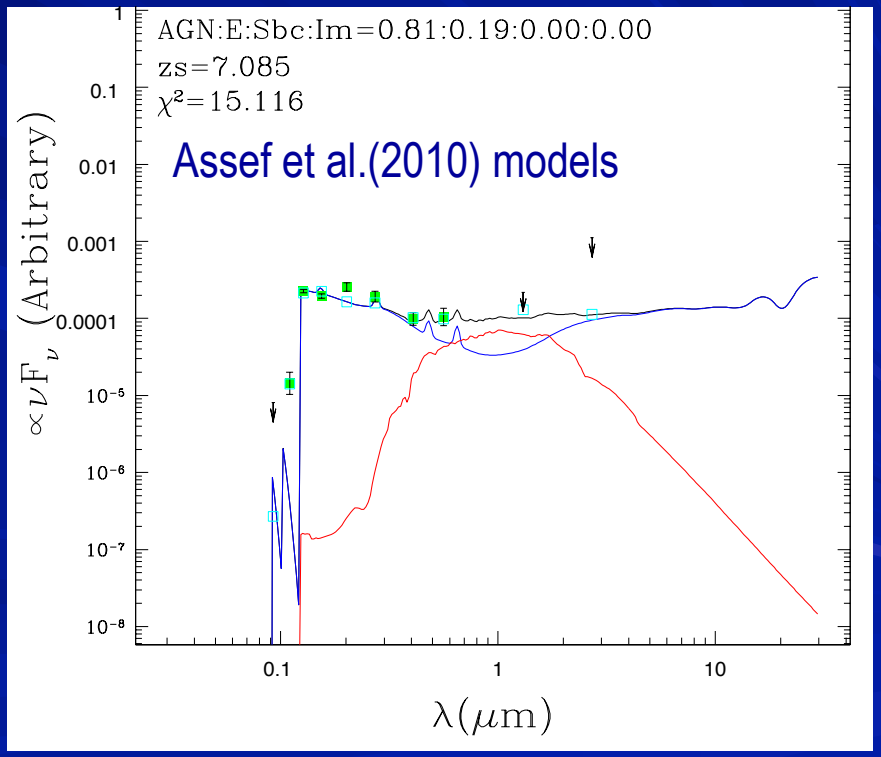
- Silvia Mateos Ibanez, Mike Watson et al
- New hard X-ray objects found in 2XMM
- 264, all but 2 detected by WISE
  - WISE colors fall in AGN cloud, some with added stellar host
  - Redshifts still proprietary
- Some are large, nearby; some VLT faint
- Extensive follow-up at VLT by Ibanez et al.
- Without WISE, Spitzer could have done this, but WISE saves huge amounts of time
- Serendipitous things that benefit from large areas coverage of both WISE & 2XMM
- Detailed object-by-object dissection of properties

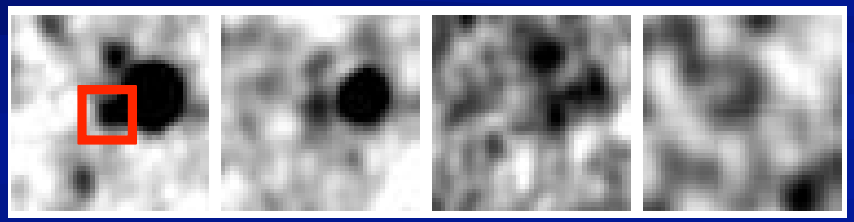
Highest z QSOs

- Individual targets.
  - SDSS, CHFTLS, **UKIDSS**, Spitzer
  - ~25 found over the sky
  - WISE detects ~ 50%
  - Spiter can also do, but WISE makes it free, and adds in 12 microns.
  - VISTA-LSST-WISE?



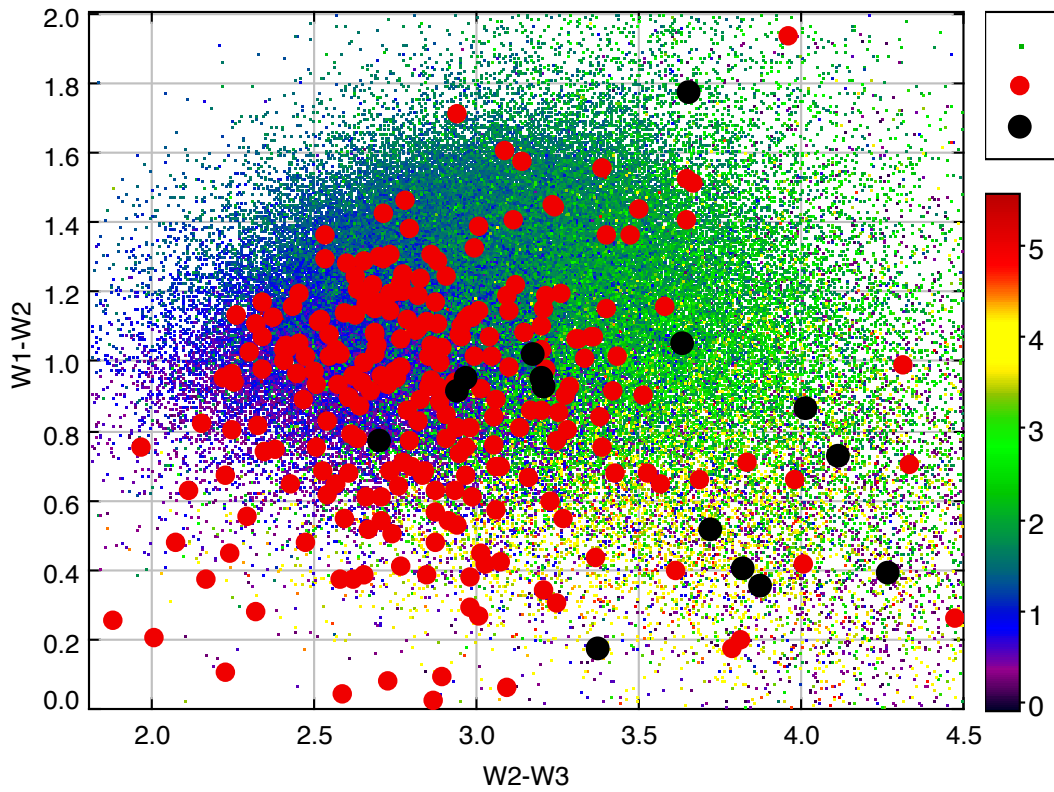
ULAS1120 from Mortlock et al. (2011)

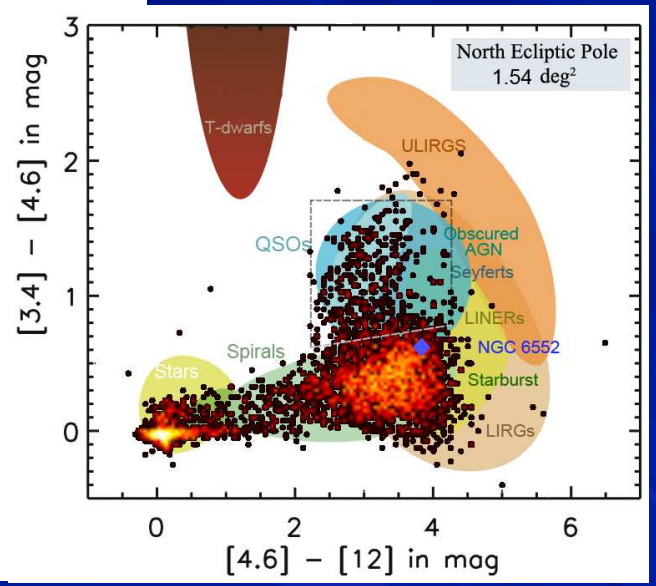




W1-W4; 1 arcmin

WISE colors of these samples

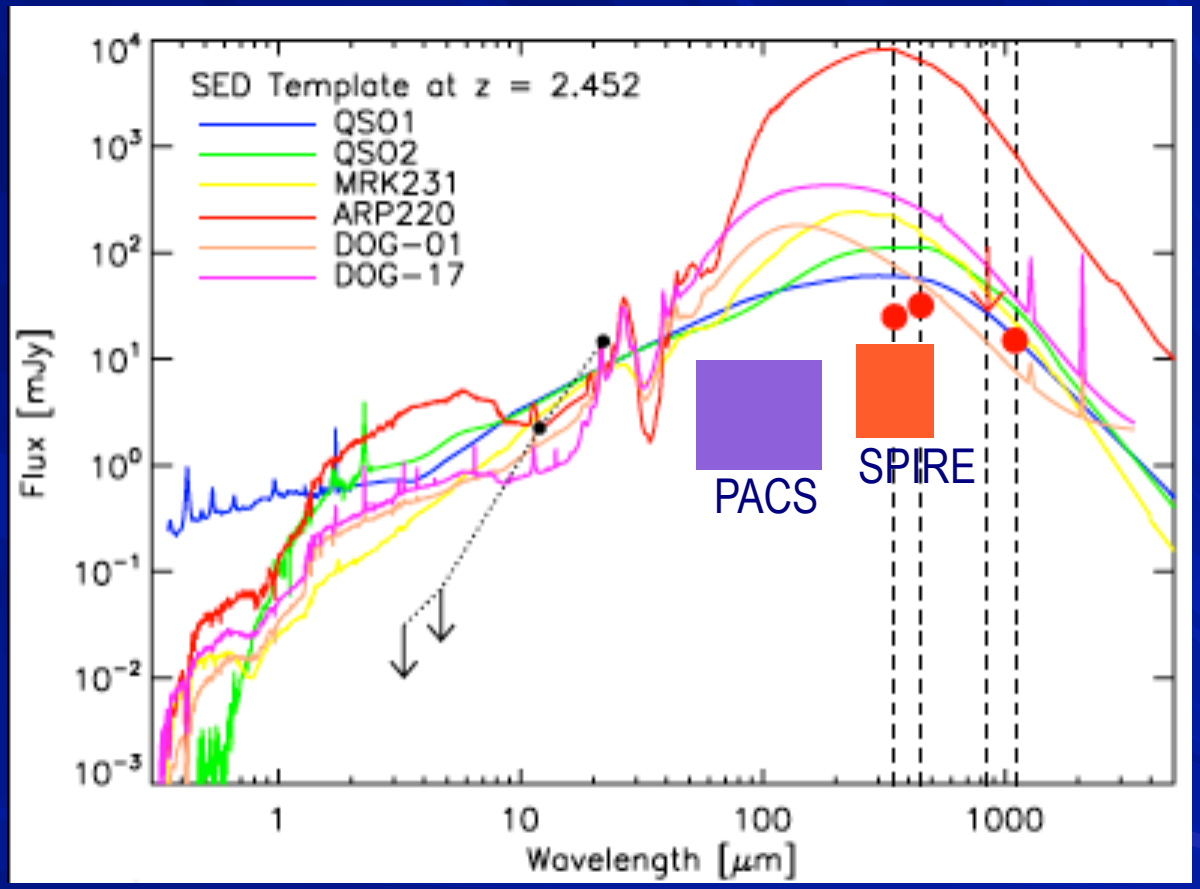




- Spectral surveys – as shown before
- z>6 – based on WISE detections, not limits
- BUXS hard X-ray sample, some stellar, some very red

Expect WISE object SEDs are odd

- WISE sources are sampling different regime of L,ρ
- Existing libraries of far-IR SEDs don't stretch far enough
- WISE hot/blue far-IR objects

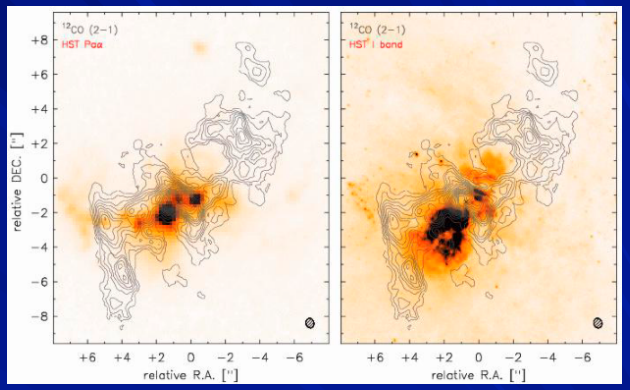


Compiled CSO results on 1814

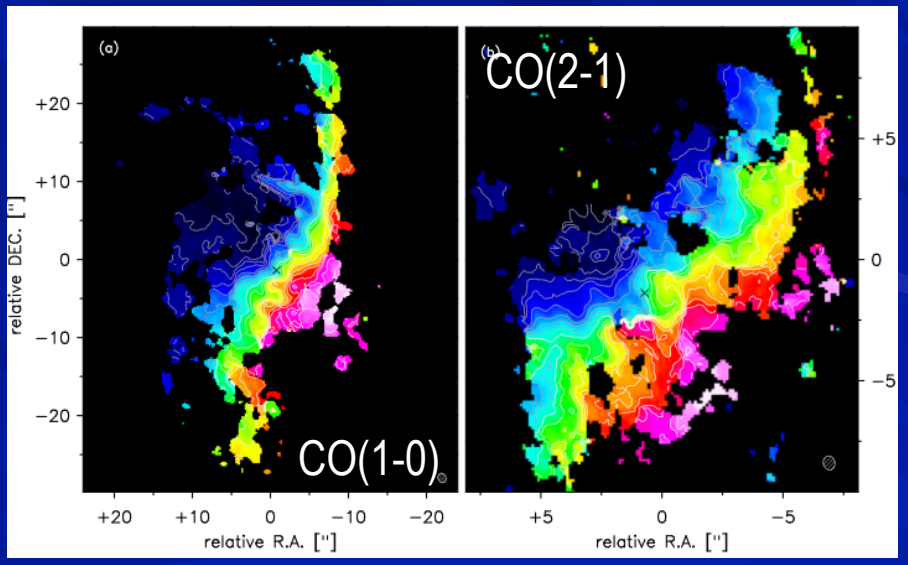
Local example of ALMA's view

- IRAM PdB CO in NGC 6946 (Schinnerer et al. 2006)
- Spatial structure & gas dynamics
- ALMA can probe at z~3
  - Resolution
  - Primary beam
- Note synergy with eVLA/eMERLIN
  - Ultimately SKA

Red: CO; green: Hα; blue: continuum



CO(2-1) contours
HST: Paα & I band



Summary

- WISE results touch tip of an iceberg
- Previous known icebergs are available to help to highlight and understand them
- Comparisons are possible with deep-field examples, at lower luminosity
- Encouraging prospects for NuSTAR, targeted observations with Chandra, and maybe XMM and Swift.