An Enhanced Multiwavelength Photometric Catalog for the Spitzer Extragalactic Representative Volume Survey

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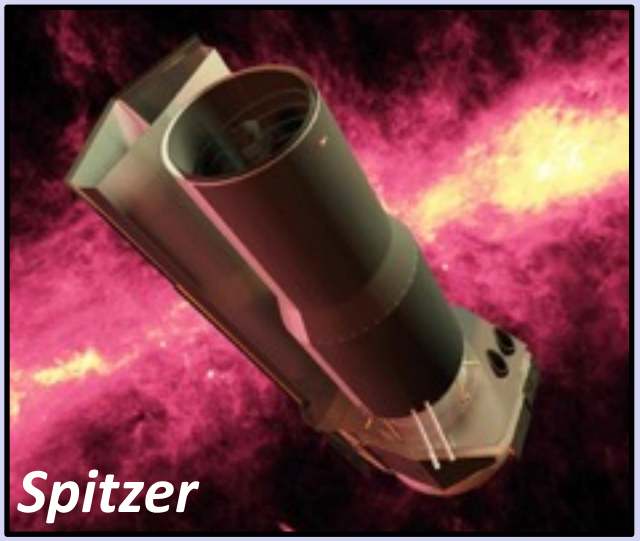
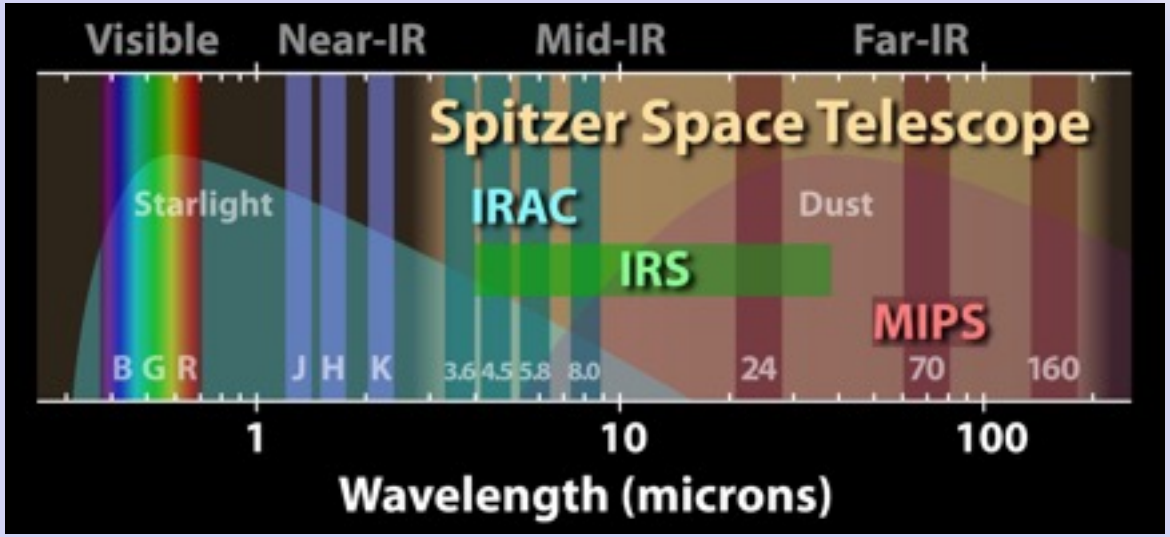
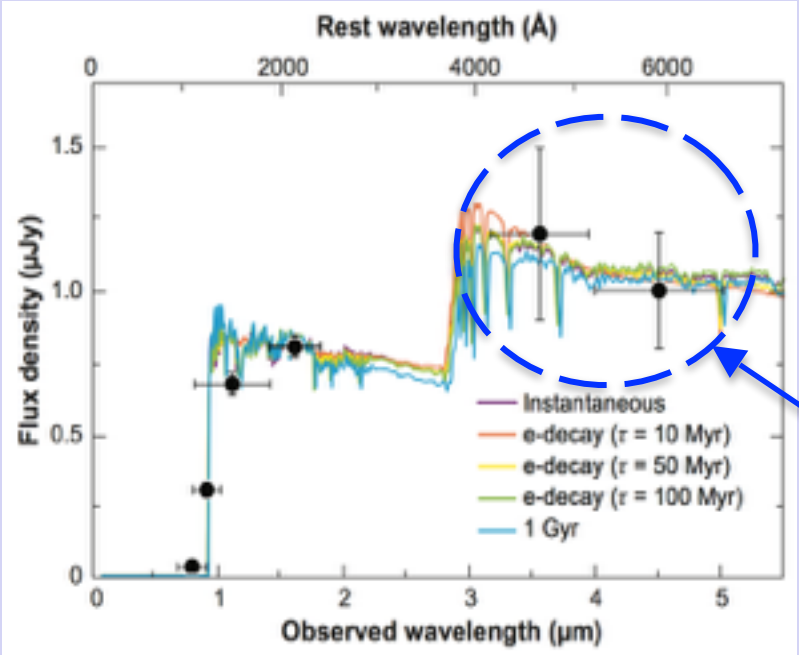
ADASS XXVI Trieste, Italy

Galaxy Evolution Science with *Spitzer*





Sample z = 7 galaxy spectrum

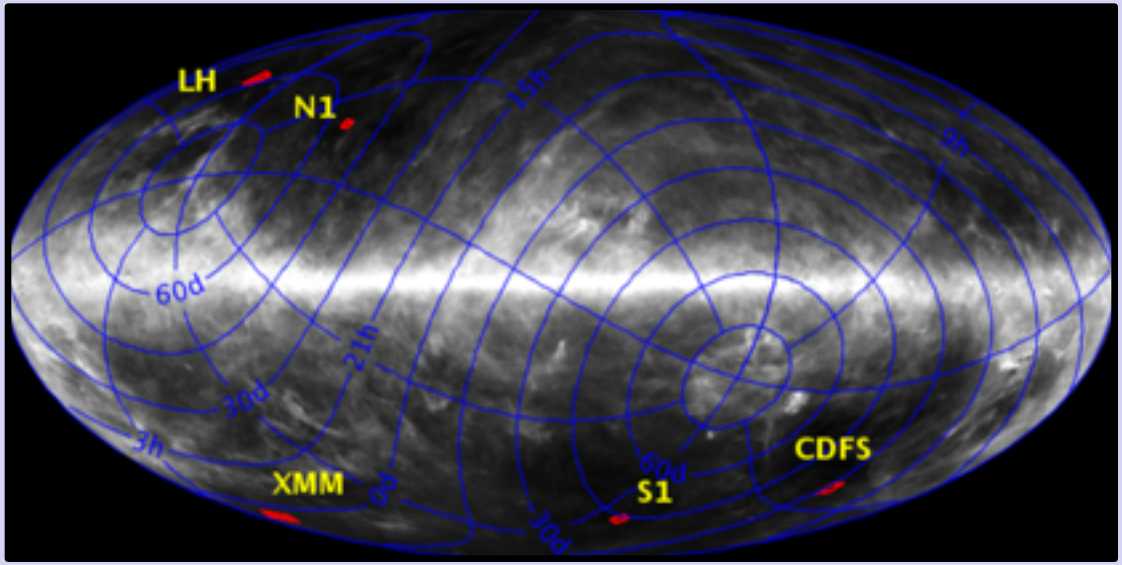


Soifer et al. 2008

IRAC samples rest frame optical light for 4 < z < 10 galaxies

Spitzer Extragalactic Representative Volume Survey

Mauduit et al. 2012



P.I. – Mark Lacy

Post-cryo IRAC 3.6 and 4.5µm observations of 5 deep fields to depth of 2µJy with a sky footprint of 18 deg^2

Multi-band Source Matching in XMM-LSS

VIDEO

Bands: Ks, H, J, Y, Z

$\theta_{FWHM} \approx 0.8''$

CFHTLS Deep

Bands: I, R, G, Z, U

$\theta_{FWHM} \approx 0.8''$

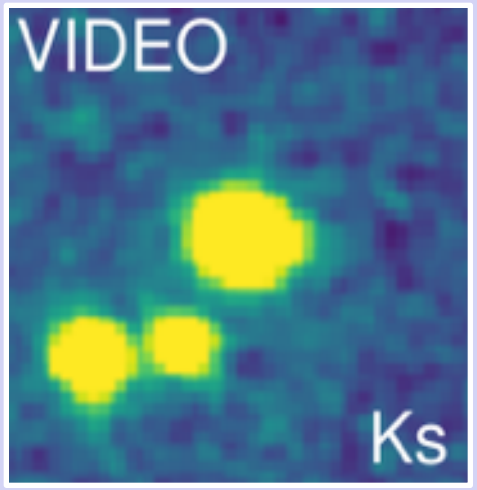
SERVS

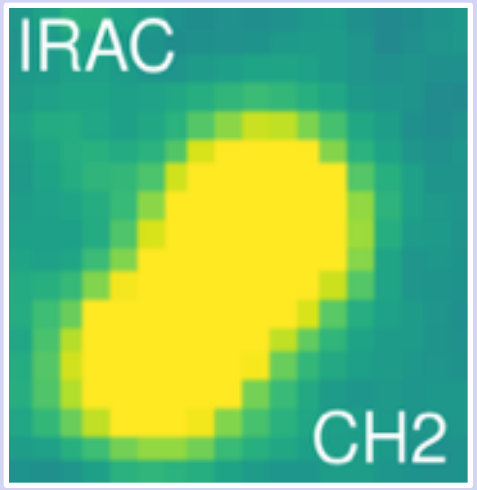
Bands: 3.6, 4.5 μm

$\theta_{FWHM} \approx 2.0''$

Accurate source matching and photometry across 12 NIR and optical bands with different resolutions?

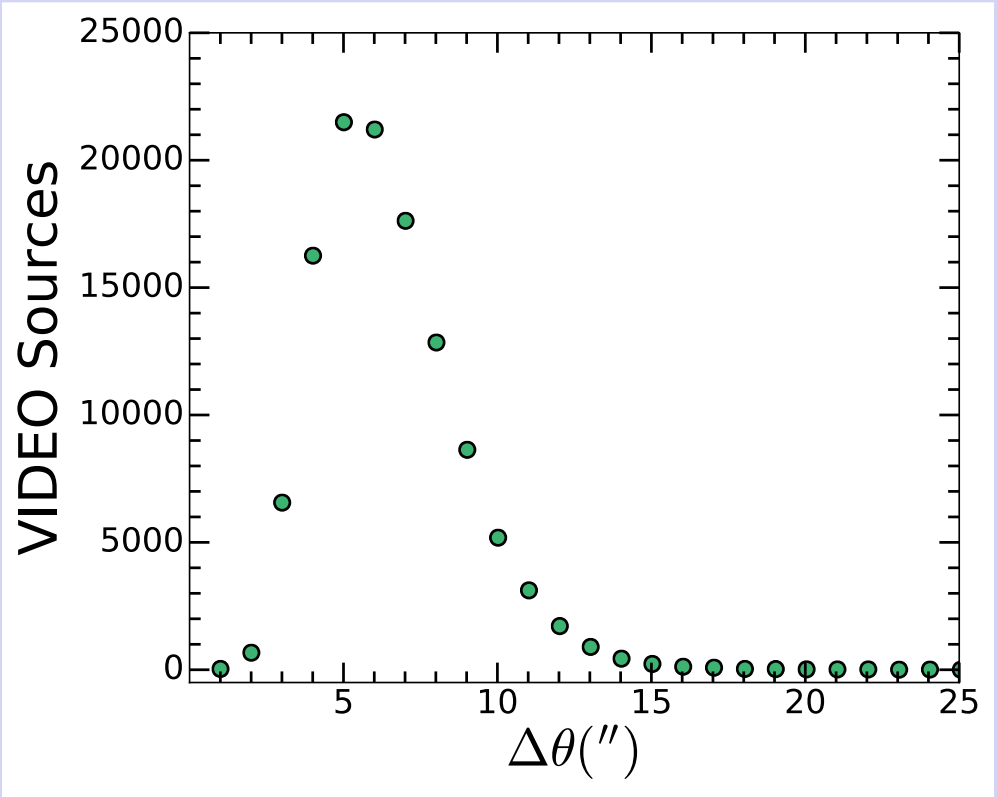
VIDEO Sources Blended in SERVS





Blended IRAC Source

At least 17% of VIDEO sources will be blended in SERVS!



Tractor to the Rescue!

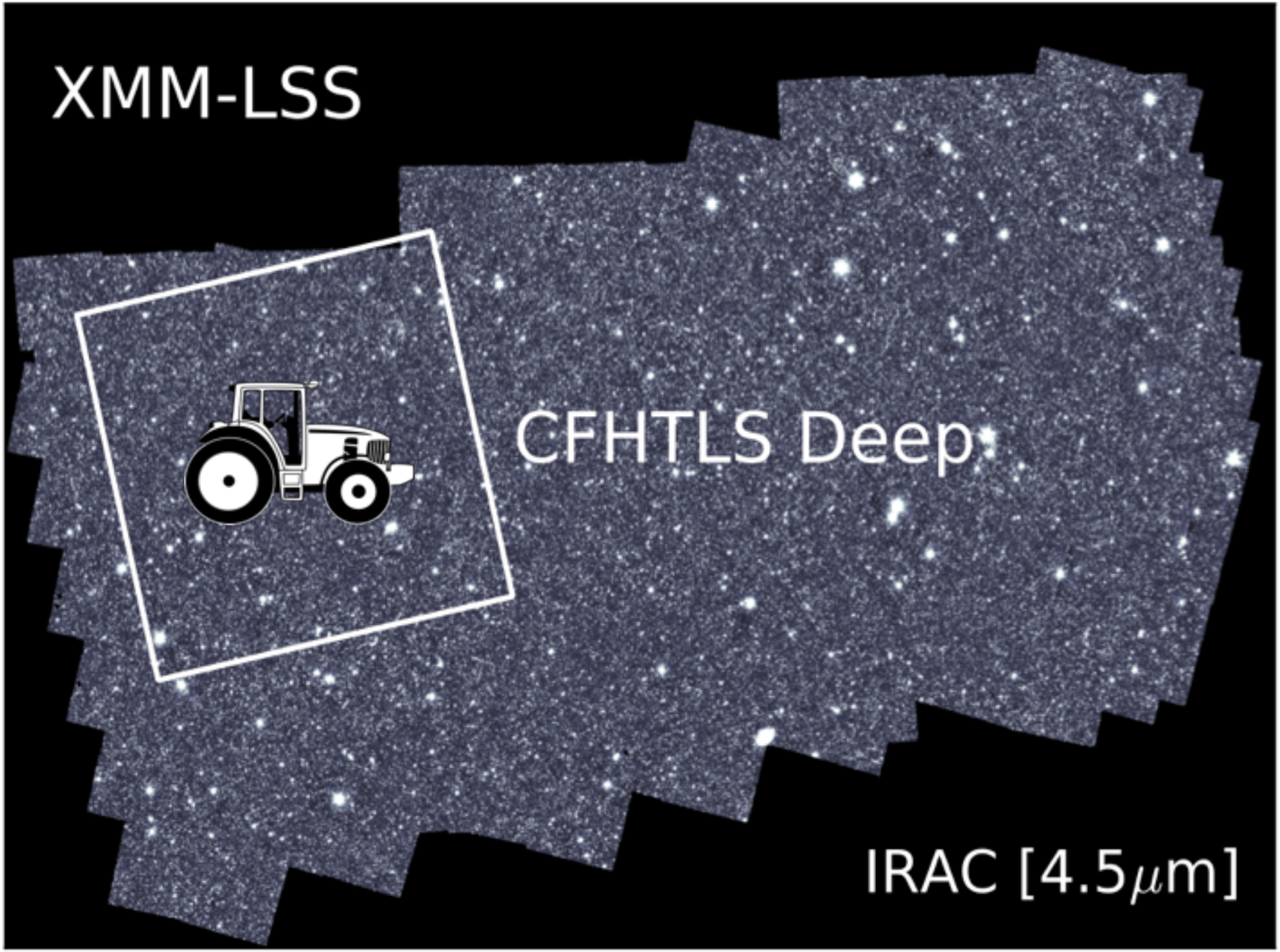
http://thetractor.org

Dustin Lang

Optimizes a likelihood for the source properties given:

1. High-resolution catalog
2. Image data
3. Source model
4. Calibration parameters (noise, PSF, WCS)

See Lang et al. 2016


XMM-LSS
CFHTLS Deep
IRAC [4.5μm]

Driving the *Tractor*

- **Input catalog: VIDEO DR4 sources in XMM test region (117,281 sources)**
- **Run time: 16 hours when run in parallel on a cluster node with 16 CPUs and 64 GB RAM**
- **Output catalog: *VIDEO-selected*, matched, multi-band, "forced photometry"**

Tractor Implementation for SERVS

Determine fiducial band

Extract fiducial cutout

Make fiducial source model

Point source model

Extended source model

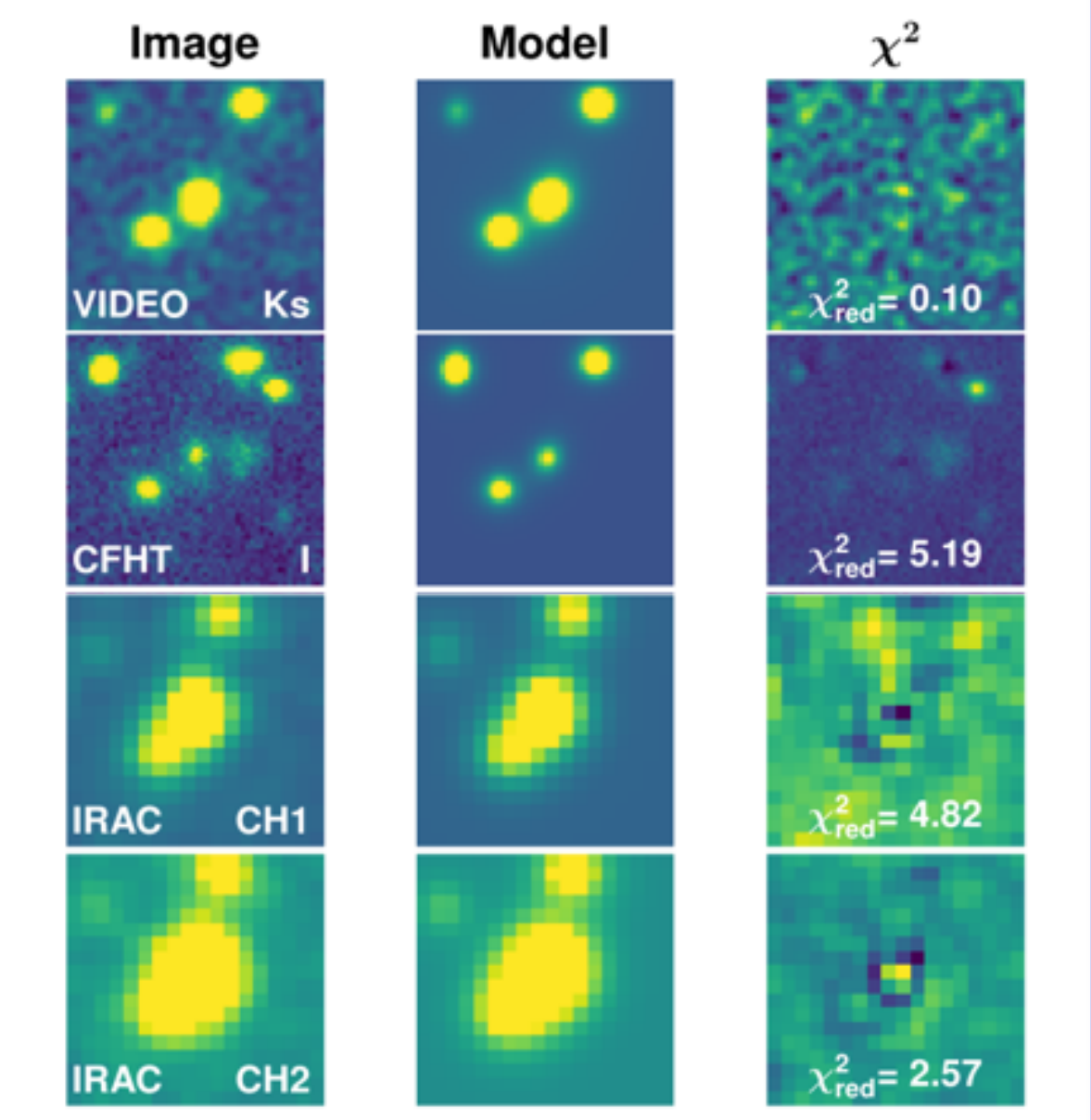
PSF fits image model

Mixture of Gaussians

Convolve model w/ PSF

Perform Tractor fit

Tractor Implementation for SERVS

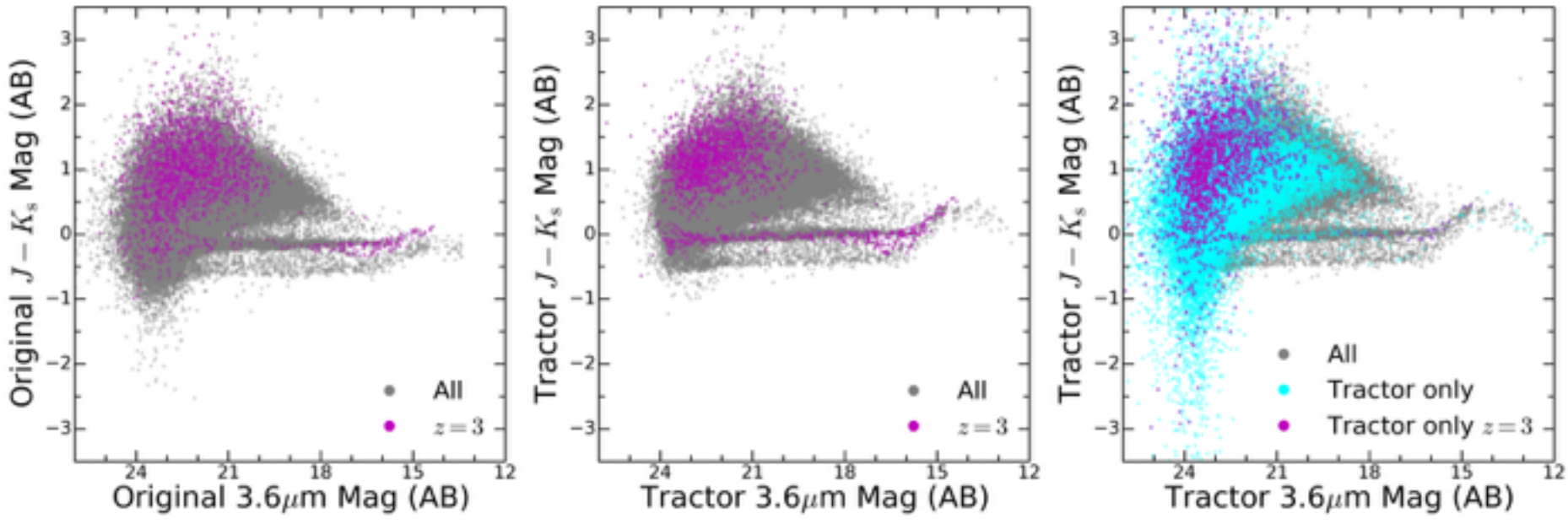


Example of a de-blended IRAC source in the *Tractor* catalog

Nyland et al., in prep.

Tractor vs. Catalog Colors

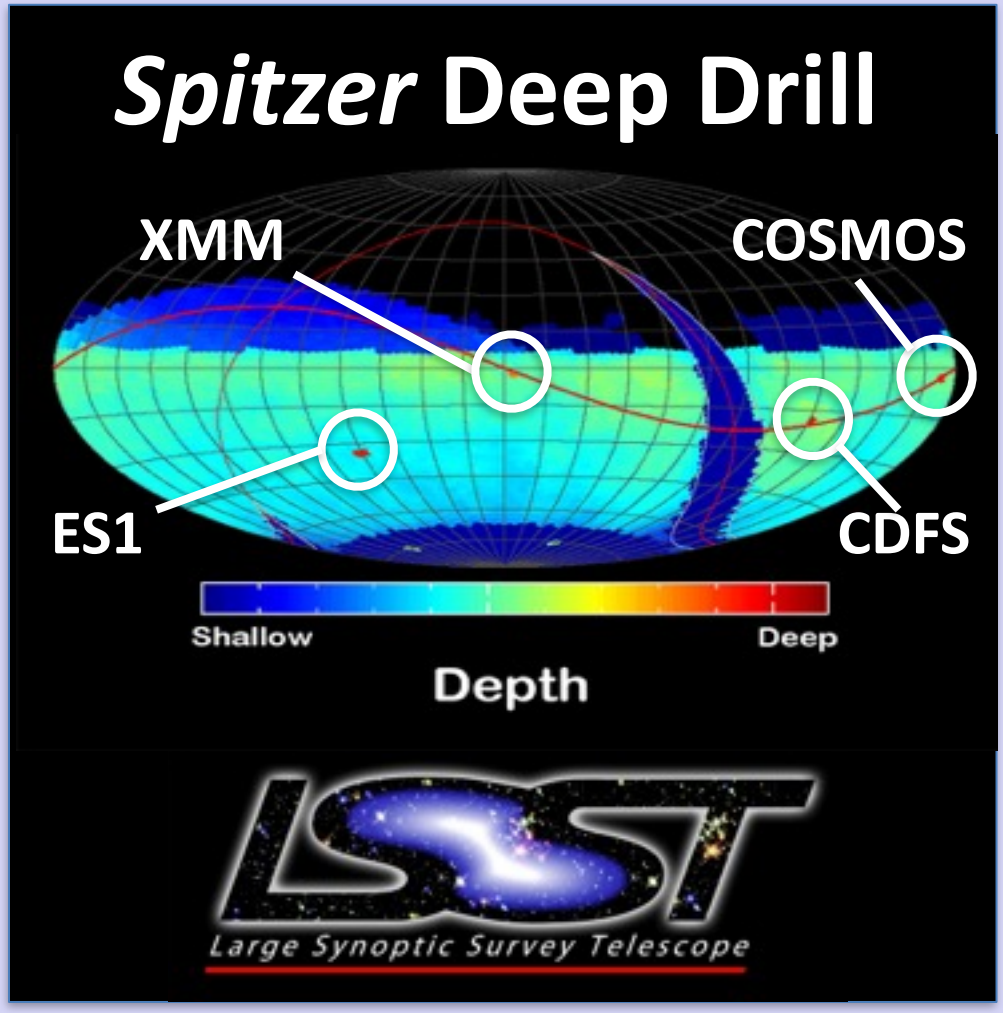
Nyland et al., in prep.



- ***Tractor*** **colors have less scatter compared to original photometry**
- ***Tractor*** **provides colors for sources originally undetected in one or more bands**

Future Work

- *Tractor* photometry for all SERVS fields (in progress!)
- Improved heuristics (PSFs, brightness profiles, source subtraction)
- Application to *Spitzer* Deep Drill survey of deep LSST fields



Summary

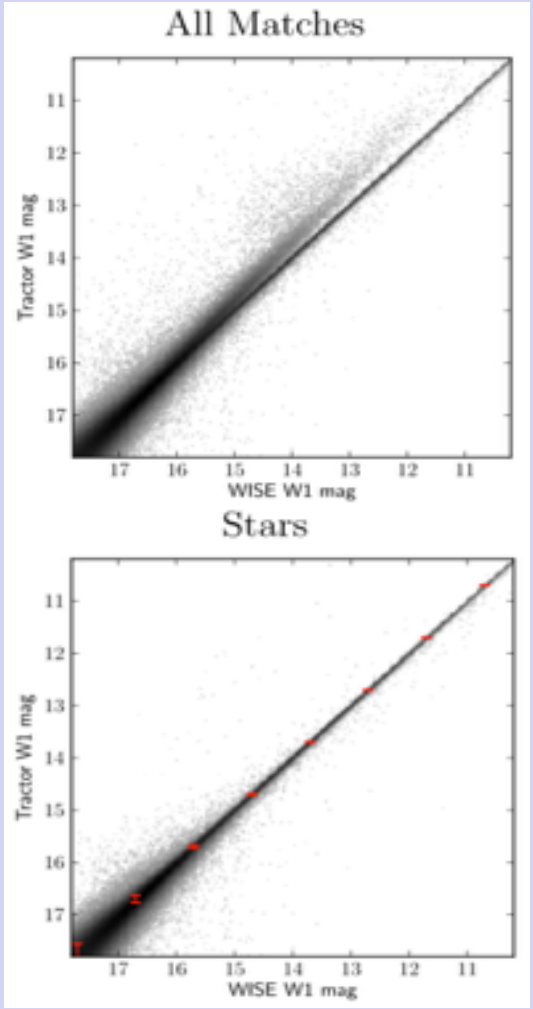
- **New 12-band *Tractor* photometry for 1 square degree of SERVS provides:**
  - **IRAC source de-blending (important for at least 17% of SERVS sources)**
  - **Better sensitivity to faint IRAC sources**
  - **More accurate multi-band source matching**

- ***Tractor* photometry will lead to more accurate photometric redshifts and SEDs and allow robust studies of galaxy evolution!**

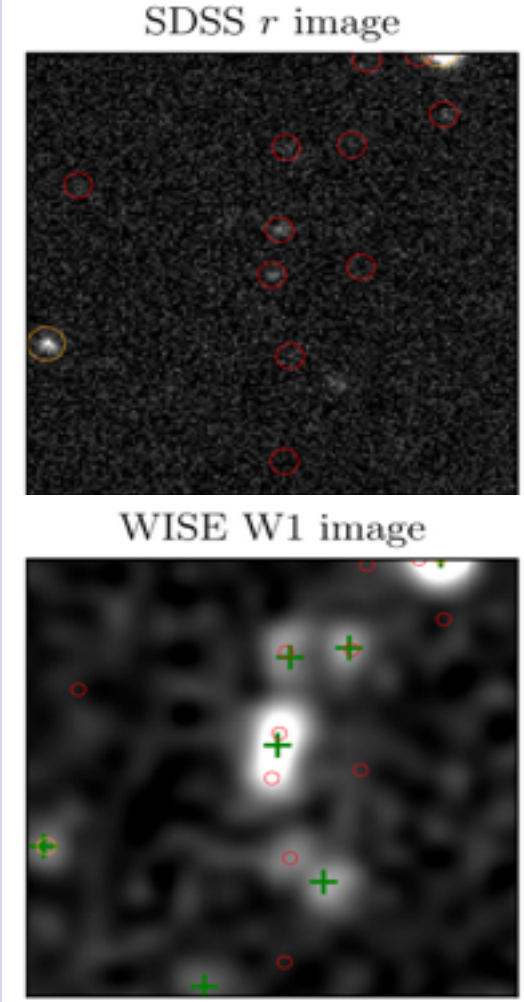
Back-up Slides

The Tractor in the Literature

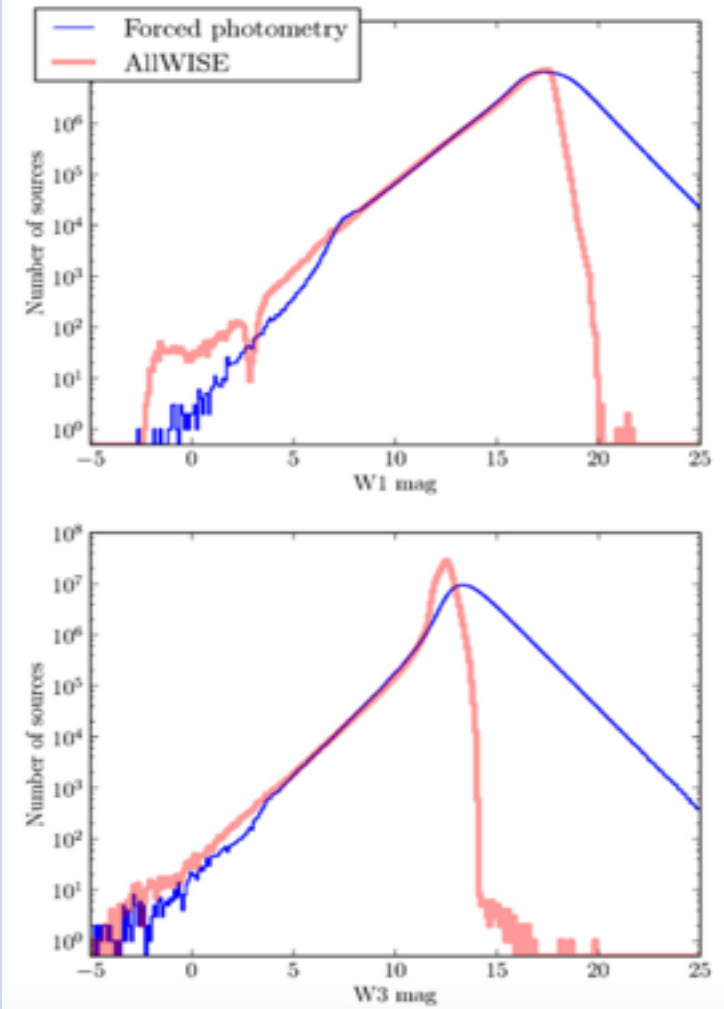
Lang et al. 2016



Tractor **photometry is reasonable**



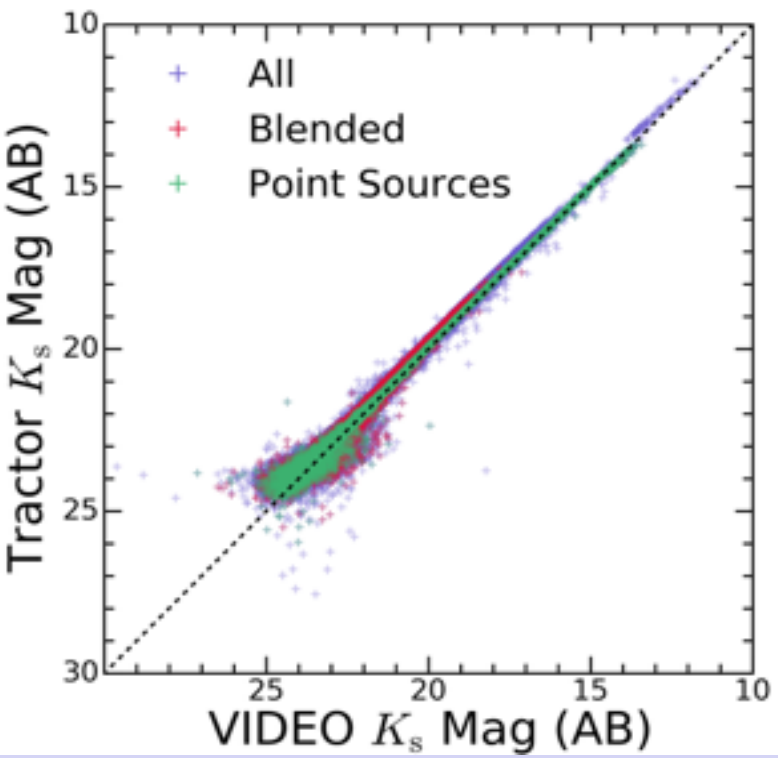
Tractor **de-blending is successful**

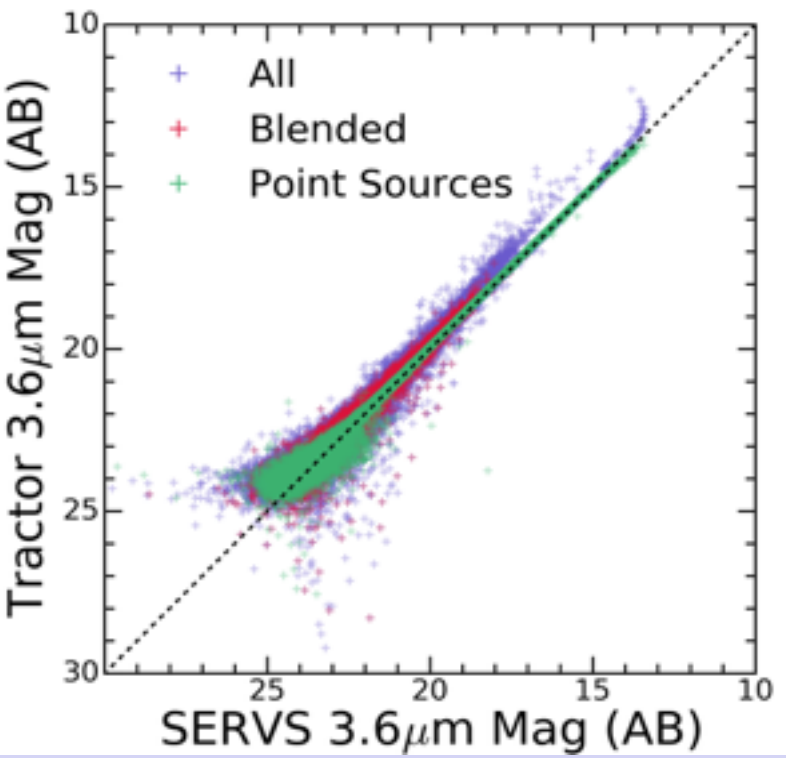


Tractor **detects more faint sources than catalog**

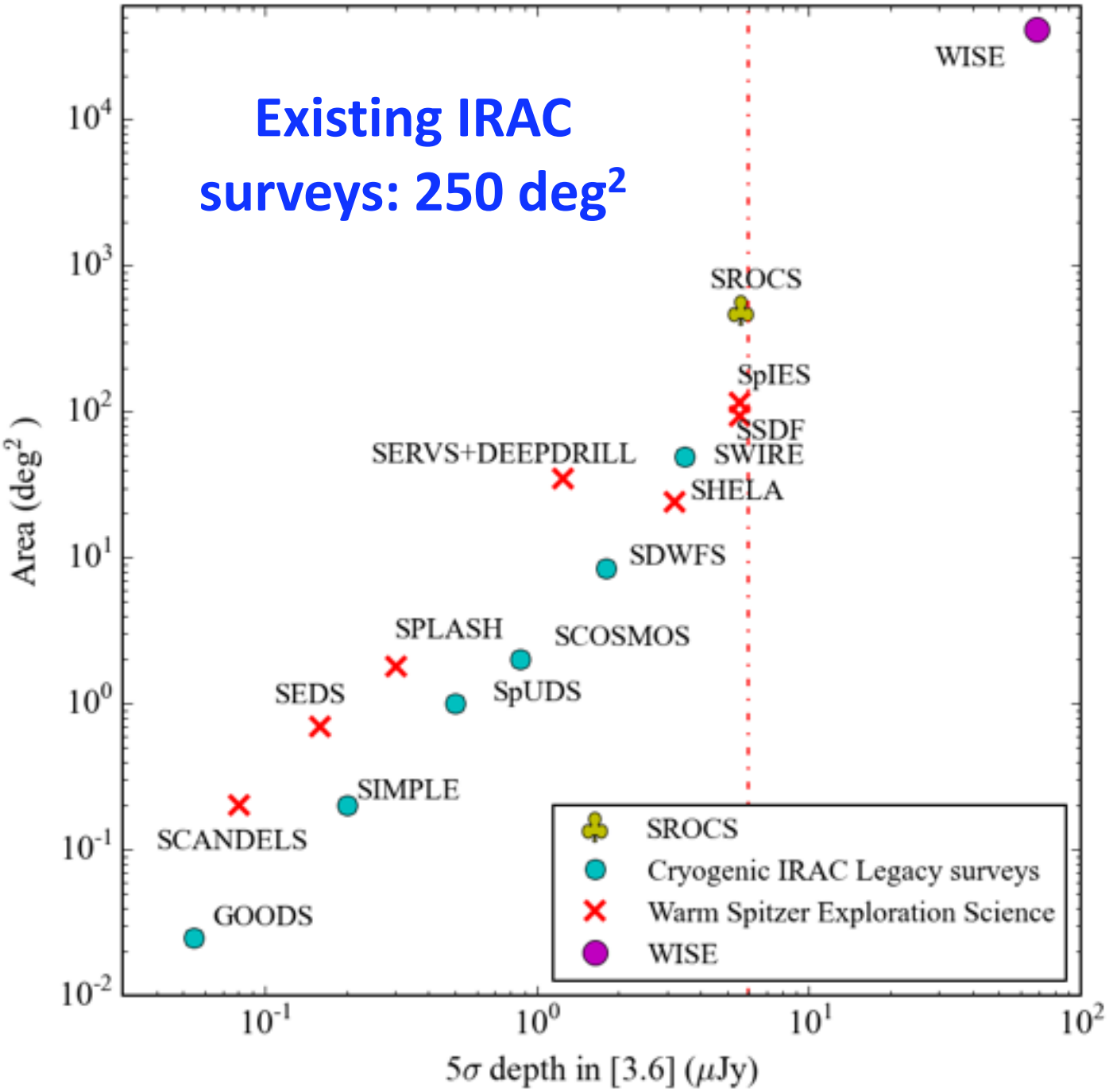
Tractor vs. Catalog Magnitudes

Nyland et al., in prep.





- ***Tractor*** **photometry generally in rough agreement with original catalog**
- **Blended sources show increased scatter**


Existing IRAC surveys: 250 deg²
WISE
SROCS
SpIES
SSDF
SERVS+DEEPDRILL
SWIRE
SHELA
SDWFS
SPLASH
SCOSMOS
SEDS
SpUDS
SIMPLE
SCANDELS
GOODS
SROCS
Cryogenic IRAC Legacy surveys
Warm Spitzer Exploration Science
WISE
Area (deg²)
5σ depth in [3.6] (μJy)
10⁴
10³
10²
10¹
10⁰
10⁻¹
10⁻²
10⁻¹
10⁰
10¹
10²