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

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Galaxy Evolution Science with *Spitzer*

**Sample** $z = 7$

*Soifer et al. 2008*

IRAC samples rest frame optical light for $4 < z < 10$ galaxies
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
VISTA
Bands: Ks, H, J, Y, Z

θ_{FWHM} \approx 0.8''

CFHTLS Deep
CFHT
Bands: I, R, G, Z, U

θ_{FWHM} \approx 0.8''

SERVS
Spitzer
Bands: 3.6, 4.5 μm

θ_{FWHM} \approx 2.0''

Accurate source matching and photometry across 12 NIR and optical bands with different resolutions?
VIDEO Sources Blended in SERVS

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

Blended IRAC Source
Tractor to the Rescue!

Optimizes a likelihood for the source properties given:

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

http://thetractor.org

Dustin Lang

See Lang et al. 2016
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”
Determine fiducial band

Extract fiducial cutout

Make fiducial source model

Convolve model w/ PSF

Perform Tractor fit

Point source model

Extended source model

PSF fits image model

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

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!
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 deg$^2$