Deconvolution of WIRE
Survey Data

JAS 8/31/98

Look at my web pages:

Http://spider.ipac.caltech.edu/~jason/wire

For general deconvolution, look at Appendix B of my thesis:

Http://spider.ipac.caltech.edu/~jason/pubs/app2.pdf.gz

Why Deconvolve?

Increased spatial resolution decreases confusion, which will ultimately limit the WIRE deep surveys.

Increased Strehl ratio increases point source detectability.

Features of WIRE Survey

- Most interested in low flux sources.
- Objects will be unresolved point sources.

There are 2 broad categories of deconvolution algorithms.

- Fourier Methods
  - Richardson-Lucy
  - MEM
  - Weiner/Inverse Filtering
- Real Plane Methods
  - CLEAN

STSDAS has good implementations of all of these.

In general, these methods are:

- Iterative
- Assume isoplanicity
- Non-invertible
- Require an input estimate of the PSF
- Need well-sampled data
- The more S/N, the better!

Testing Methods

- Start with simulated, coadded data
- Extract PSF using DAOPHOT
- Deconvolve data with PSF
- Extract post-processing PSF
- Run source extractor with new PSF
- Run MATCH and STATS to test performance
- Tweak extractor and MATCH to handle performance since survey defaults are inappropriate

Very labor-intensive!

CLEAN

- Damped iterative PSF-fitting in image plane.
- Assumes all data is point-like (as it is with WIRE!)
- Produces very cosmetically clean results with WIRE data. Replaces dirty telescope beam with a simple diffraction limited gaussian beam.

- Good for medium depth survey, but visually fails when significant source blending and confusion are present.

- Roughly doubles the number of detected sources.
- These detections are typically below 0.4 mJy.
- Their reliability is poor (below 80%).

Richardson-Lucy

•Most popular fourier method.
• Very, very fast. 1 WIRE field can be processed in 1-2 minutes.
• Easily restores diffraction limit or better.

• Amplifies high-sigma noise outliers into real sources, producing a mottled background which clobbers reliability at faint end. R-L is probably worthless for what we want on noisy fields like the medium depth survey. Probably great for AIs, though.

• As per Terry's suggestion, however, R-L appears promising for Ultradeep survey fields, where real source signal dominates background.

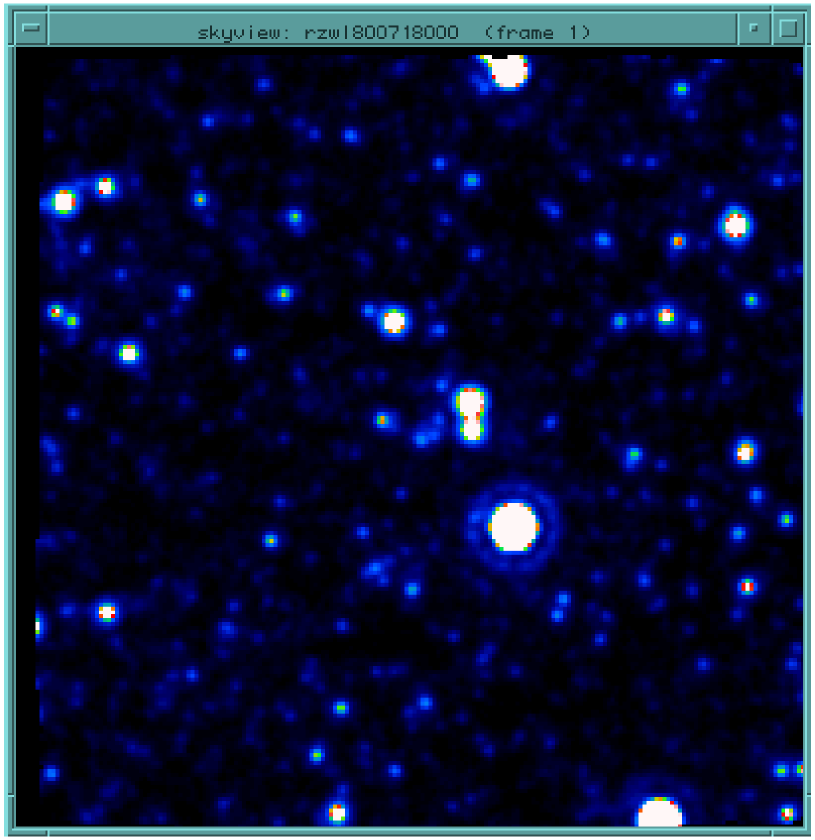
R-L and Ultradeep Fields

- Background is due to confused low flux sources.
- Ran test on 25um ultradeep coadd in manner similar to other tests.

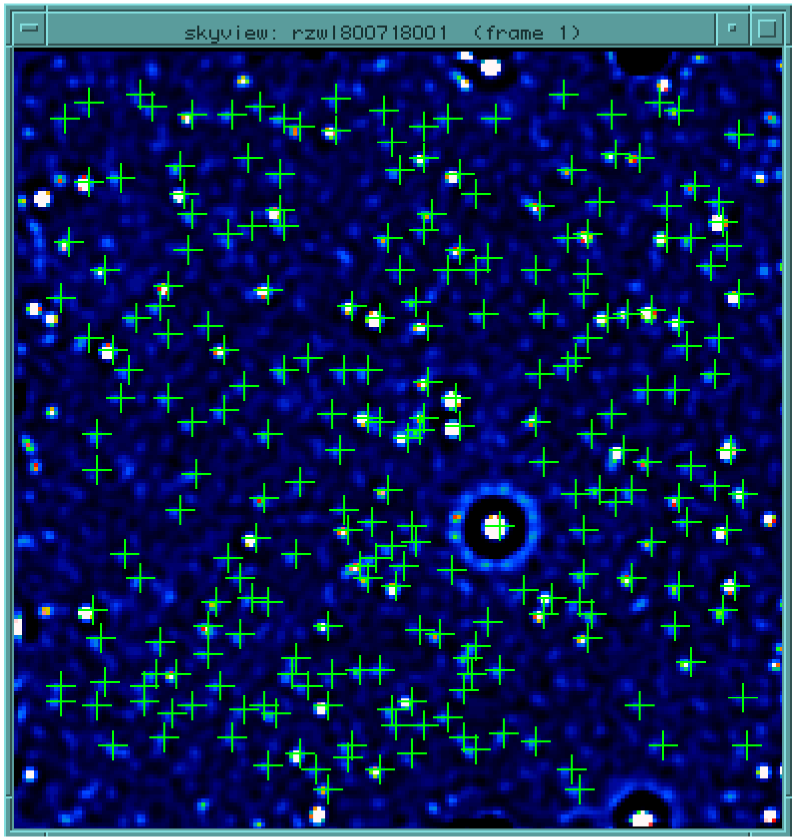
- 80% more detections!
- These detections are mostly below 0.4 mJy
- Initial strange reliability figures due to artifacting around bright stars (Jarrett??)
- Compensation for these artifacts brings reliability to >90% down to 0.1 mJy!

- Problems with flux-dependent R-L PSF and source extractor.
- Still needs more thought about QA tools to confirm this result.

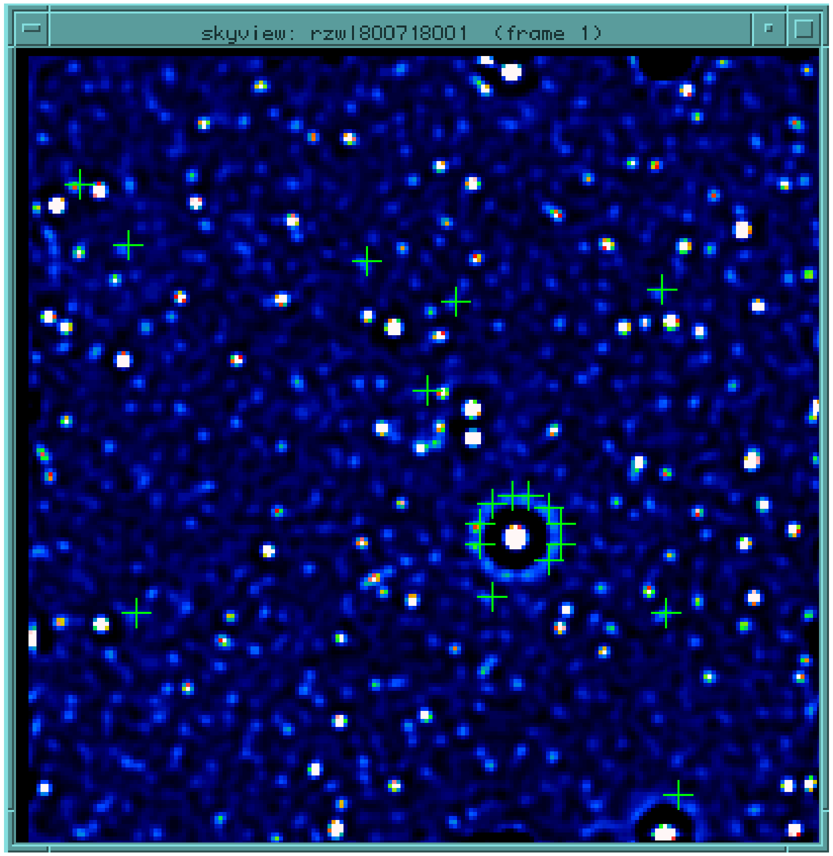
Raw Coadd



R-L Ultradeep True Detections



False Detections in R-L Ultradeep



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