Making maps from submillimetre data:

Lessons from SCUBA and BLAST.

Mark Halpern, UBC

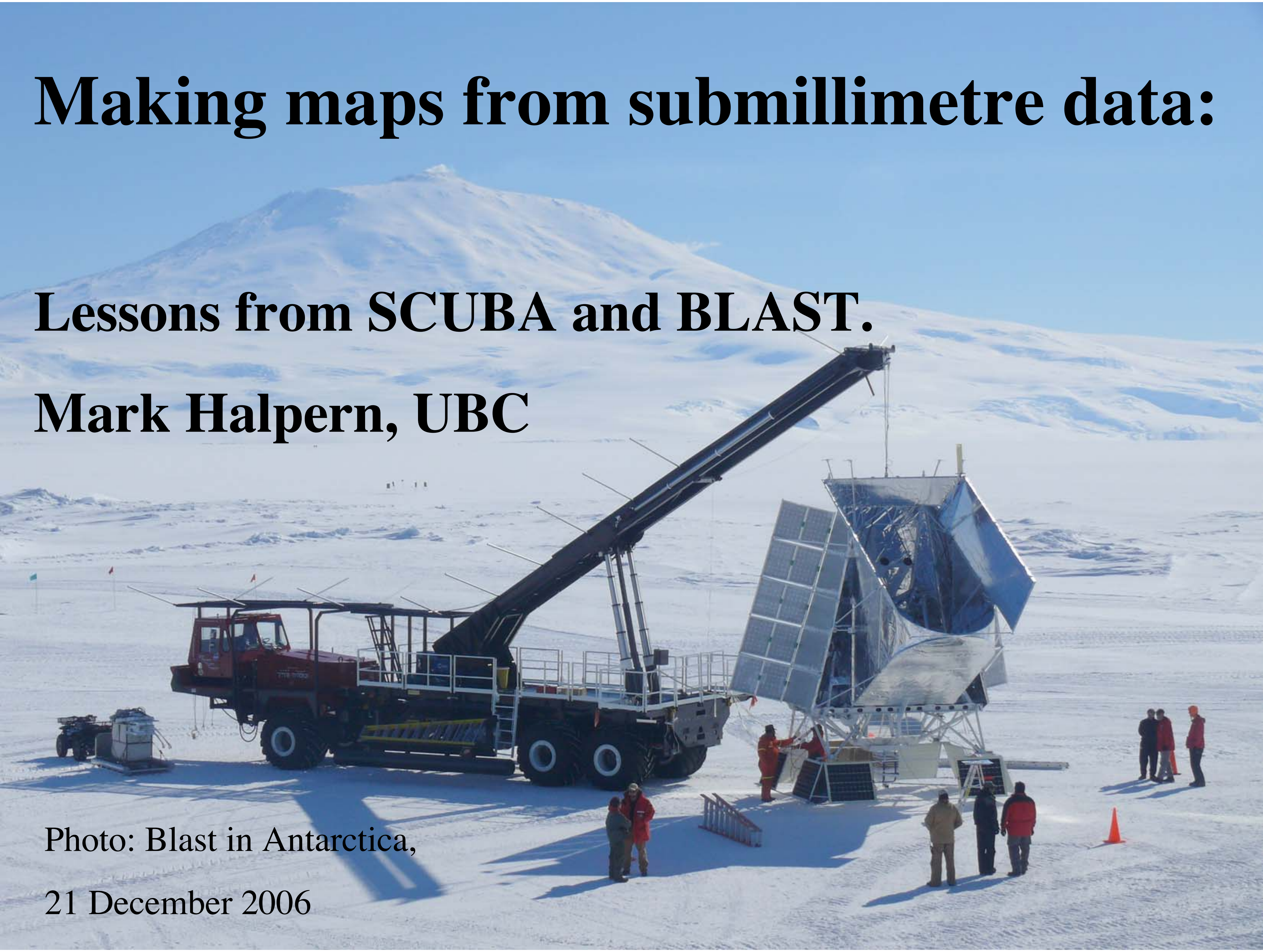
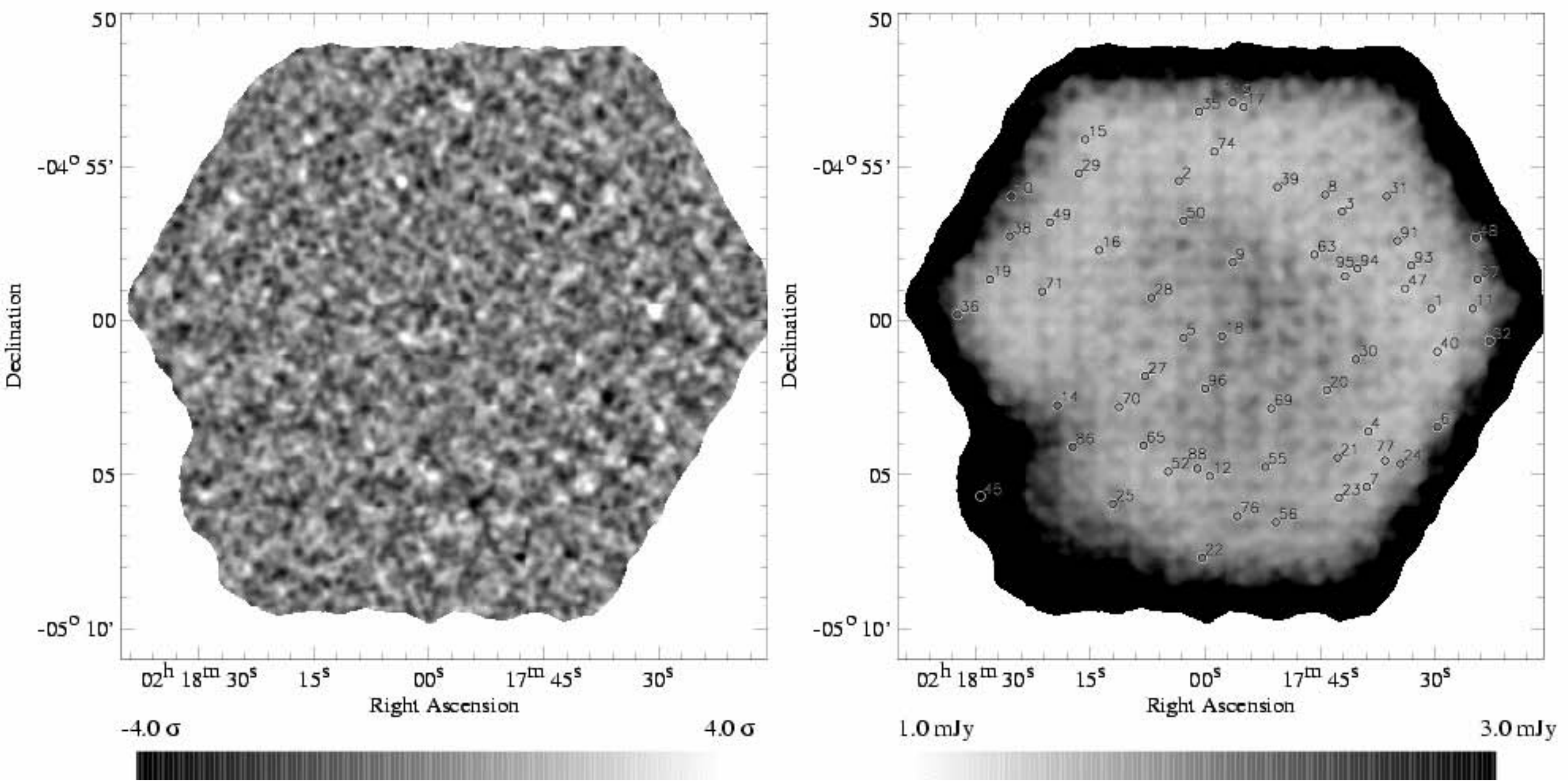


Photo: Blast in Antarctica,

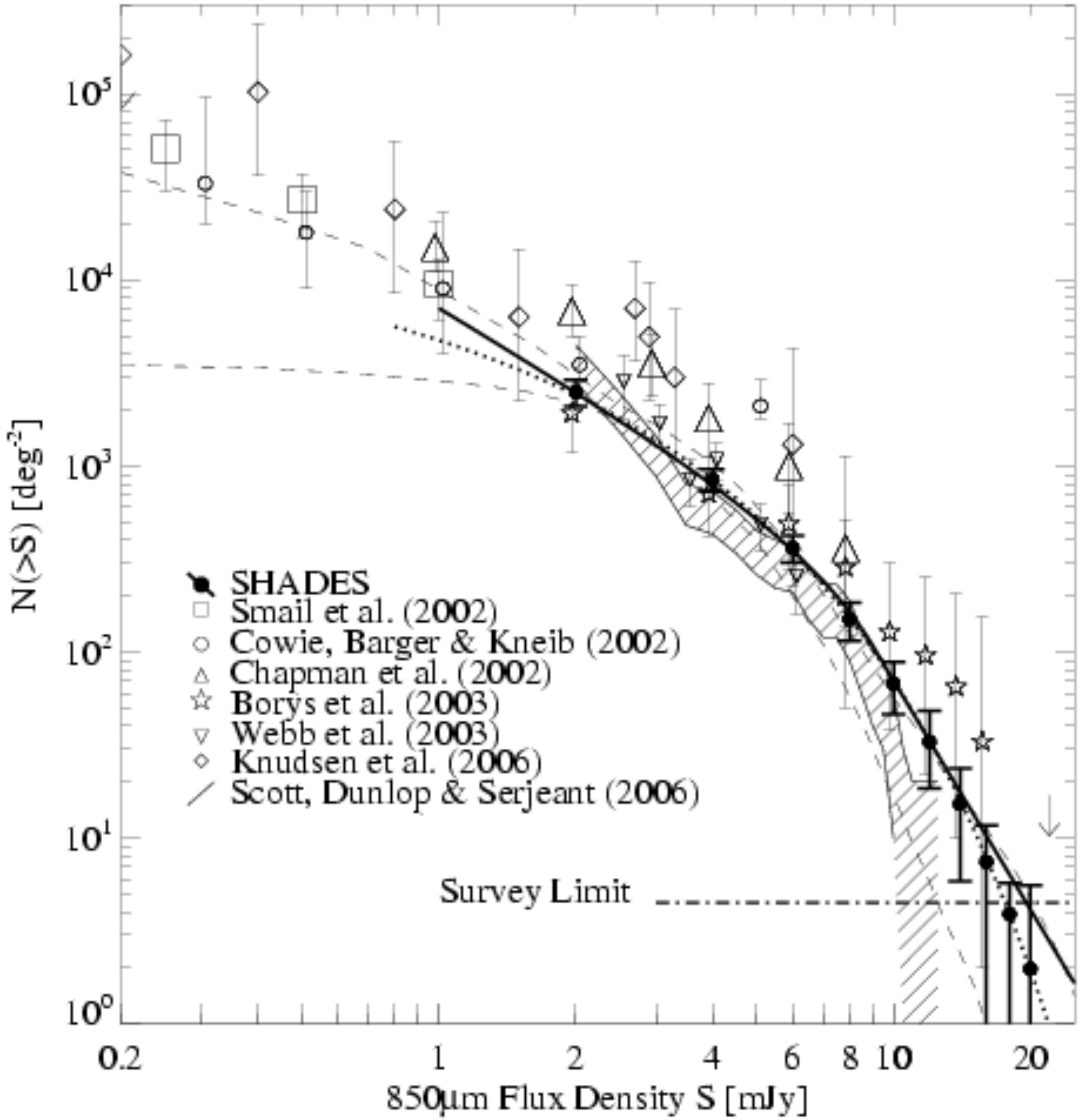
21 December 2006

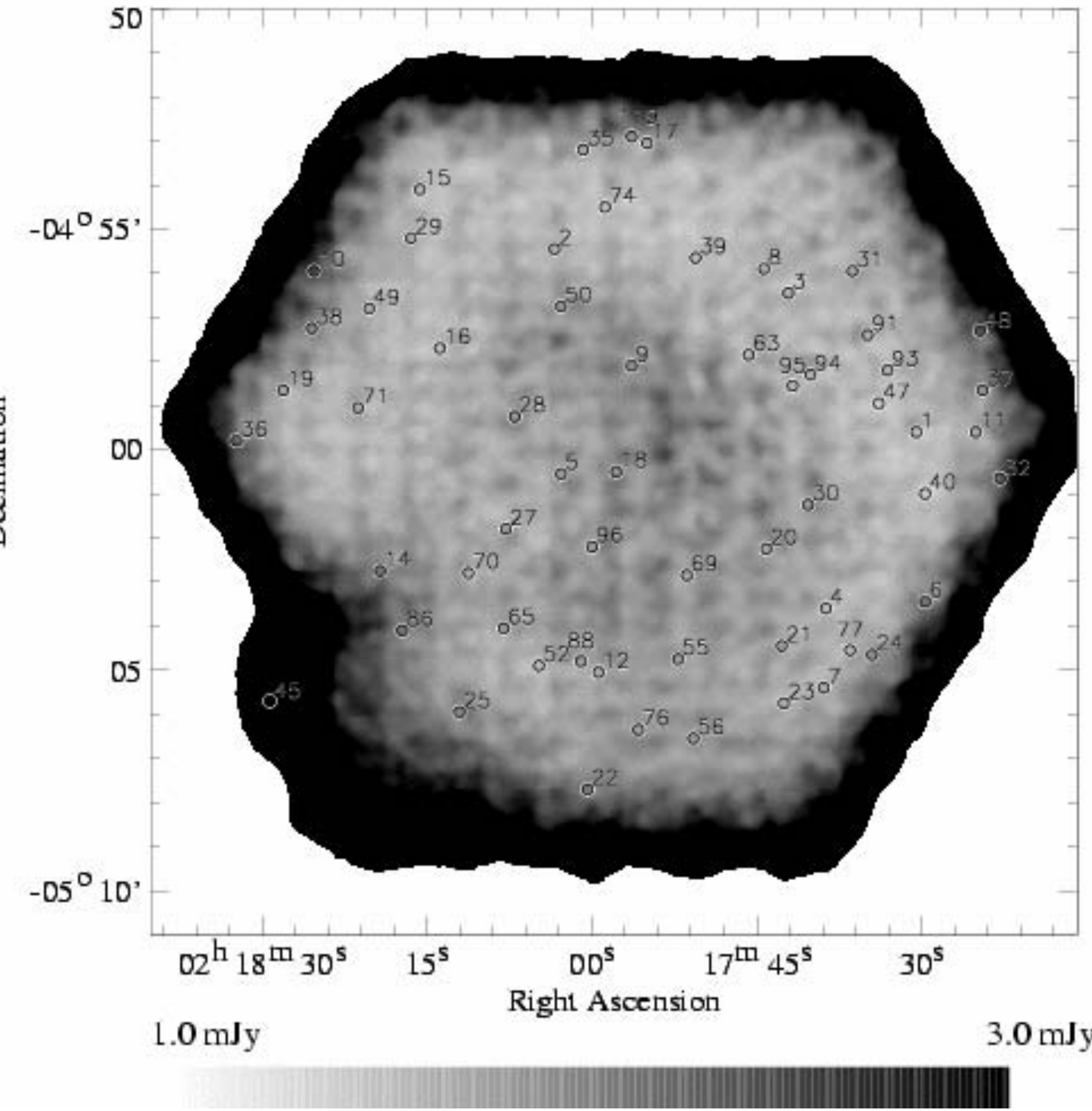
SHADES is the largest blank field extragalactic survey made at the JCMT. Here is ~1/10 square degree mapped at 850 microns in several hundred hours. Source locations are marked in the noise map at the right. This is half of the Shades data set.



Coppin *et al*. MNRAS **372**, 1621…(2006) Astro-ph 0609039

SHADES and other surveys show that the number density of sources drops very rapidly as one goes to brighter sources. The result is that most detections lie very near the survey noise floor.





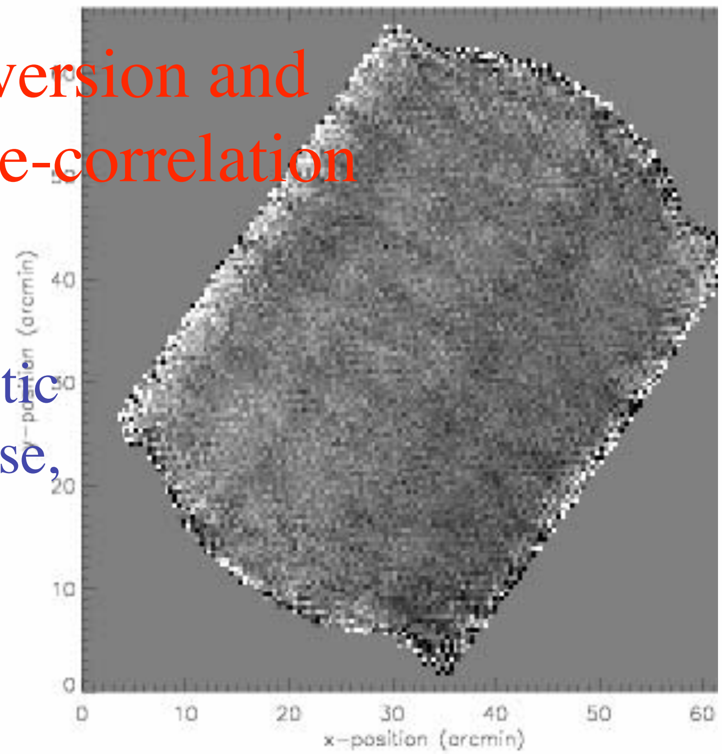
Take a look at the SHADES noise map again. Notice:

1. It has structure
2. The sources are all found at low noise spots.

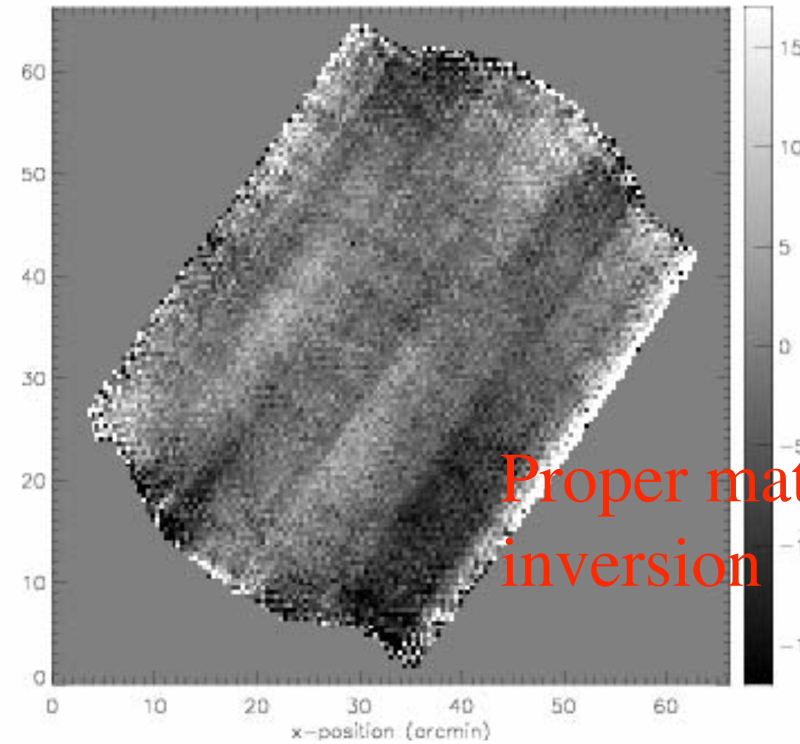
This makes studying clustering, or even counting sources really difficult.

We need maps which are higher fidelity.

Matrix inversion and detector de-correlation



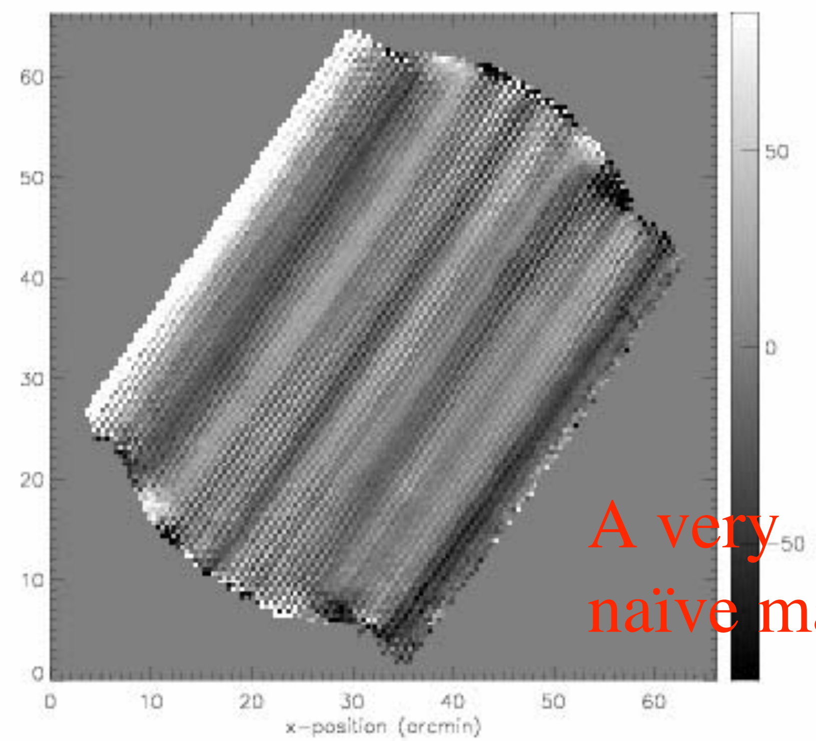
These sims are made with realistic pointing and noise, but no data.



Proper matrix inversion

We have made a map-making program (SANEPIC, Patanchon et al.) for BLAST which performs an optimal reconstruction of the sky which accounts for correlated signals from the array of detectors.

(There are several similar approaches.)



A very naïve map

Cost of computing an image:

SANEPIC requires several fourier transforms of the full time series per detector. We find that for any single BLAST channel (150 bolometers sampled at 100 Hz) and using a single processor,

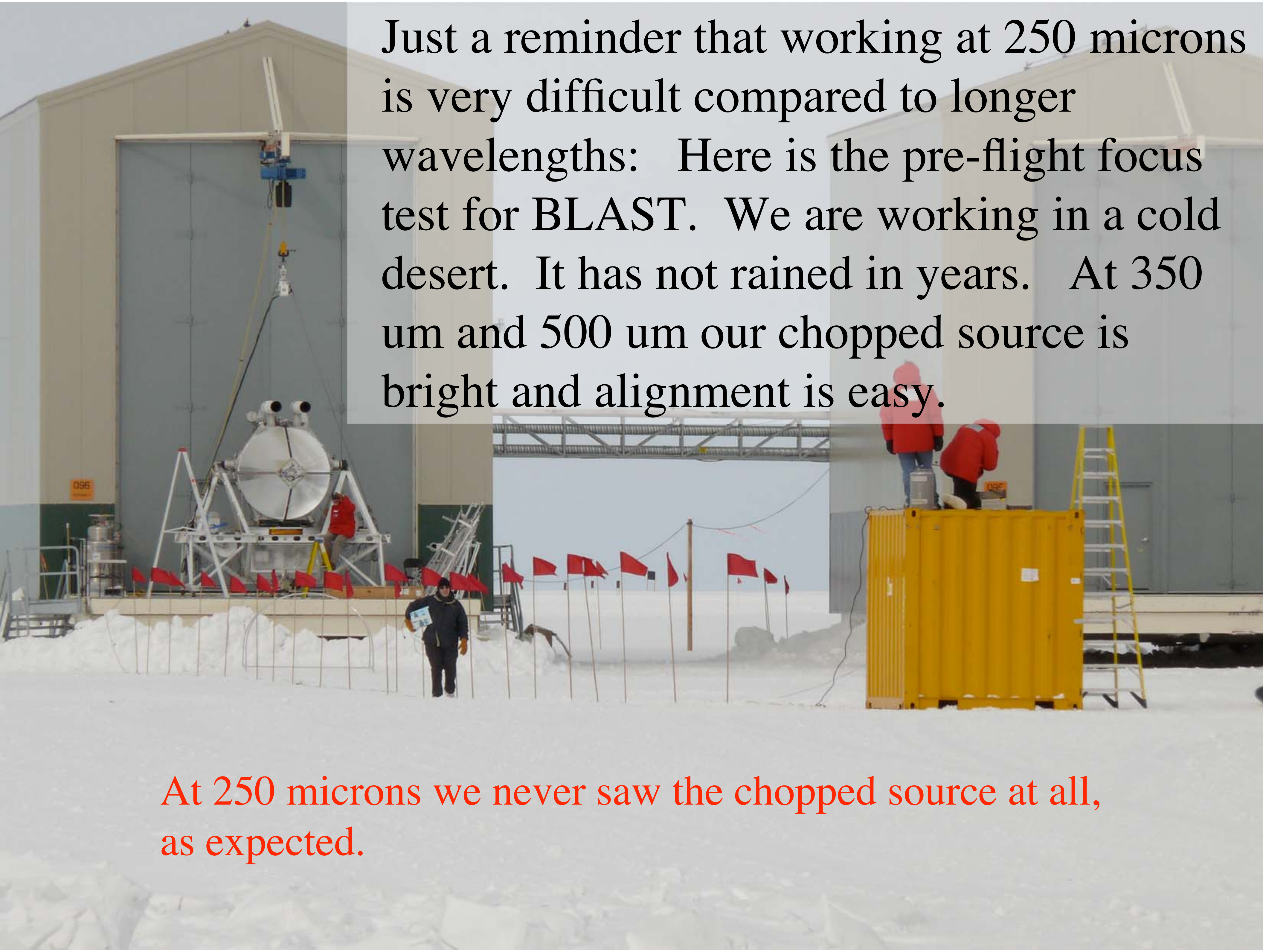
we can calculate an optimal map in about 5x as much time as we spend collecting data,

The calculation scales as approximately the number of samples, ie **Number of Sensors x Sample Rate x Time of Observation.**

CCAT will have over 100x more bolometers than BLAST, and sample them more rapidly.

Map making will require a dedicated cluster of ~1000 processors running full time to make maps as quickly as CCAT collects data

Just a reminder that working at 250 microns is very difficult compared to longer wavelengths: Here is the pre-flight focus test for BLAST. We are working in a cold desert. It has not rained in years.   At 350 um and 500 um our chopped source is bright and alignment is easy.



At 250 microns we never saw the chopped source at all, as expected.

Students and Post Docs whose data I have used:

SHADES:

Kristen Coppin,
UBC/Durham
Ed Chapin,
INAOE/UBC
Ange Mortier
Kent/Edinburgh
Jeff Wagg,
INAOE/NRAO

BLAST:

Guillaume Patanchon, Paris/UBC
Gaelen Marsden,UBC
Ed Chapin, UBC,
Marie Rex, Penn,
Don Weibe, Toronto,
Enzo Pascale, Toronto,
Matt Truch, Brown/Penn,
Bruce Sibthorpe, Cardiff,
Peter Hargrave, Cardiff