MeqTrees

http://www.astron.nl/meqwiki
http://www-astro.physics.ox.ac.uk/~ianh/SSSC

Meq...?

The Measurement Equation

(see the tetralogy of papers by Hamaker, Bregman & Sault)

Electric field of output polarized radiation

Electric field of input polarized radiation

$$\begin{bmatrix} e'_x \\ e'_y \end{bmatrix} = \begin{bmatrix} a & b \\ c & d \end{bmatrix} \begin{bmatrix} e_x \\ e_y \end{bmatrix}$$

2 x 2 linear operation matrix (a.k.a. the Jones Matrix)

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Meq...?

Different Jones terms for different effects along the signal path...

$$J_{rotation} = \begin{bmatrix} e^{i\theta} & 0 \\ 0 & e^{-i\theta} \end{bmatrix}$$

$$J_{gain} = \begin{bmatrix} G_x & 0 \\ 0 & G_y \end{bmatrix}$$

$$J_{leakage} = \begin{bmatrix} 1 & d \\ -d & 1 \end{bmatrix}$$

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http://www-astro.physics.ox.ac.uk/~ianh/SSSC

Meq...?

What does each antenna measure?

Antenna-specific receptor voltages

$$\bar{v}_a = J_a \bar{e}$$

$$\bar{v}_b = J_b \bar{e}$$

Electric field vector describing radiation from source

Cumulative product of 2x2 Jones matrices along the signal path from the source to each antenna

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Meq...?

What does a correlator correlate?

$$V_{ab} = \langle \bar{v}_a \otimes \bar{v}_b \rangle$$

$$V_{ab} = \langle J_a \bar{e} \otimes J_b^* \bar{e}^* \rangle$$

$$V_{ab} = (J_a \otimes J_b^*) \langle \bar{e} \otimes \bar{e}^* \rangle$$

What you measure is related to the true emission from the source via the outer product of the cumulative, per-station Jones terms.

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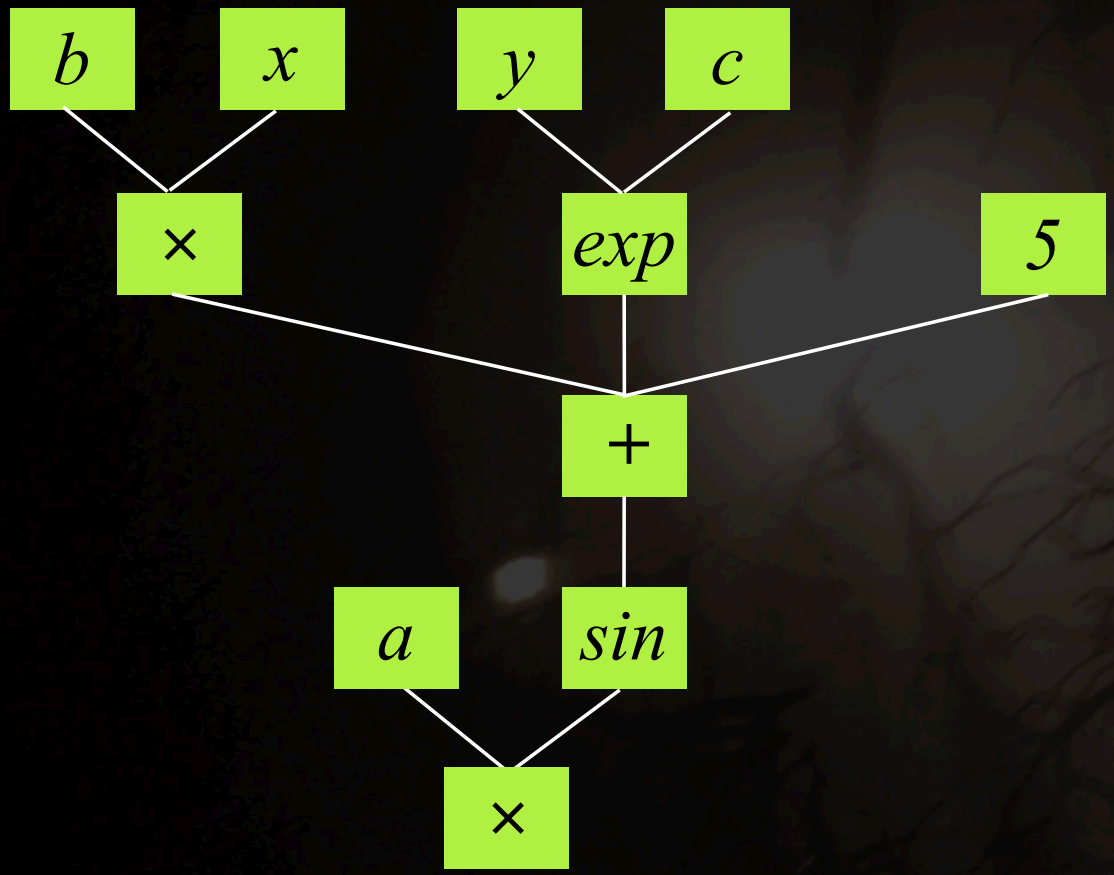
...Trees?

$$f = a\ sin(bx + y^c + 5)$$



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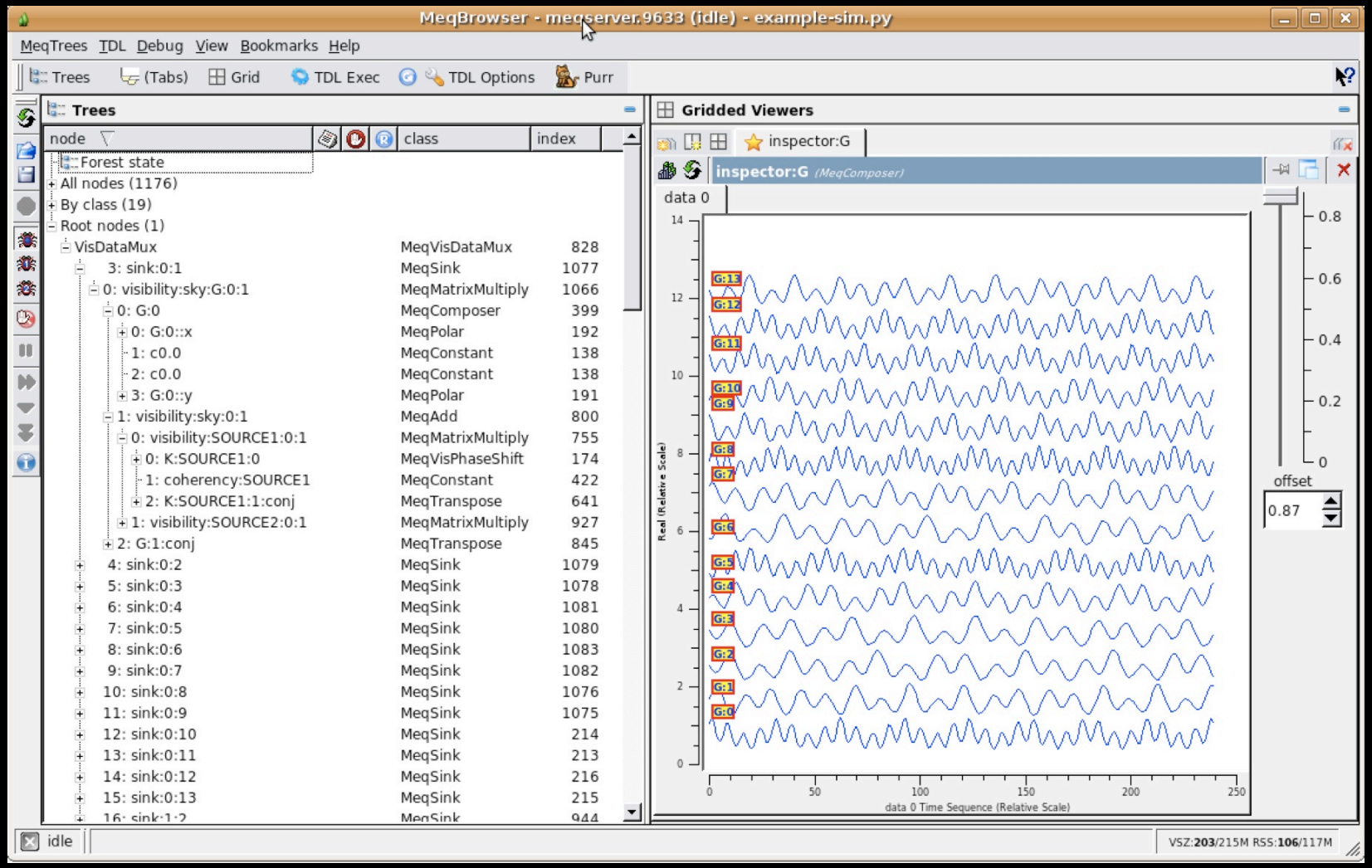
MeqBrowser

LEGO® for Jones Matrices



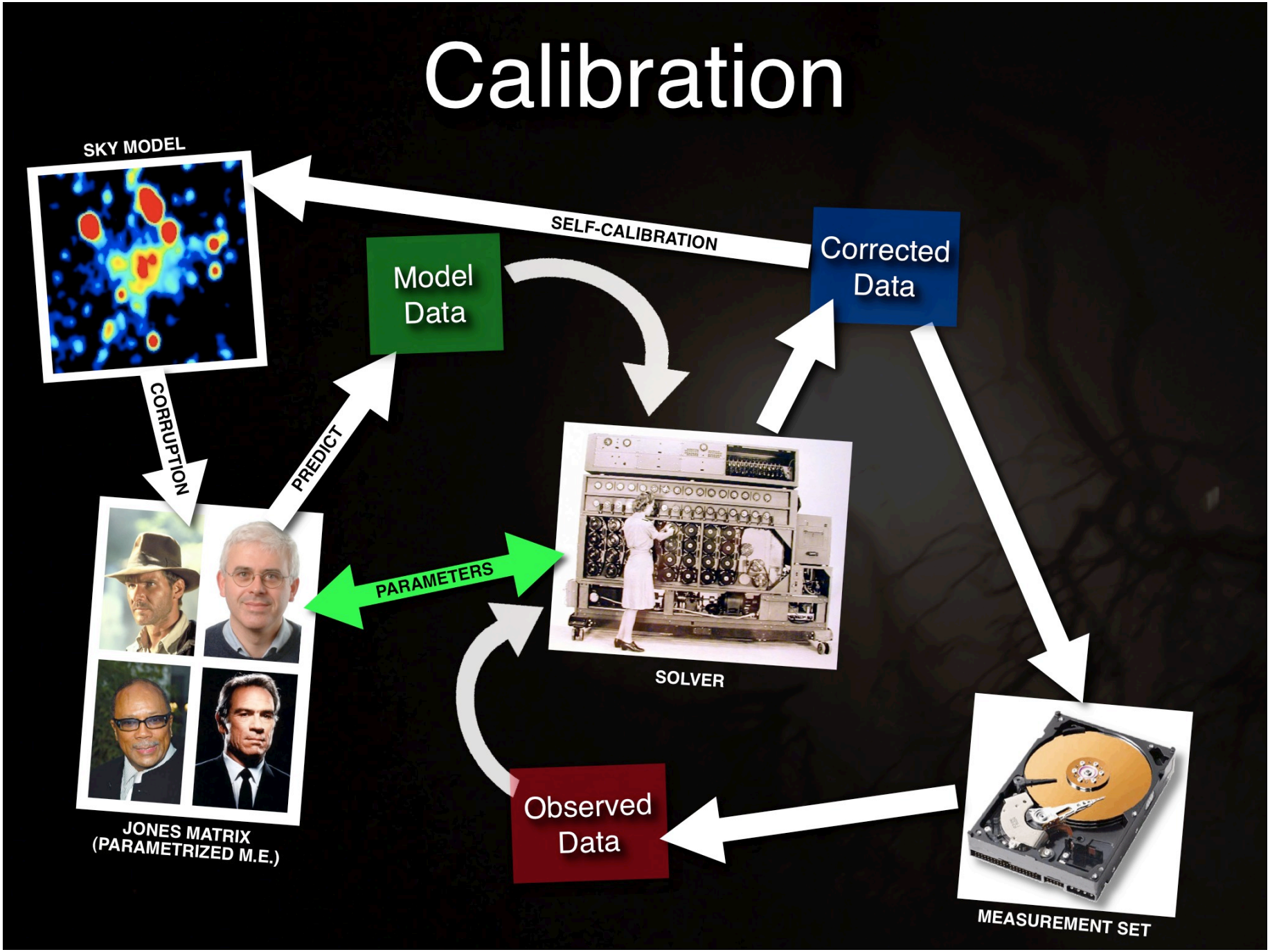
Simulation

CORRUPTION

PREDICT

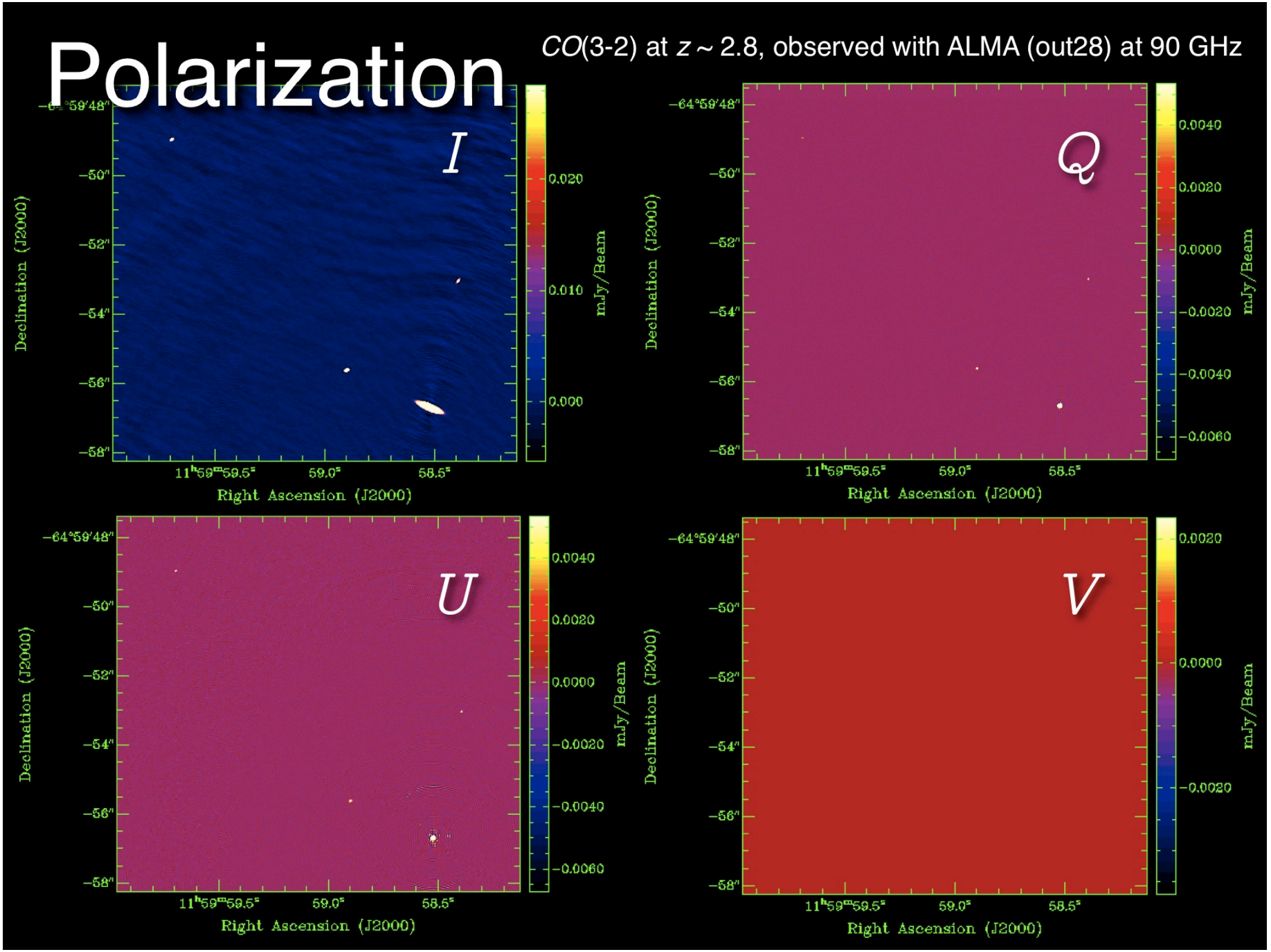
Model
Data

Calibration



Polarization

CO(3-2) at $z \sim 2.8$, observed with ALMA (out28) at 90 GHz



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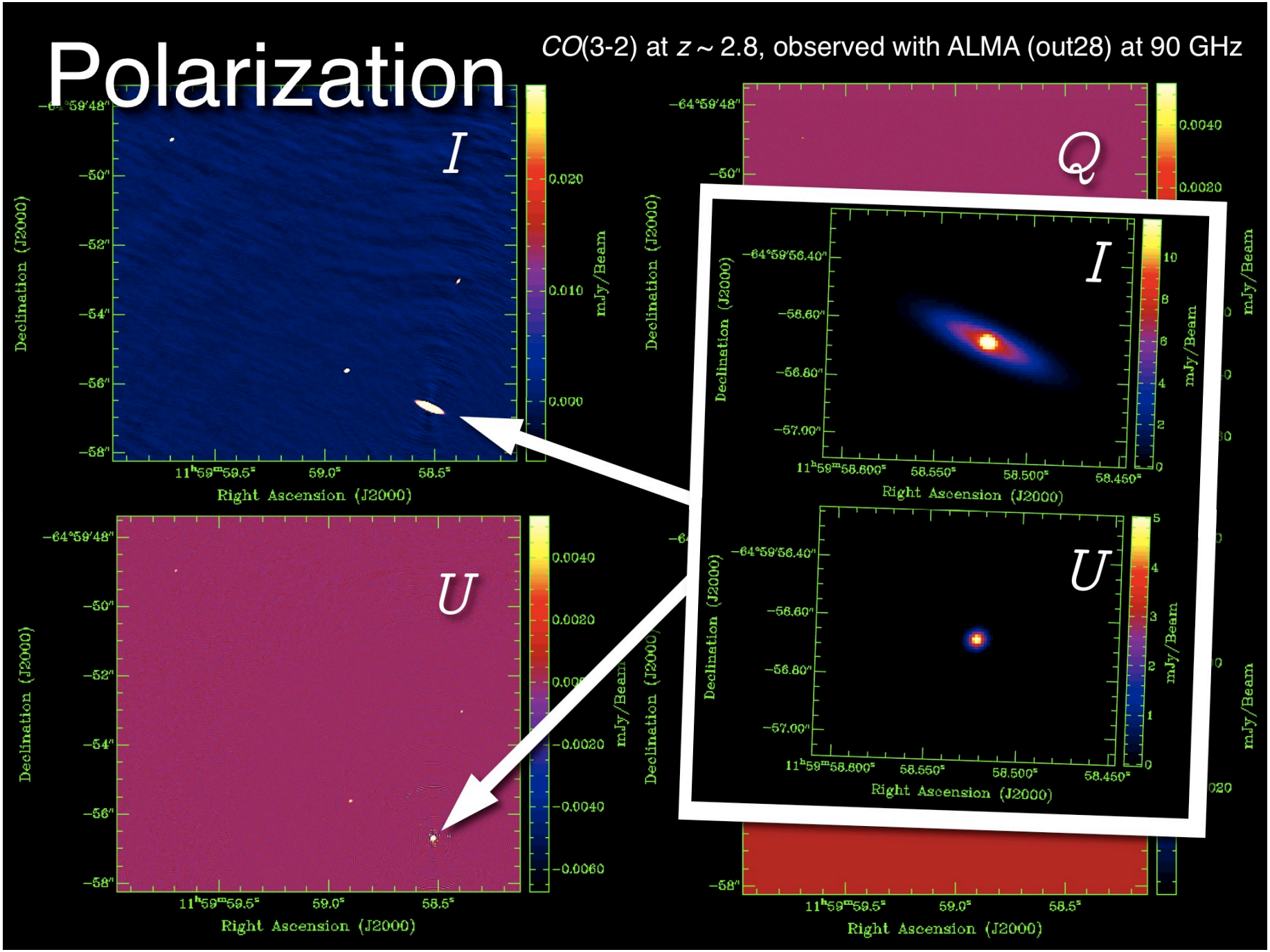
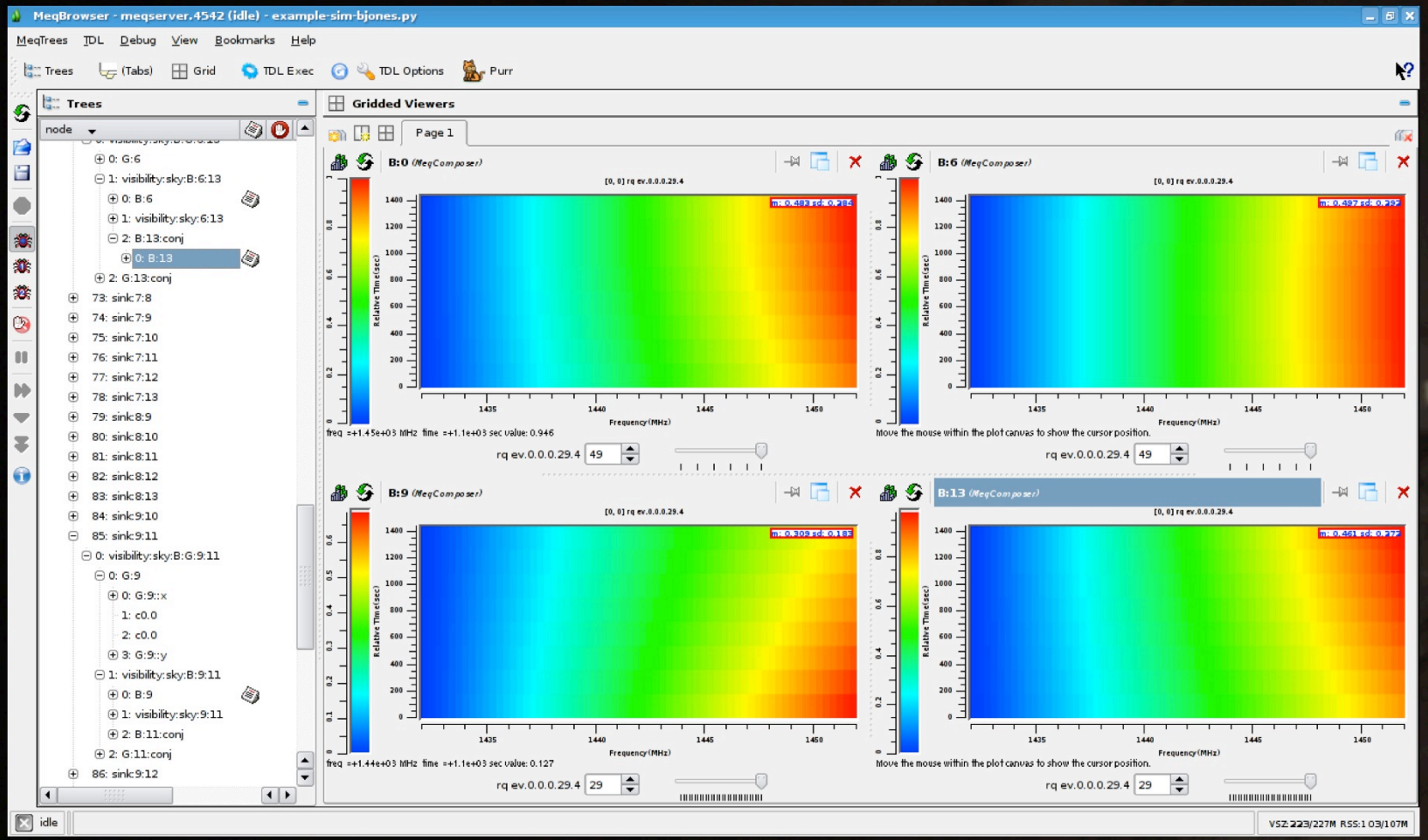
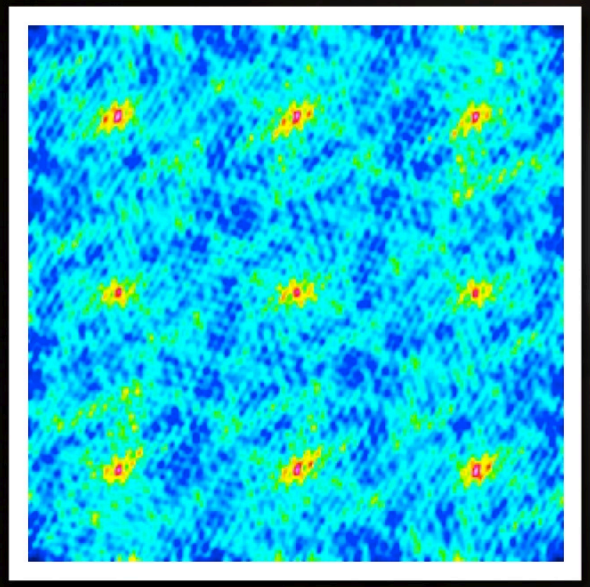


Antenna-specific bandpass

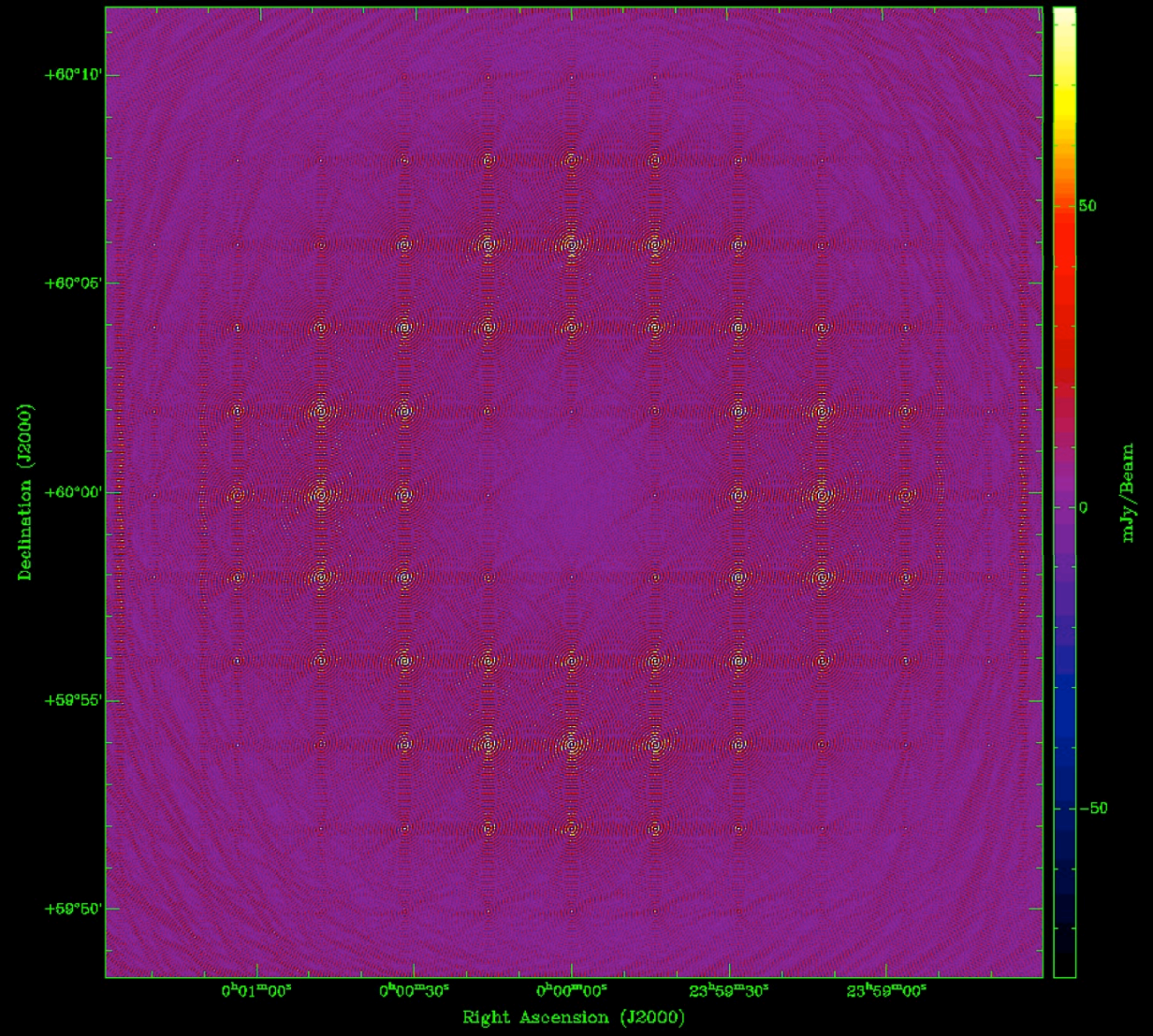


Ionosphere Simulation



(With thanks to Roger Deane)

Primary Beam Simulations



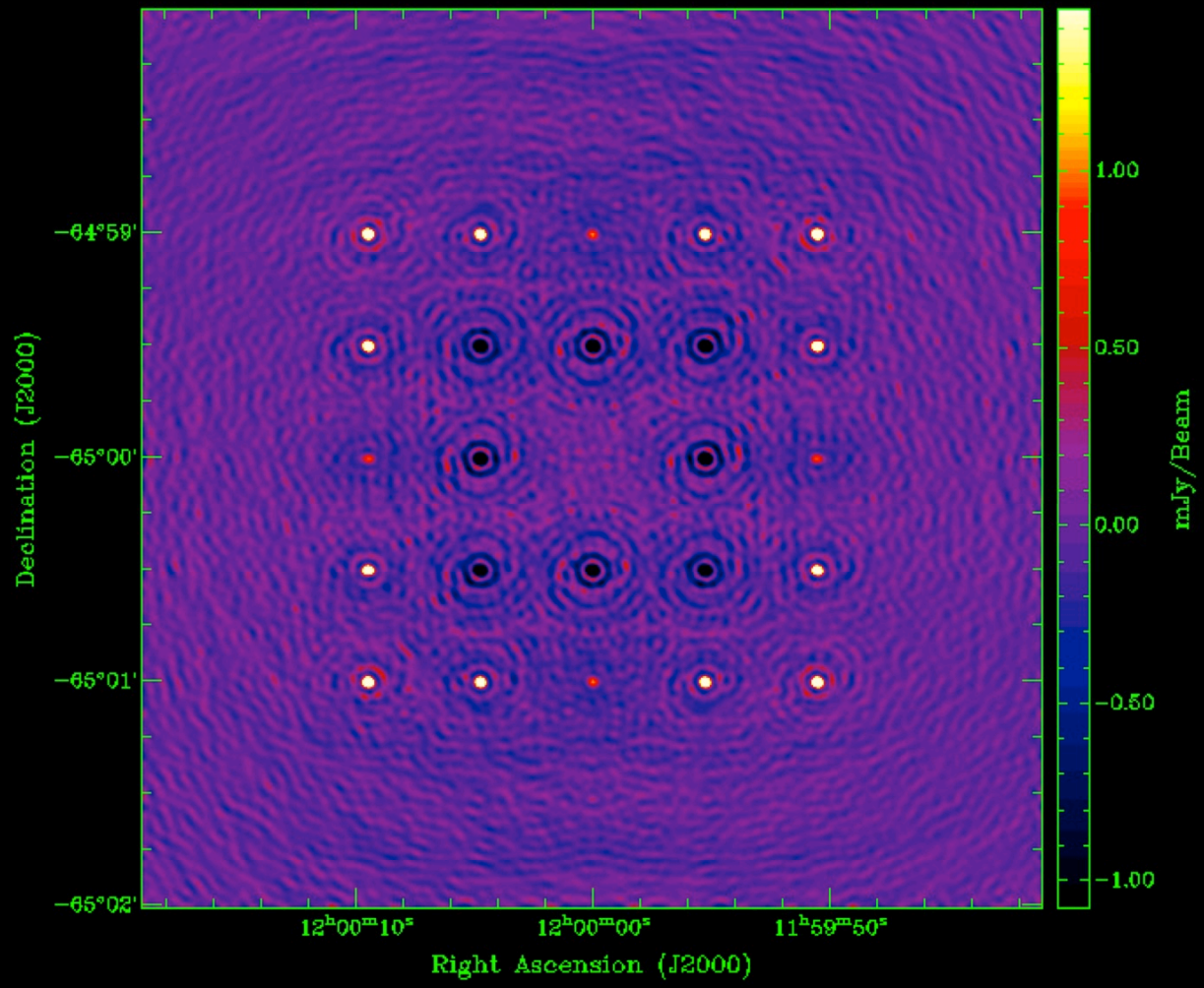
Differential simulation

1 x sub-band at L-band

512 x 62.5 kHz channels
Start freq = 1.3 GHz

6 x 25 m
-
4 x 25 m
1 x 32 m
1 x 76 m

Primary Beam Simulations



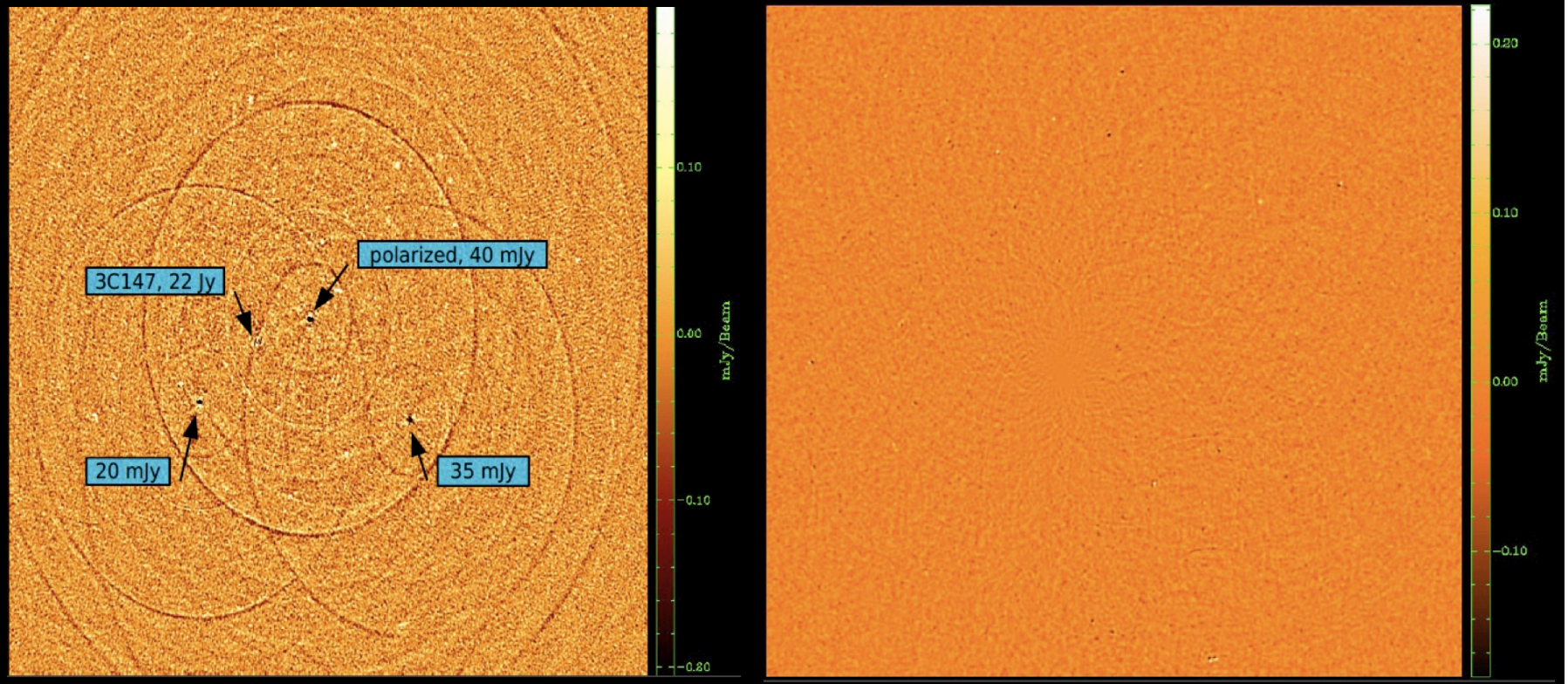
Differential simulation

ALMA (out06 + ACA)

Single channel at 90 GHz

62 x 12 m
-
50 x 12 m
12 x 7 m

3C147- Calibration Example



"Current dynamic range record 1,000,000:1 (de Bruyn 3C147)"
(Neal Jackson's talk)

http://www.astron.nl/meqwiki/OlegSmirnov/3C147CalibrationTutorial

(Oleg Smirnov)

Isn't this session supposed to be about pipelines...?

1. MeqTrees is very good at rapidly turning an idea into an algorithm into a result

2. It's excellent at generating realistically corrupted simulated datasets to test out your existing pipeline (spot the pitfalls now, before someone hits the 'on' button)

3. Check out the existing WSRT pipeline for a peek at what can be achieved

`http://www.astron.nl/meqwiki`

The MeqTrees homepage

`http://www-astro.physics.ox.ac.uk/~ianh/SSSC`

Super Simulation / Calibration Fun-Time

`http://s-cubed.physics.ox.ac.uk`

Simulated radio/sub-mm skies