ALMA Data Reduction Training Day, 23 Oct. 2024

Imaging

Joshiwa van Marrewijk

Alma LocaL expErtise GROup (Allegro)

Universiteit Leiden
Sterrewacht Leiden

Data used in this tutorial

- TW Hya from the “First Look at Line Imaging CASA 6” guide, N2H+ J=4-3
- ALMA Project 2011.0.00340.S, "Searching for H2D+ in the disk of TW Hya v1.5", PI Chunhua Qi
- Also, see CASA Tutorial 1

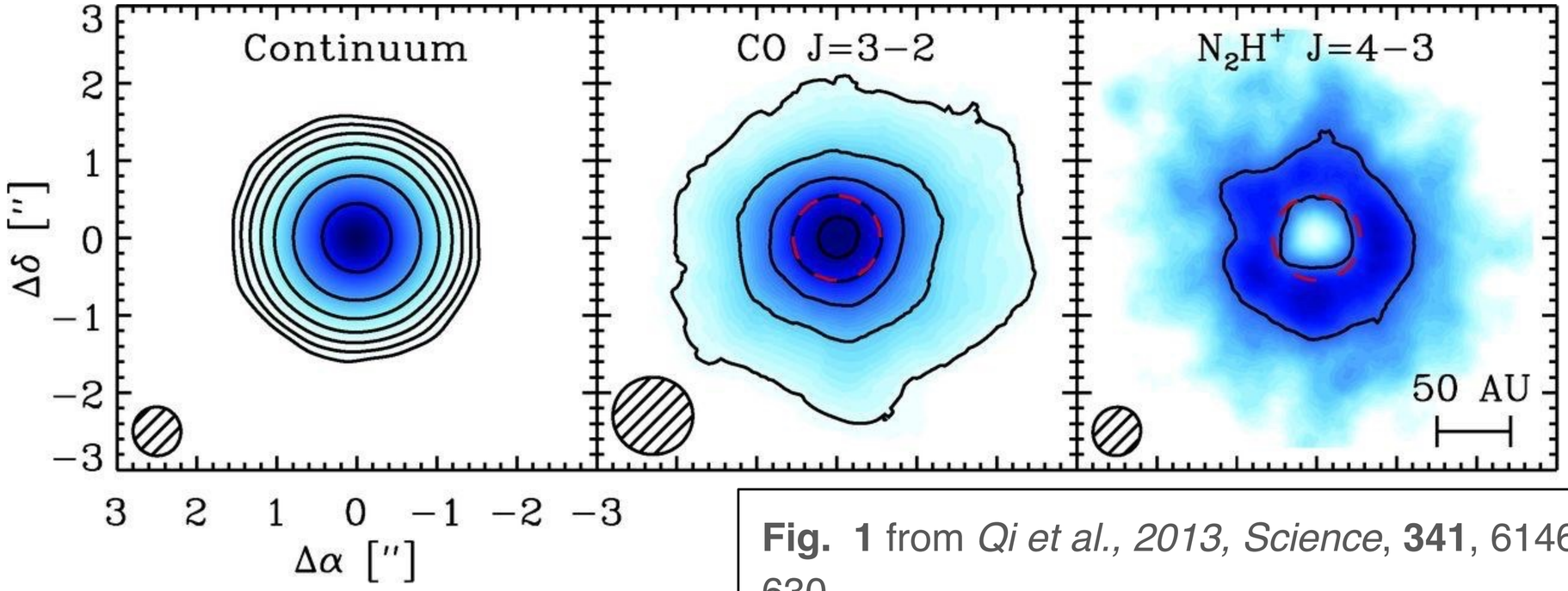
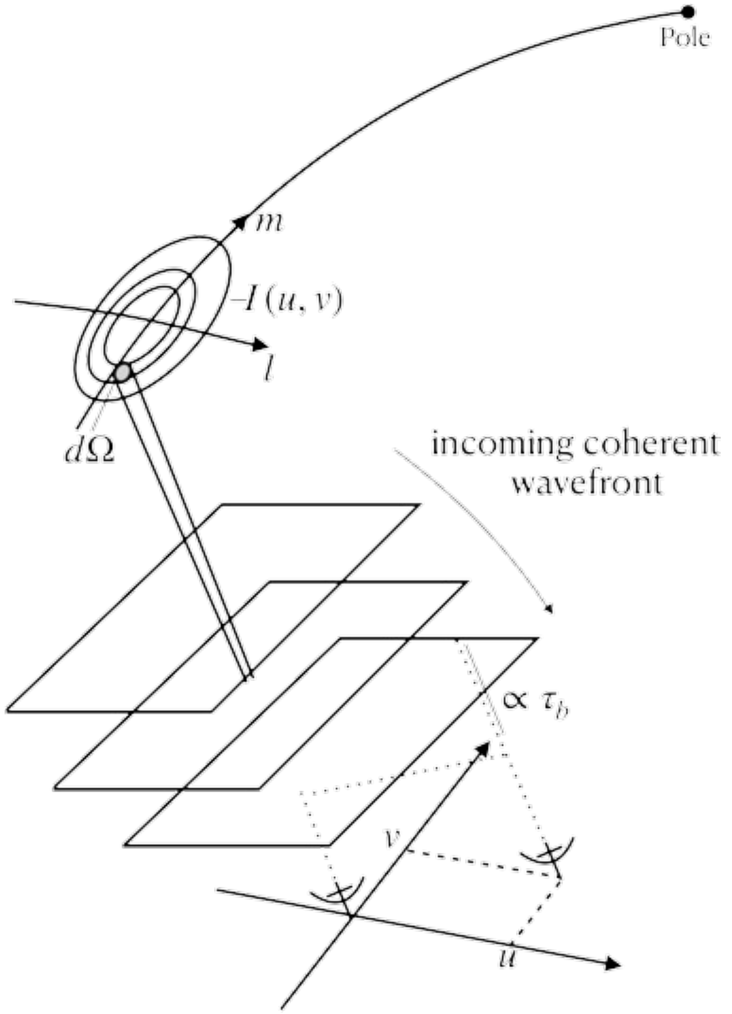


Fig. 1 from *Qi et al., 2013, Science*, **341**, 6146, 630

Fundamentals: What is ALMA data?



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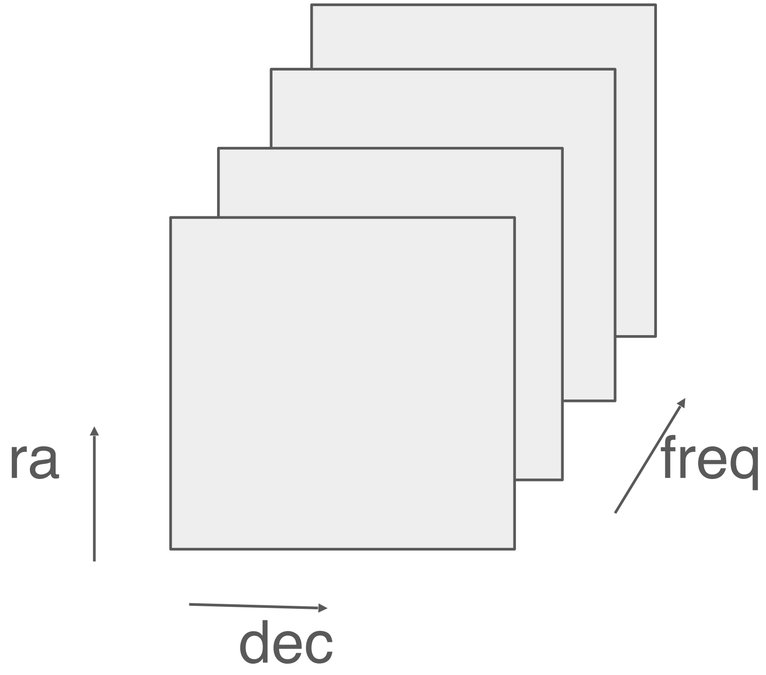
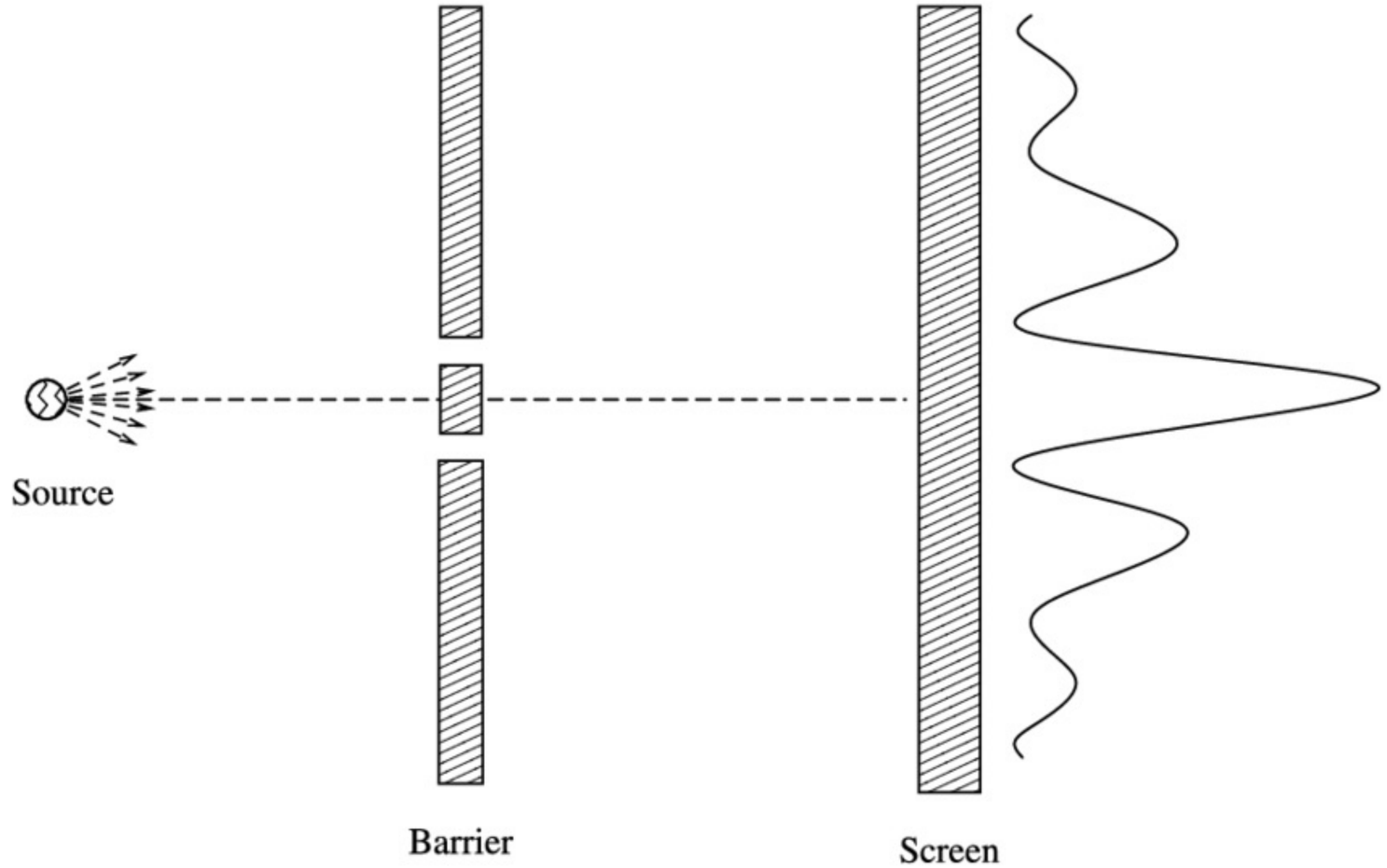


Fundamentals: What is ALMA data?

Think about the double split experiment



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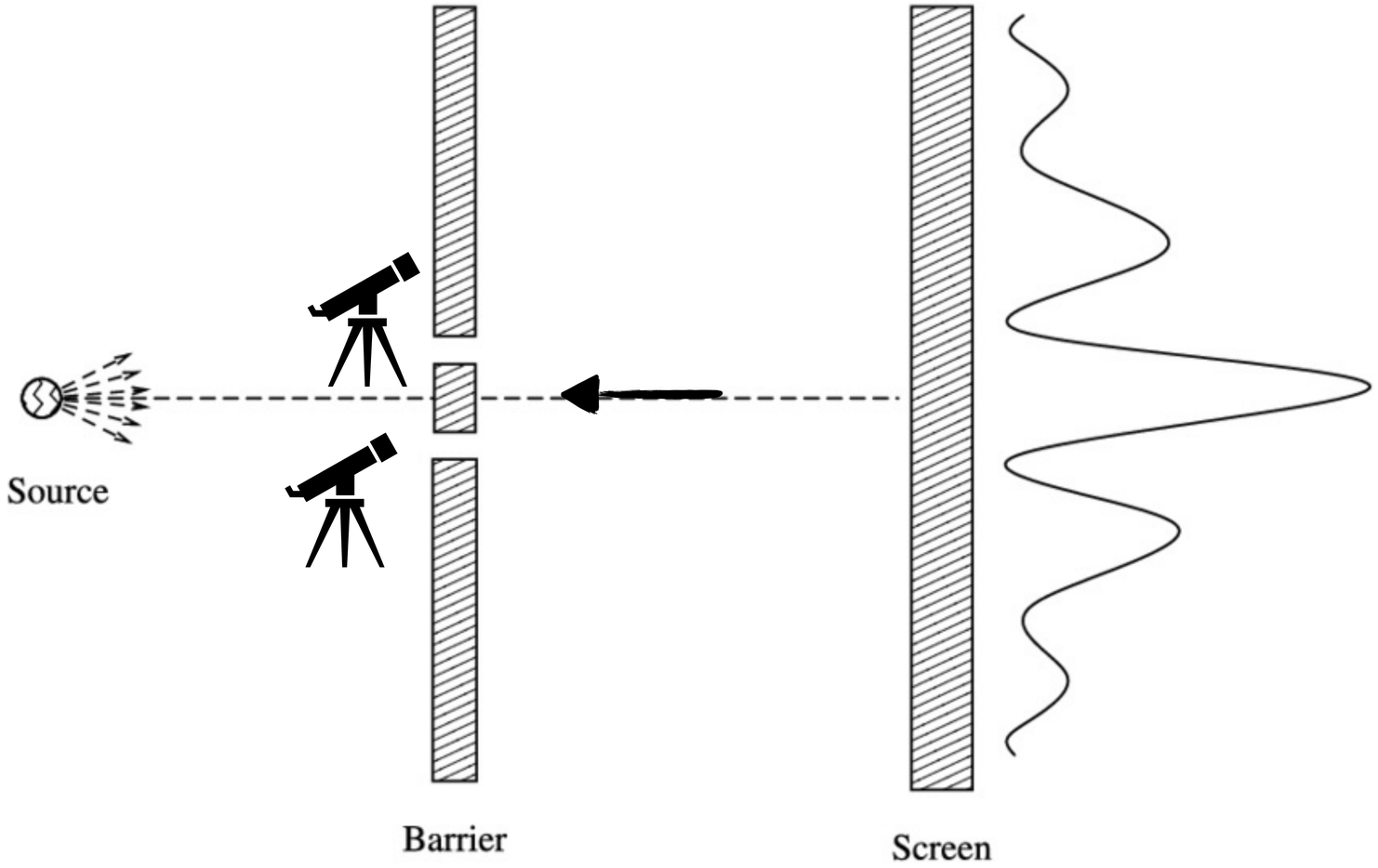

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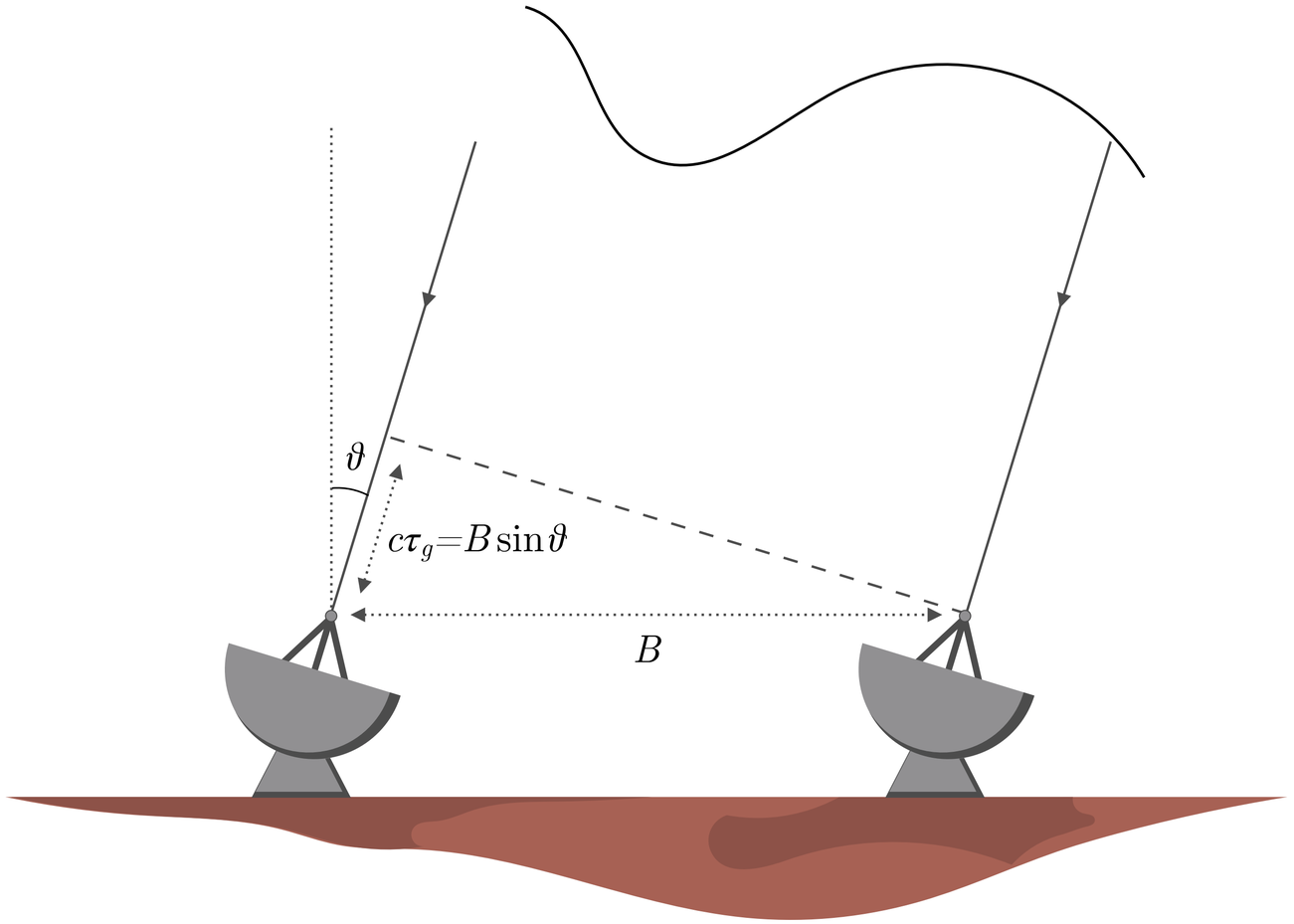
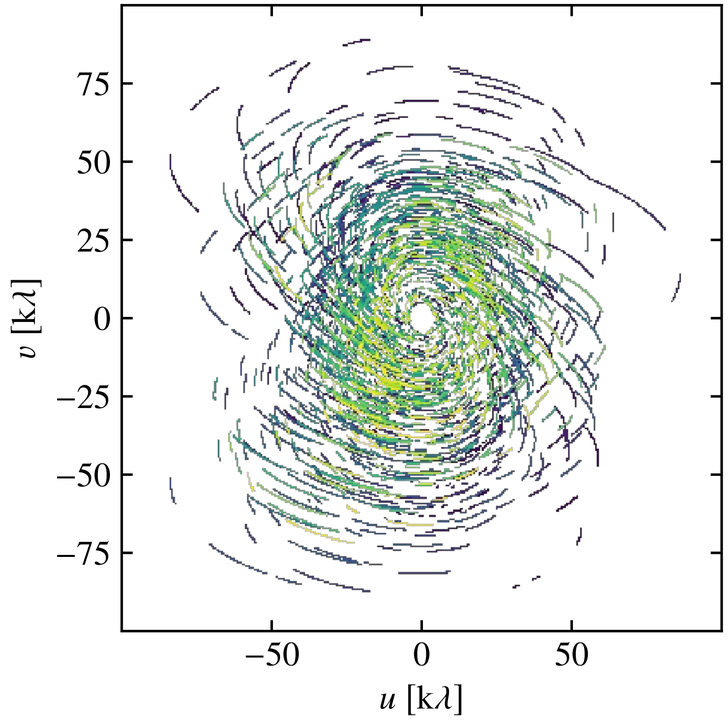


Measure the Amplitude and phase of an incoming wave front (light).

Fundamentals: What is ALMA data?

uv-coverage

Distribution of
baseline differences



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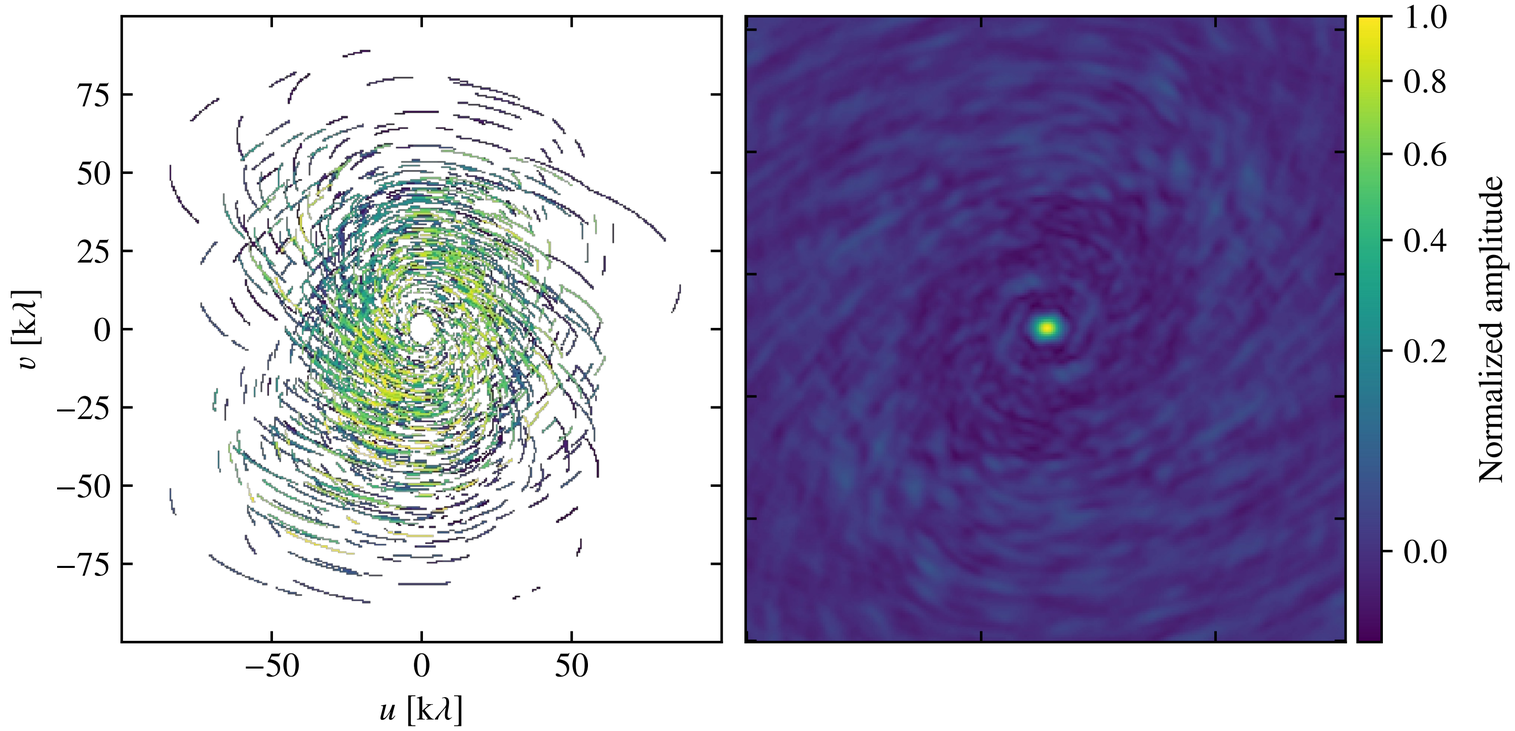


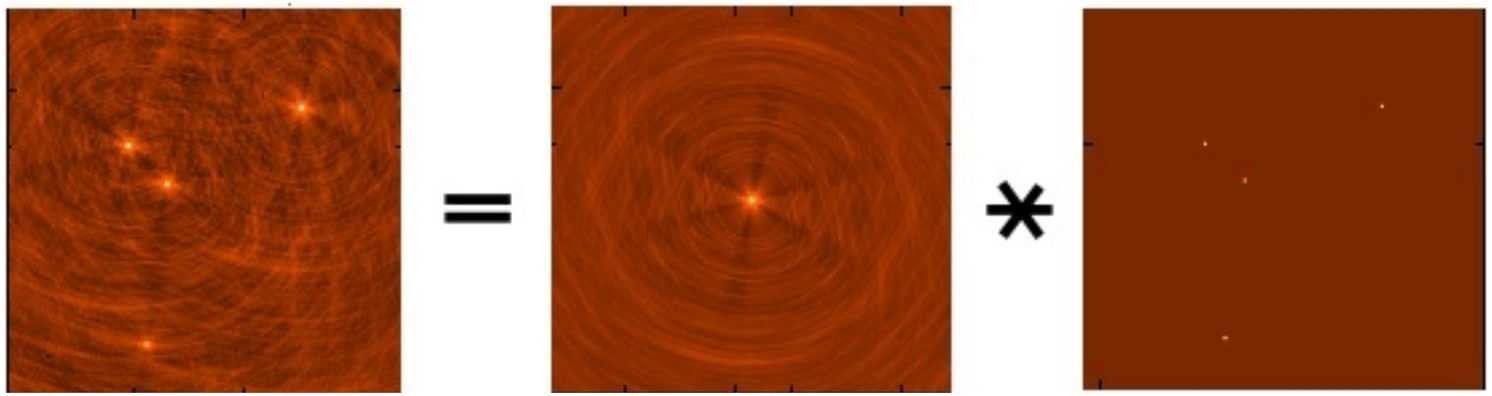
Fourier transform to get something like a PSF

How to get your intensity distribution back?

Imaging!

‘**Dirty map**’ of source brightness distribution is convolved with telescope PSF or ‘**dirty beam**’

Assumption: sources in radio sky can be **modeled** by multiple **point sources** and/or **Gaussians**



Dirty map = **Dirty beam** * **Model**

Figure from CASA Docs

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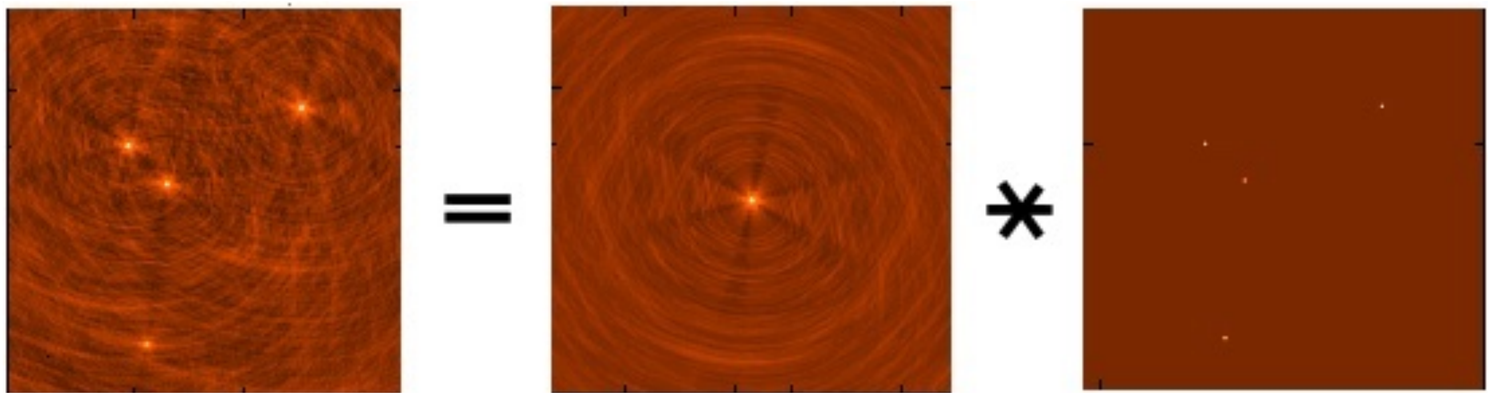

Dirty map = **Dirty beam** * **Model**

Clean **uses an iterative method to deconvolve dirty beam from dirty source brightness distribution**

Figure from CASA Docs

Synthesis Imaging

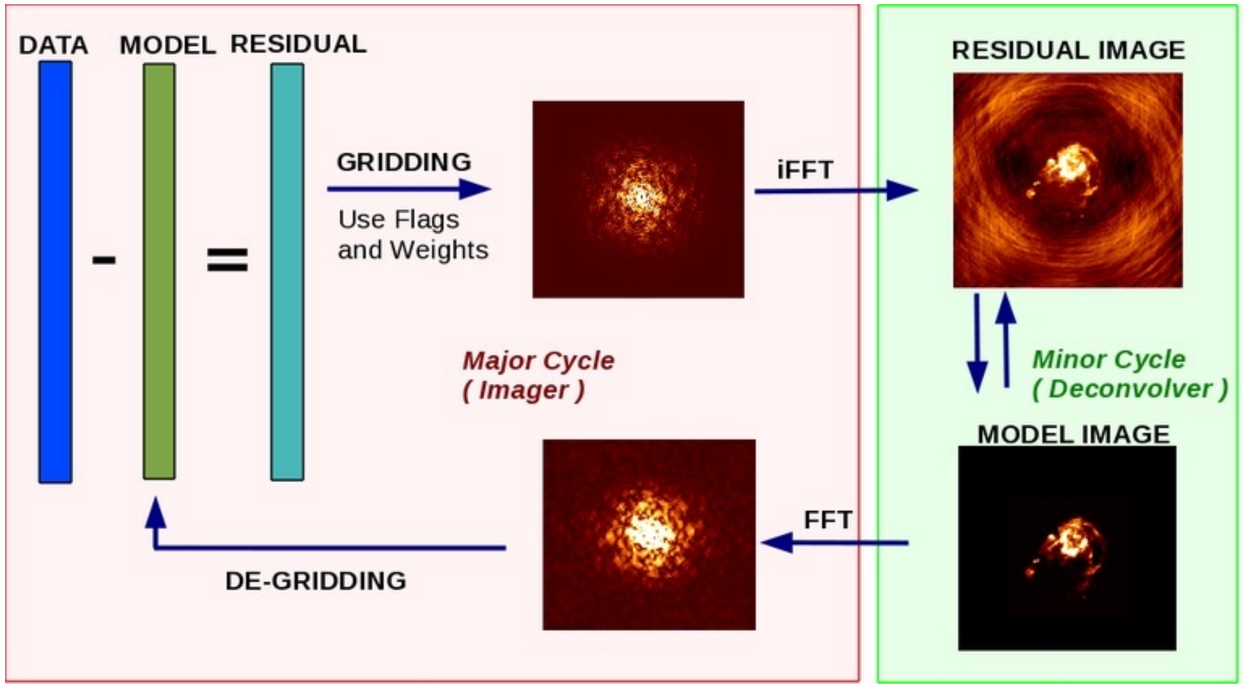

Figure from CASA Docs

Major Cycle: *visibility* frame

1. Subtract model from data to generate residual visibilities
2. Grid residual visibilities, iFFT into image frame to produce residual image

Minor Cycle: image frame

Use specified clean algorithm (e.g. Högbom, multiscale, etc.) to generate model of source

Source model components convolved with PSF and subtracted from residual image

Back to Major Cycle: *visibility* frame

3. FFT model image into *uv* frame, de-grid visibilities