Hub-Filament Structure and Star Formation in OMC-1

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Motivation

Study the structure and kinematics of OMC-1

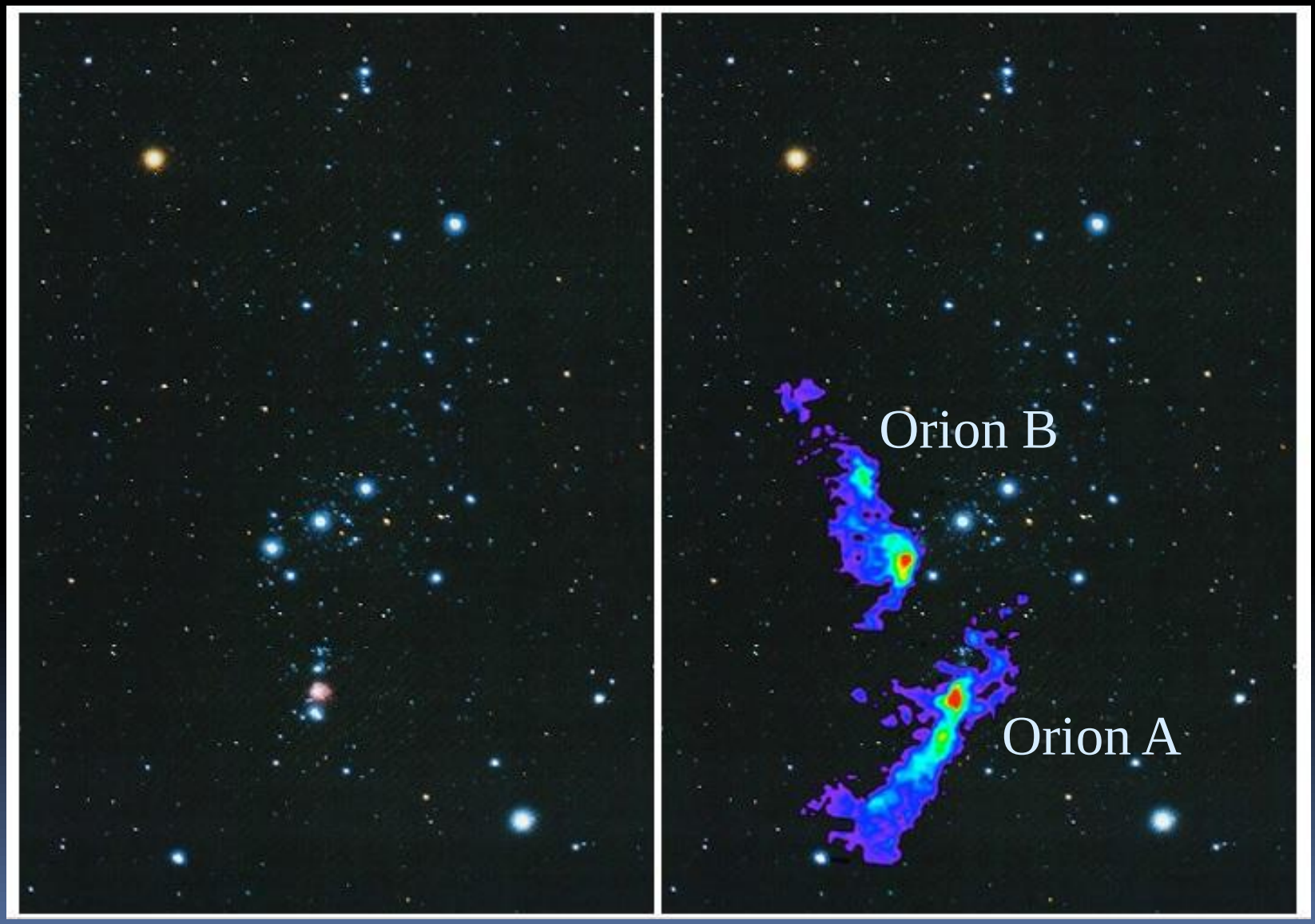
Distance: 414 pc

Nearest high mass star forming region

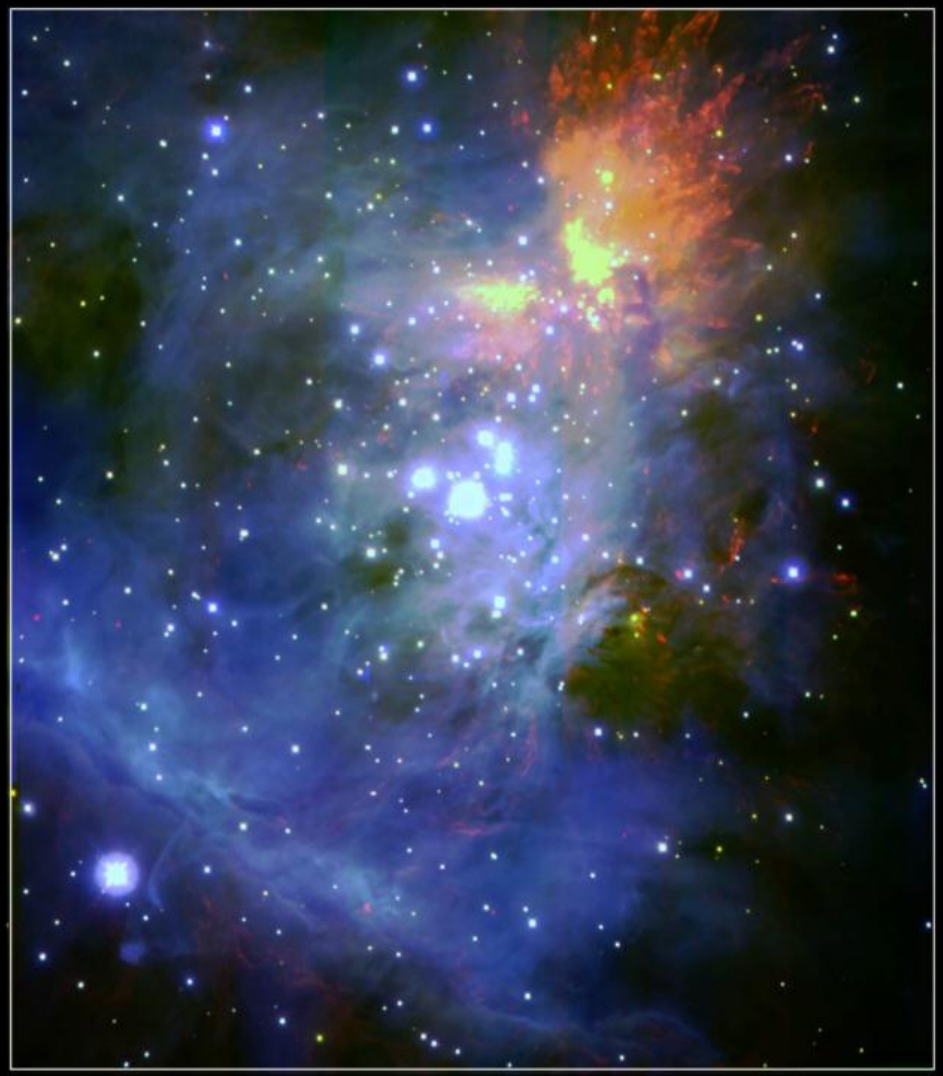
Outline

- Introduction
  - Hub-Filament Structure
- Observations
  - SMA & CSO Observations
  - Missing Flux Problem
- SMA + CSO Data Combine
  - Combine in visibilities
  - Combine in images
  - Results- Combined Maps
- Future Analysis

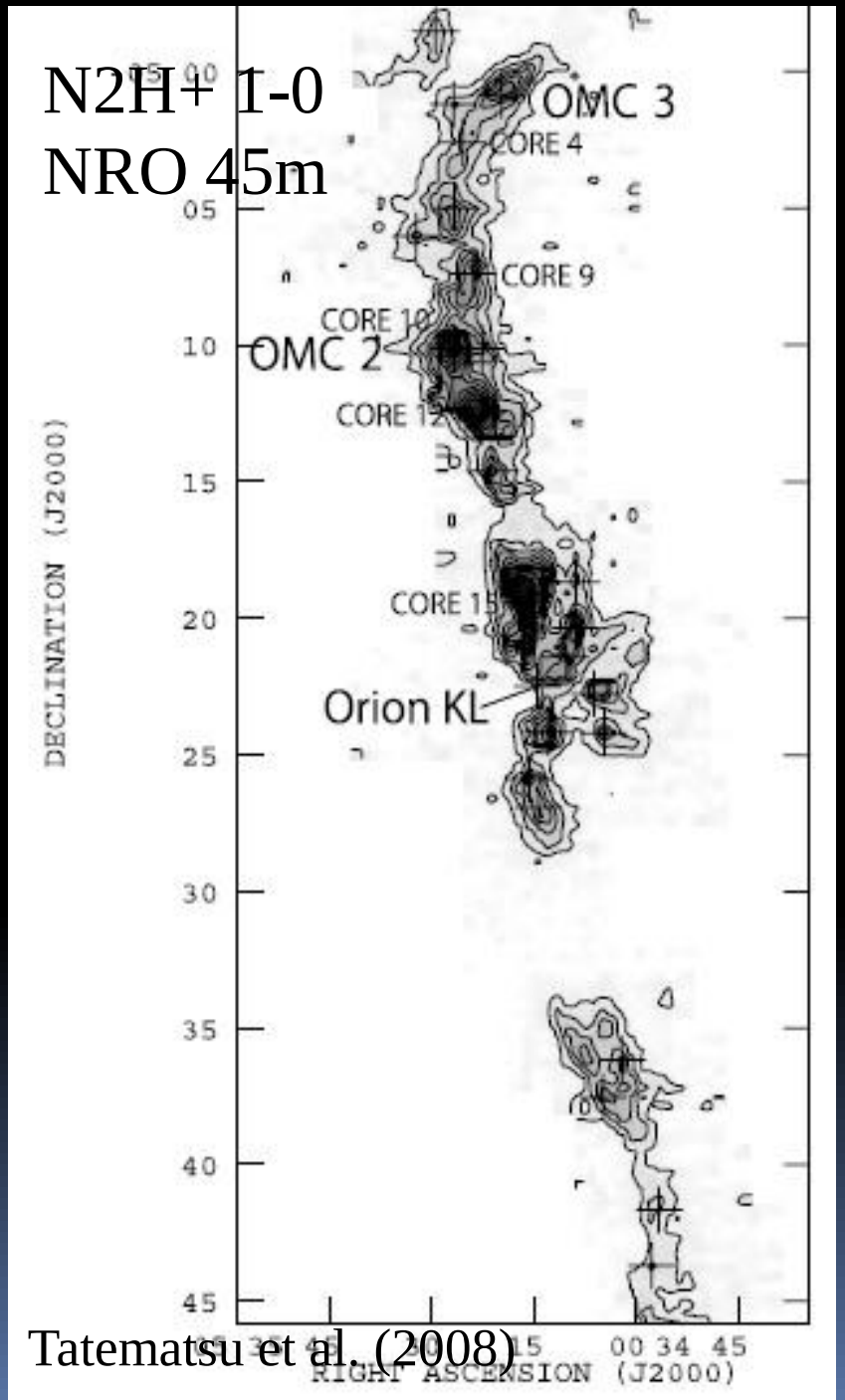
Orion in visible light & CO J=2-1(1.3mm)



Orion Molecular Cloud 1

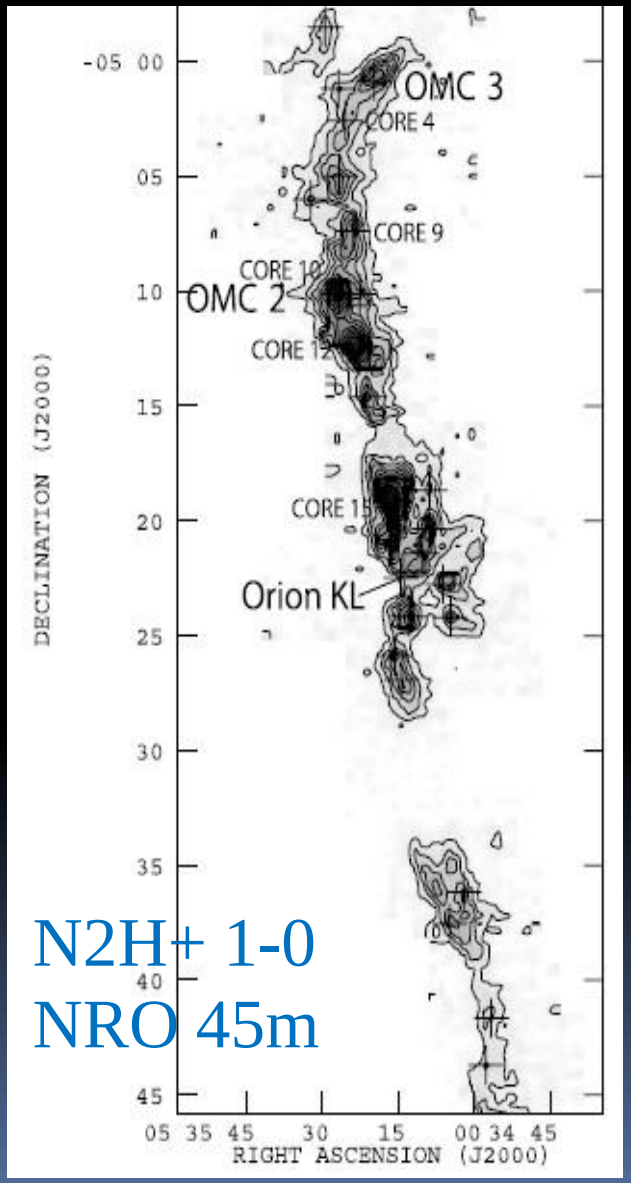


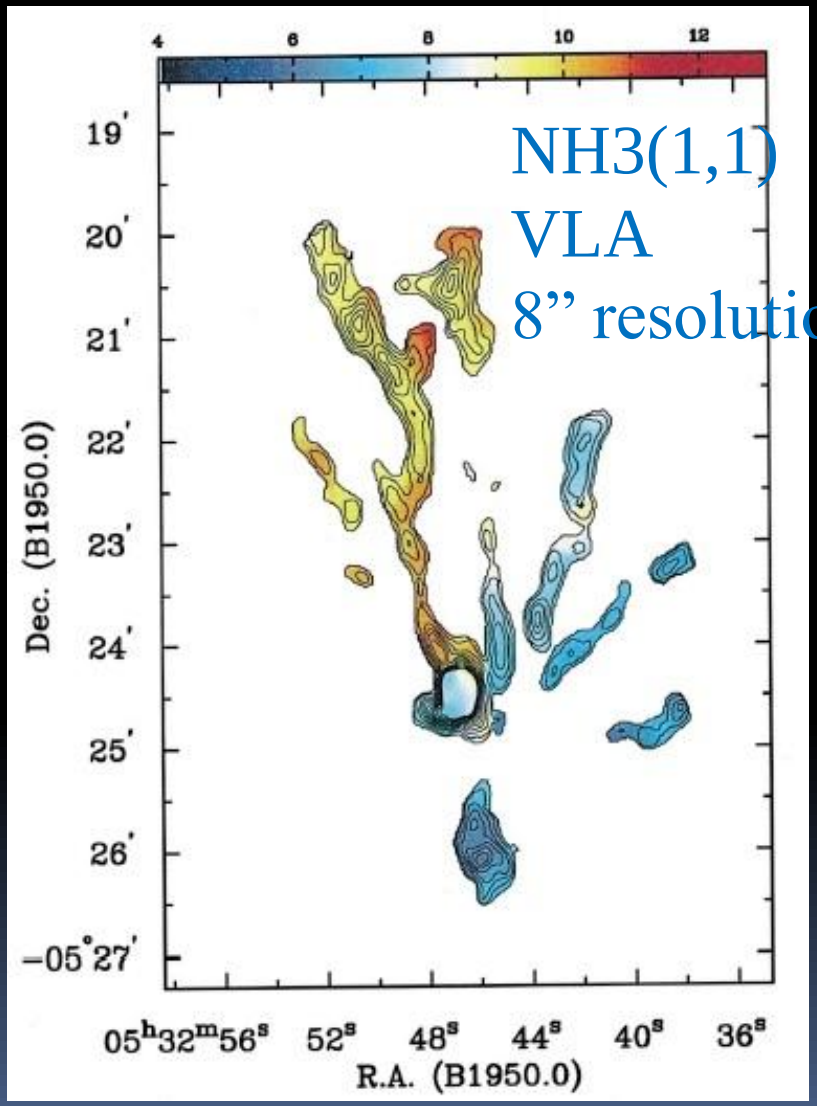
N2H+ 1-0
NRO 45m



Tatematsu et al. (2008)

Hub-Filament Structure





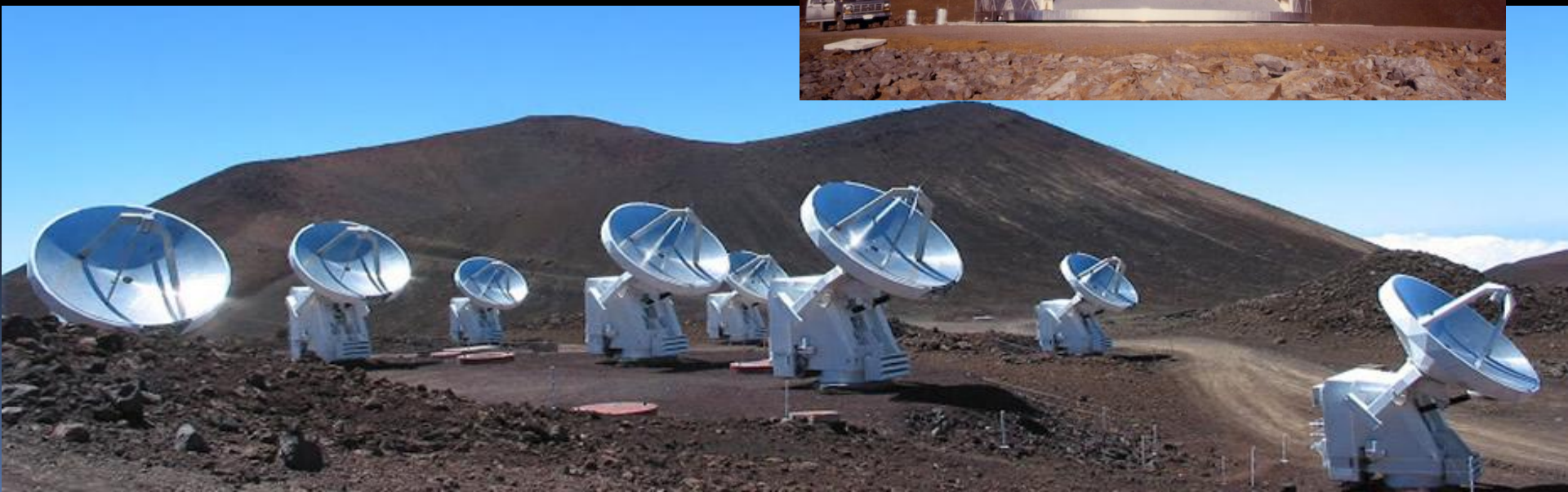
Wiseman and Ho (1997)

Observation

Submillimeter Array (SMA) + CSO telescope

Frequency: 279.5 GHz

Emission Line : N_2H^+ J:3-2
(Critical density~10^6 cm^{-3})



SMA Observation

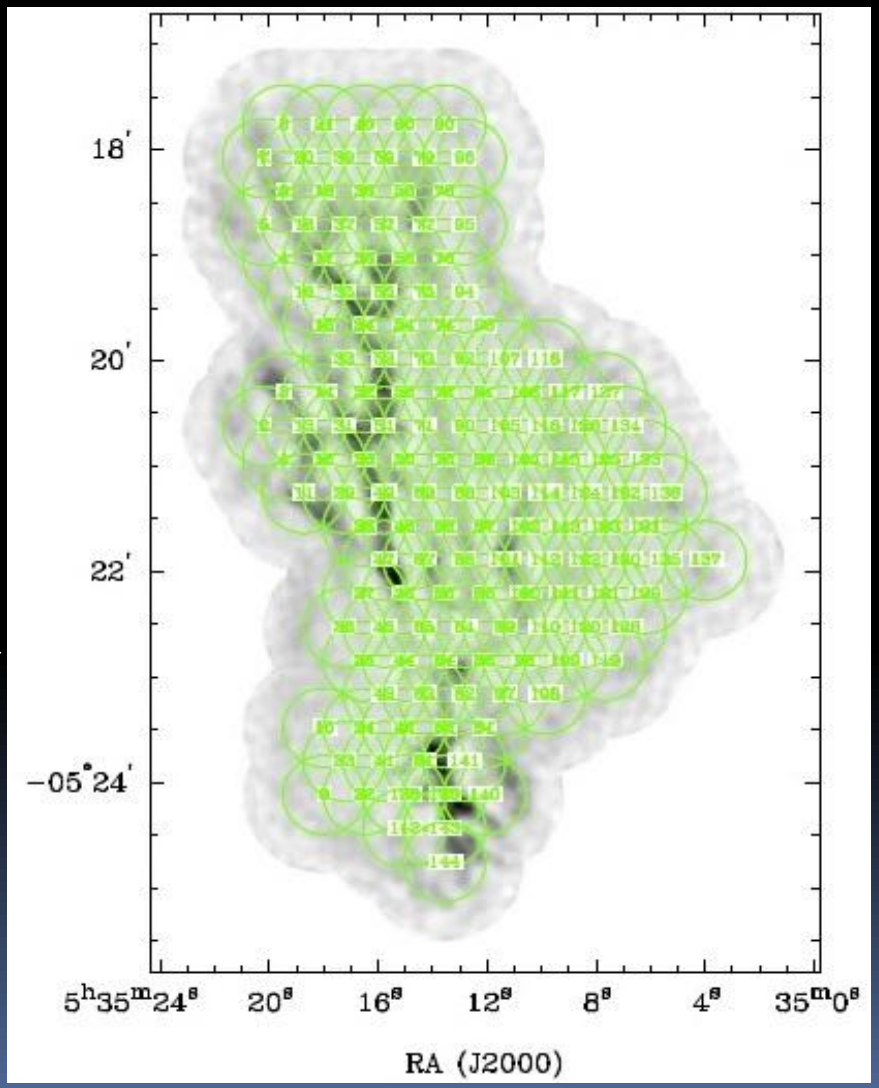
-Array configuration: Subcompact

-Primary beam (FOV): 42" (HPBW)

-Observed area: ~4' x 5'

-144 pointing mosaic

- Frequency resolution: 512 ch/chunk
  Velocity resolution ~ 0.22 km/s



CSO Observation

-Beam size: 26.8" (HPBW)

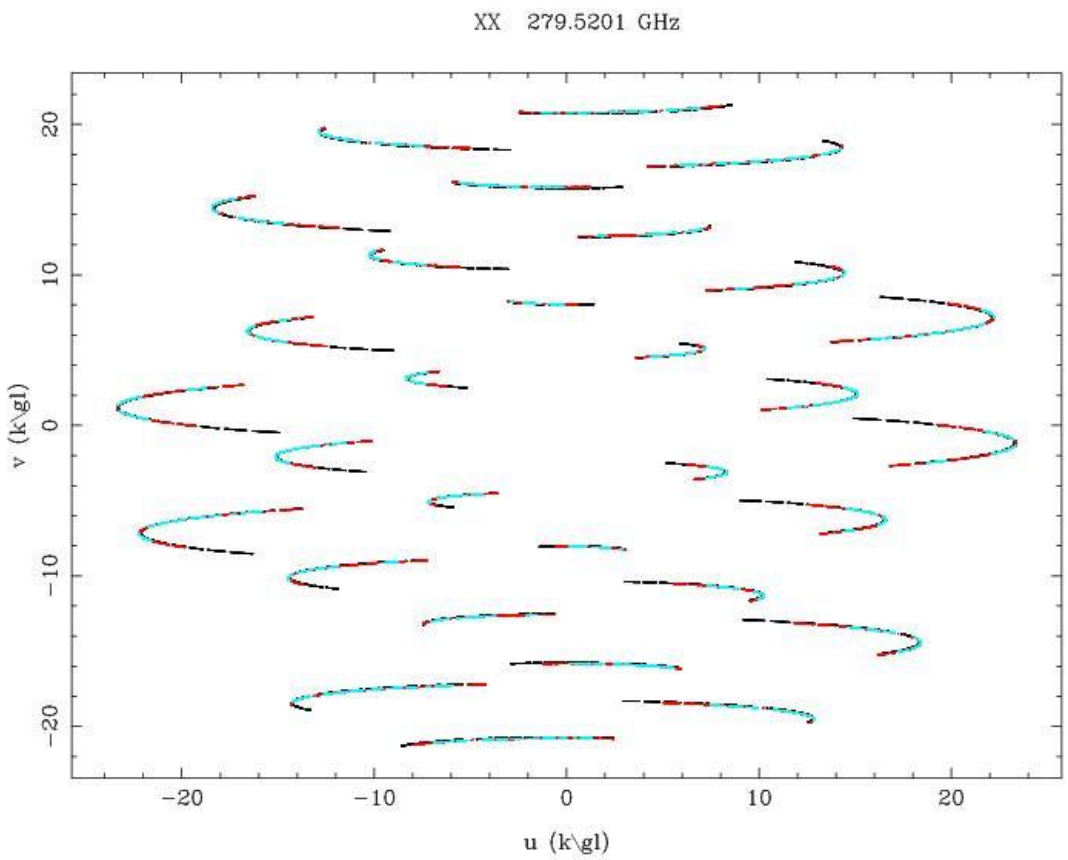
- Mapping area: 12' x 12'
  centered at R.A. = 05:35:15.0, Dec. =-5:22:06.99

-Mapping mode: On the Fly

-Frequency resolution: 61 kHz

-Velocity resolution ~ 0.065 km/s

UV Coverage & Missing Flux Problem

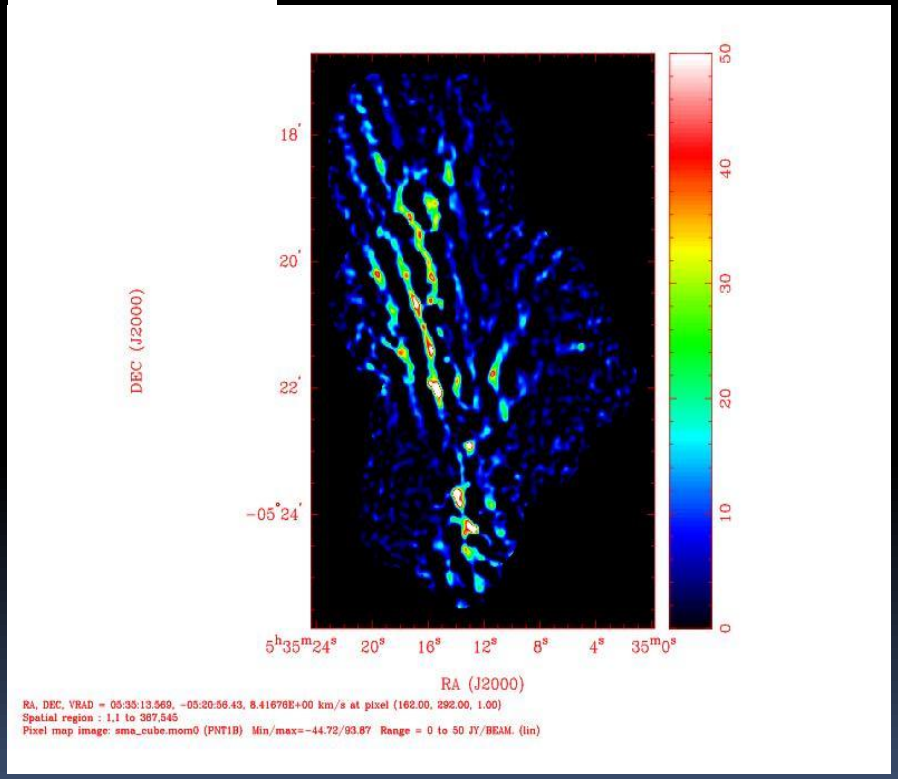


Limited uv-coverage

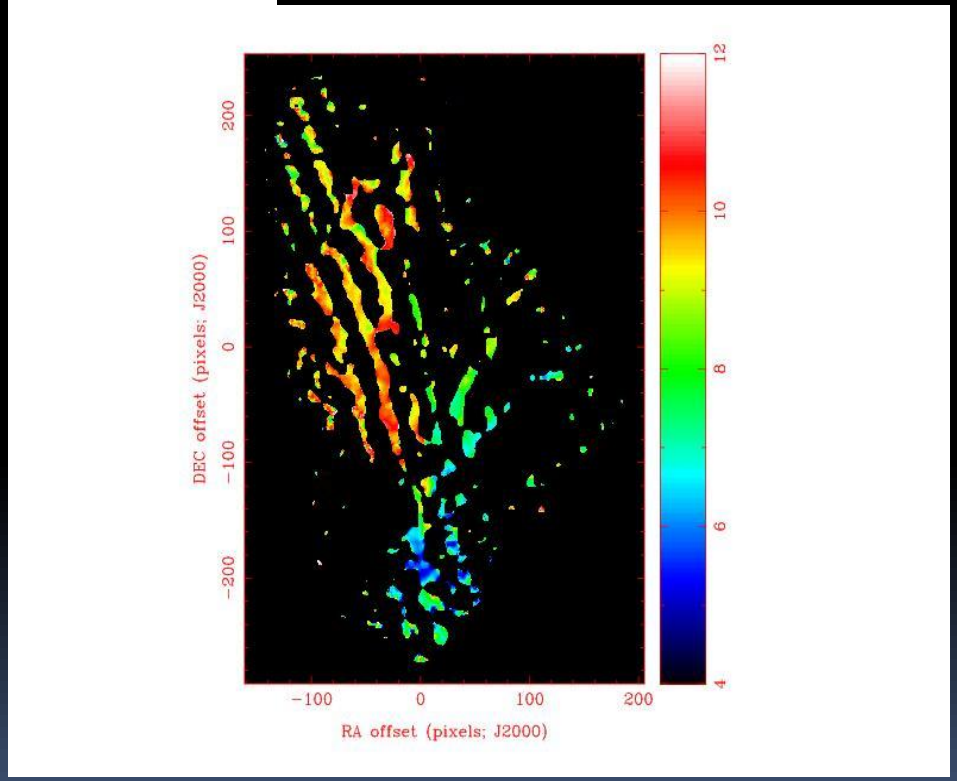
Extended feature?

SMA Results

Moment 0



Moment 1

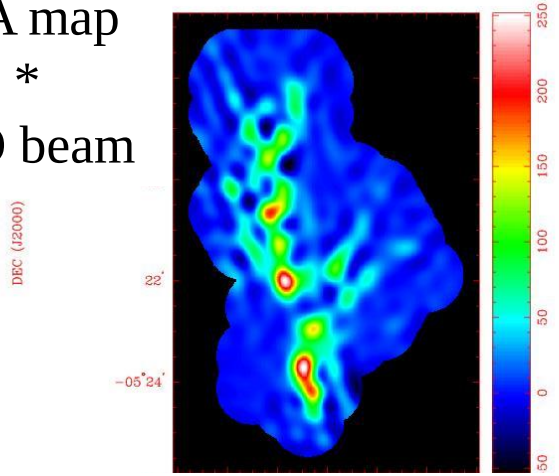


Missing flux ratio between SMA & CSO

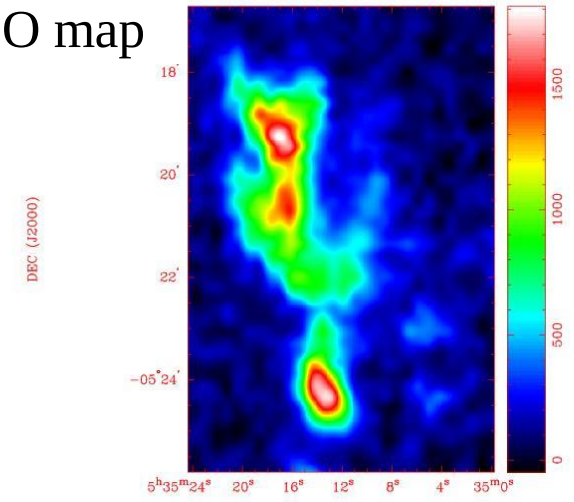
SMA map

*

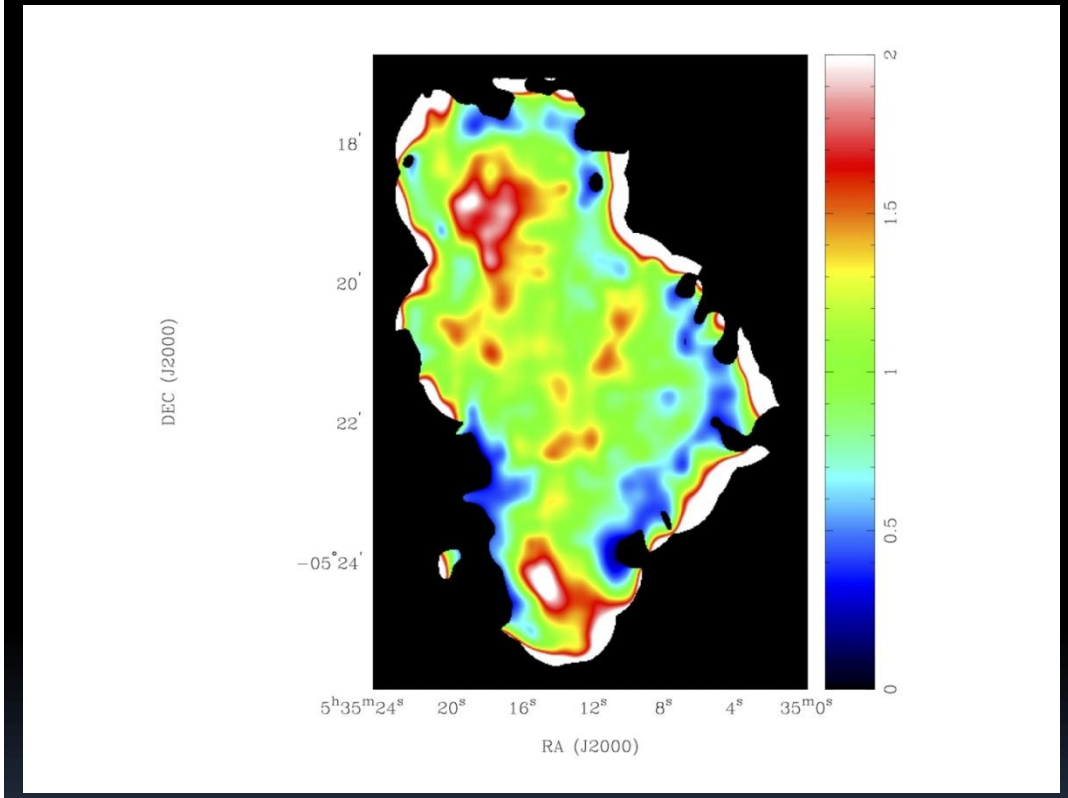
CSO beam



CSO map



RA, DEC, VRAD = 05:35:13.569, -05:20:56.43, 7.20660E+00 km/s at pixel (162.00, 292.00, 1.00)
Spatial region : 1.1 to 387.545
Pixel map image: CSO_sel_regrid.mom0 (OMC1) Min/max=-47.79/1812 Range = -47.79 to 1812 JY/BEAM. (lin)



Missing flux ~50%

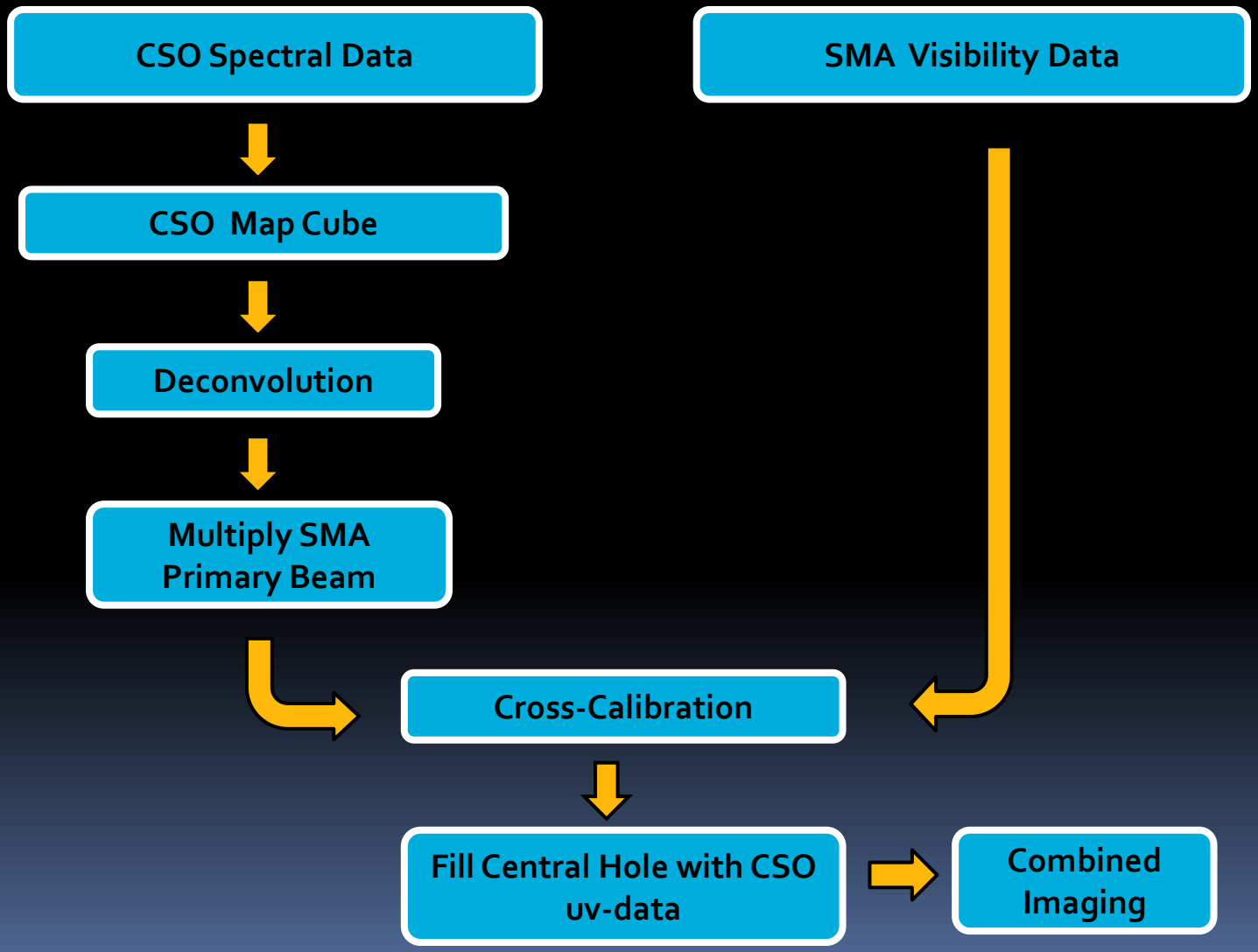
Single Dish + Interferometer

- Use Miriad v.4.3.8

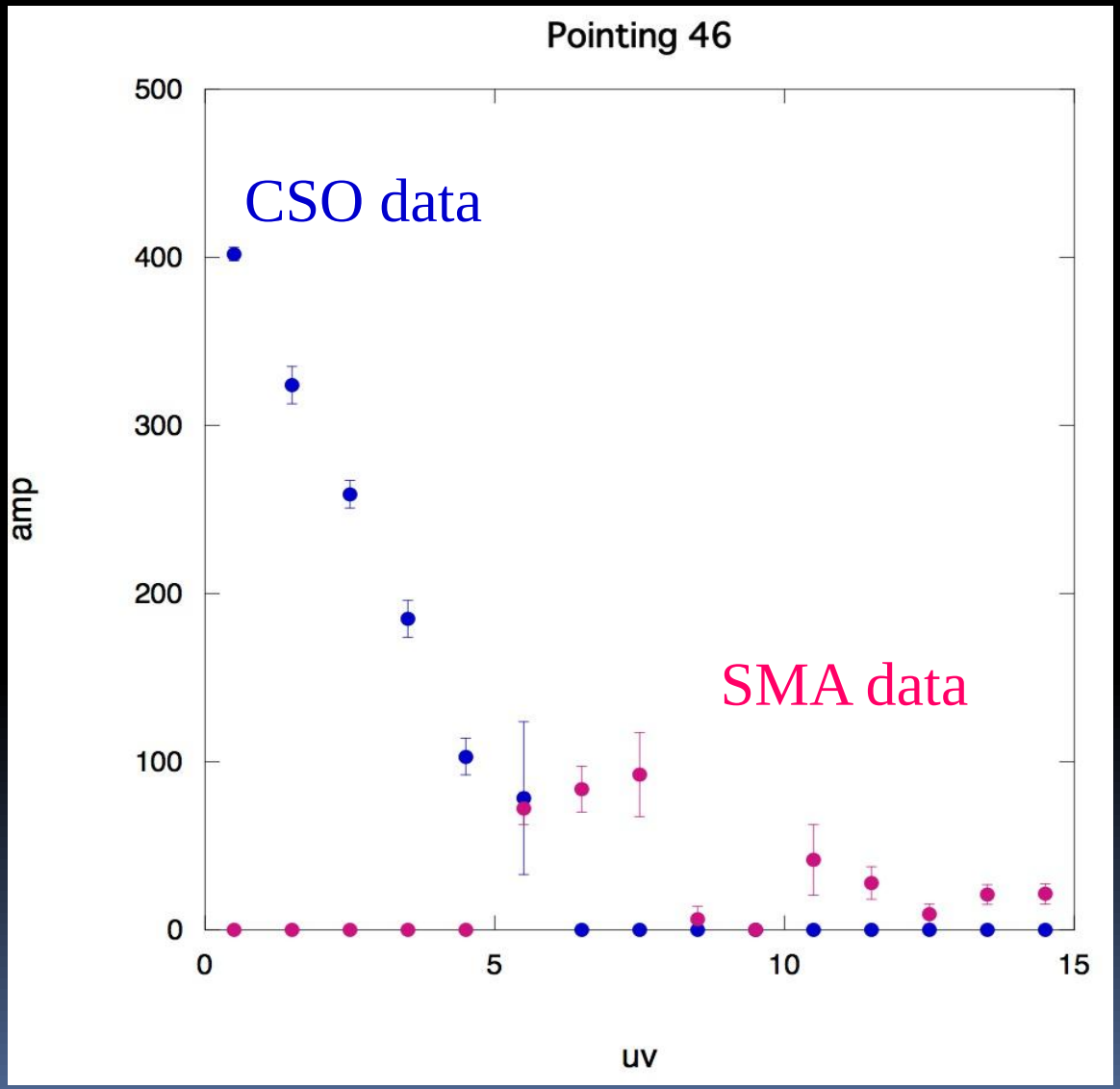
- Method 1 - Combine the visibilities
    1. Make the visibility data from the CSO image and fill the central uv hole
    2. The SMA and CSO visibility data are combined and inverse-Fourier transformed

- Method 2 - Combine the images
    1. The SMA and CSO images are combined using the task "immerge"
    2. The input SMA image should be the "clean map"

Method 1 - Flow Chart of Combining Process

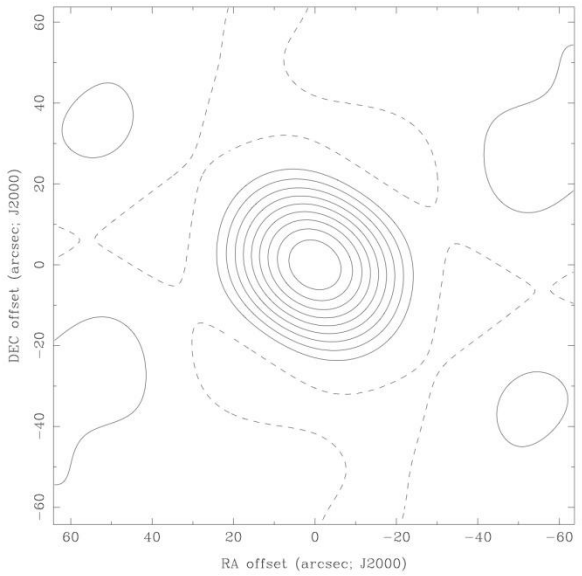


Cross Calibration

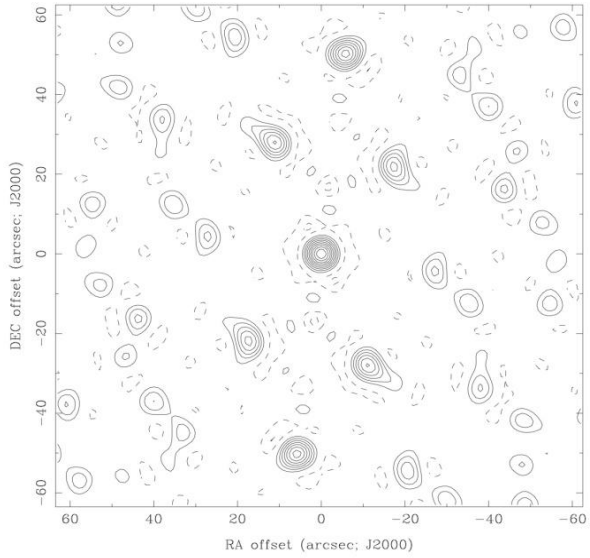


Beam maps

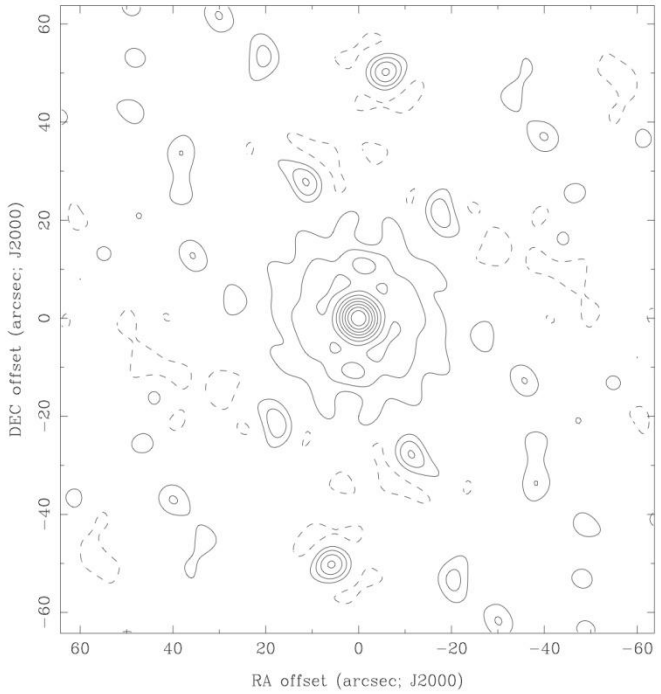
CSO beam



SMA beam

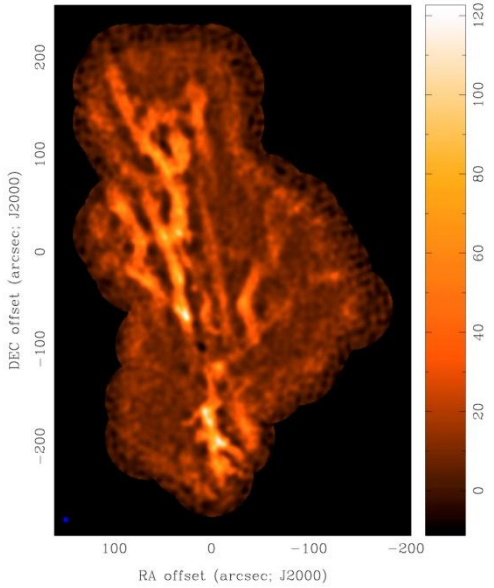


Combined beam

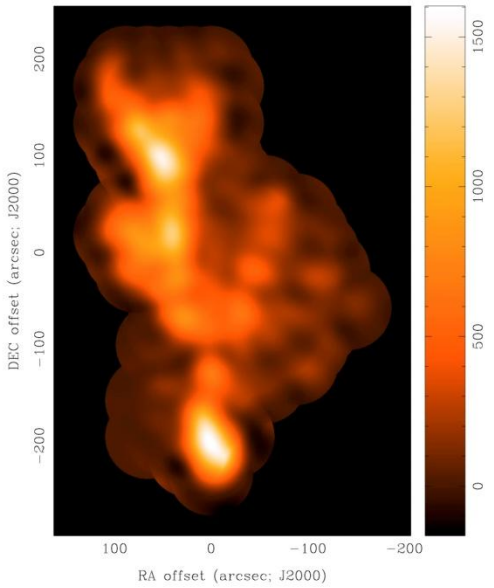


Moment 0 maps

SMA map beam size:5.53”x5.25”

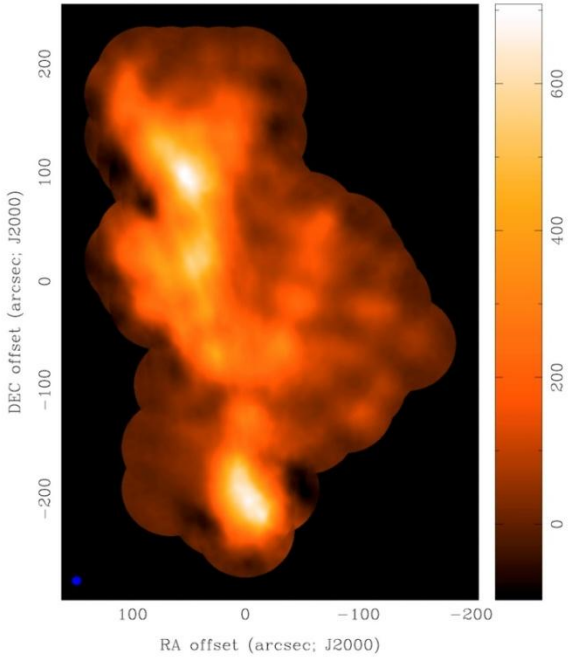


CSO map beam size:26.8”x26.8”



$$M_0 = \int I(v)dv$$

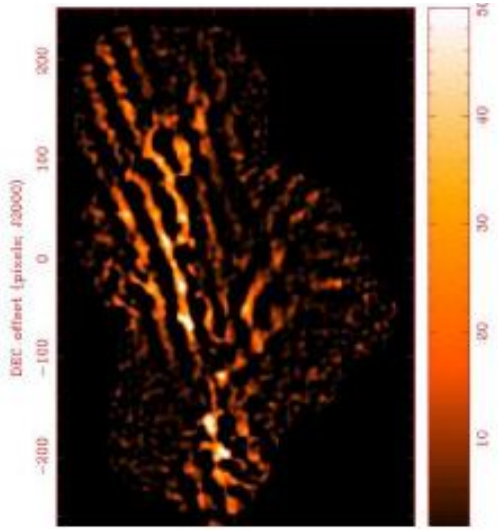
Combined map beam size:8.2”x7.9”

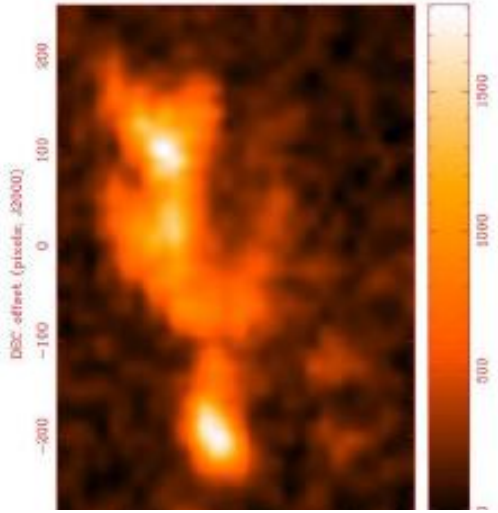


Method 2 – Combine in Images

moment 0 maps

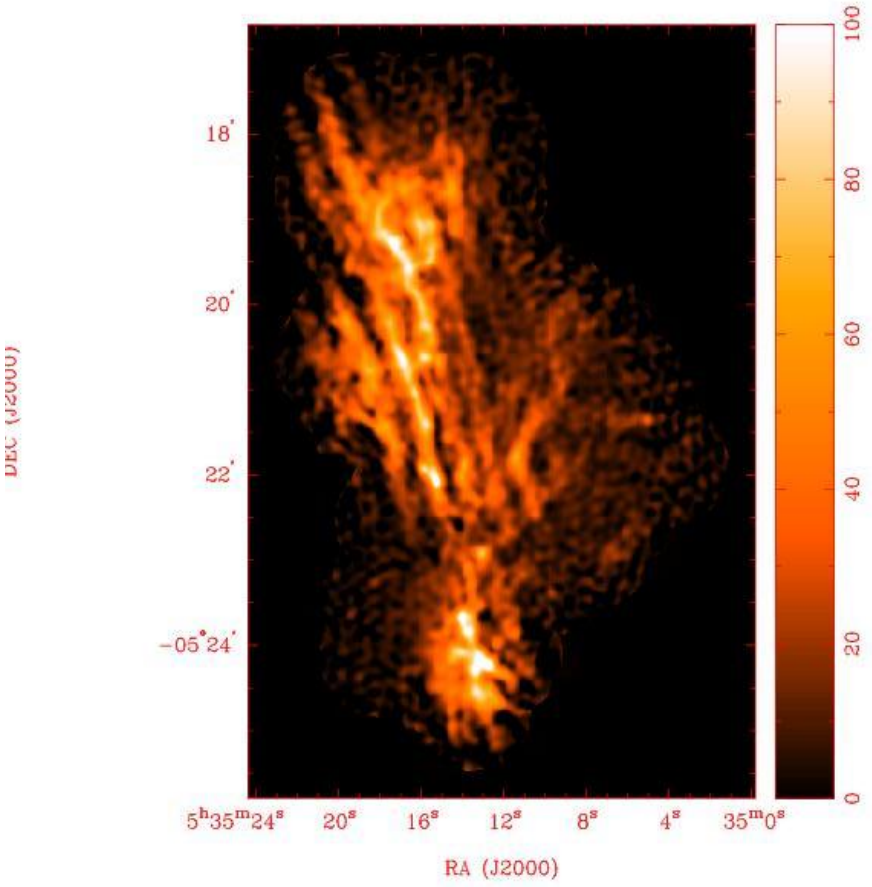
SMA map beam size:5.53”x5.25”





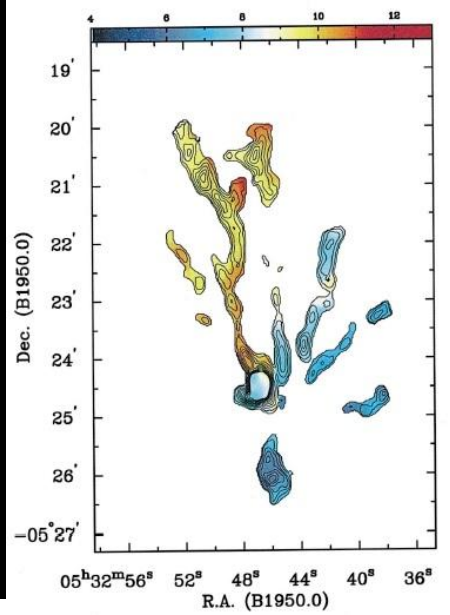
CSO map beam size:26.8”x26.8”

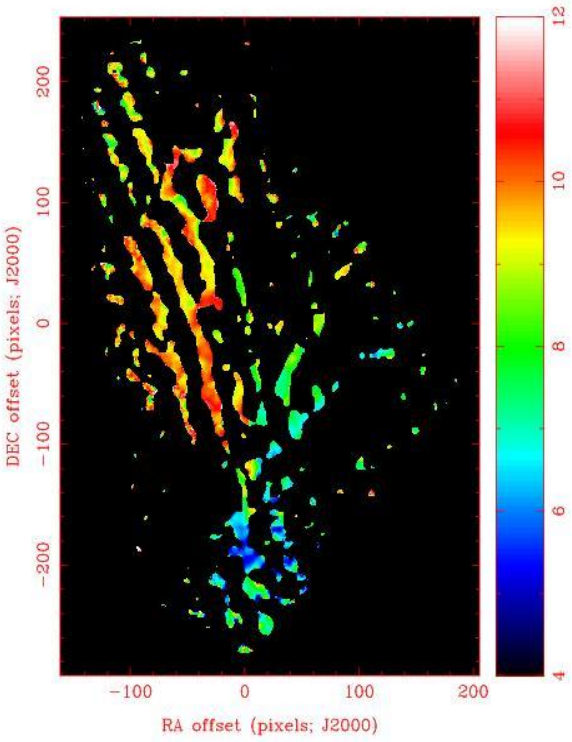
Combined map beam size:5.53”x5.25”

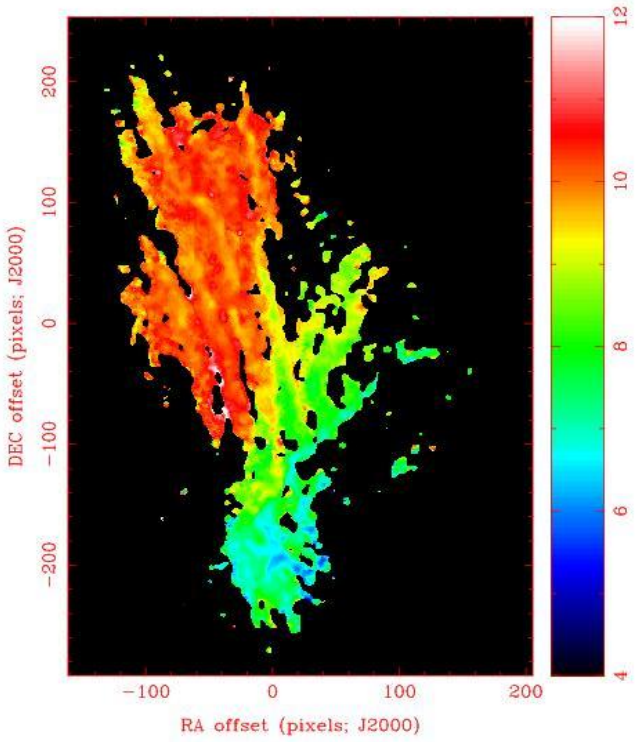


Moment 1 maps

$$M_1 = \frac{\int I(v) v dv}{\int I(v) dv}$$

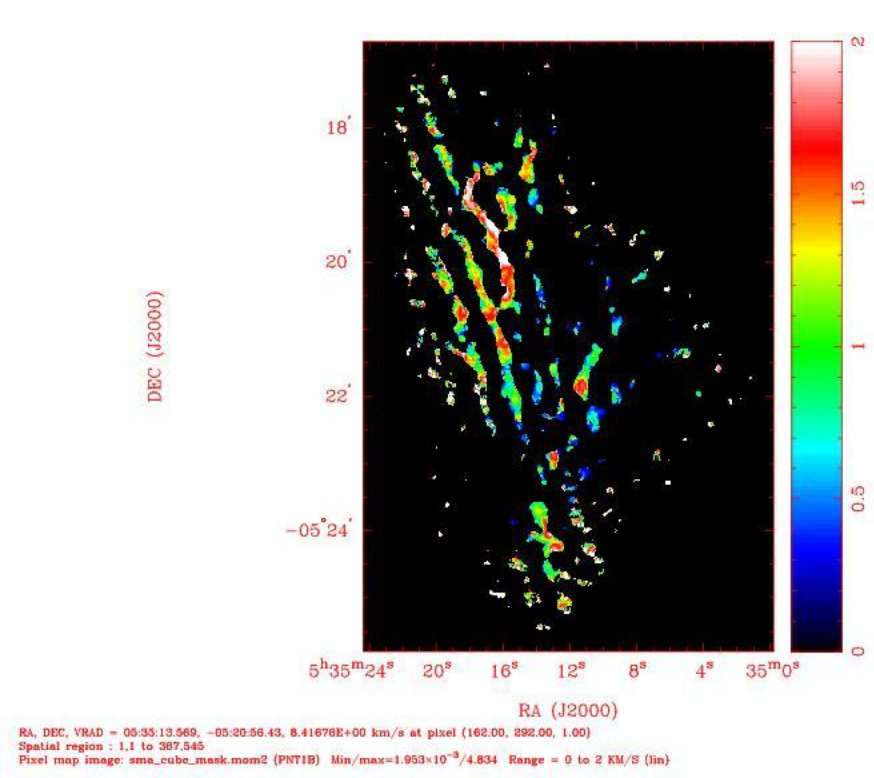


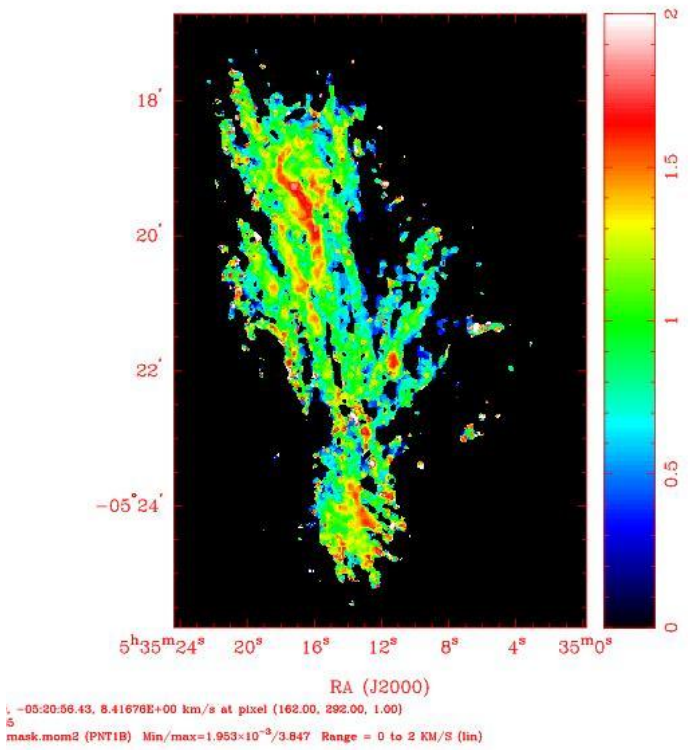




Moment 2 maps

$$M_2 = \sqrt{\frac{\int I(v)(v - M_1)^2 dv}{\int I(v) dv}}$$





Future

- Optimize the parameter for uv-combine
- Analyze the internal structure and kinetics of filaments
  - Velocity patterns
- Compare with other emission lines
  - NH_3
  - HCO+ 3-2
  - HCN 3-2

Thank you for your attention

Combined Moment0 map * CSO beam