

The Studies for NGC 1808 and NGC 4321 using the ALMA Observation

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1. Introduction

- The observational studies with high resolution are rare in center region of galaxies, but ALMA can see the substructures
- Molecular gas clouds are highly correlated with star-formation .
- Here we study the molecular gas distribution and kinematics of NGC 1808 and NGC 4321 using $^{12}\text{CO}(1-0)$ from ALMA observations.

2. Objects & Observations

NGC 1808

RA : 05h07m42.34s

Dec : -37d30m47.0s

Redshift : 0.00332 +/- 0.00001

Systematic velocity (LSR) :

995.011307 +/- 3.897302

Position angle : -82.9 deg

Inclination : 82.7 deg

Morphological type : (R)SAB(s)a

Activity : H II, Seyfert 2

NGC 4321

RA : 12h22m54.831s

Dec : +15d49m18.54s

Distance : 0.00524 +/- 0.00000

Systematic velocity (LSR) :

1570.912700 +/- 0.899378

Position angle : 40.18 deg

Inclination : 24 deg

Morphological type : SAB(s)bc

Activity : H II, Liner, SB

2. Objects & Observations

NGC 1808

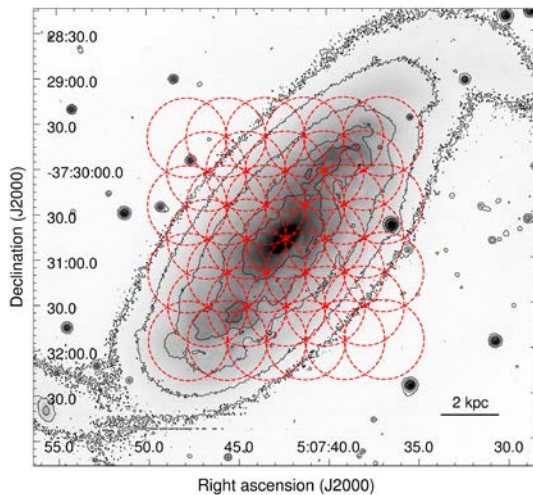
ALMA 12m Array

of Antennas : 27

Primary Beam FWHM = 52"

($\lambda = 2.7mm$)

Total time : 46 minutes



Salak+2016

NGC 4321

ALMA 12m Array

of Antennas : 42

Primary Beam FWHM = 52"

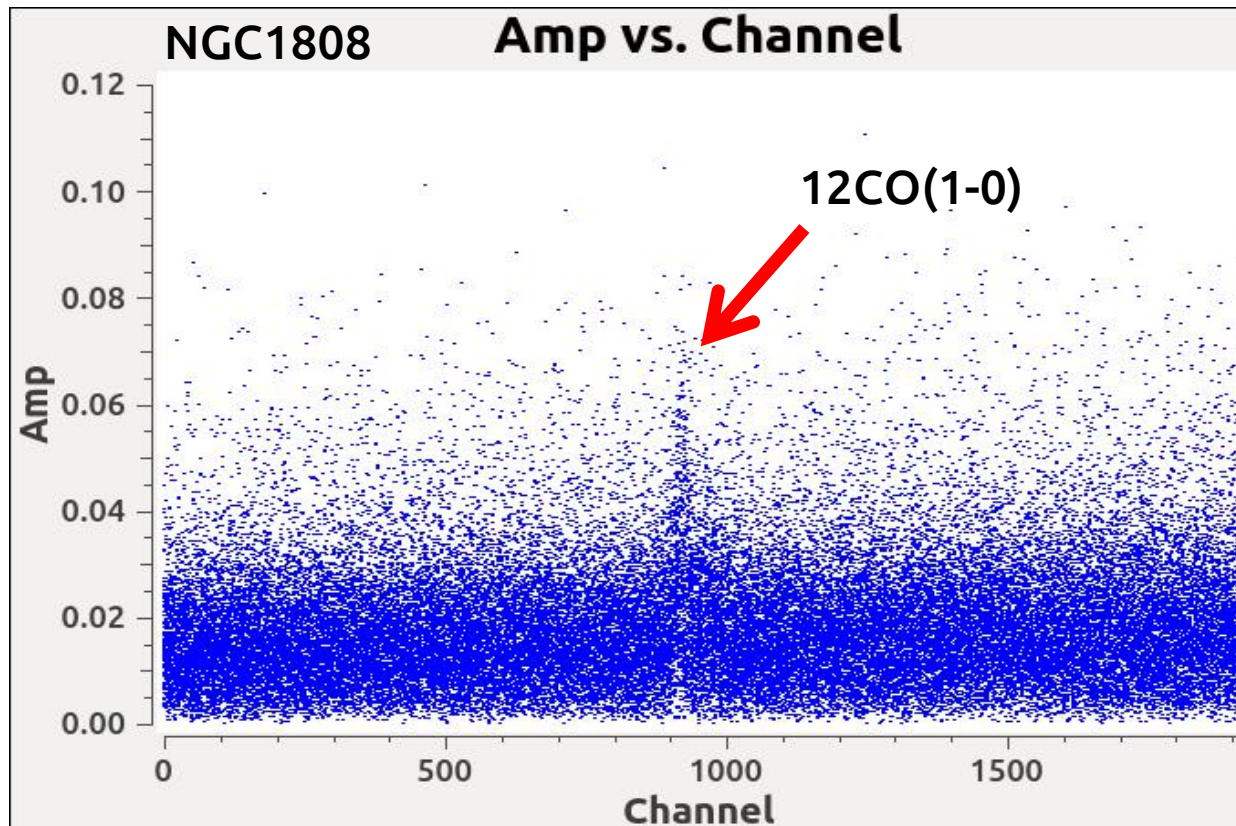
($\lambda = 2.7mm$)

Total time : 33 minutes

Imaging

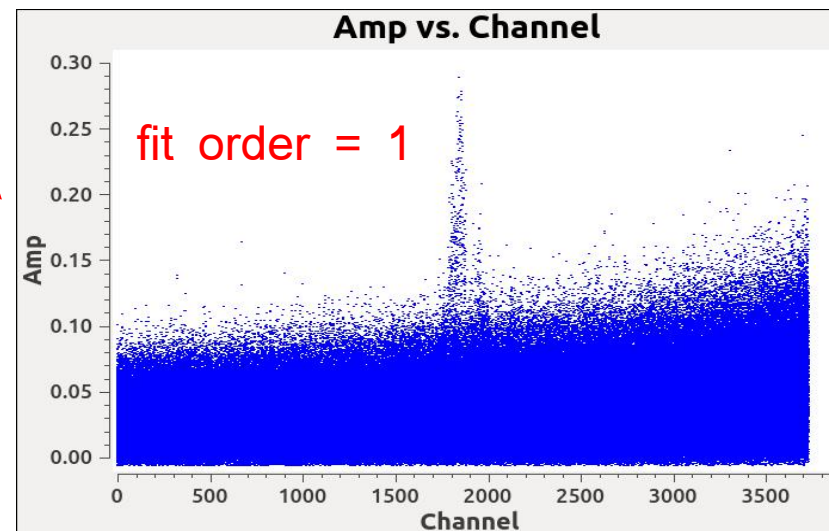
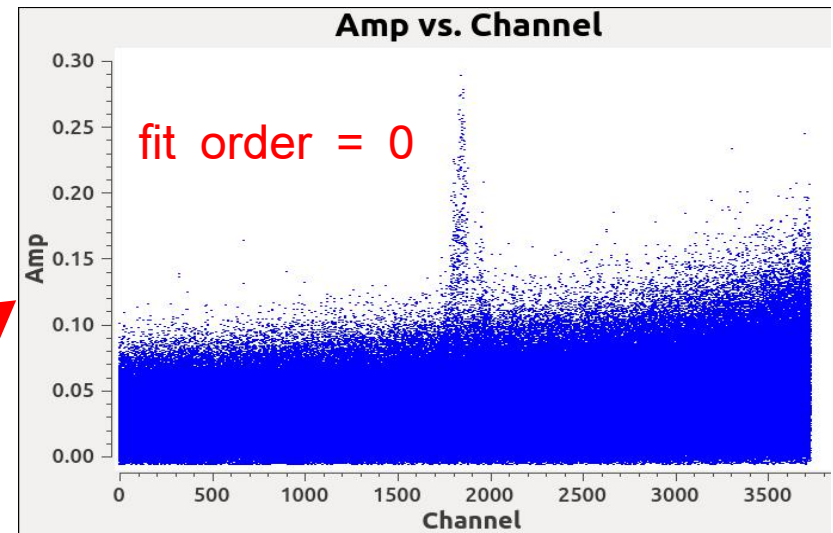
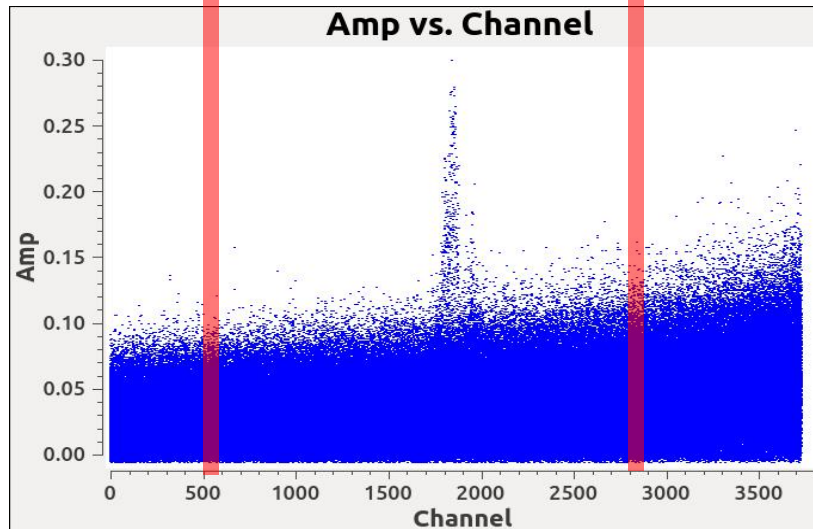
Band 3 data

Goal : get "clean" CO(1-0) spectral line from the data



Continuum subtraction

fit spw = 500~600, 2800~2900



No significant difference

Dirty map

important input parameters


- start, **width**, nchan, cell, imsize
- weighting = 'Natural' / 'Uniform' / 'Briggs'
 - **Natural**: more weight to short baselines, show large scale distribution
 - **Uniform**: more weight to long baselines, show small scale distribution
 - **Briggs**: between Natural and Uniform (robust = 0.5)

Dirty map

important input parameters

- start, **width**, nchan, cell, imsize
- weighting = 'Natural' / 'Uniform' / 'Briggs'

Natural

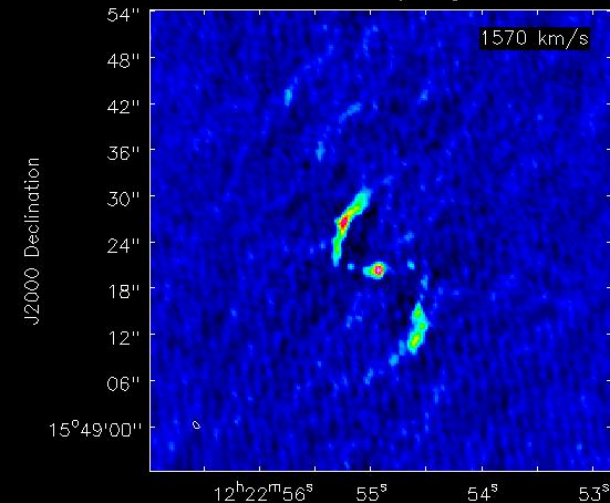
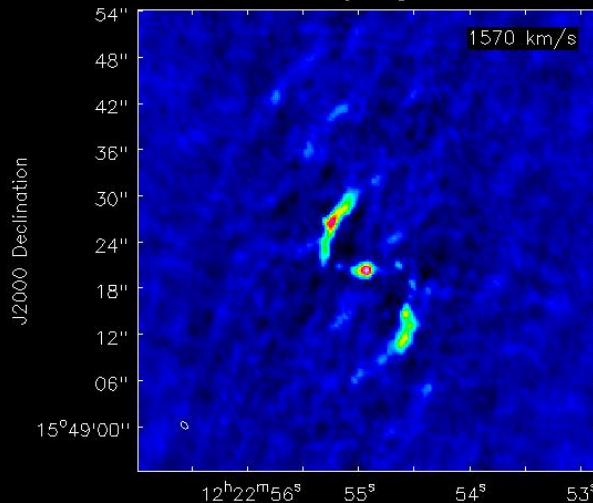
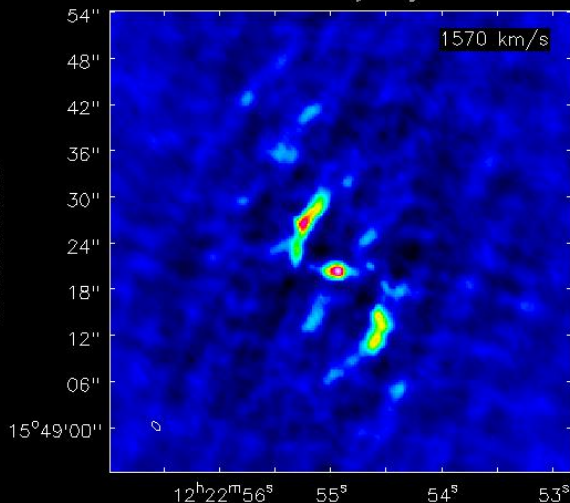
Briggs (robust) 

Uniform

n4321_natural.dirty.image-raster

n4321_dirty.image-raster

n4321_uniform.dirty.image-raster



Beam size **1.38"x0.77"**

>

1.17"x0.67"

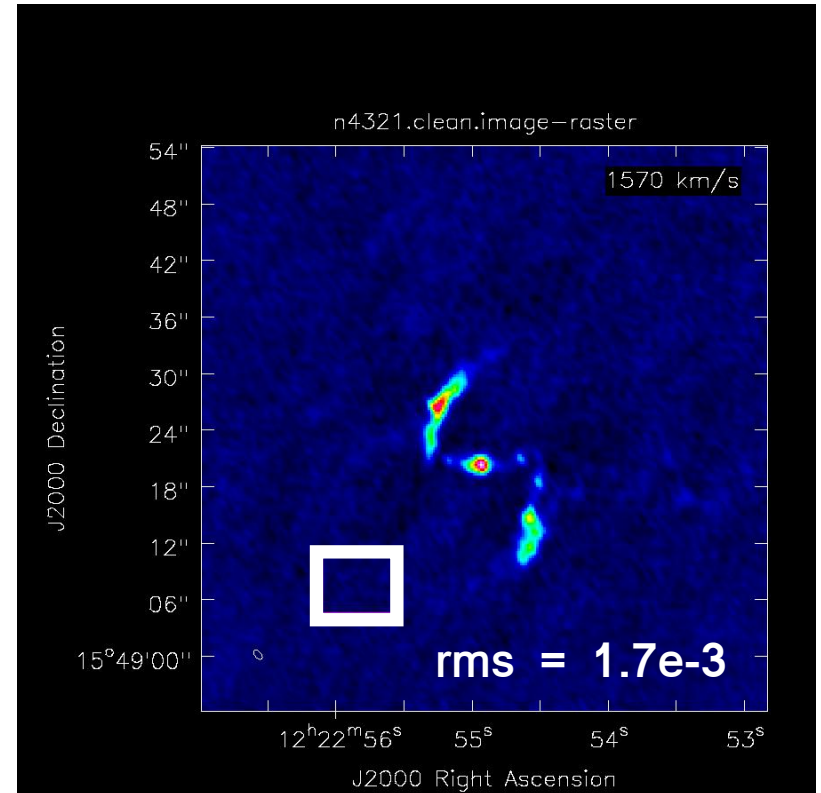
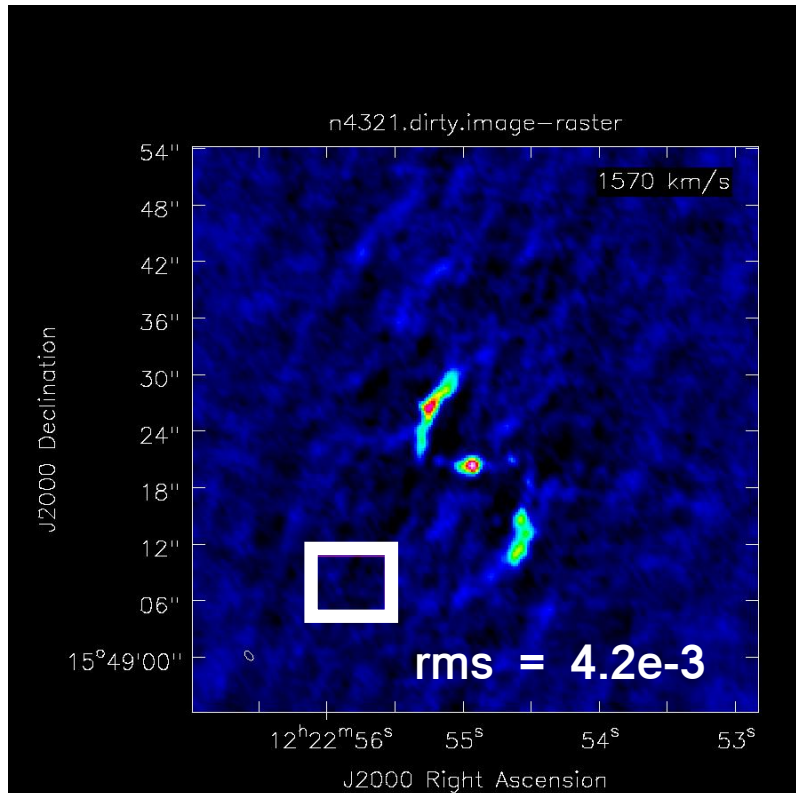
>

1.07"x0.62"

Clean map (Auto)

important input parameters

- threshold : 2 x proposed rms

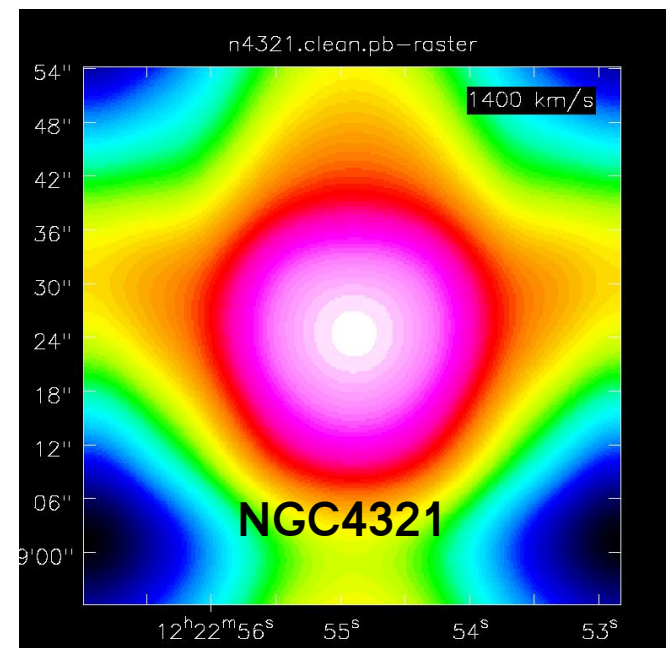
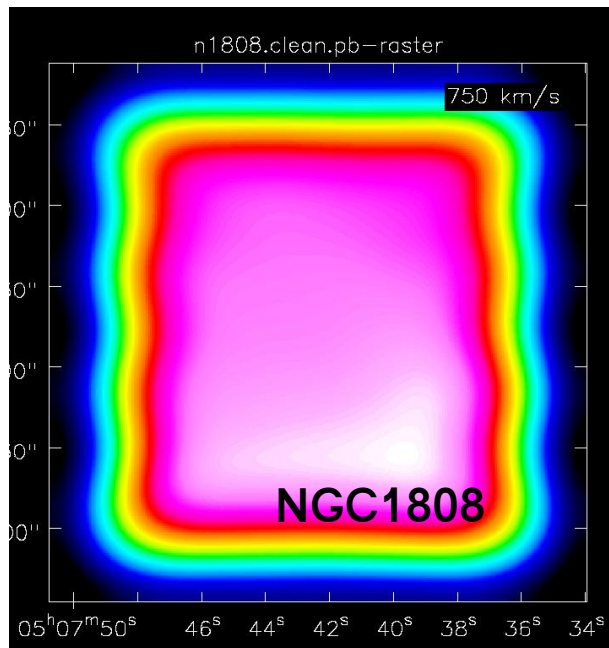


Primary beam correction

Observed images are weighted by the primary beam sensitivity

$$S(u, v)V(u, v) \Rightarrow B_D(l, m) * [A(l, m)I(l, m)]$$

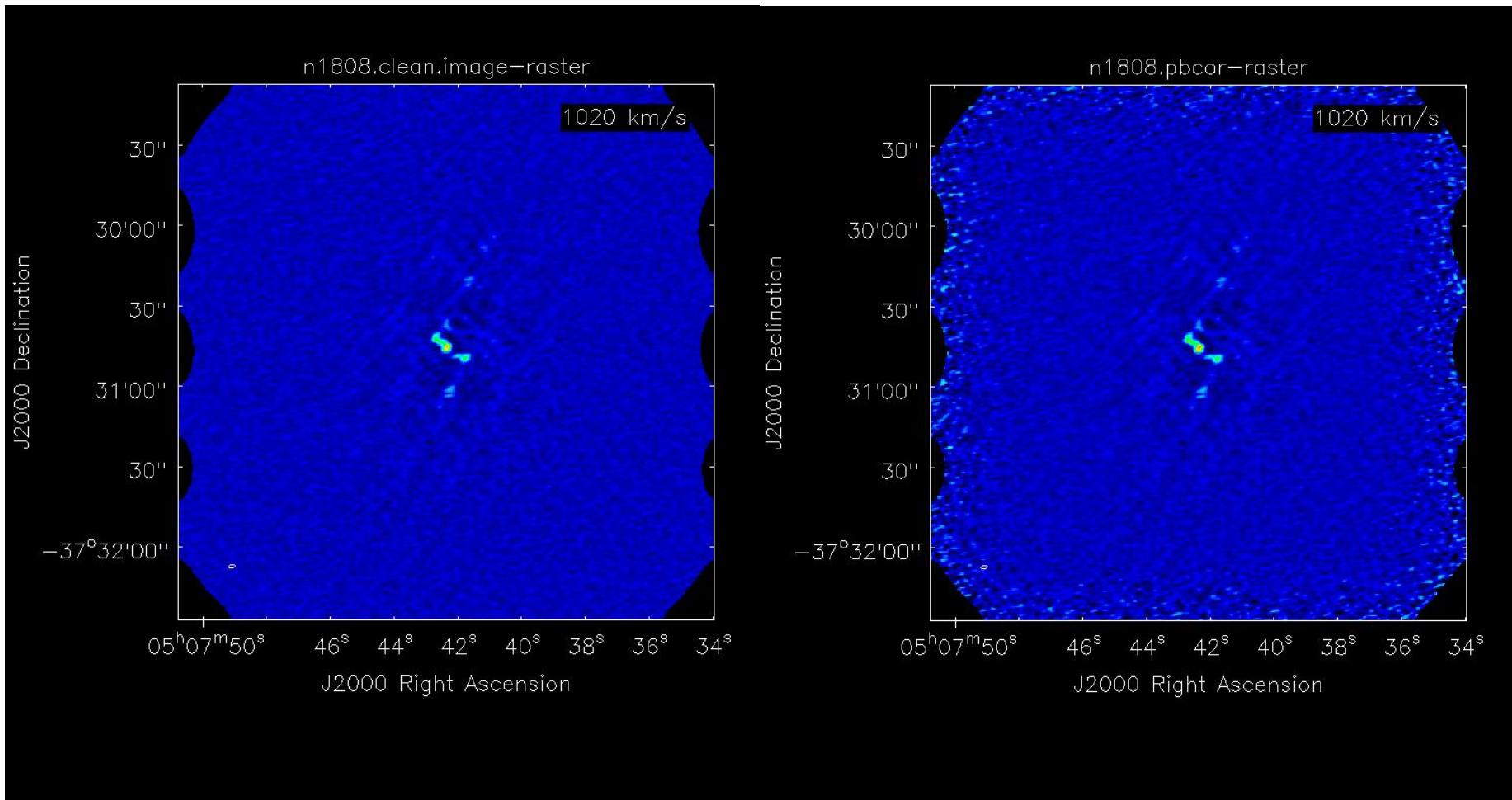
Divide the primary beam to get the expected brightness



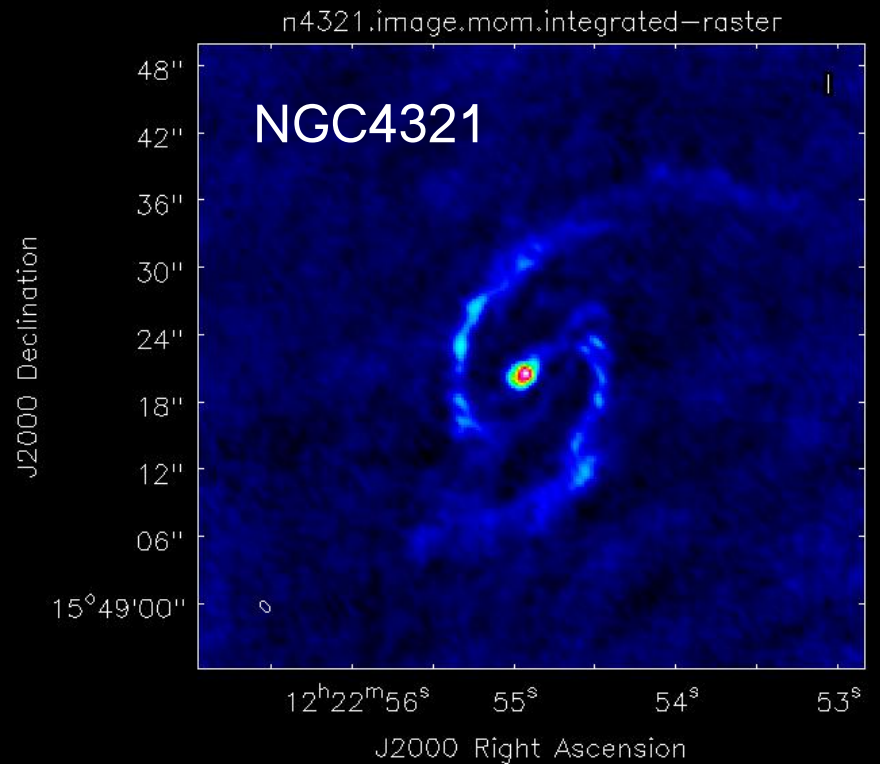
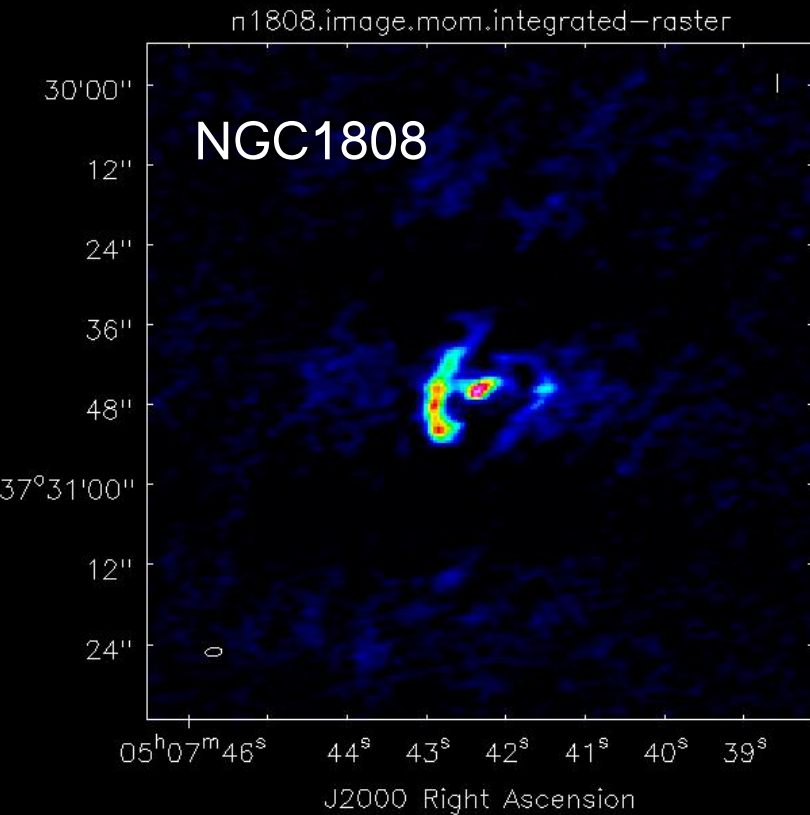
Primary beam correction

Clean image

pb corrected



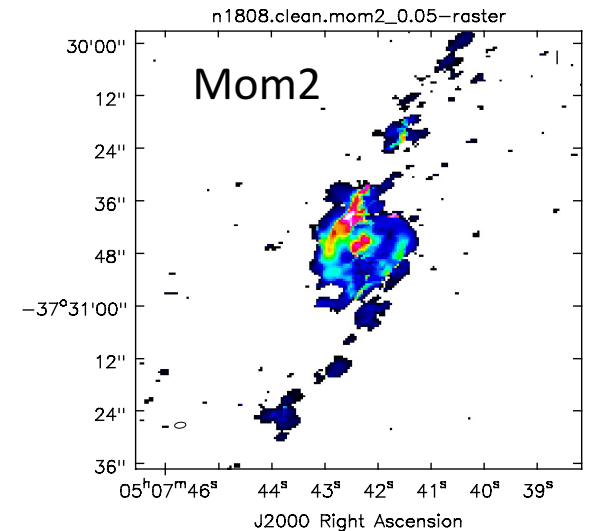
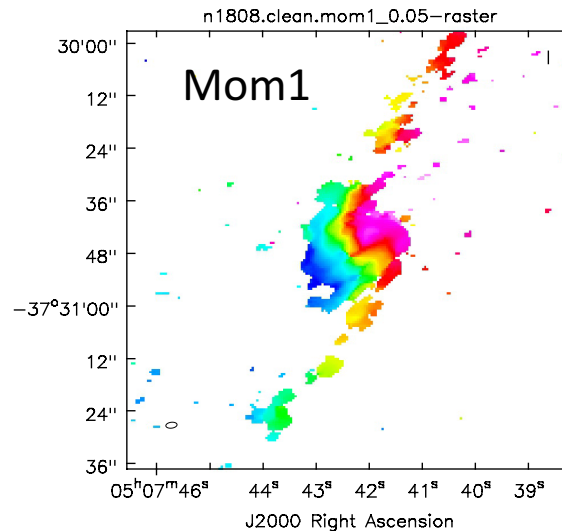
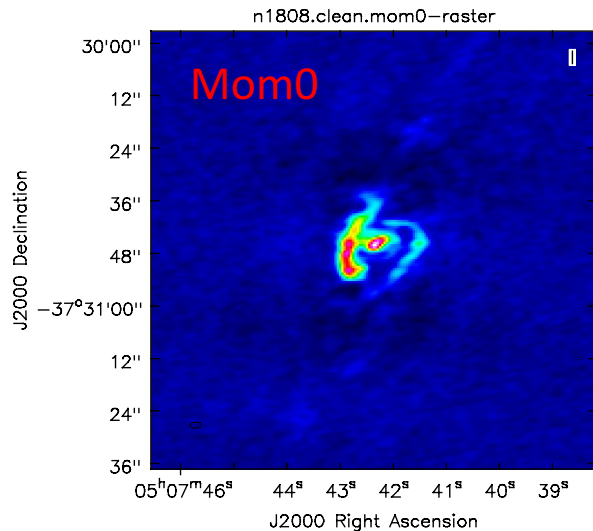
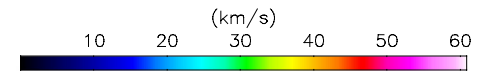
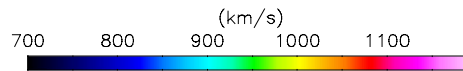
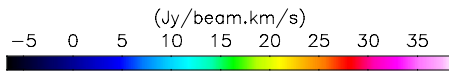
Momentum 0 map



Kinematics +PVD (NGC 1808)

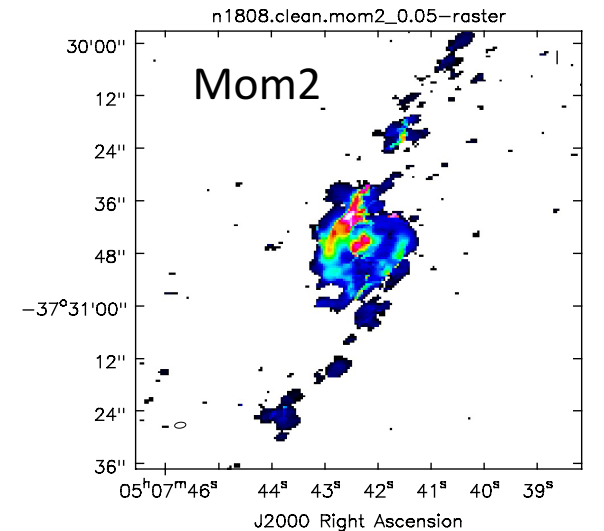
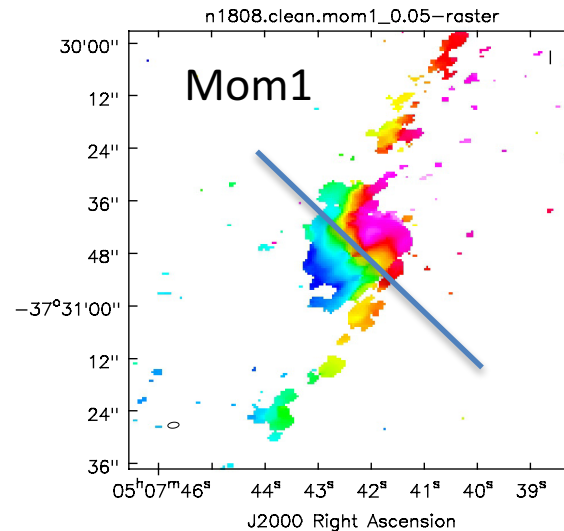
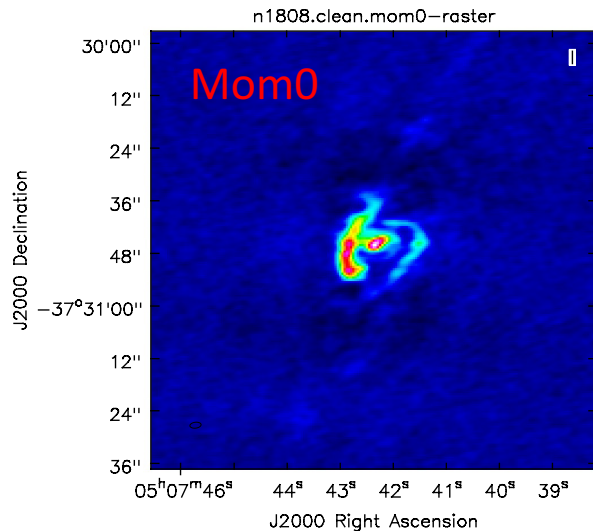
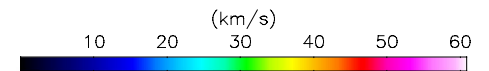
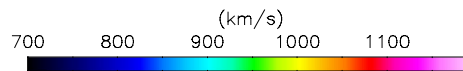
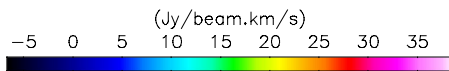
Moment maps (N1808)

- Mom0: CND (200 pc, 3'') + star formation ring (500 pc, 7'')
- Mom1: Rotation+??
- Mom2: high velocity dispersion in the star formation ring

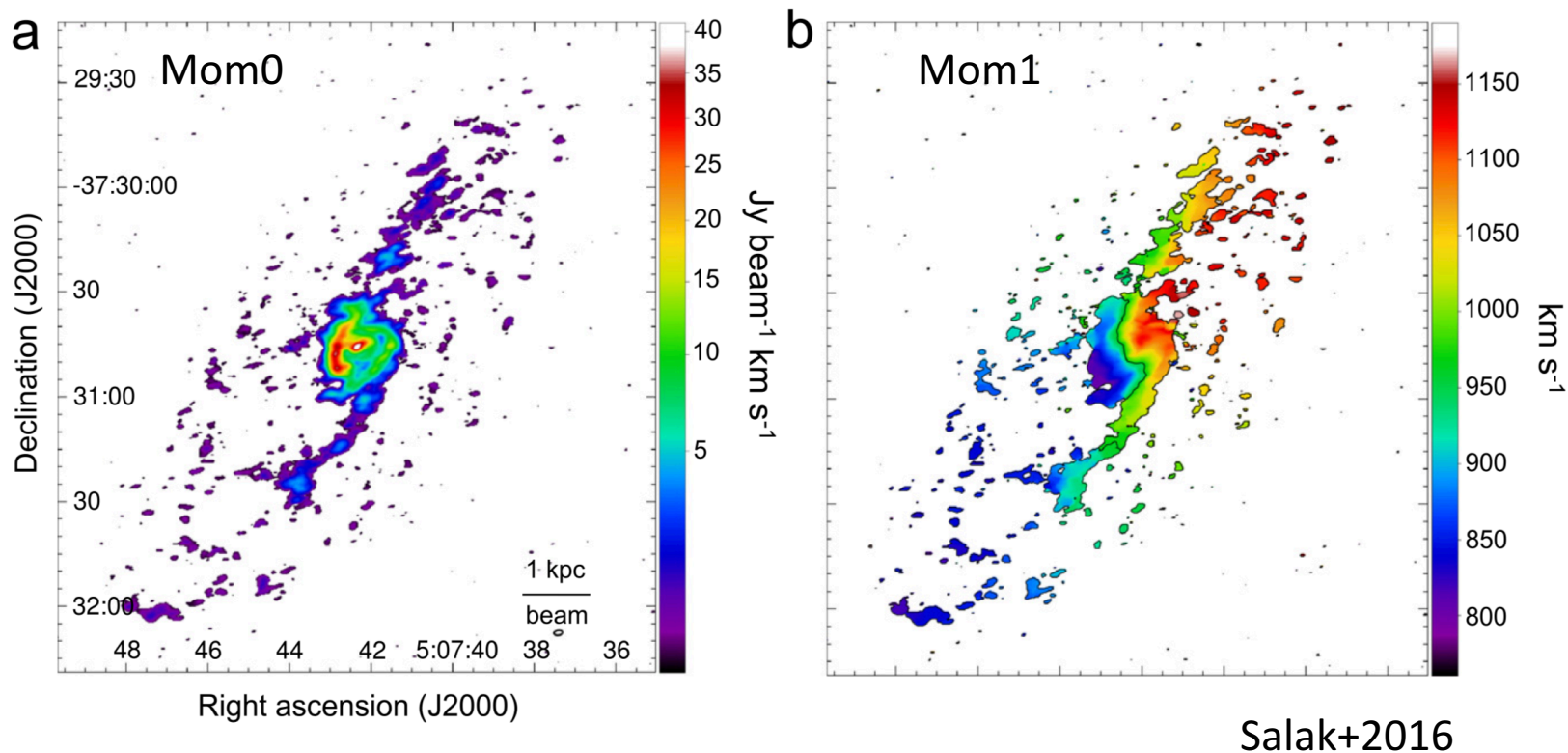


Moment maps (N1808)

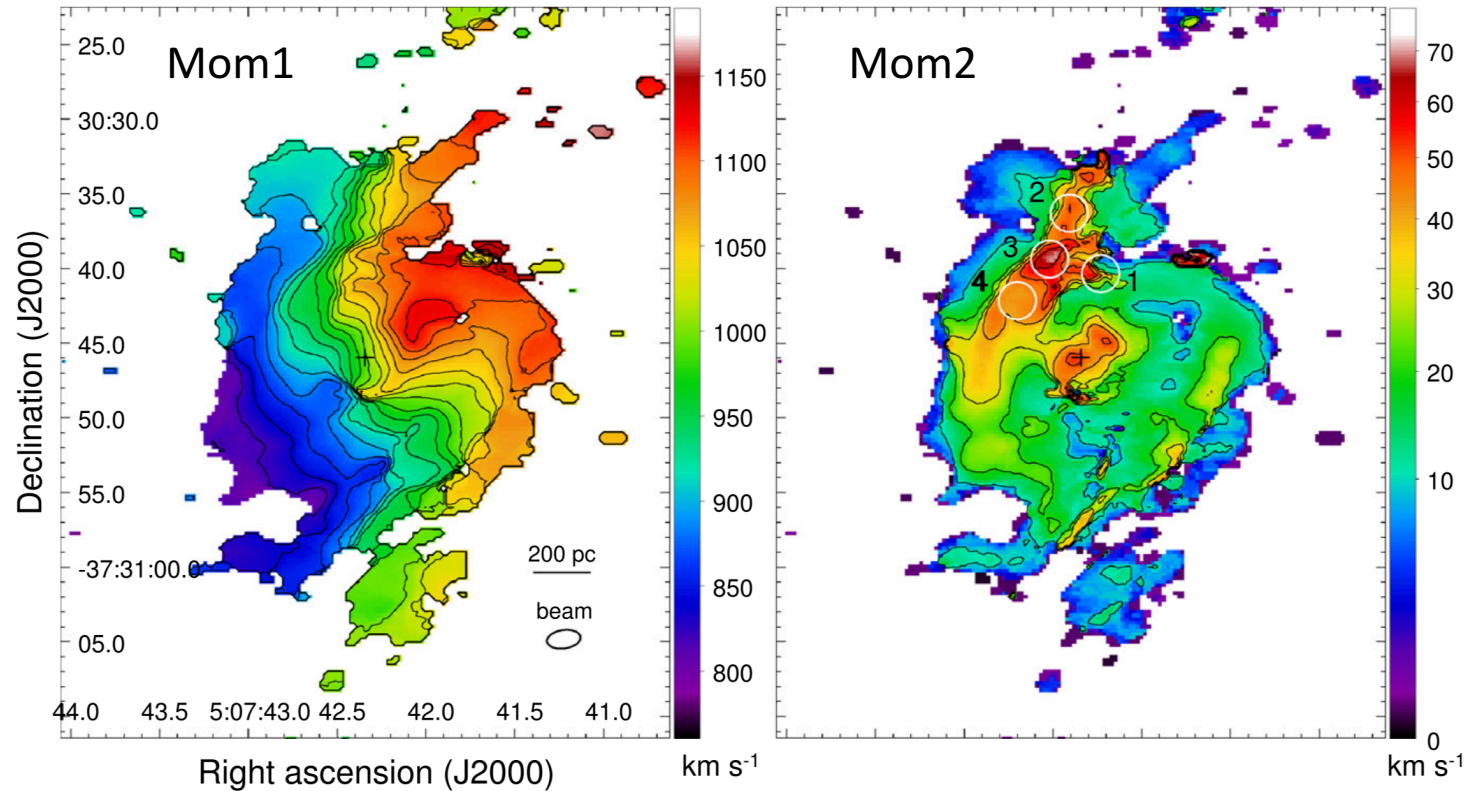
- Mom0: CND (200 pc, 3'') + star formation ring (500 pc, 7'')
- Mom1: Rotation+??
- Mom2: high velocity dispersion in the star formation ring



Moment maps from a reference

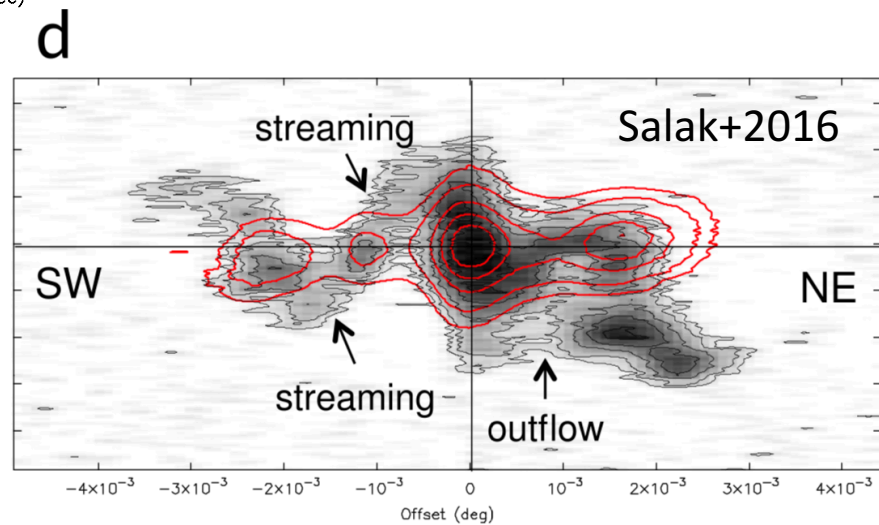
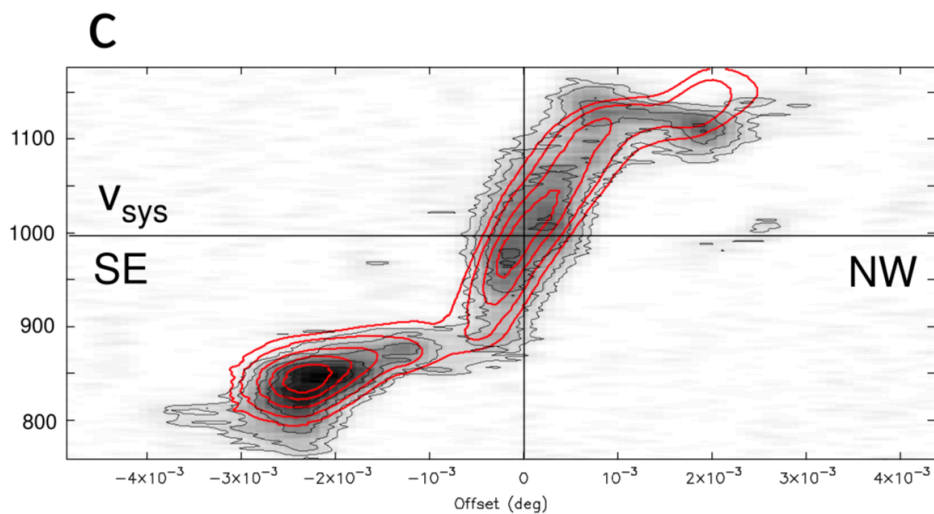
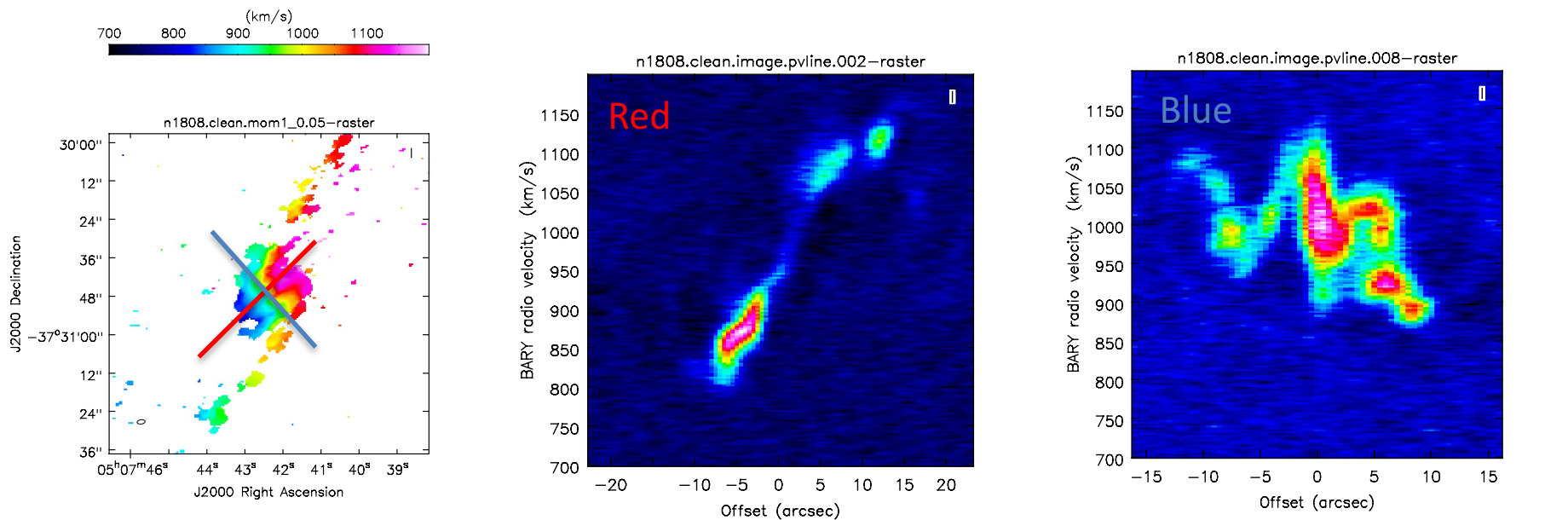


Moment maps from a reference



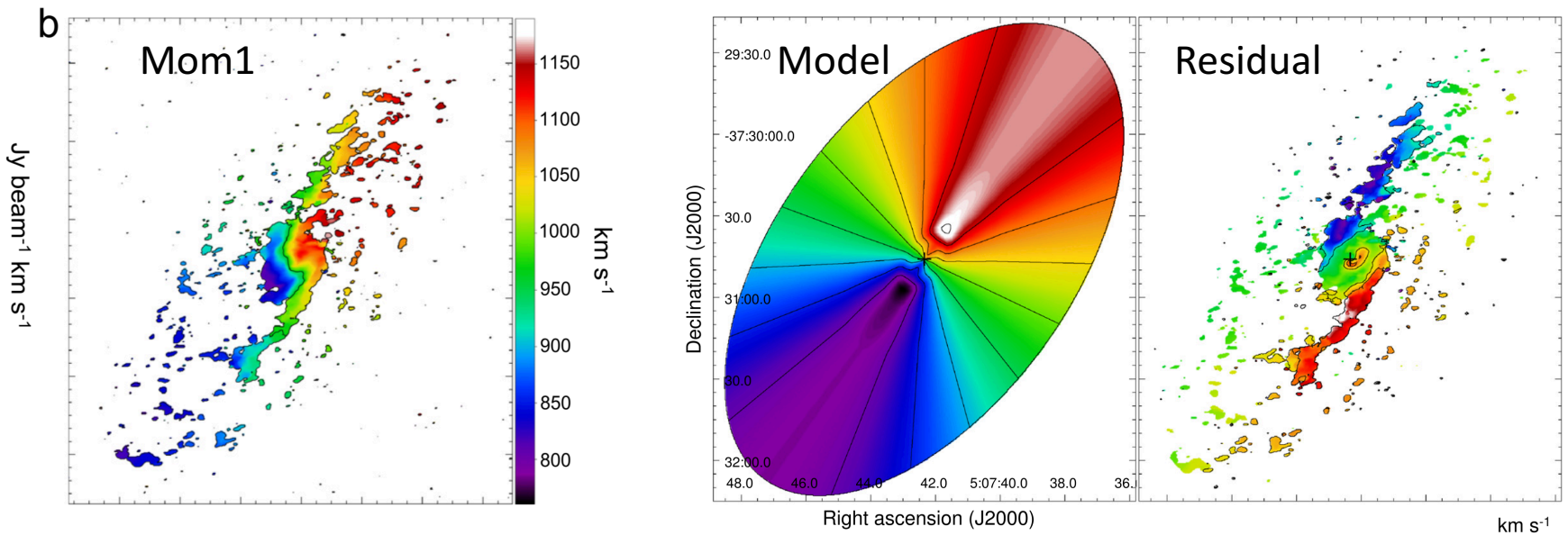
Salak+2016

Position-velocity diagram (N1808)



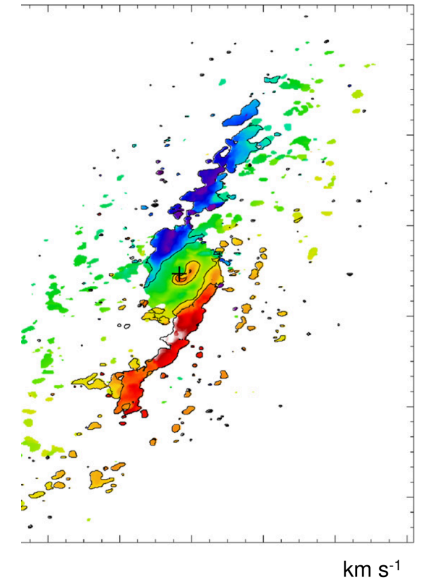
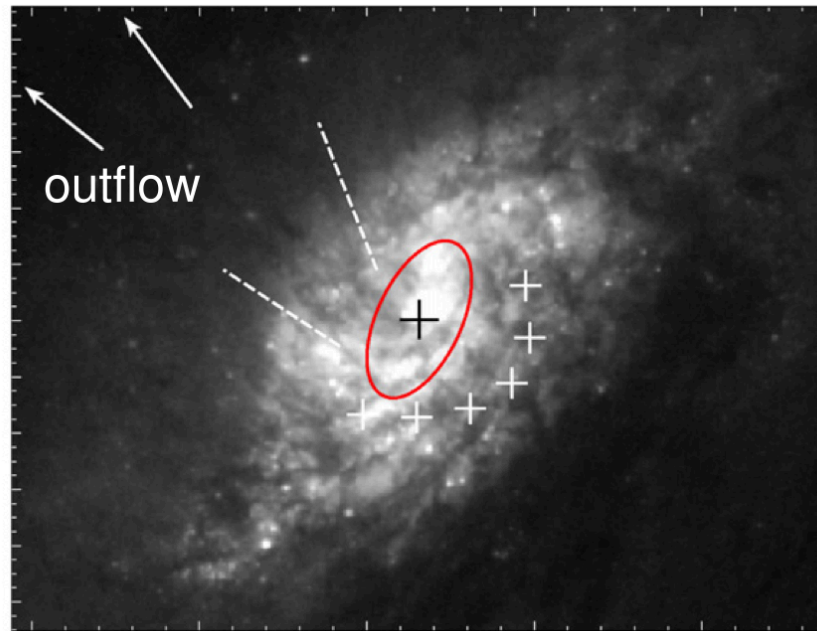
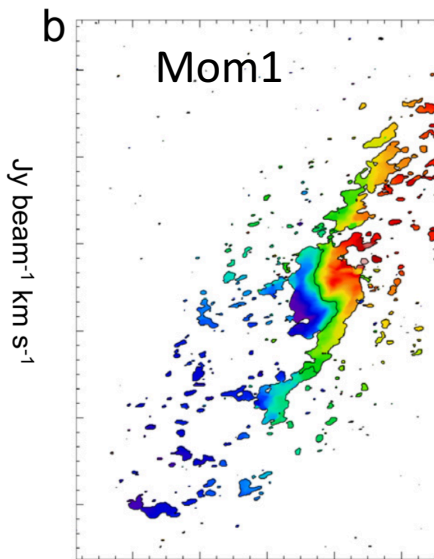
Velocity field modeling

- Modeling with 3D Barolo
- Residual velocity \rightarrow outflow



Velocity field modeling

- Modeling with 3D Barolo
- Residual velocity \rightarrow outflow

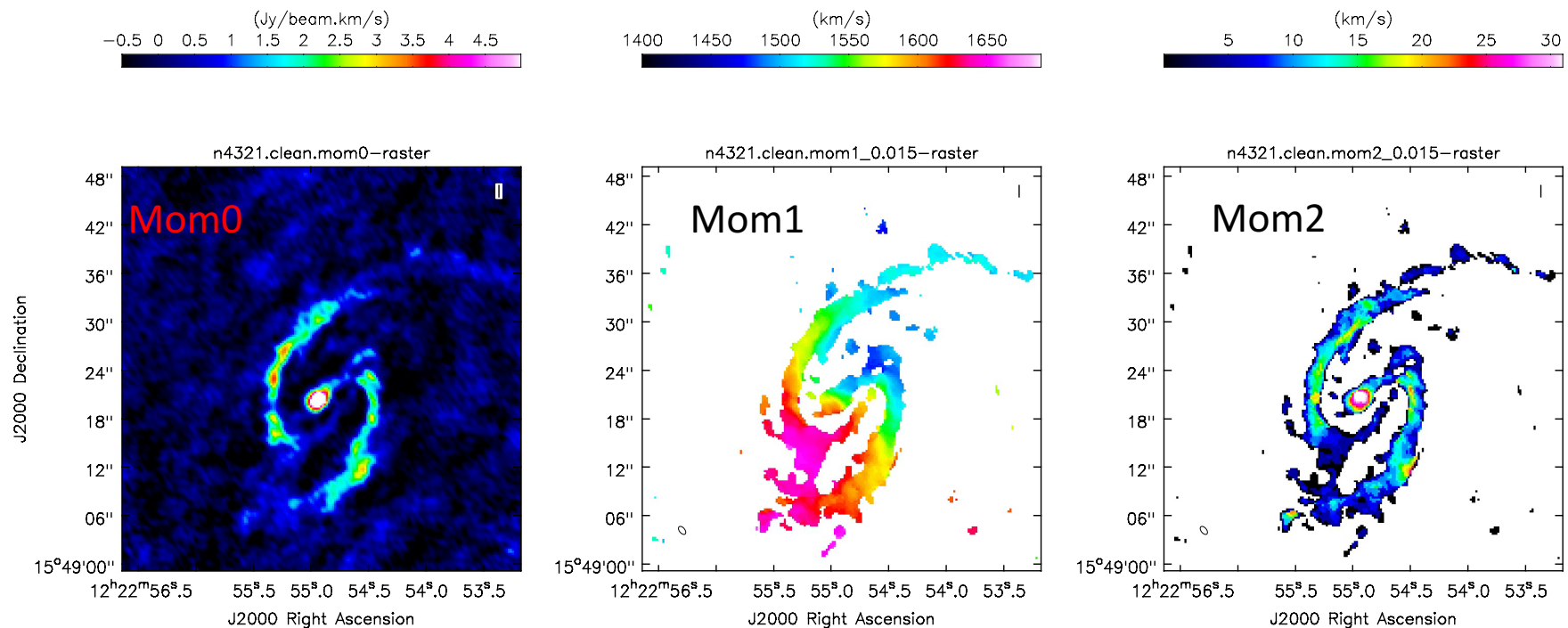


Salak+2016

Kinematics +PVD (NGC 4321)

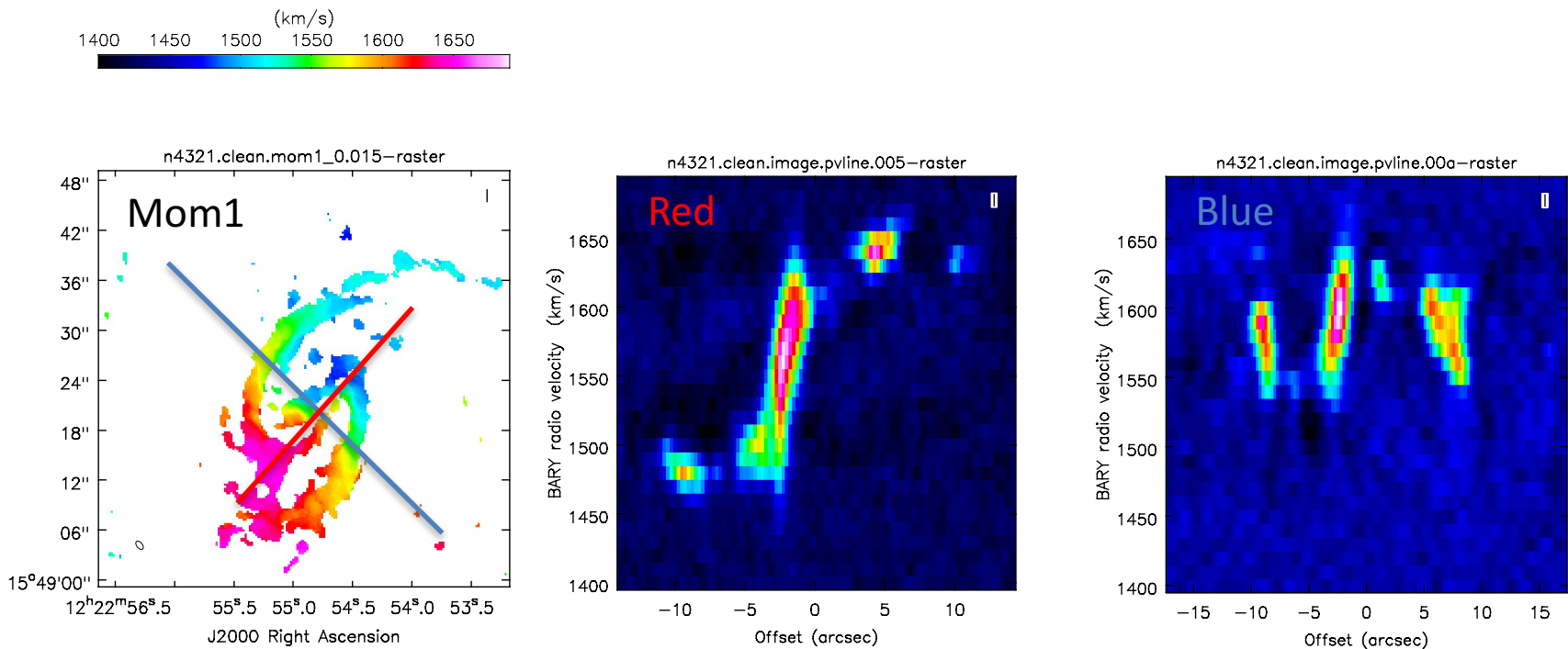
Moment maps (N4321)

- Mom0: spiral arms
- Mom1: rotation



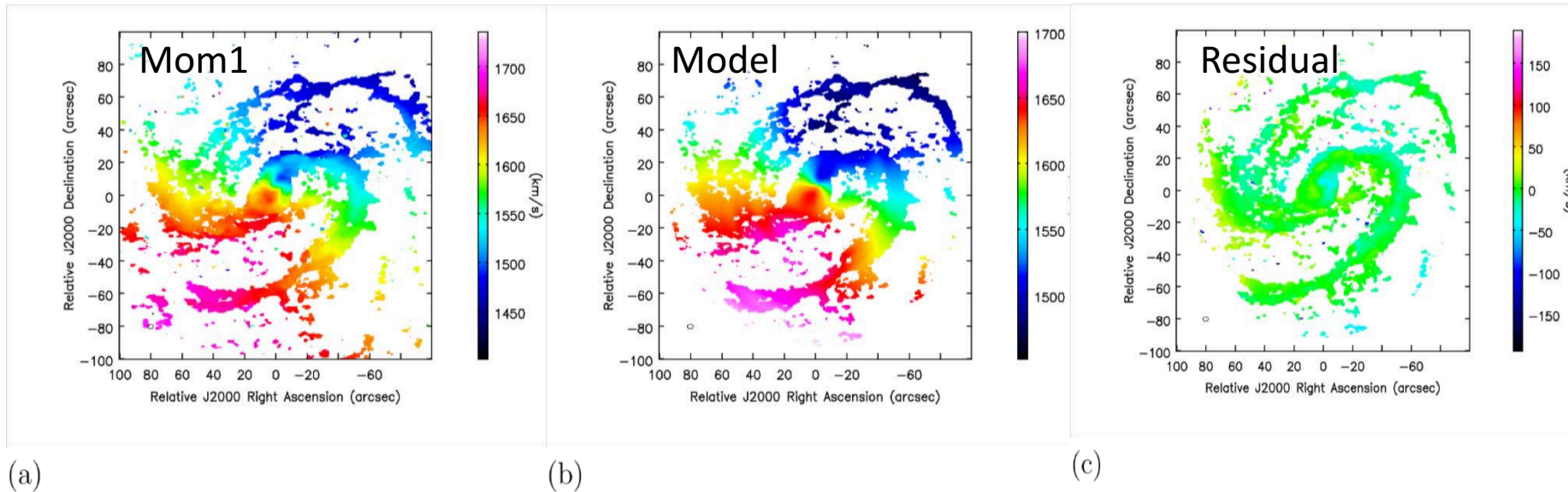
Position-velocity diagram (N4321)

- Peculiar PVD along the minor axis--> outflow?



Velocity field modeling

- Modeling with 3D Barolo
- \sim zero residual velocity \rightarrow rotation



Summary in this part

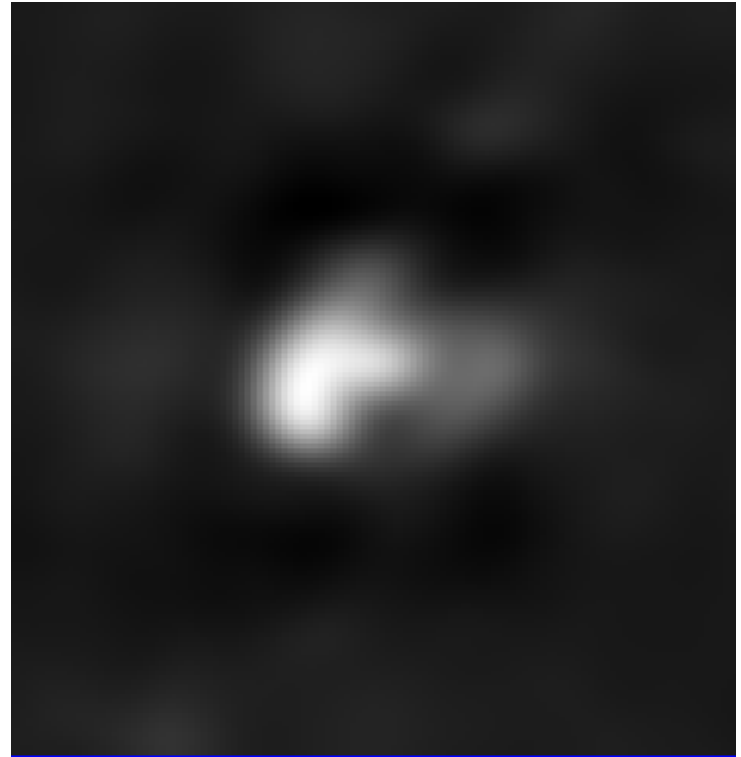
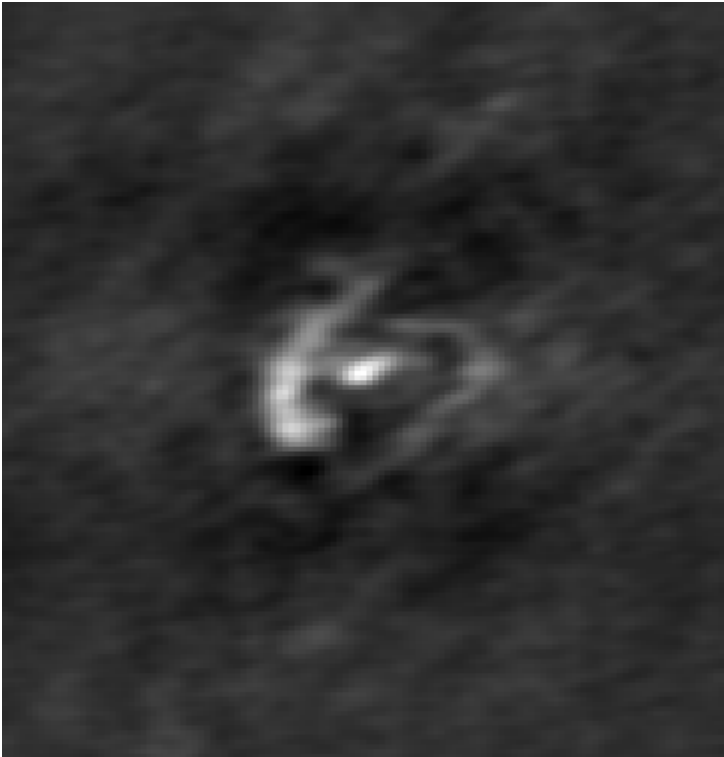
- Our results are sufficient to publish
- Outflow is detected in NGC 1808
 - Due to starburst or AGN?
- It is worth to look at multiwavelength data to investigate the outflow more (e.g., MUSE, will be released in Sep 2019)

Star Formation Rate

Star Formation Rate

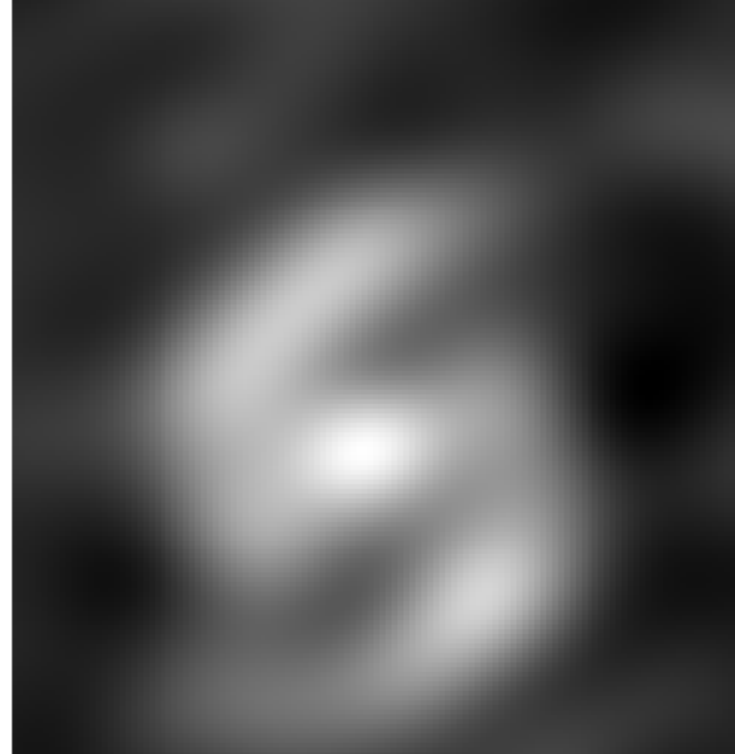
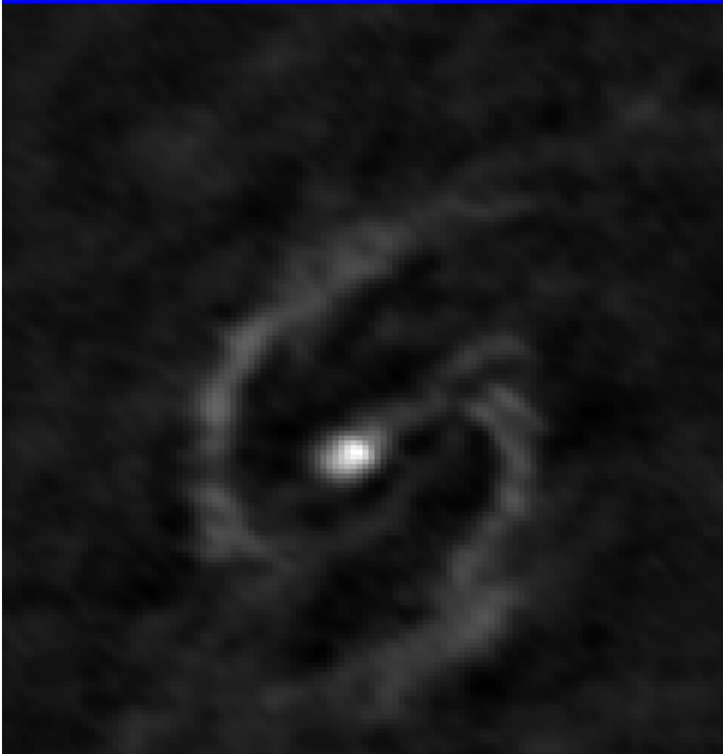
- Convolution(NGC 1808)

Using task 'imsmooth'



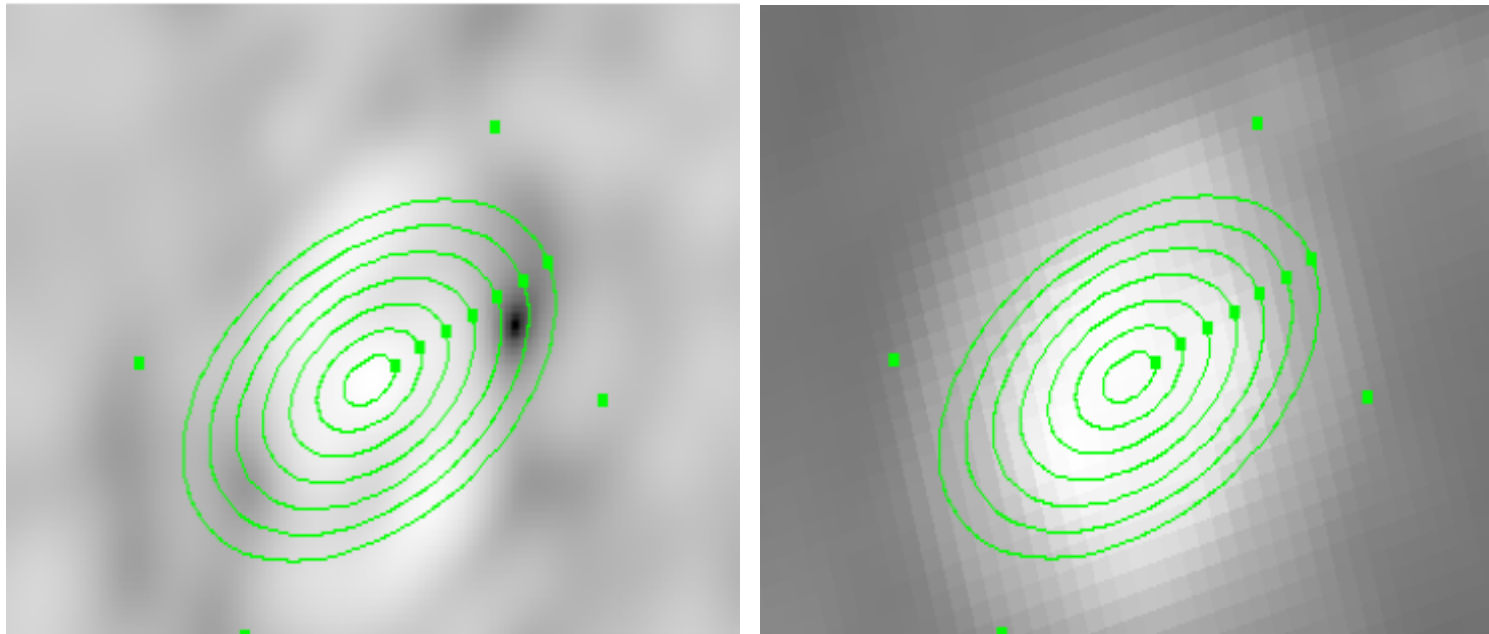
Star Formation Rate

- Convolution(NGC 4321)



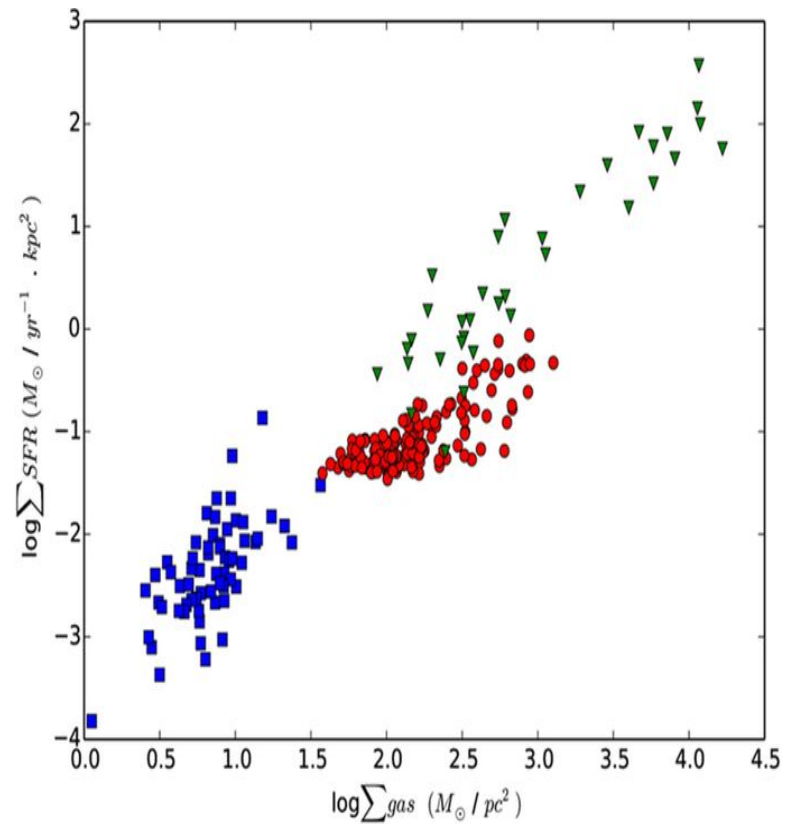
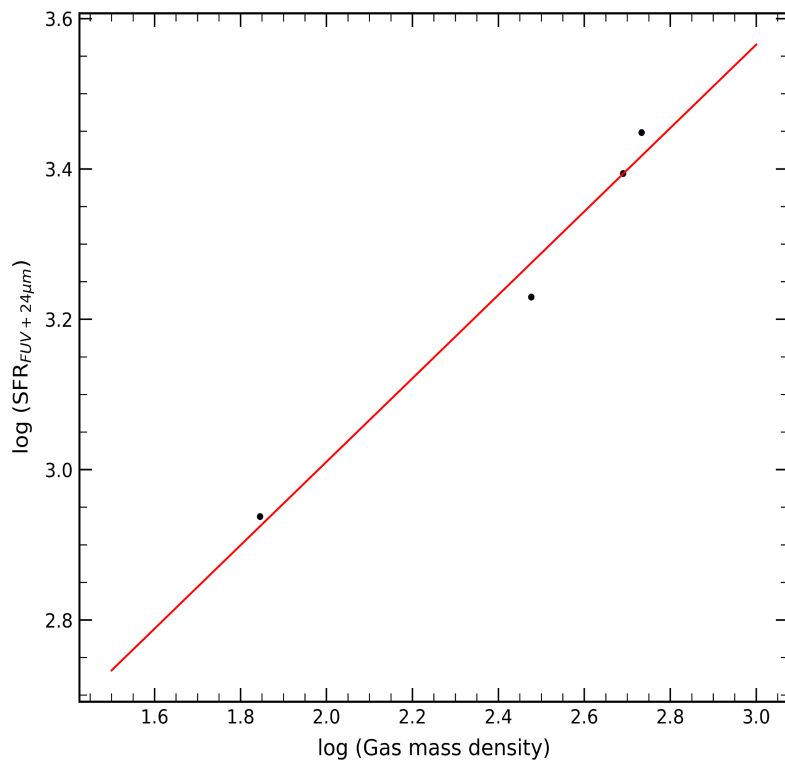
Star Formation Rate

- Using ds9, obtain surface brightness of elliptical annulus



Star Formation Rate

- Star Formation Rate(NGC 1808)



Star Formation Rate

- Star Formation Rate(NGC 4321)

