

# Making smart moment maps\*

As part of analysis of spectral maps, we often wish to make integrated intensity maps (zero-th moment), average velocity maps (1st moment), and velocity dispersion maps (2nd moment).

The typical way to make a moment map:

*moment in=mymap mom=0 clip=<noise level>*

## **Problem:**

Sensitivity across observed field is non-uniform due to primary beam pattern. There is no single clip level that will work in all regions of the map. So your moment map is either too noisy or cuts out real emission.

## **Solution:**

Devise a clipping level that is a function of position across the map, with higher clipping at the edges.

\* This was originally derived for BIMA mosaic maps but should work for single field CARMA15 maps since they are mosaics of 2 primary beam types

# Making smart moment maps

The MIRIAD task *mossen* computes the gain and sensitivity across as a function of position in the map. The task *maths* can be used to create an appropriate clipping mask:

$$\text{ABS}(\text{MAP VALUE}/\text{SENSITIVITY}) > \text{CLIP\_LEVEL}$$

where CLIP\_LEVEL is e.g., the RMS in the center of the map.

This process has been encapsulated in the csh script *moment.csh*, originated with the BIMA SONG project, and modified by different people over the years. Available on the wiki and in \$MIR/example/school.

Example usage for file *myimage.cm*

```
moment.csh start=straight file=myimage ext=cm rms=0.1 vmin=-10.1 vmax=5.4
```

This will create four files:

*myimage.dmom0* - The “dumb” moment

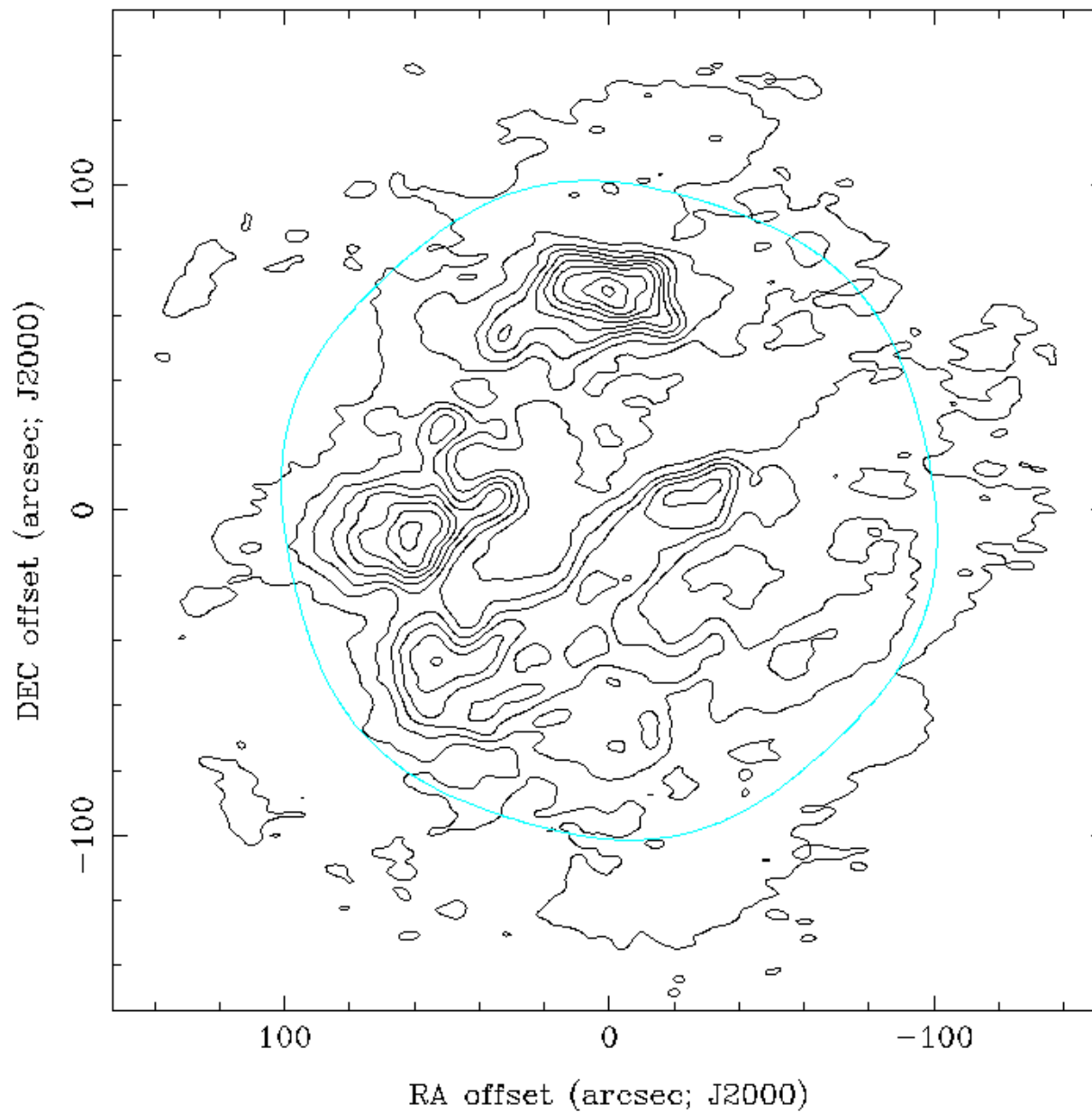
*myimage.mom0* - The “smart” zero moment (integrated intensity)

*myimage.mom1* - The “smart” 1st moment (mean velocity)

*myimage.mom2* - The “smart” 2nd moment (velocity dispersion)

# Integrated intensity image made with *moment* task (“dumb”)

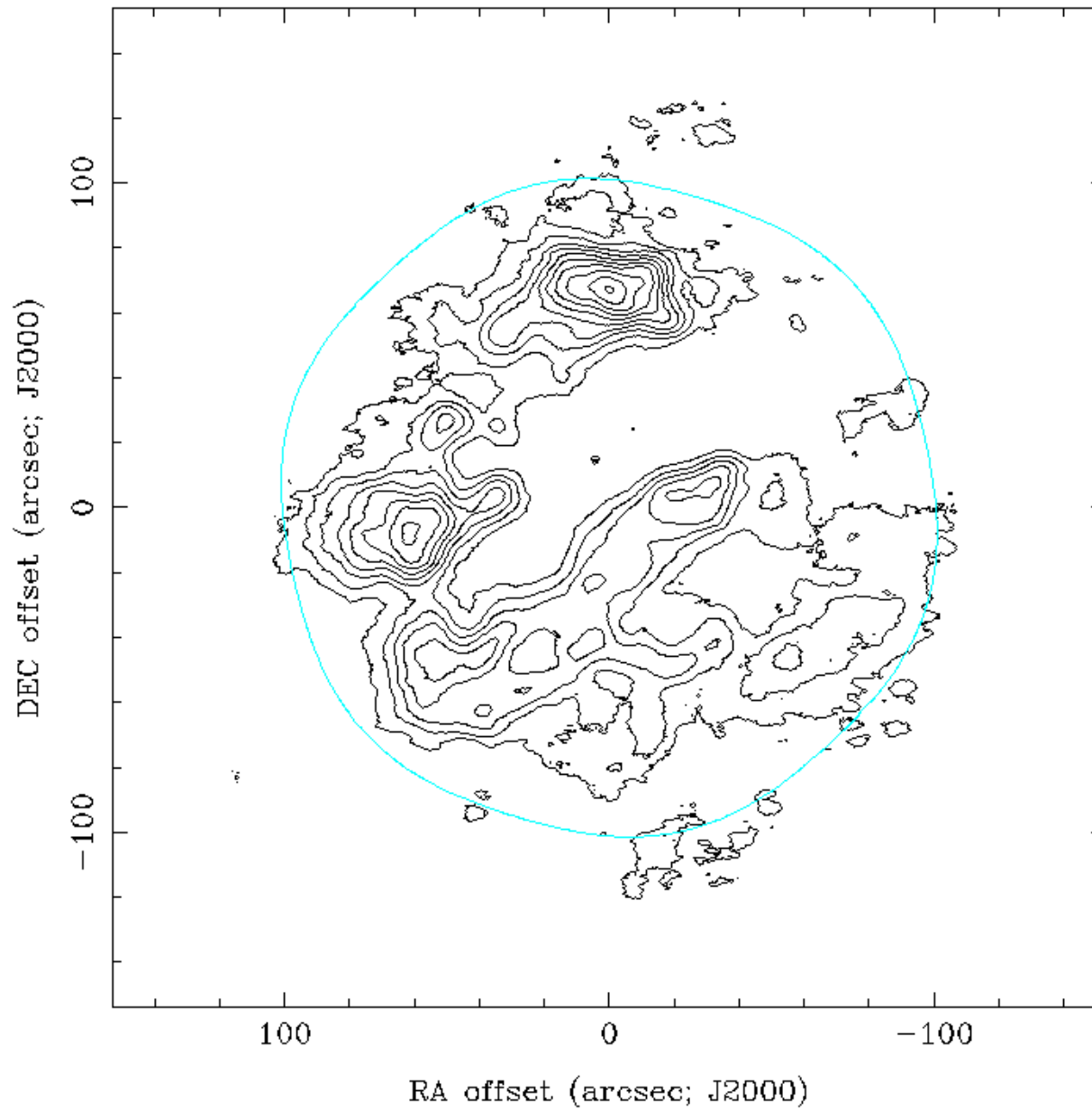
Blue contour  
is half-power  
point



RA, DEC, VRAD = 18:18:51.280, -13:50:02.33, 2.35069E+01 km/s at p1rel (308.00, 308.00, 1.00)  
Spatial region : 1,1 to 811,615  
Contour image: m16.co.mem.r\_loop1.dmoment (M16-S) Min/max=-15.29/224.2 Contours x 22 JY/BEAMKM/S  
Contours : 1, 2, 3, 4, 5, 6, 7, 8, 9, 10  
Contour image: gain (M16-S) Min/max=10<sup>80</sup>/-10<sup>80</sup> Contours x 0.5 GAIN  
Contours : 1

Same image made with moment.csh script ("smart")

Blue contour  
is half-power  
point



RA, DEC, VRAD = 18:18:51.280, -13:50:02.33, 2.35069E+01 km/s at p1rel (308.00, 308.00, 1.00)  
Spatial region : 1,1 to 811,615  
Contour image: m16.co.mern.r\_loop1.mom0 (M16-S) Min/max=-10.23/222.8 Contours x 22 JY/BEAM.KM/S  
Contours : 1, 2, 3, 4, 5, 6, 7, 8, 9, 10  
Contour image: gain (M16-S) Min/max=10<sup>80</sup>/<sub>-10<sup>80</sup></sub> Contours x 0.5 GAIN  
Contours : 1