Single Dish Radio Observation

Visualization of the map data with
the moment 0 and moment 1 maps

Hyeong-Sik Yun

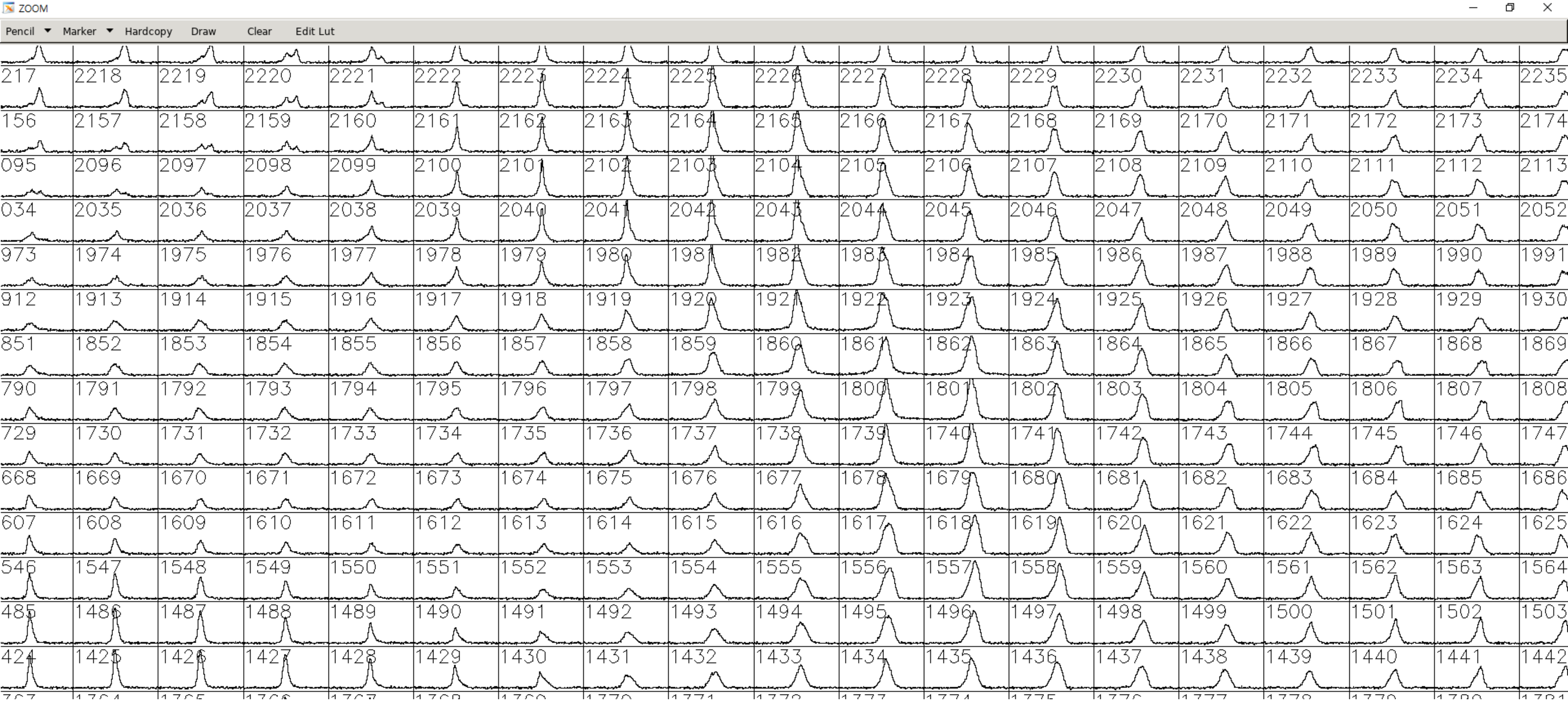
What is the map data?

- Open the map data using GILDAS/CLASS
- Orion_13CO_baseline_subtracted.class from Singledish_clss3

```
LAS> file in Orion_13CO_baseline_subtracted.class
LAS> set unit v f
LAS> find
LAS> set mode x 25 -5
LAS> set mode y -1 12
LAS> map /num /grid
```


LAS> zoom
Press 'z' to zoom-in
Click somewhere that you want to zoom-in.
DEC. offset [arcsec]
R.A. offset [arcsec]
500
0
−500
500
0
−500

How can we visualize the data?



Github repository, Singledish_class5

- [HyeongSikYun/Singledish_class5 (github.com)]

- Orion_13CO_baseline_subtracted.class
- Orion_13CO_baseline_subtracted.fits
- Singledish_class.py

} Map data

Singledish_class.class

1. hdu = read_fits('/path/to/file/','name_of_fits_file.fits')

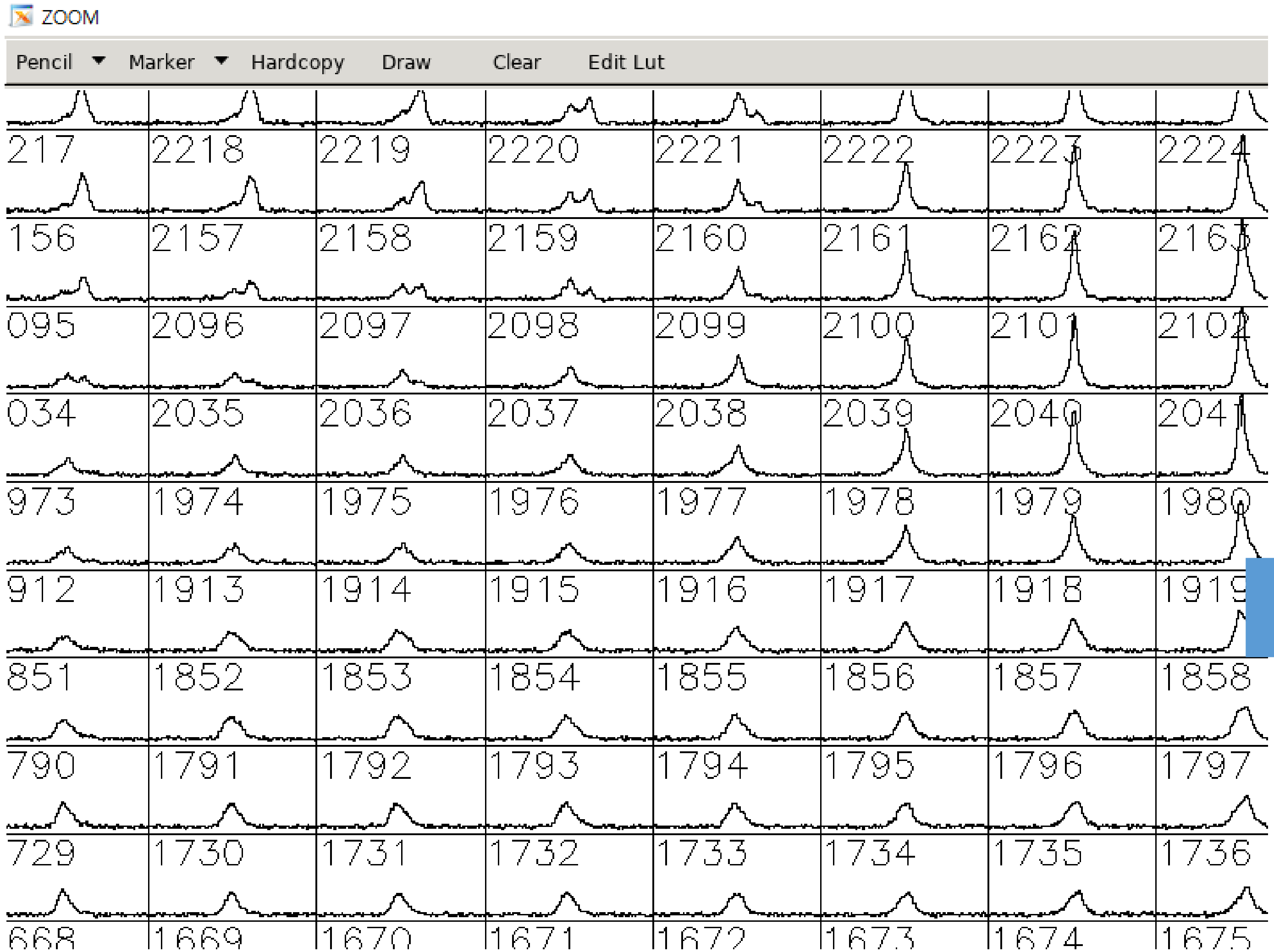
2. **what_do_you_want_to_see(velo,spec)**

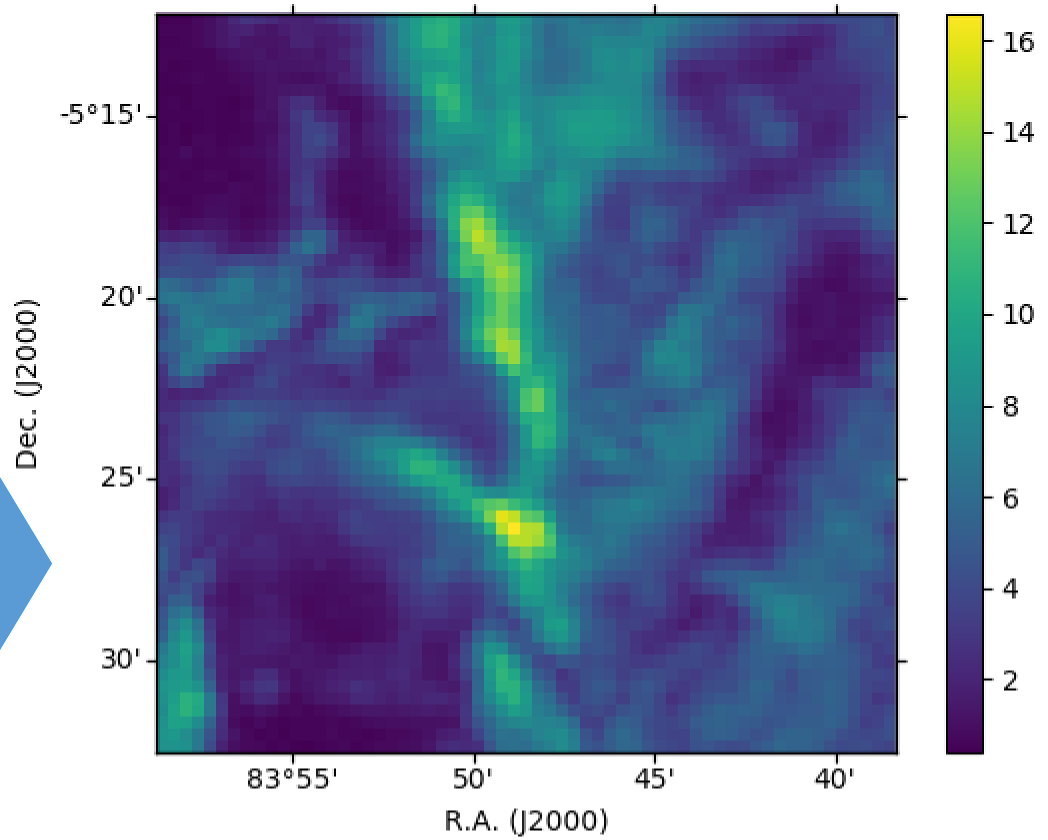
3. produce_map_fig(hdu)

Modify it to produce other maps

❖ sub-routine 'produce_map_fig' initially produces the peak temperature map

Test run (the T_{peak} map)



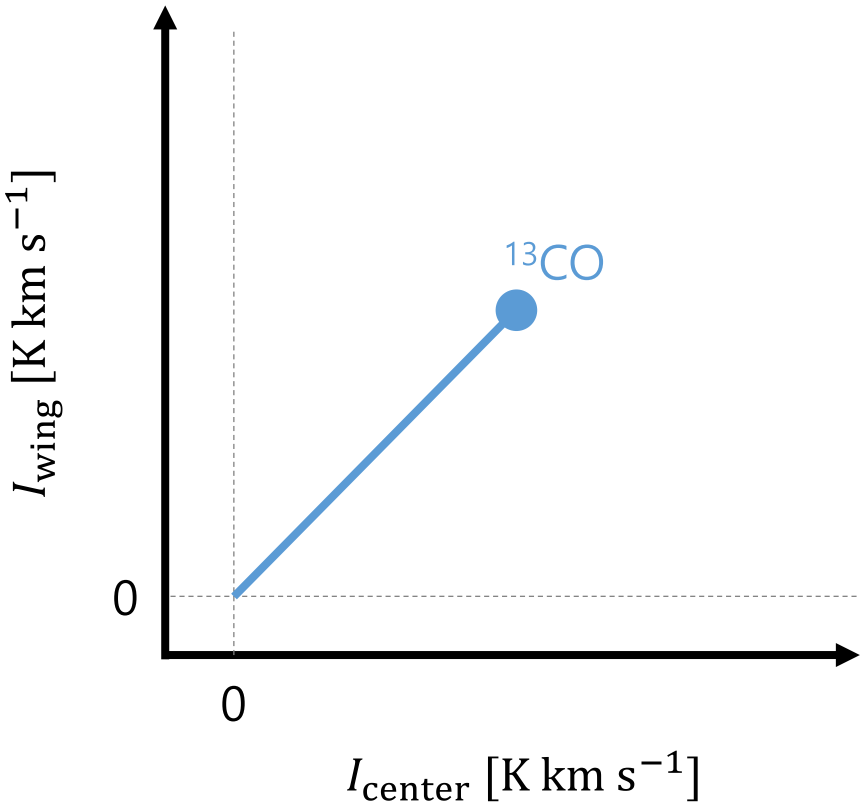


From singledish_class4...

Integrated intensities of each components

- $I_{\text{center}} = \int_{5}^{13} T(v)dv$
- $I_{\text{wing}} = \int_{-11}^{5} T(v)dv + \int_{13}^{29} T(v)dv$

- Integration over a given velocity range.



Total line intensity emitted from each pixel

- Integrate over the whole velocity range

-> integrated intensity

$$\int_{v_1}^{v_2} T(v) \cdot dv$$

We cannot obtain the continuous data.

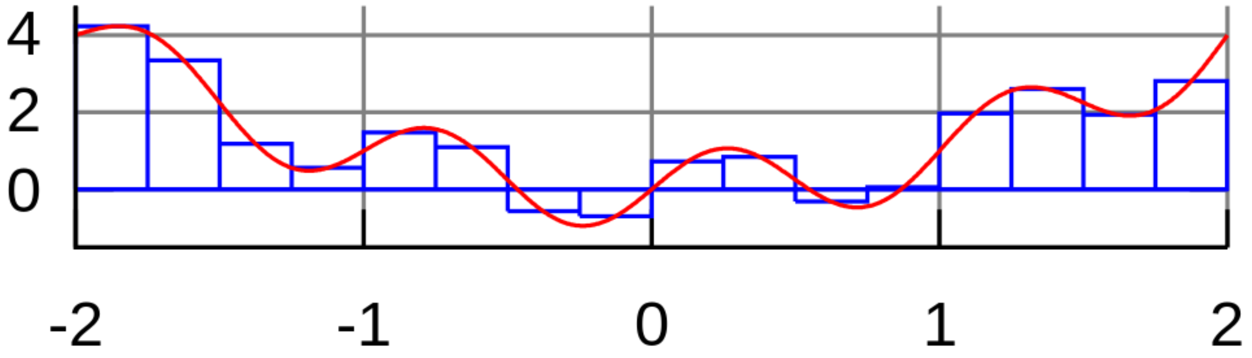
$T(v)$ contains intensities (T) at regularly spaced velocities (v).
All the data are discrete!!

Integration in discrete data (numerical integration)

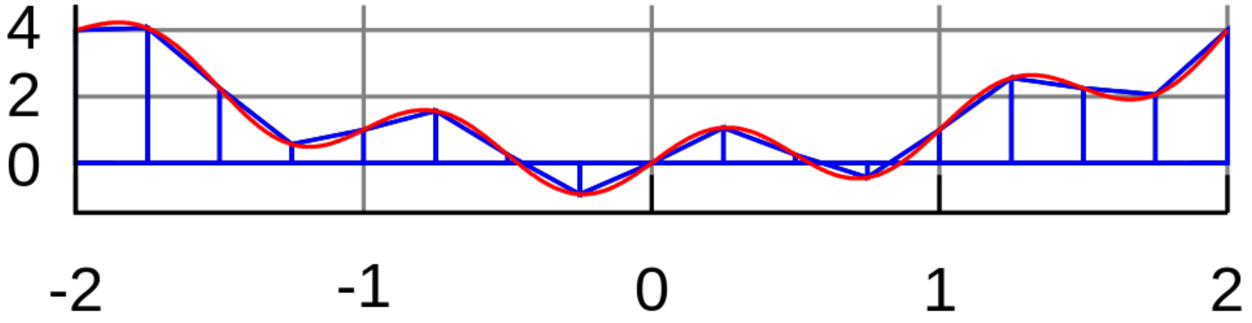
Rectangule rule

$$\int_{v_1}^{v_2} T(v) \cdot dv = \sum_{v_1}^{v_2} T(v) \cdot \Delta v$$

[Δv: a velocity channel width]



- More fancy methods of integration are as follows,
  - Trapezoidal rule, Simpson's rule, …



Integration in discrete data (numerical integration)

Rectangule rule

$$\int_{v_1}^{v_2} T(v) \cdot dv = \sum_{v_1}^{v_2} T(v) \cdot \Delta v$$

$$= \boxed{\Delta v \cdot \sum_{v_1}^{v_2} T(v)}$$

[If Δv is constant; Δv: a velocity channel width]

In python,

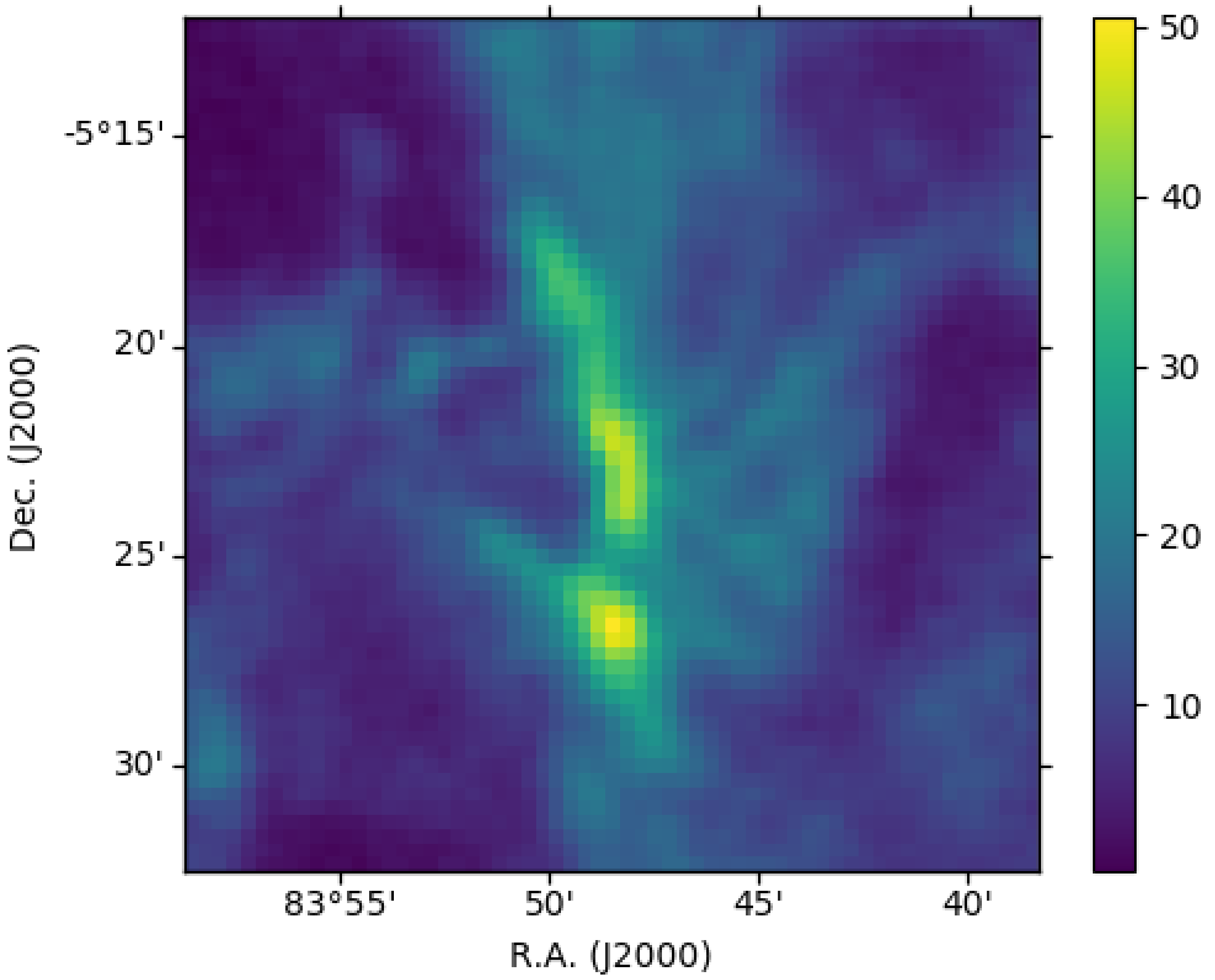
```
>>> dv = velo[1] – velo[0]
>>> Int = dv * np.sum(spec)
```

Exercise: Integrated intensity map

- Modify a function, ‘what_do_you_want_to_see’ in ‘singledish_class.py’.

- Use a following command

>>> produce_map_fig(hdu)



Intensity weighted velocity map

- Moment 1 map

$$moment\ 1 = \frac{\sum_{v_1}^{v_2} T(v) \cdot v}{\sum_{v_1}^{v_2} T(v)}$$

- Similar to the expected value of a given probability distribution function.

$$E[X] = \int_R x \cdot f(x)\, dx$$

Exercise: intensity weighted velocity map

$$moment\ 1 = \frac{\sum_{v_1}^{v_2} T(v) \cdot v}{\sum_{v_1}^{v_2} T(v)}$$

- Modify a function, ‘what_do_you_want_to_see’ in ‘singledish_class.py’.

- Use a following command

```
>>> produce_map_fig(hdu)
```

Exercise: intensity weighted velocity map

$$moment\ 1 = \frac{\sum_{v_1}^{v_2} T(v) \cdot v}{\sum_{v_1}^{v_2} T(v)}$$

?