

Final Presentaiton : Dark Matter in galaxies

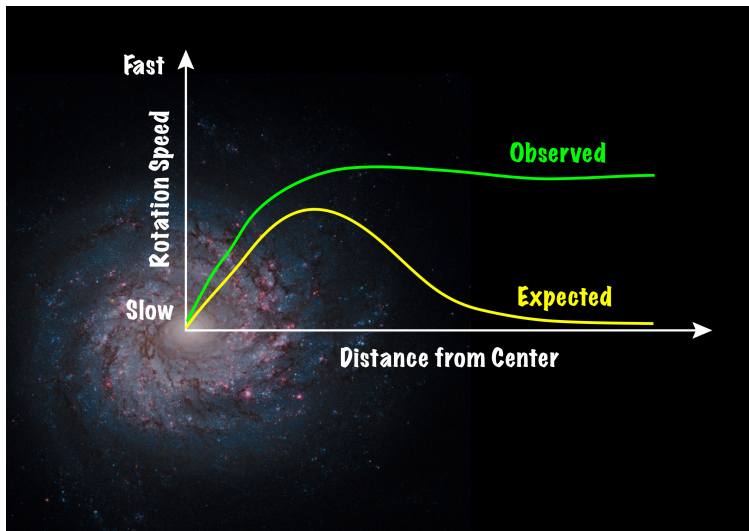
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What problem do we face?

Gravity seems to be too weak to make stars and other celestial bodies orbit steadily.



The possible solutions : MOND

MOND = Modified Newtonian dynamics The original Newtonian law $F = ma$ fits the observation quite well, but it leads to different behavior at low acceleration.

$$F = m\mu\left(\frac{a}{a_0}\right) a$$

Here F is the Newtonian force, m is the object's (gravitational) mass, $\mu\left(\frac{a}{a_0}\right)$ is unspecified function (called "interpolating function"), and a_0 is a constant.

For example, in general the interpolating functions are chosen to be

- ▶ simple interpolating function $\mu\left(\frac{a}{a_0}\right) = \frac{1}{1 + \frac{a_0}{a}}$
- ▶ standard interpolating function $\mu\left(\frac{a}{a_0}\right) = \sqrt{\frac{1}{1 + \left(\frac{a_0}{a}\right)^2}}$

Do we misunderstand gravity?



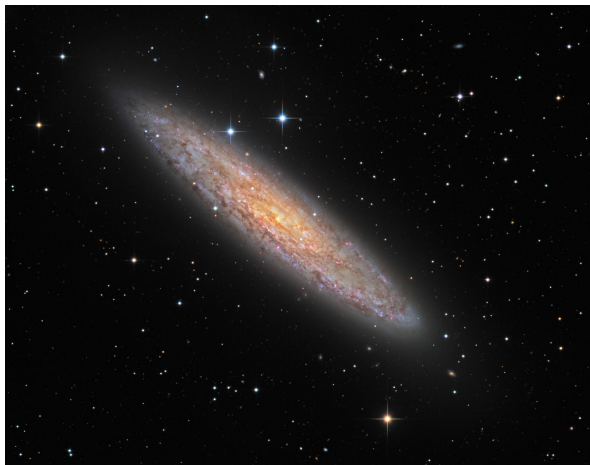
The possible solutions : Dark Matter

It is supposed that there are "unknown" matter which only gives gravitational interaction. By putting this additional mass, the celestial bodies acquire sufficient (gravitational) force to orbit the center of the galaxy without modifying the gravity theory.

Target

Sculptor Galaxy, also known as Silver Coin, Silver Dollar Galaxy, NGC 253.

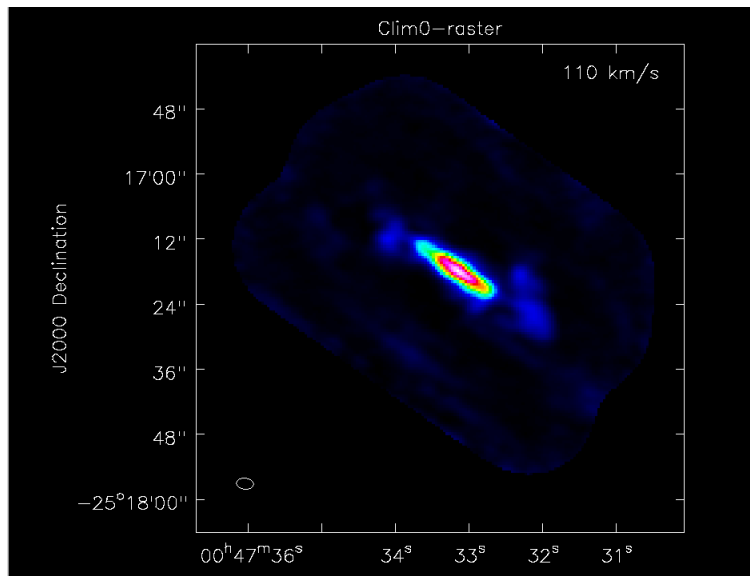
The Sculptor Galaxy is a starburst galaxy, which means that it is currently undergoing a period of intense star formation.



Data imaging

Moment 0

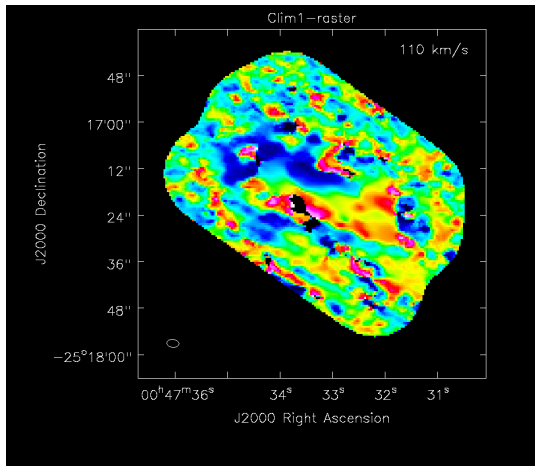
integrated value of the spectrum



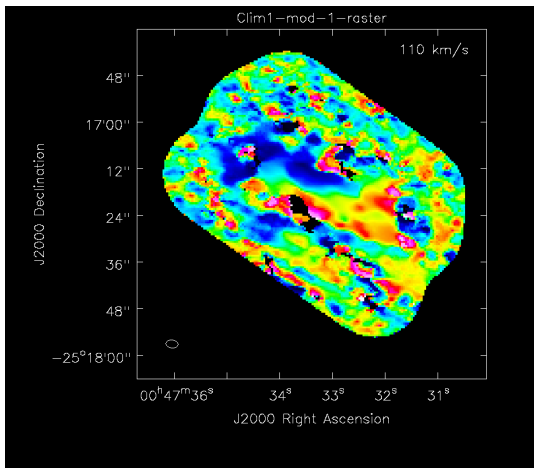
Data imaging

Moment 1

intensity weighted coordinate; traditionally used to get 'velocity fields'

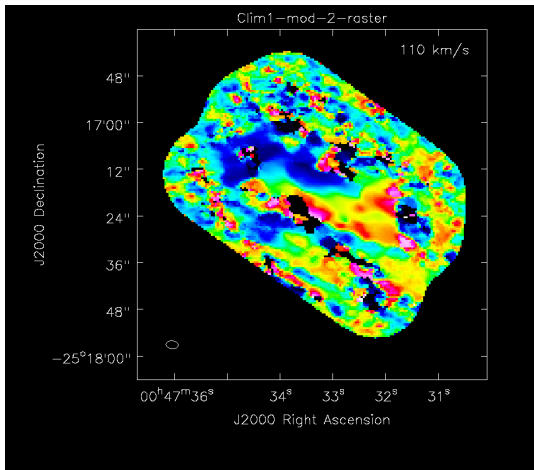


Data imaging



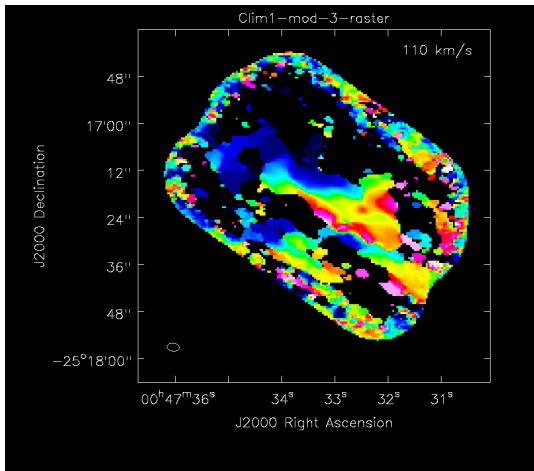
```
CASA ~10> taskname = "immoments";
      imagedata = "/calibrated/NGC253.image.CI.image.pbcor.fits";
      moments = 1;
      outfile = "Clim1-mod-1";
      chans = "11-42";
      includepix = [0.07, 100000];
      go
CASA ~11> go()
Executing: immoments()
```

Data Imaging



```
CASA ~12 taskname = "immoments";
        imagedata = "/calibrated/NGC253.image.CI.image.pbcor.fits";
        moments   = 1;
        outfile   = "Clim1-mod-2";
        chans     = "11-42";
        includepix = [0,1,100000];
        ~~~~~
CASA ~13> go
        go()
Executing: immoments()
```

Data Imaging



```
CASA ~14: taskname = "immoments";  
          imagedata = "/calibrated/NGC253_image/CI_image_pbcor.fits";  
          moments = 3;  
          outfile = "Clim1-mod-3";  
          chans = "11-42";  
          includepix = [0.3, 100000];  
            
CASA ~15: go  
          go()  
Executing: immoments()
```