Simulations vs mock observations of dwarf EAGLE galaxies

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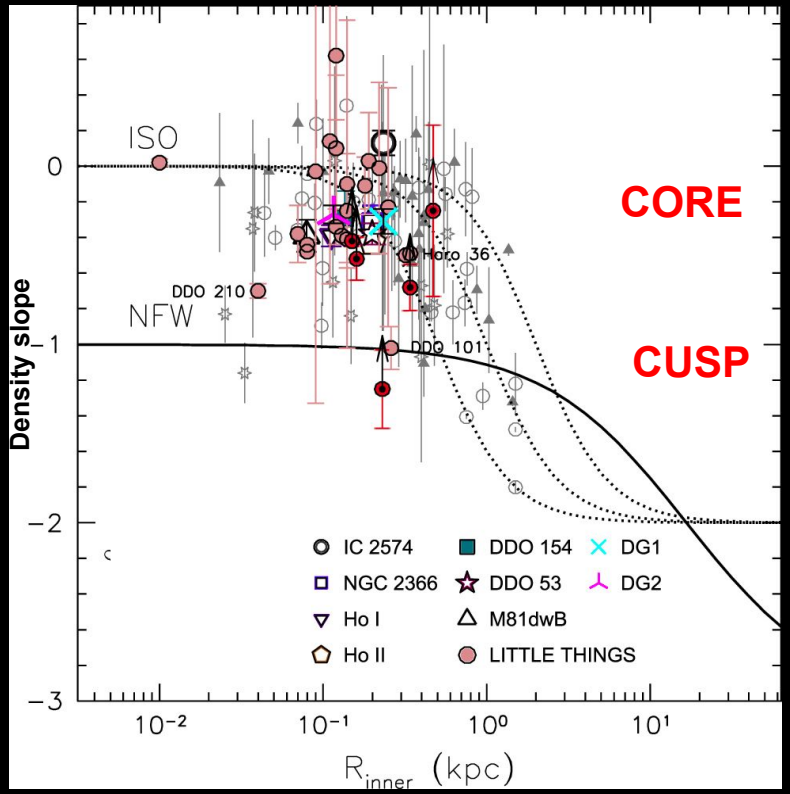
Overview

- Simulations vs observations: background and relevance
- Building mock IFU cubes
- Methods of obtaining dark matter distribution
- Future work

Motivation: Core/cusp problem



Oh et al., 2015

Dark matter density distribution:

- DM only simulations: cusp
- Observations: cusps and cores

Solution? Baryonic feedback simulations?

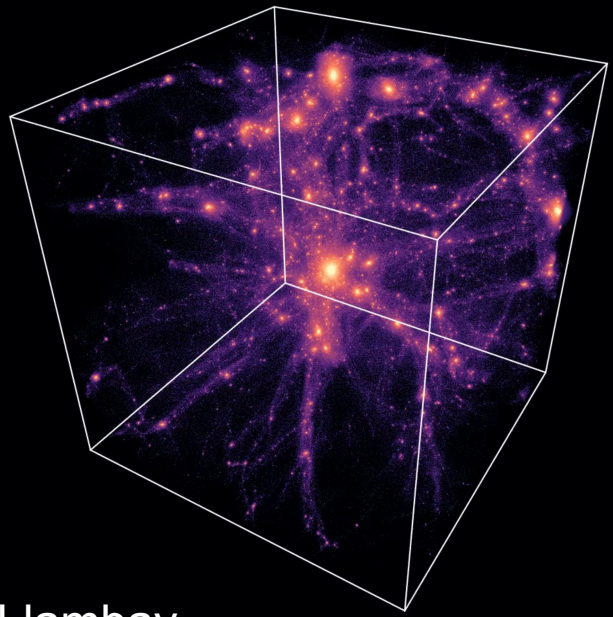
- Cores and cusps depending on chosen parameters

OR

Methods of deriving quantities from observations?

EAGLE simulations

- 12 Mpc box
- Baryonic feedback
- Resolution:
  - DM particles 3.2 x 10^6 $M_\odot$
  - Baryons: 5.3 x 10^5 $M_\odot$



(The EAGLE Project)

Star formation gas density threshold's effect (Benitez-Llambay et al. 2019) – some produce cores

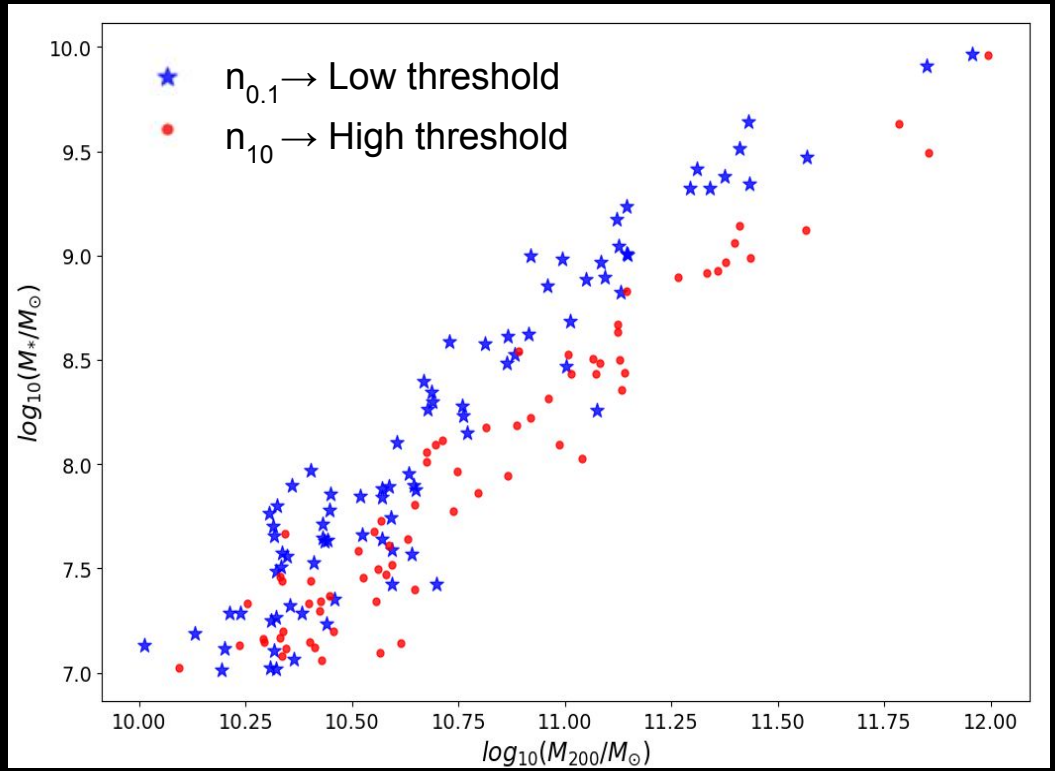
- Runs used: n_{th} = 0.1 cm^{-3} = 10 cm^{-3}
  Low threshold High threshold

Galaxy selection

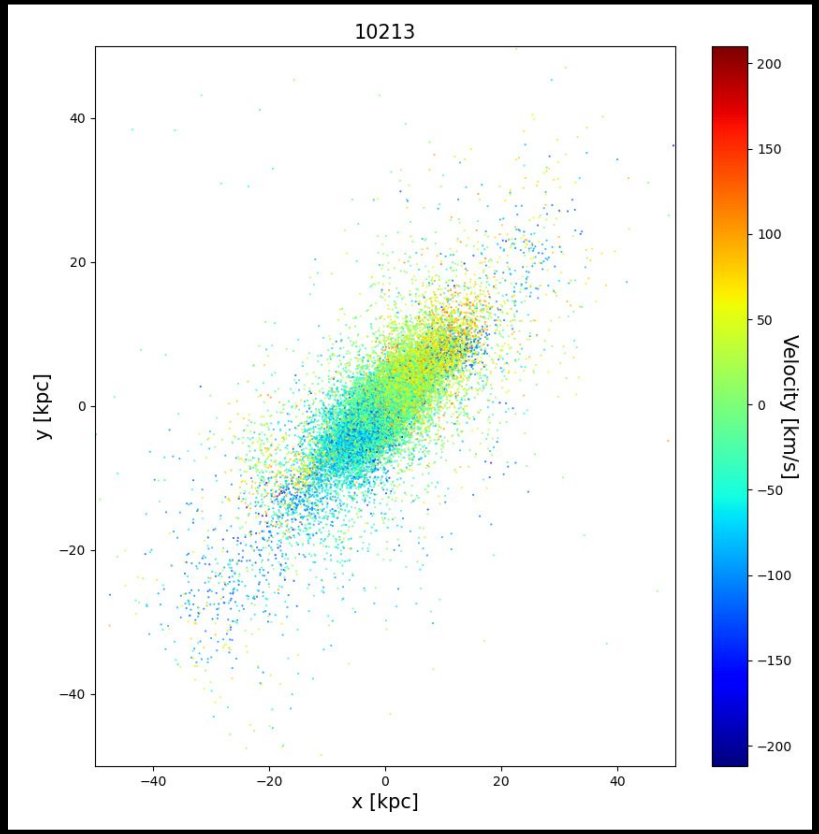
Select $10^7 < M_\star < 10^{10}\ M_\odot$ (dwarf)

Approx. 80 galaxies at low and high n_{th}

- Some have mergers or lack of rotation



EAGLE stellar particle data

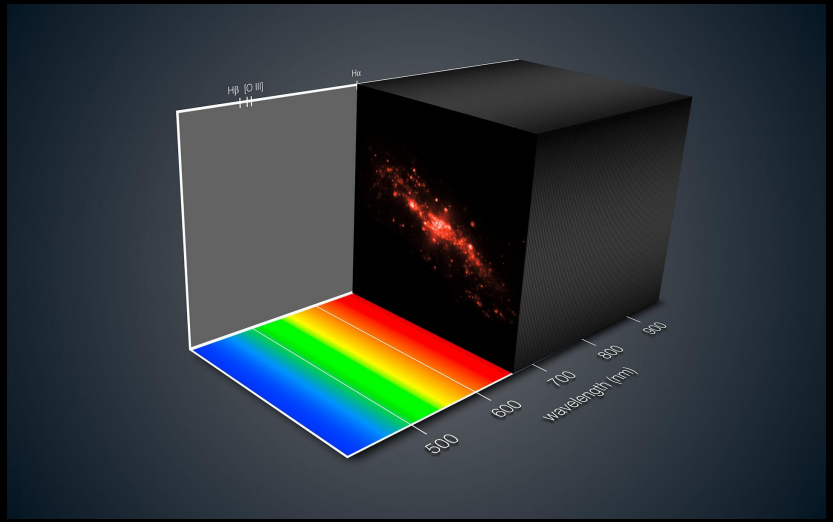


MUSE Integral Field Units (IFUs)

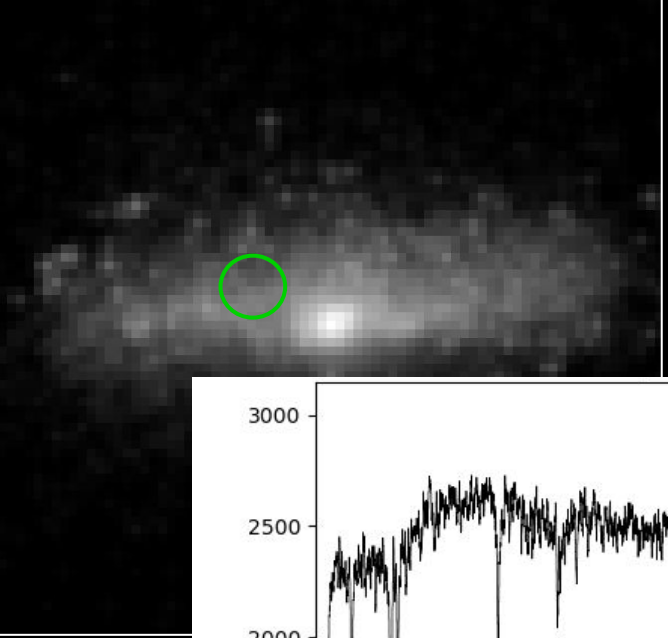
MUSE: instrument on the VLT

- FOV: 60”
- λ range: 4650 - 9300 Å

Photometry and spectroscopy



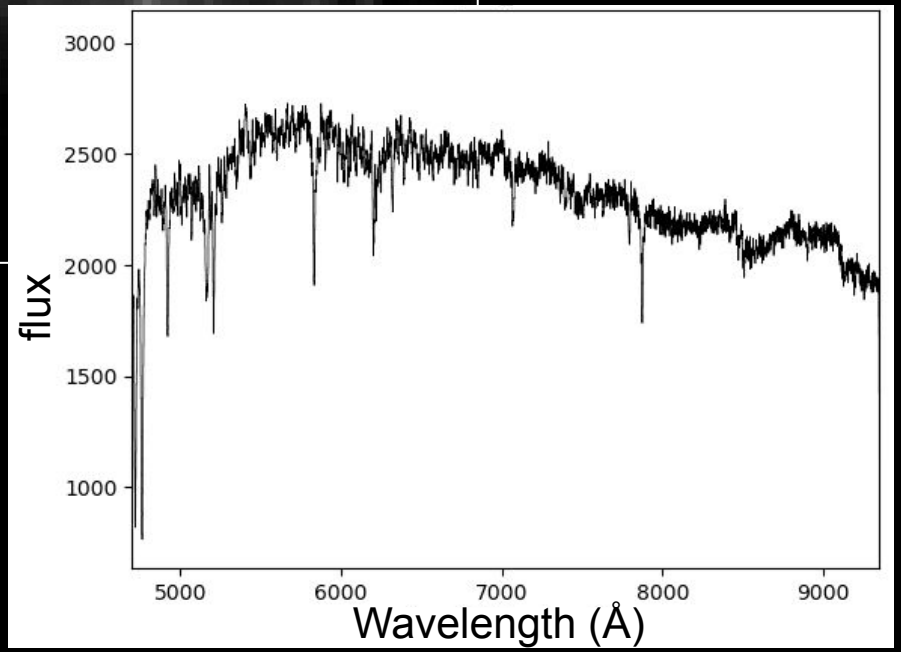
(ESO/MUSE)



SimSpin (Kate Harborne, 2020)

IFU mock data cubes from simulations (using stellar data) - MUSE parameters

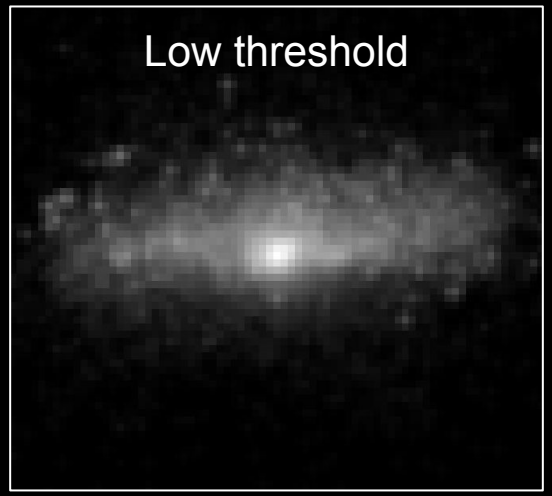
- z = 0.2
- PSF = 0.3”
- Inclination = 75 (rotation visible)
- Spectral template = EMILES (Vazdekis et al., 2016)

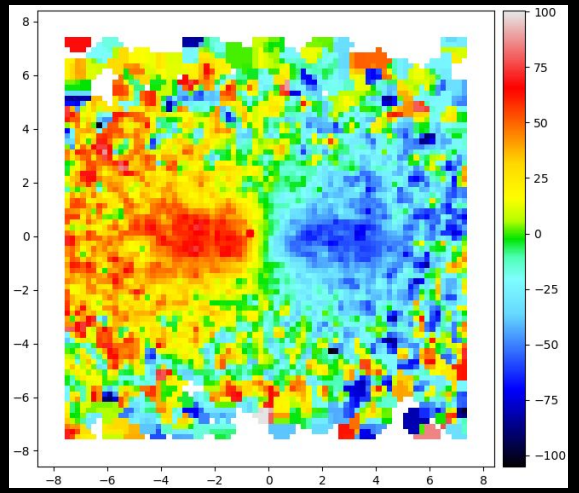


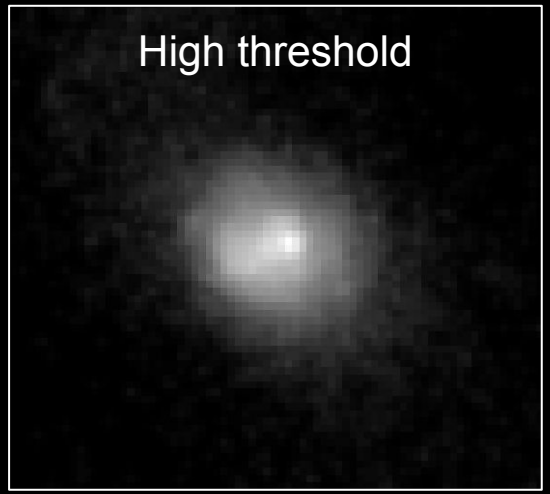
Kinematic analysis

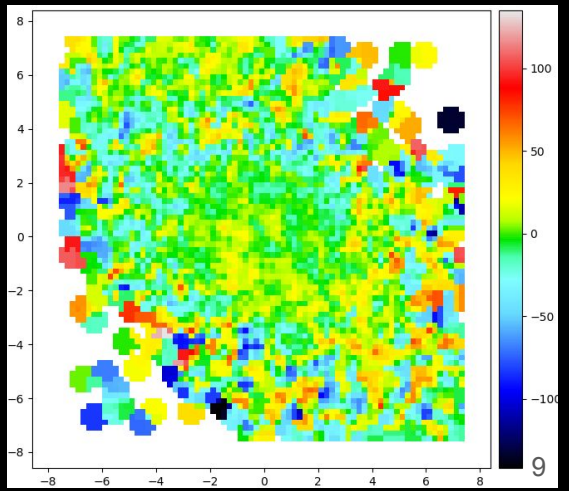
GIST pipeline (Bittner, 2021)

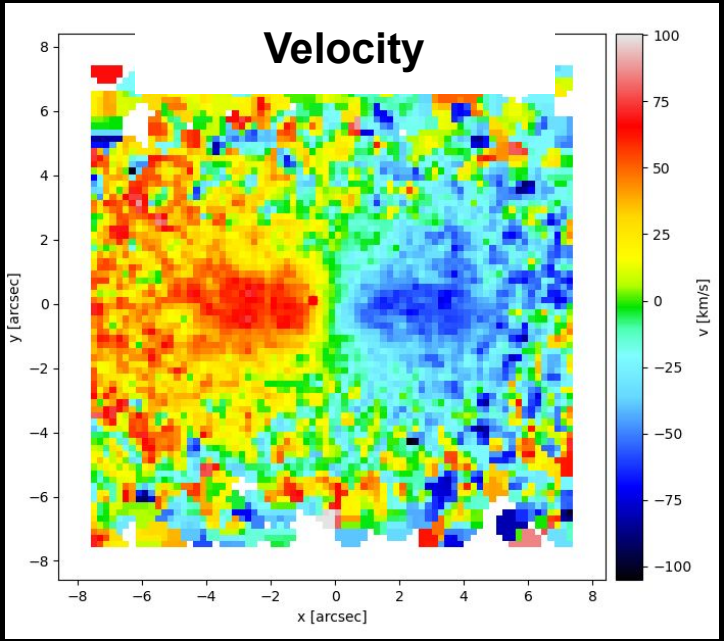
- Data binning
- pPXF fitting of absorption lines → stellar kinematics

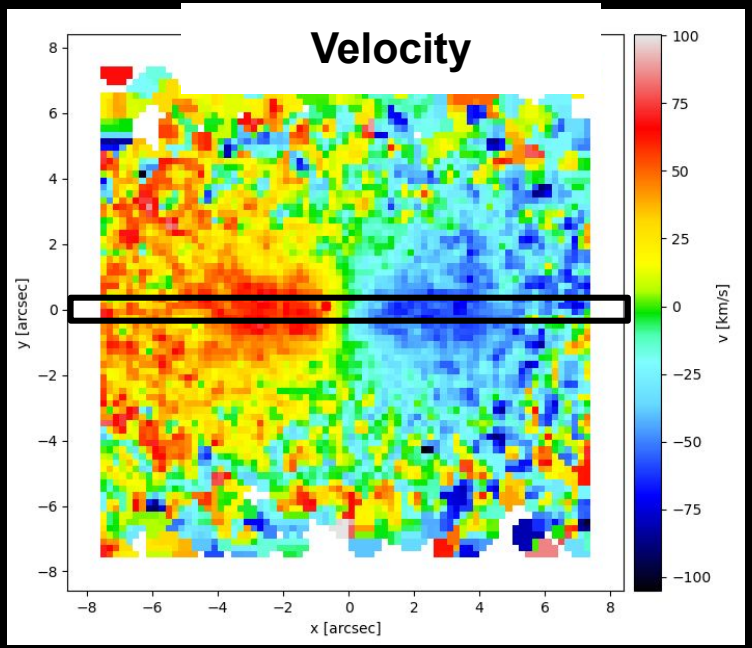




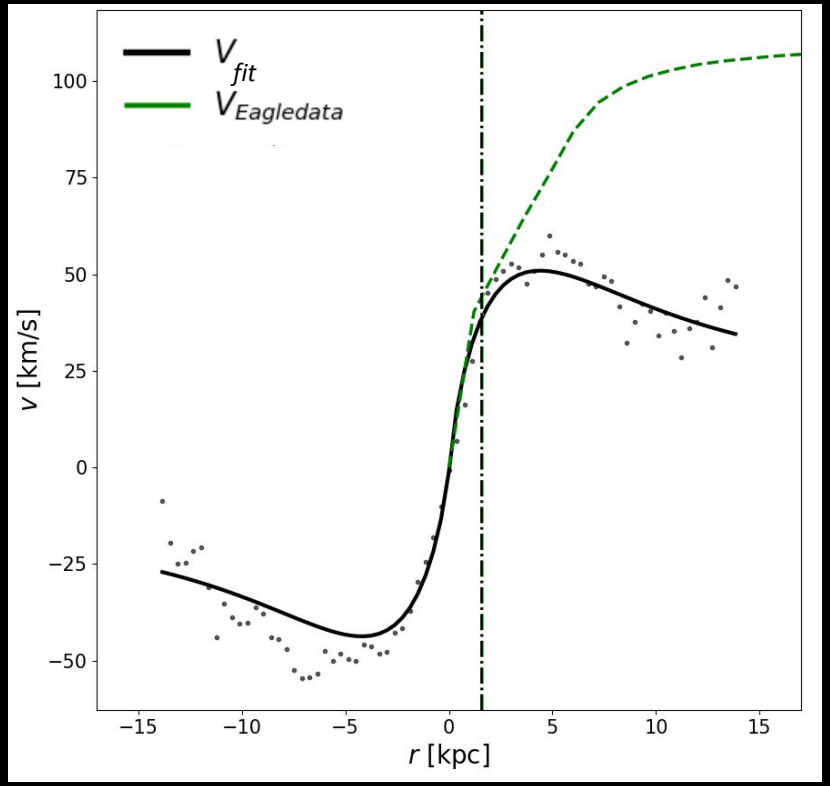








Find major axis of rotation,
Take average over a slit width



Circular velocity

Get velocity of bins, fit, and compare with **EAGLE**

$$v_{circ} = \sqrt{\frac{GM(R)}{R}}$$

Further steps: correct for velocity dispersion?

Next steps

- Compare recovered data with data from EAGLE
- Do the same procedure with galaxies at the higher density threshold and compare differences
- Check fidelity of observational methods in recovering the dark matter density profile

Outlook

- Find V_{in}/V_{max} of the galaxies → get information about the density slope
- Look into age and metallicity

- Test other simulations and add gas dynamics

- Run for higher thresholds