Explaining Diverse Rotation Curves of Spiral Galaxies with Self-Interacting Dark Matter (SIDM)

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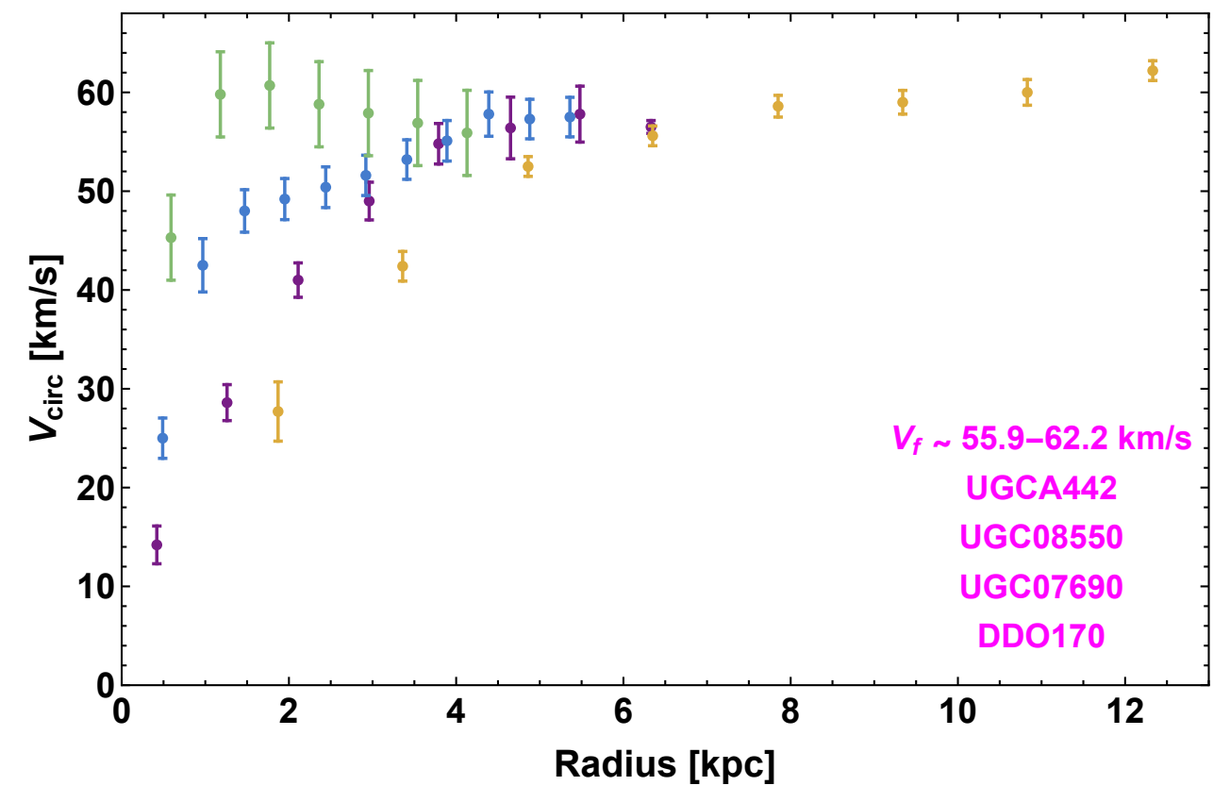
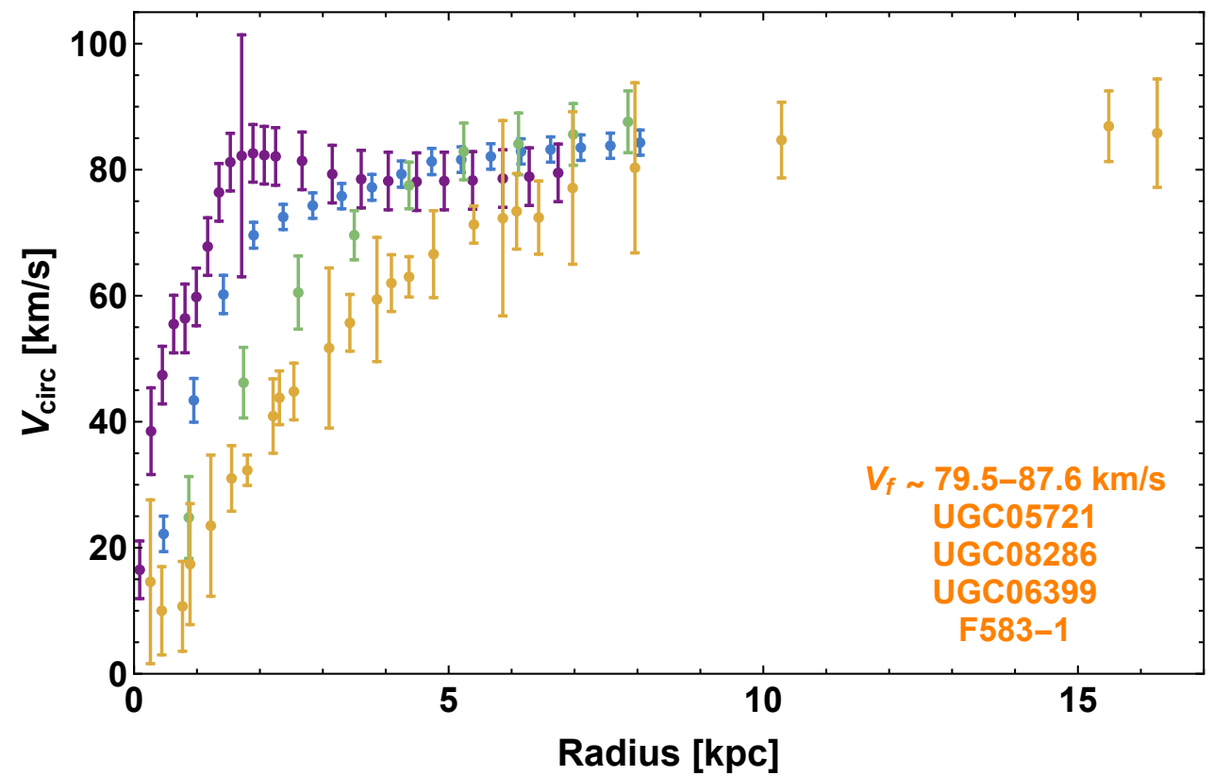
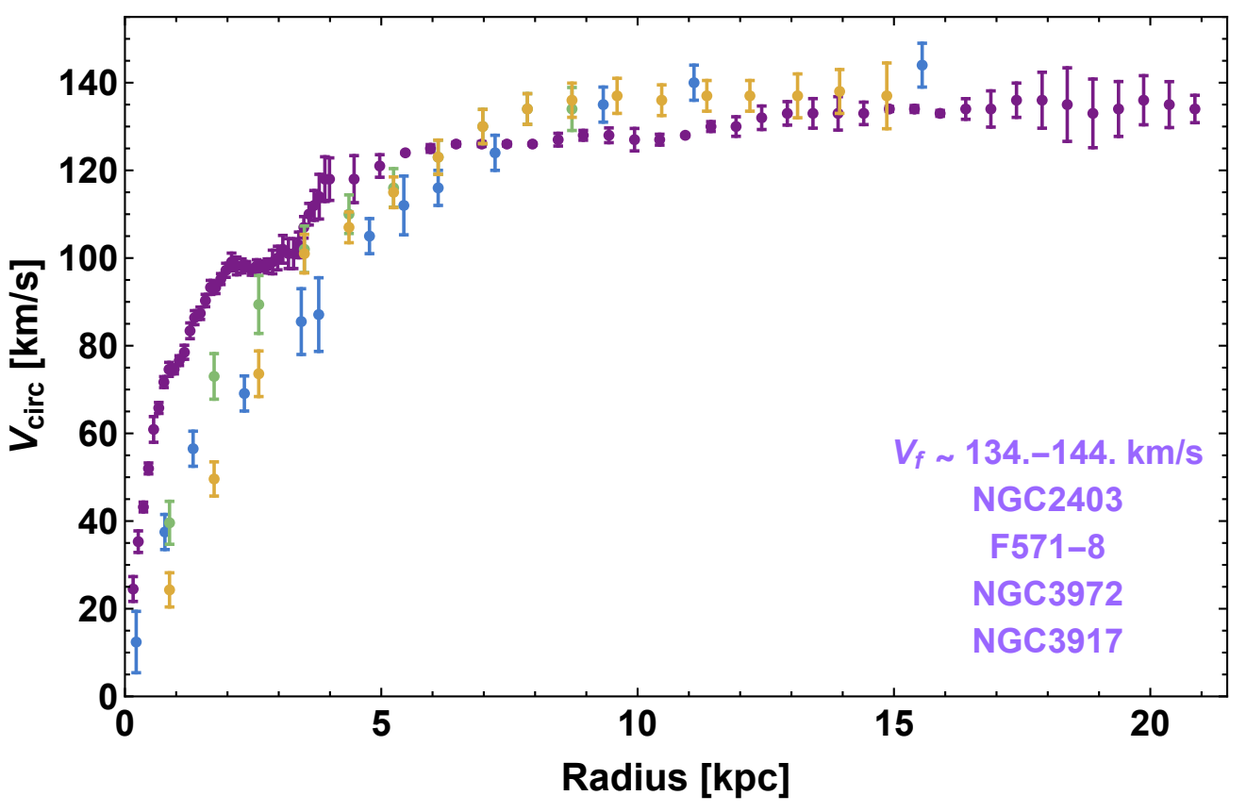
with Hai-Bo Yu (UCR), Anna Kwa, Manoj Kaplinghat (UCI)

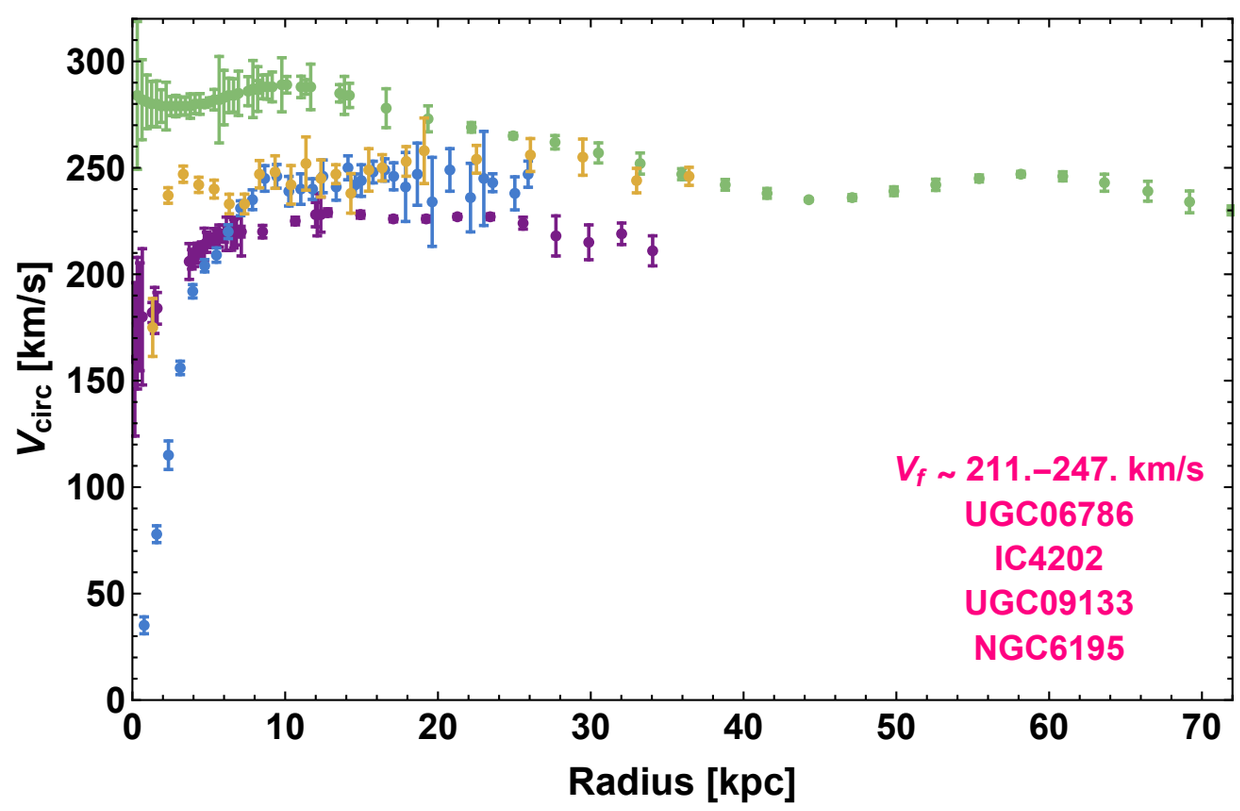
Diversity in Rotation Curves

Data Source: SPARC
1606.09251



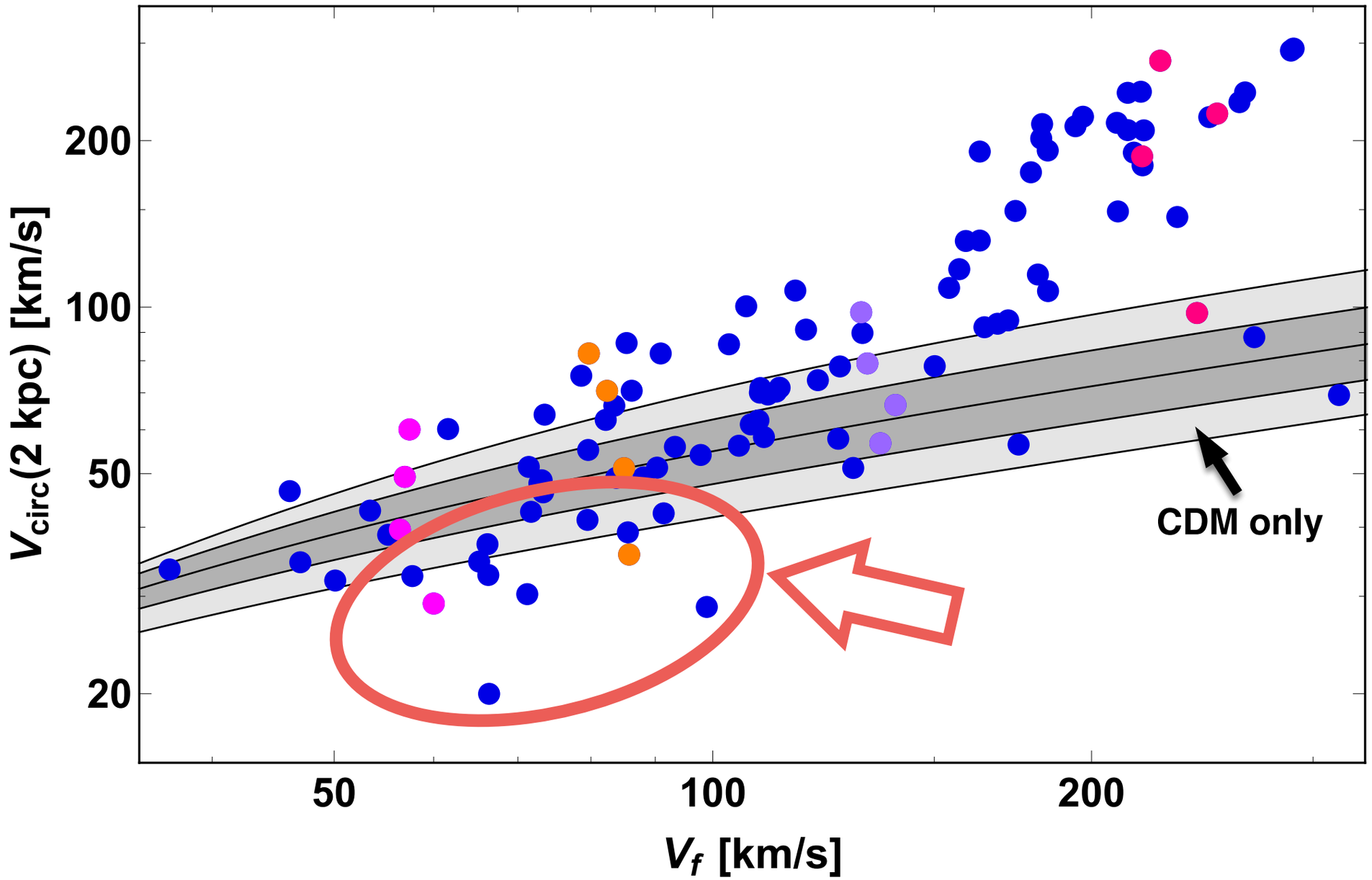






Headache for Cold Dark Matter (CDM)

DM
+
Baryon



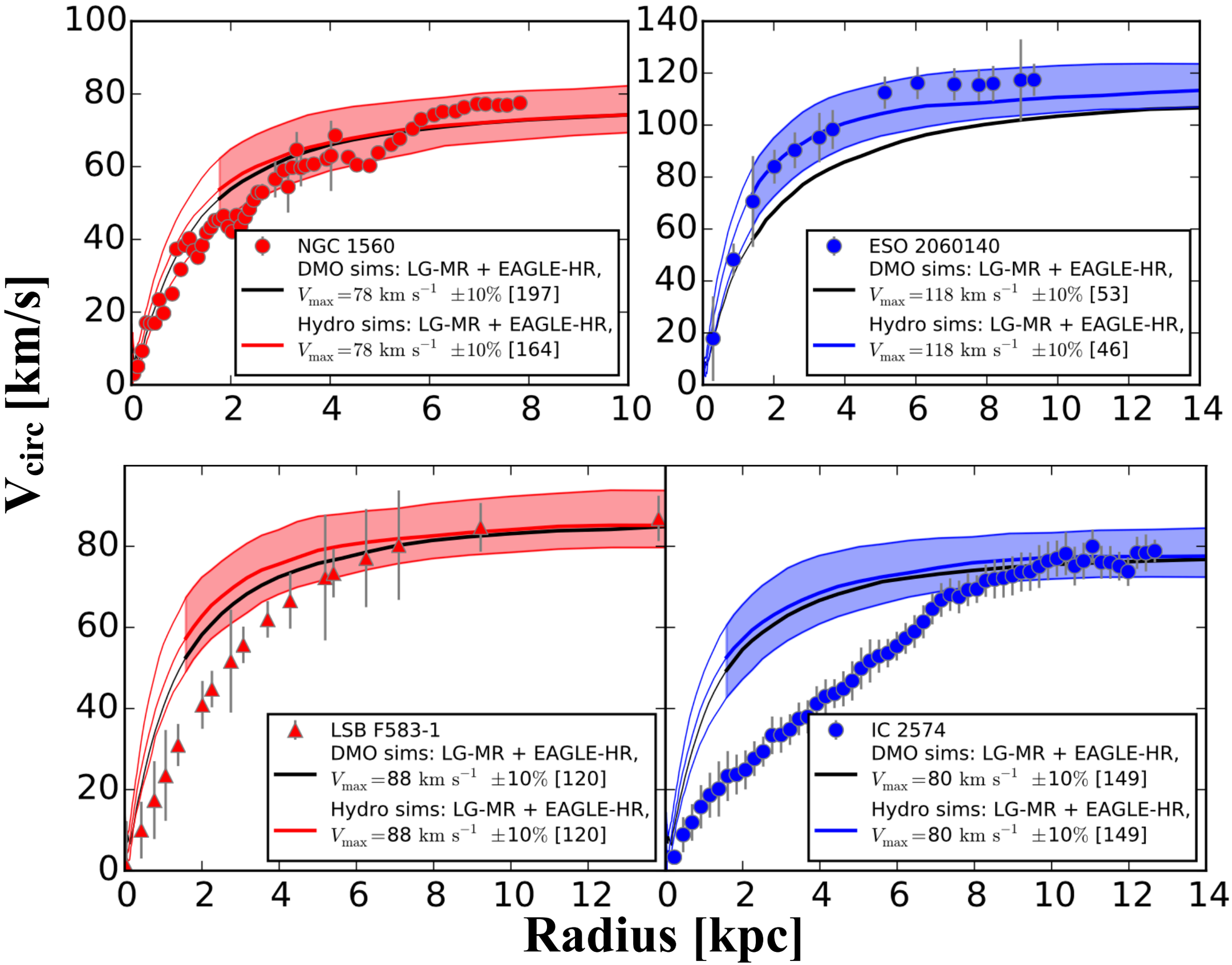
Halo Mass (M200)
&
Concentration (c200)

$$c_{200} = (10^{0.905+\delta*0.11})(\frac{M_{200}}{10^{12} * h^{-1} M_{\odot}})^{-0.101}$$

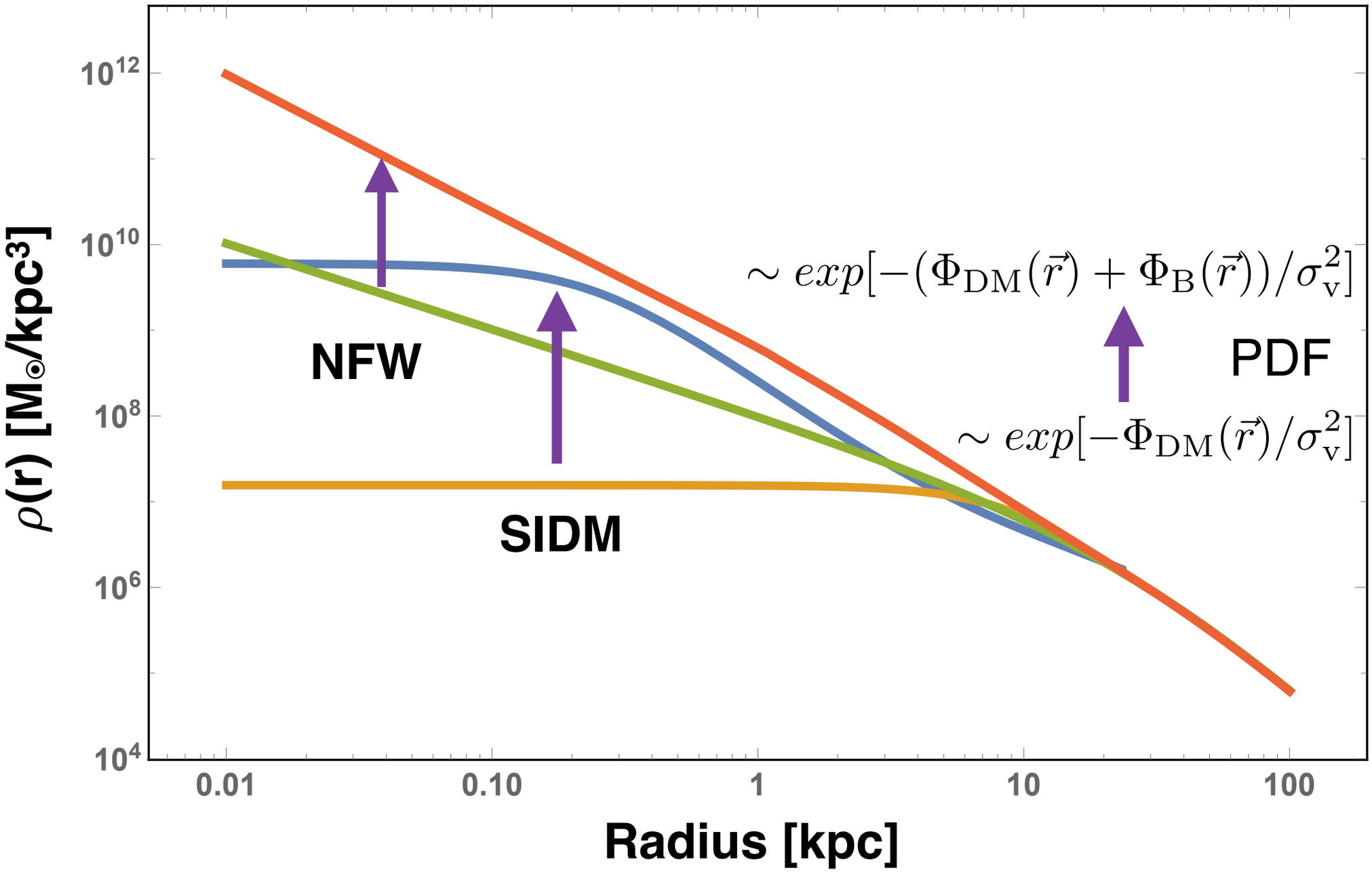
A. A. Dutton et al. (2014)

Examples for the Trouble

K. A. Oman et al. (2015)



SIDM & CDM Density Profile



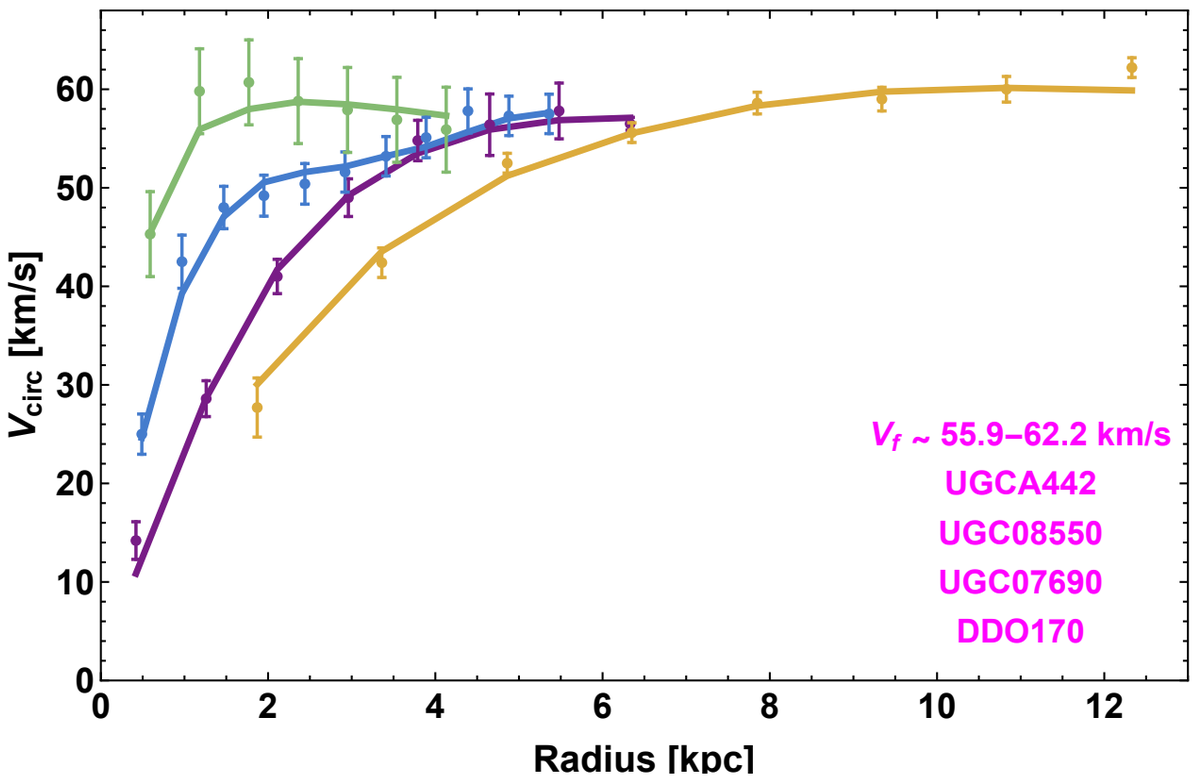
How SIDM works:

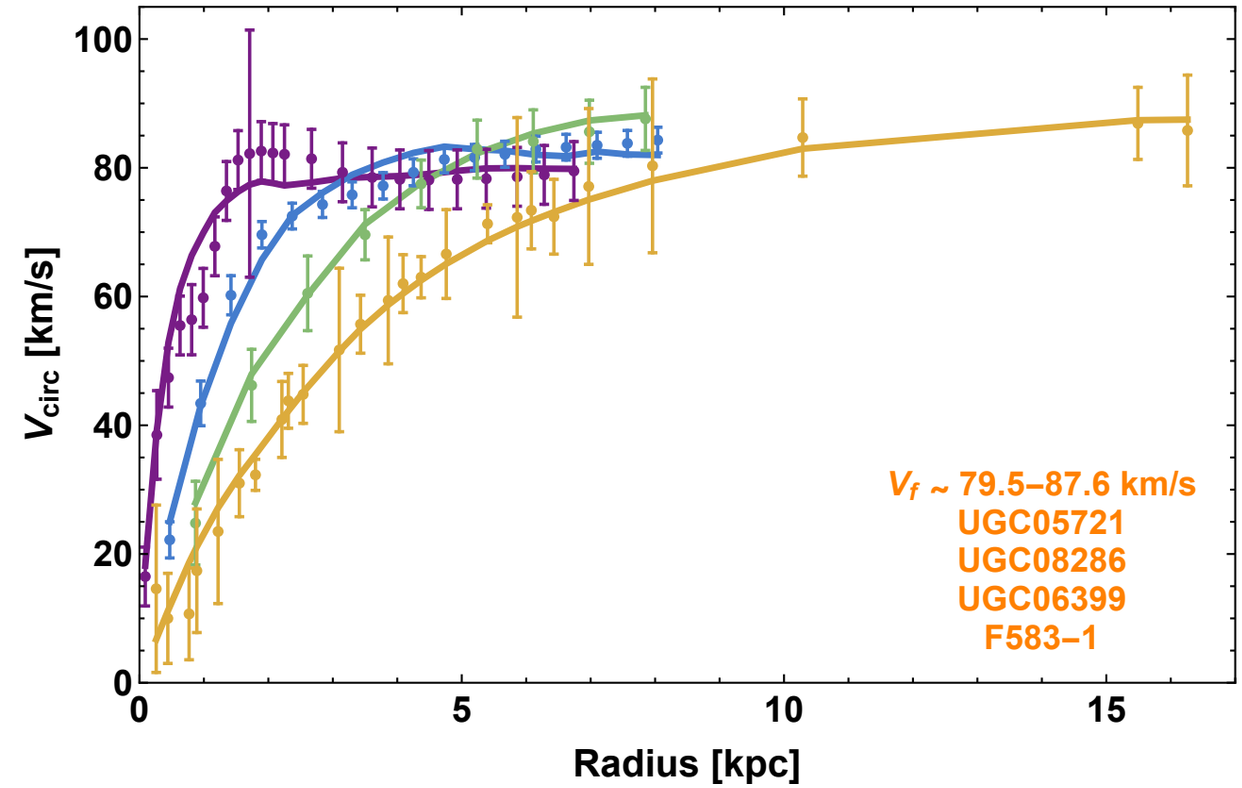
Self-Interaction + Baryon Effect + M200-c200 Relation

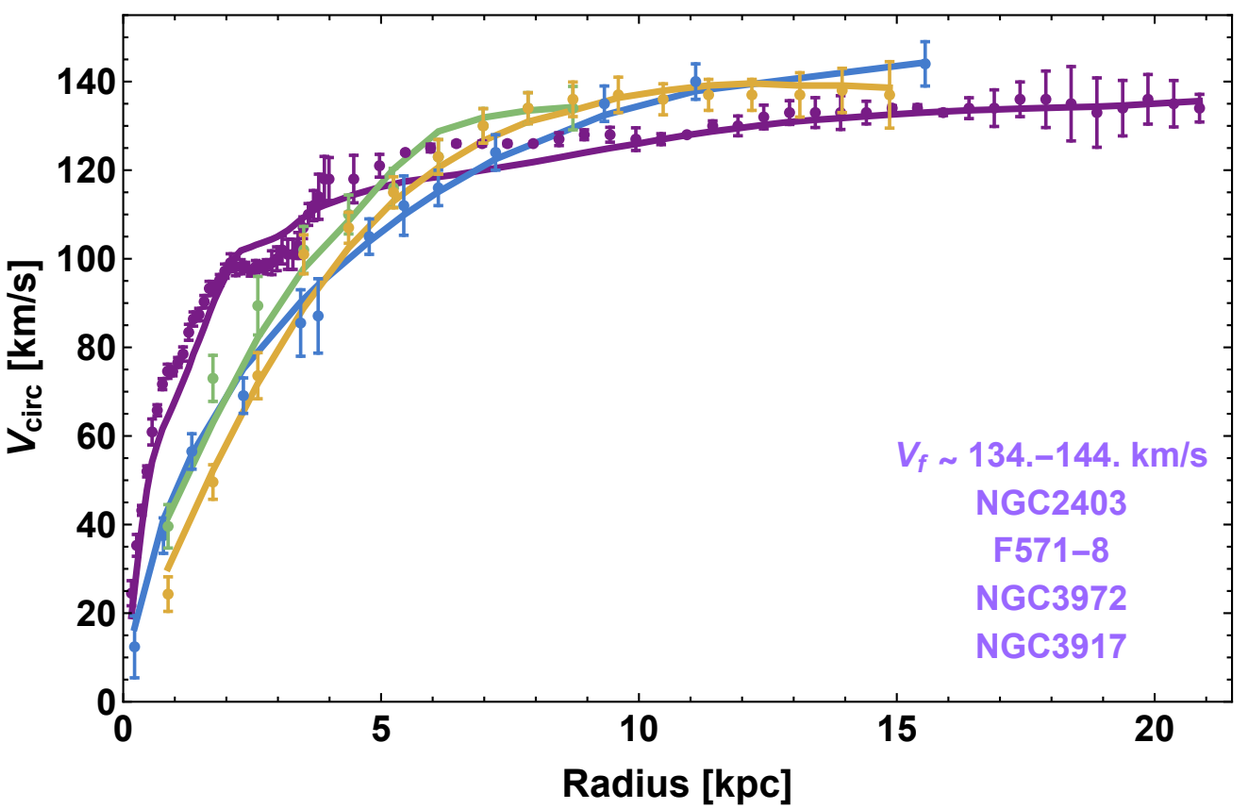
CDM : 1504.01437

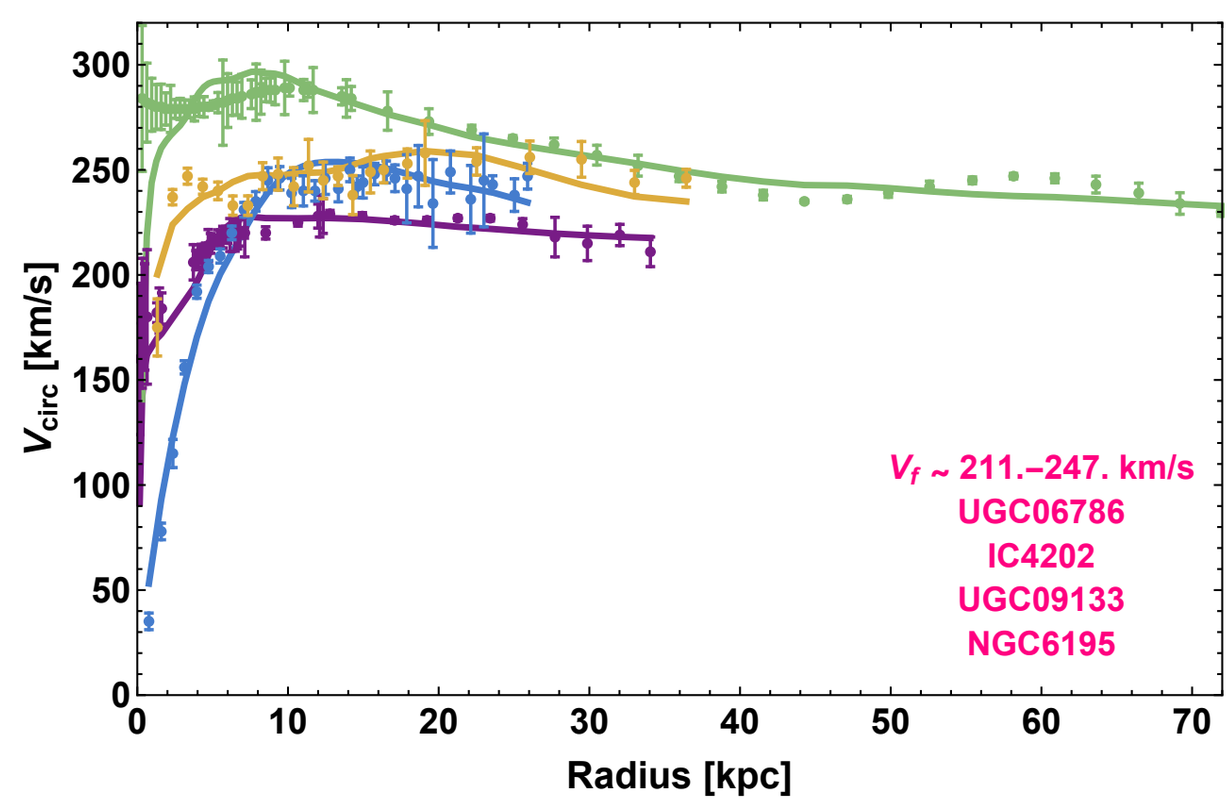
SIDM Fitting Examples

Kamada, Kaplinghat, Pace, Yu, (2016)

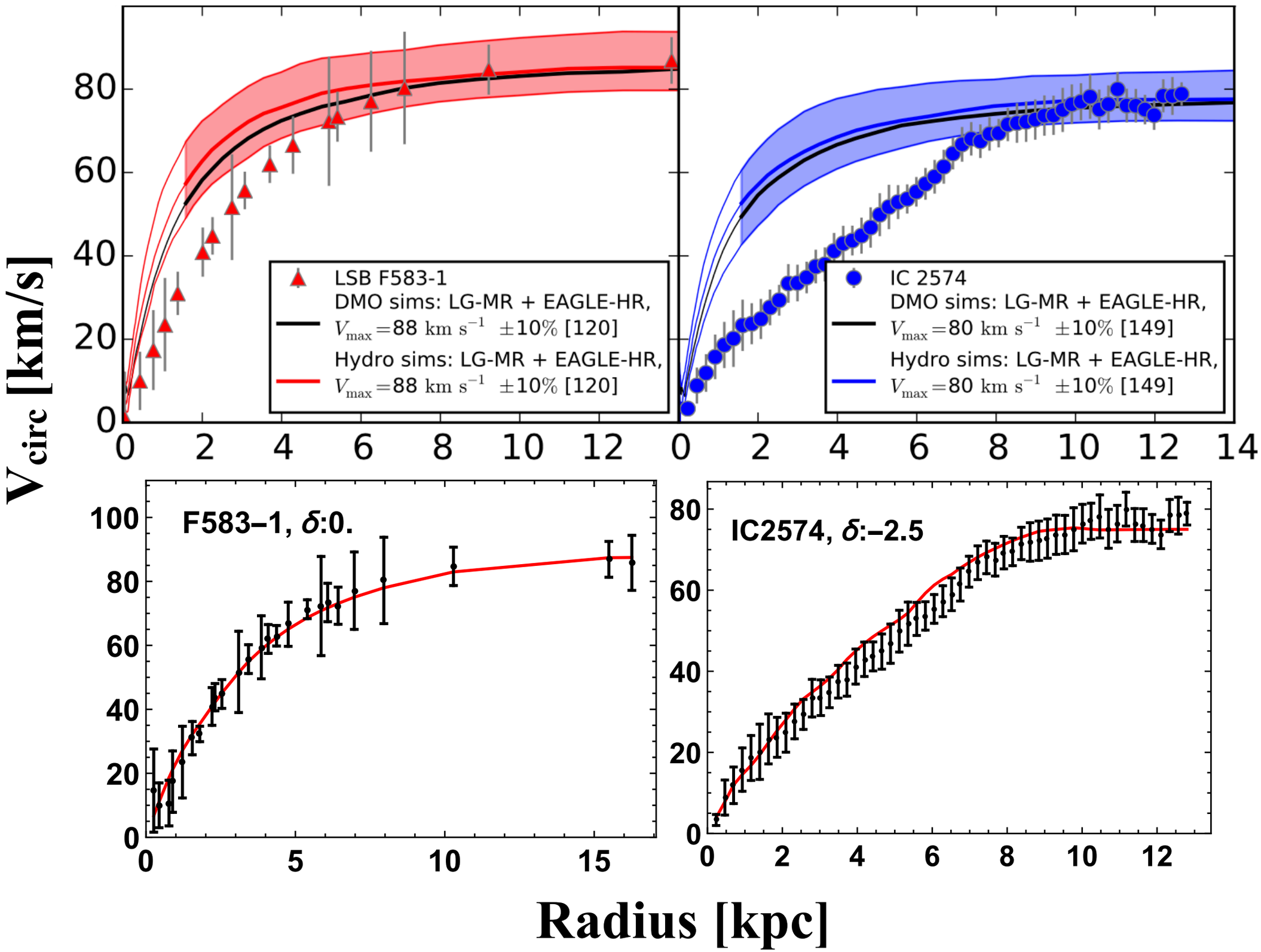






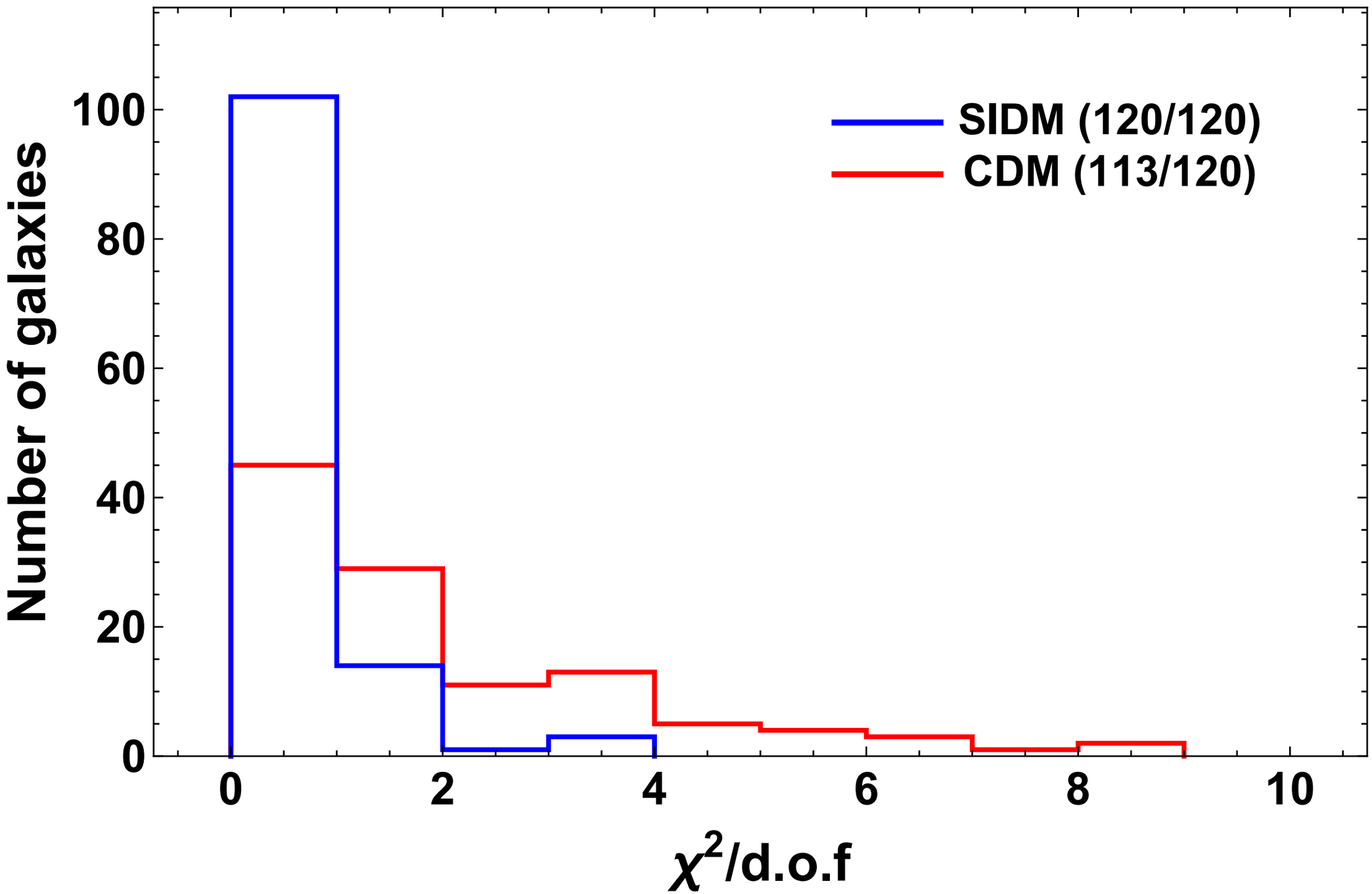


SIDM: the "Aspirin" for "Headache"



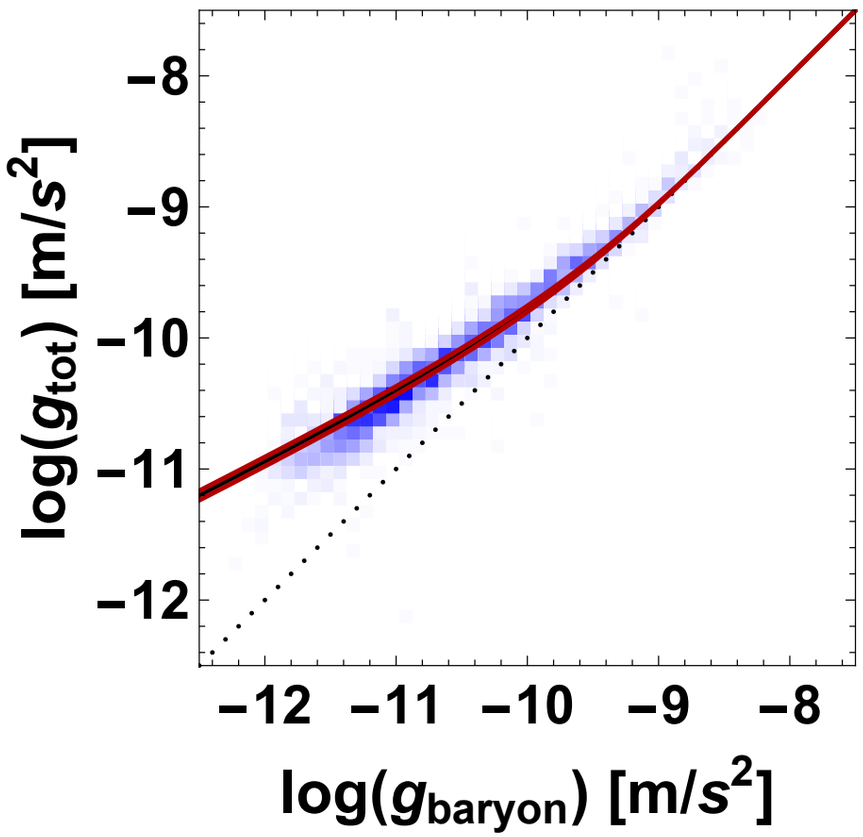
SIDM

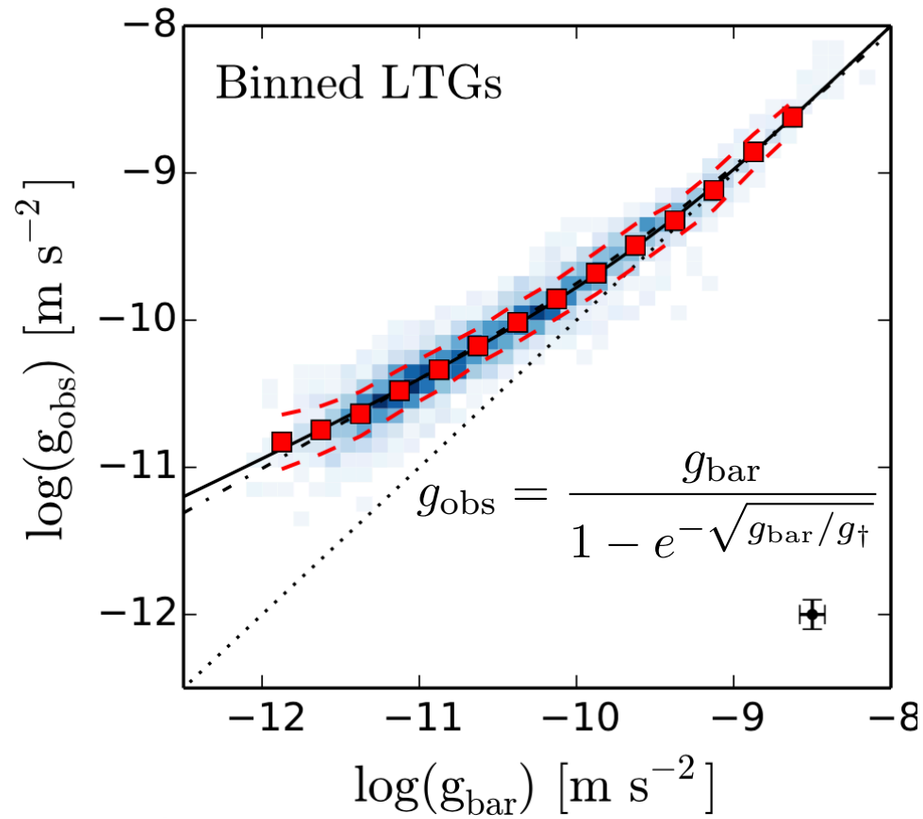
Fitting to 120 Galaxies

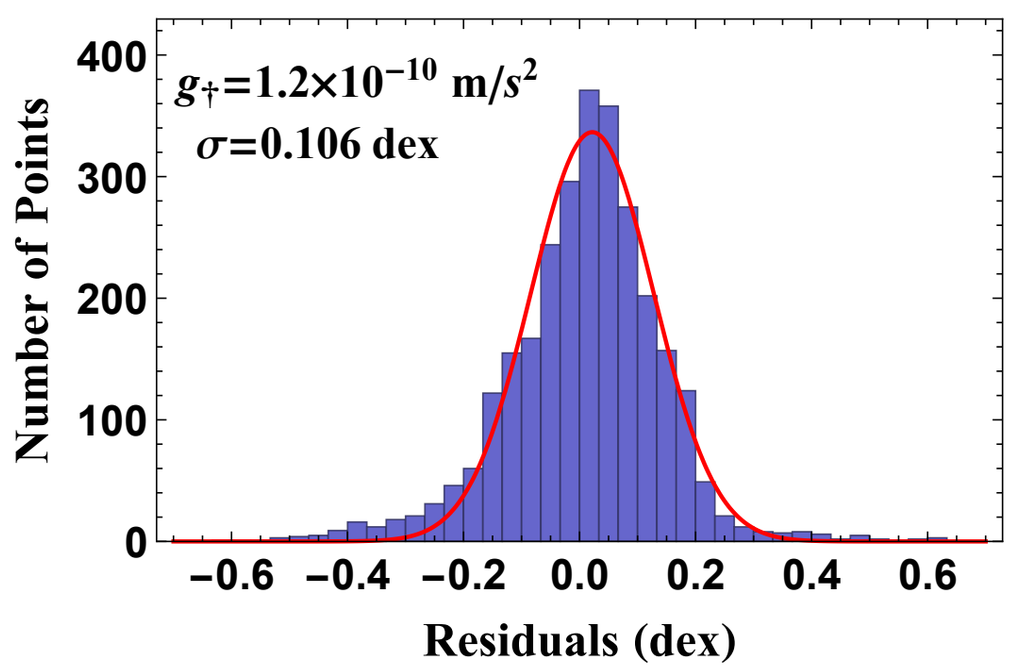


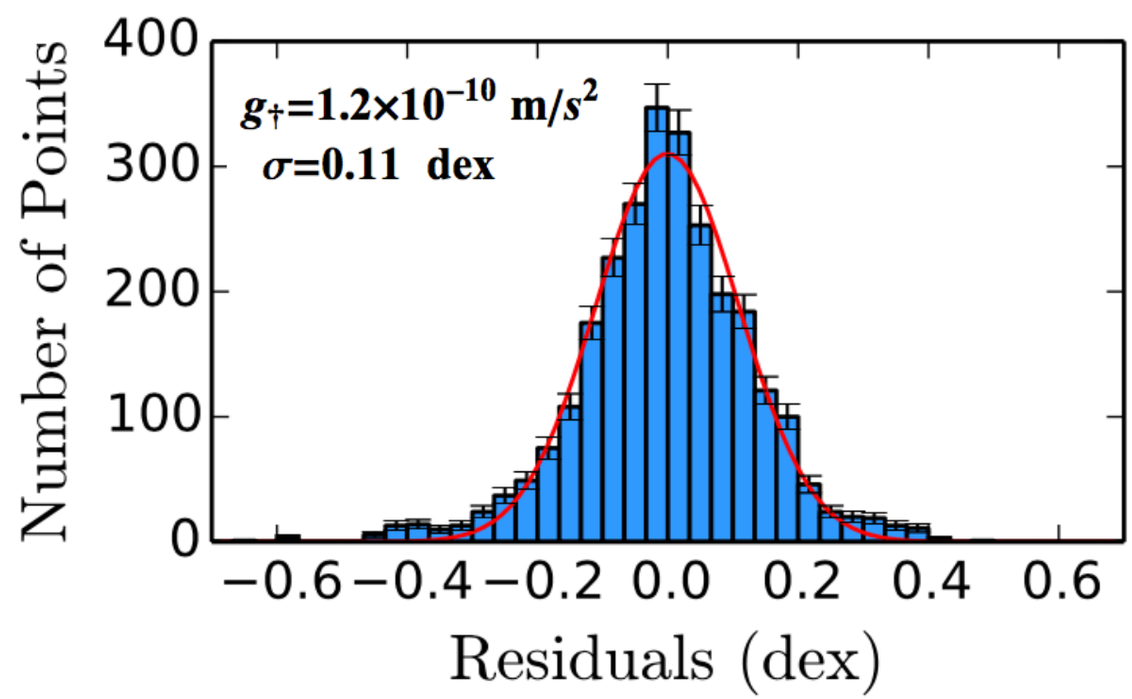
Radial Acceleration Relation

McGaugh, Lelli, Schombert, Pawlowski (2017)









From Diversity to Uniformity

Summary

Diversity in rotation curves of spirals

Trouble of CDM

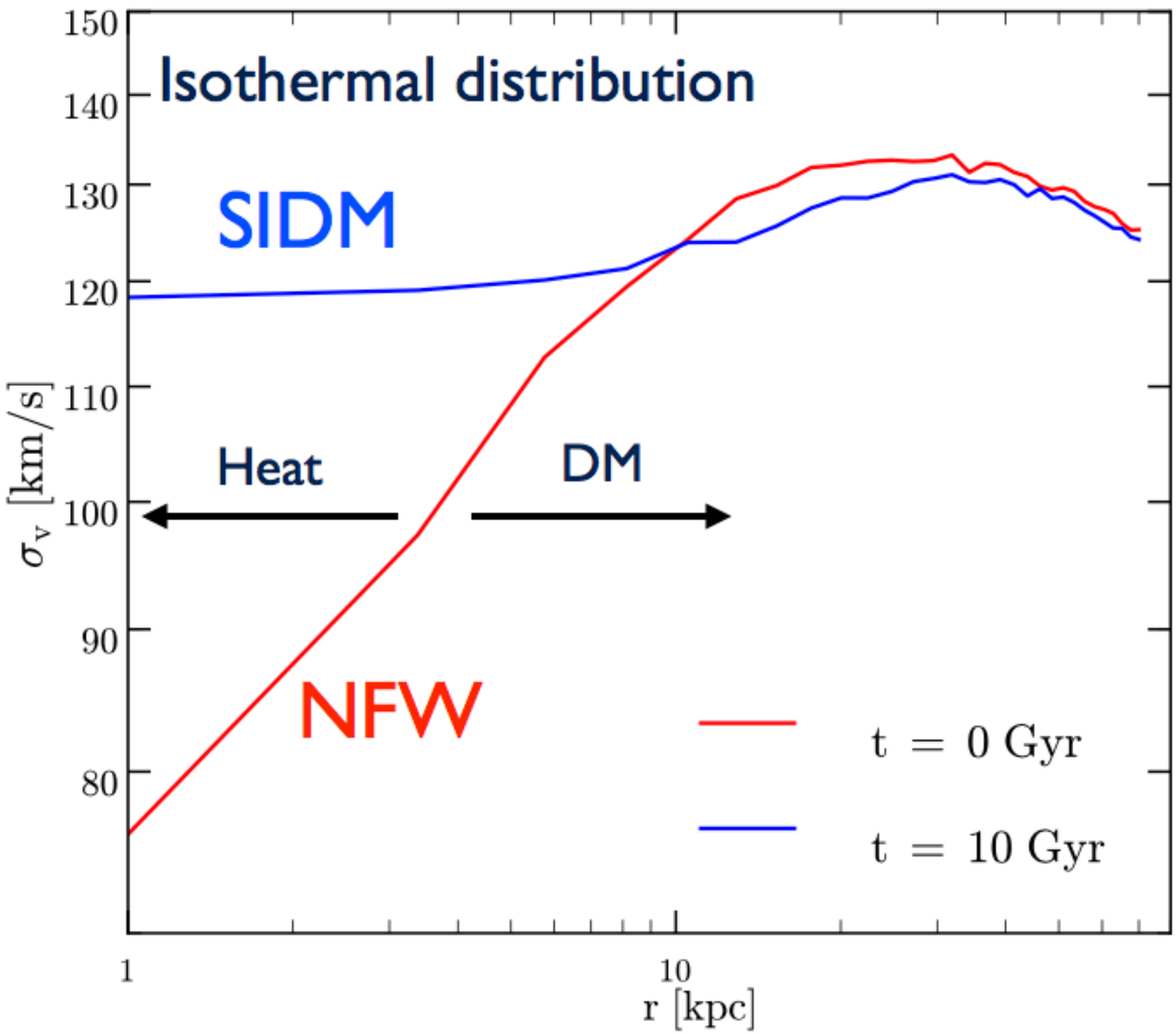
How SIDM works :
Self-Interaction+Baryon effect+M200-c200

Fitting results for 120 galaxies

Radial acceleration relation

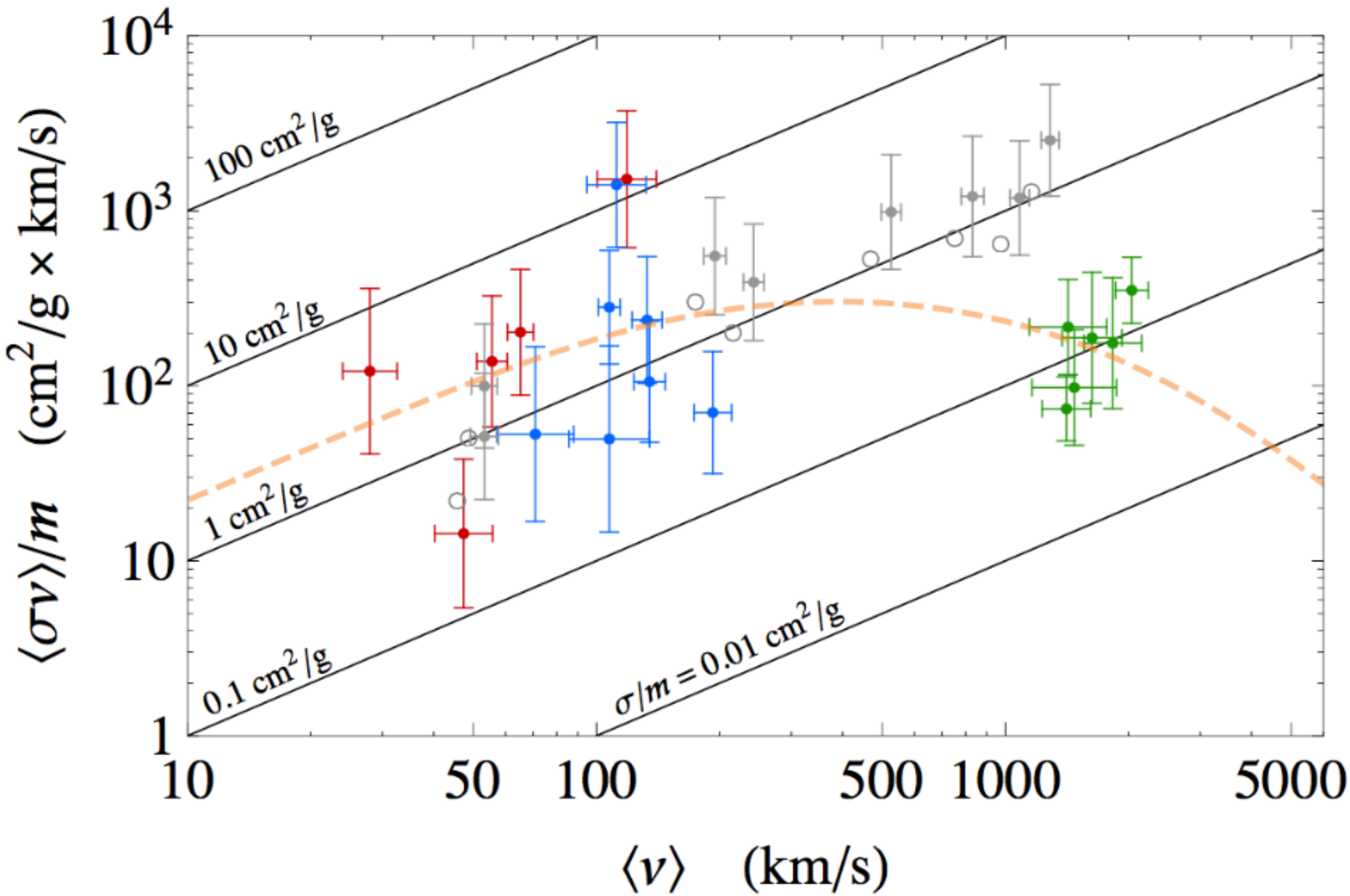
Back Up Slides
&
Supporting Information

Self-interaction & Velocity Dispersion



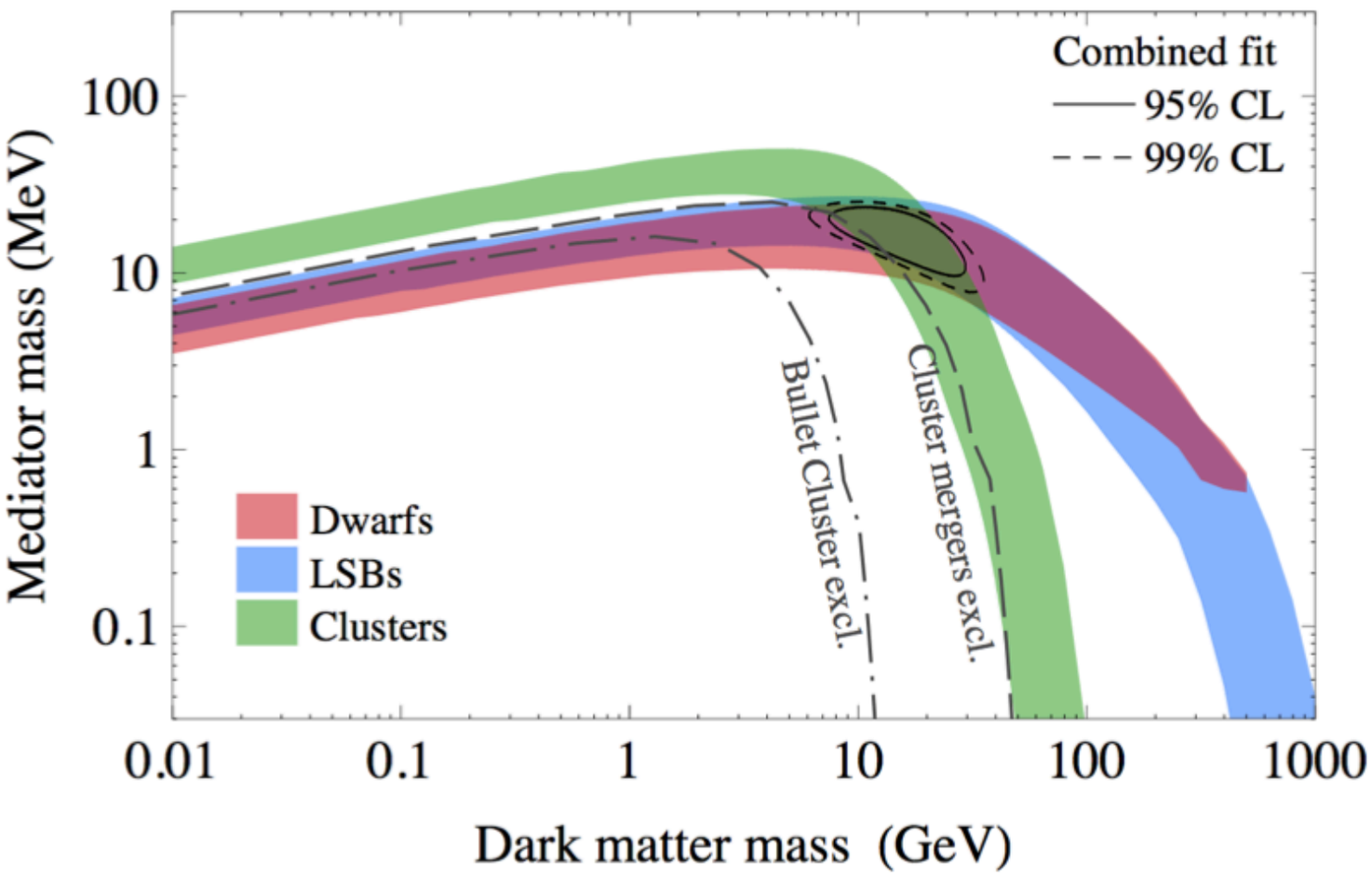
with Huo+(UCR SIDM code)

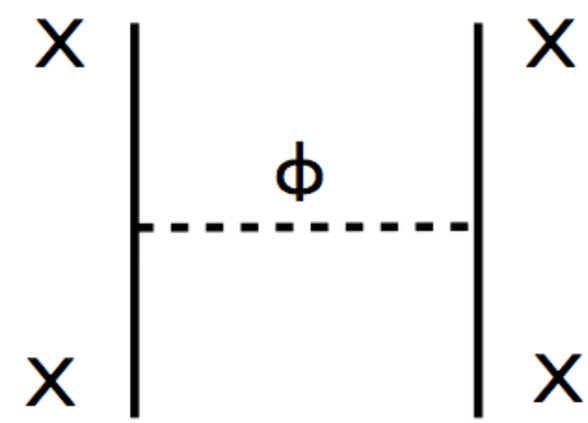
Velocity Dependent Cross Section



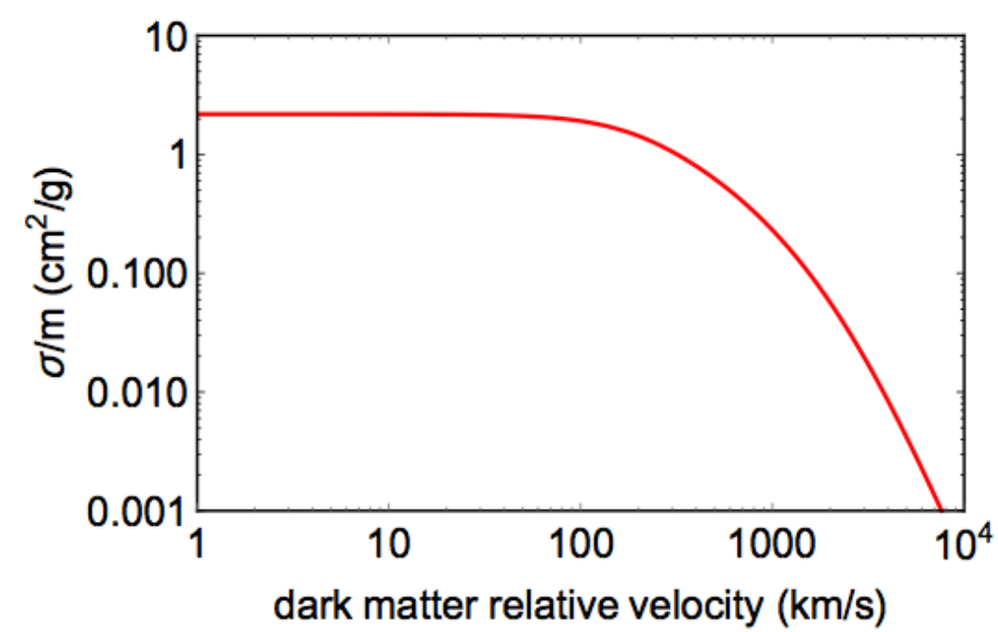
Kaplinghat, Tulin, Yu (2015)

SIDM Model Example & Parameter Measurement



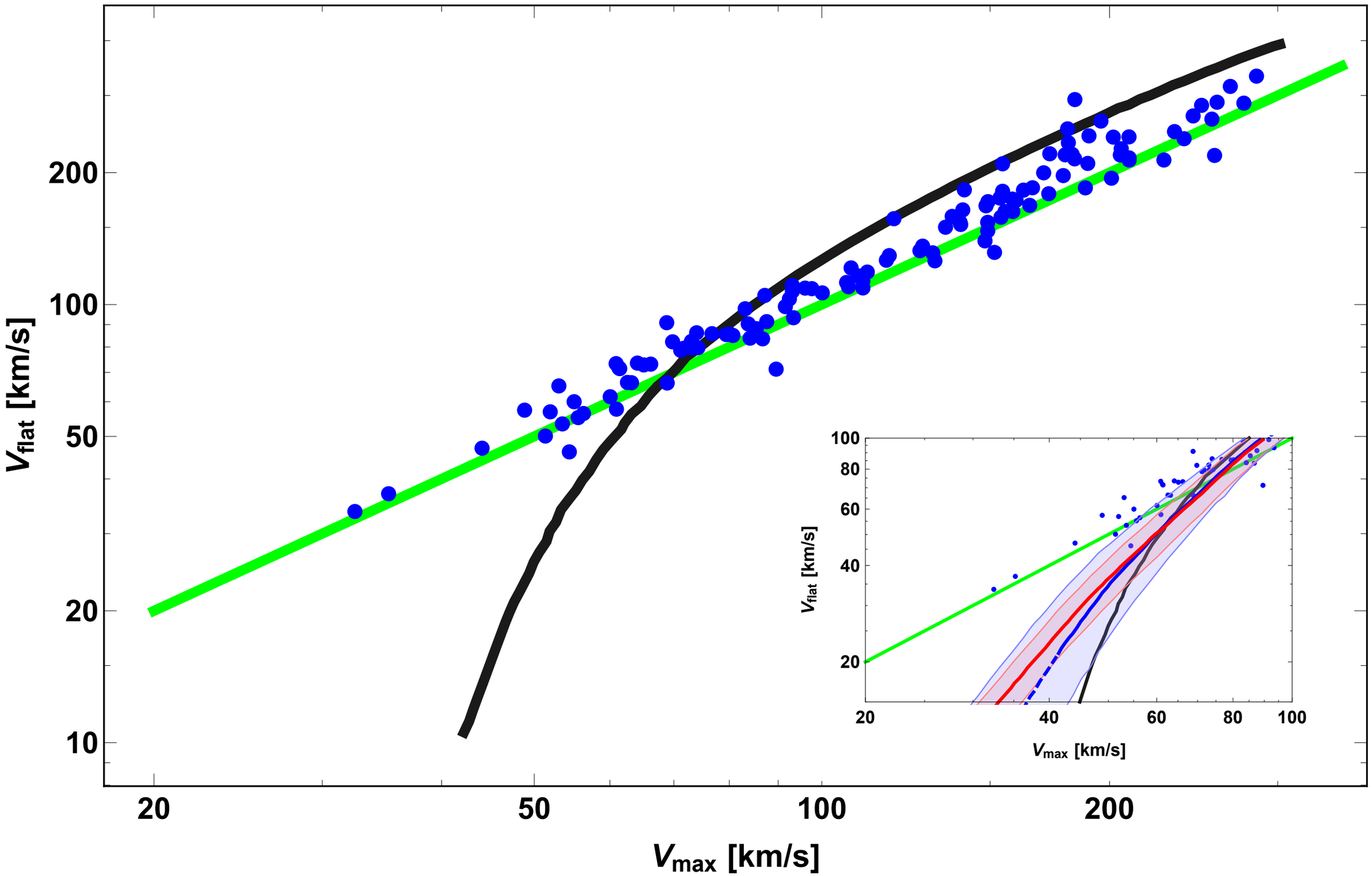


$$V(r) = \frac{\alpha_X}{r} e^{-m_\phi r}$$



$\alpha_X = 1/137$

m_X: ~15 GeV, m_ϕ: ~17 MeV

with Kaplinghat, Tulin (PRL 2015)

Possible Too-Big-To-Fail Problem in SIDM