

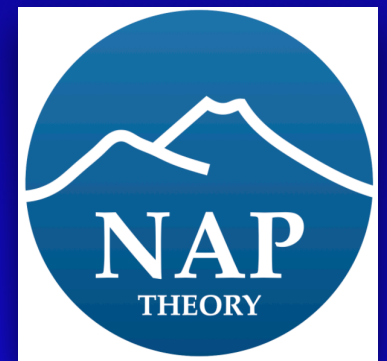
*The Milky Way mass
(and DM distribution)
in the GAIA era*

Fabio Iocco

Università Federico II, NAPOLI

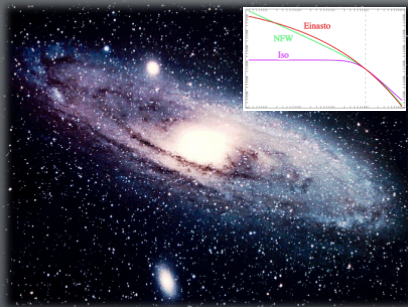


DM & CR focus meeting
Napoli, 11 Nov. '24

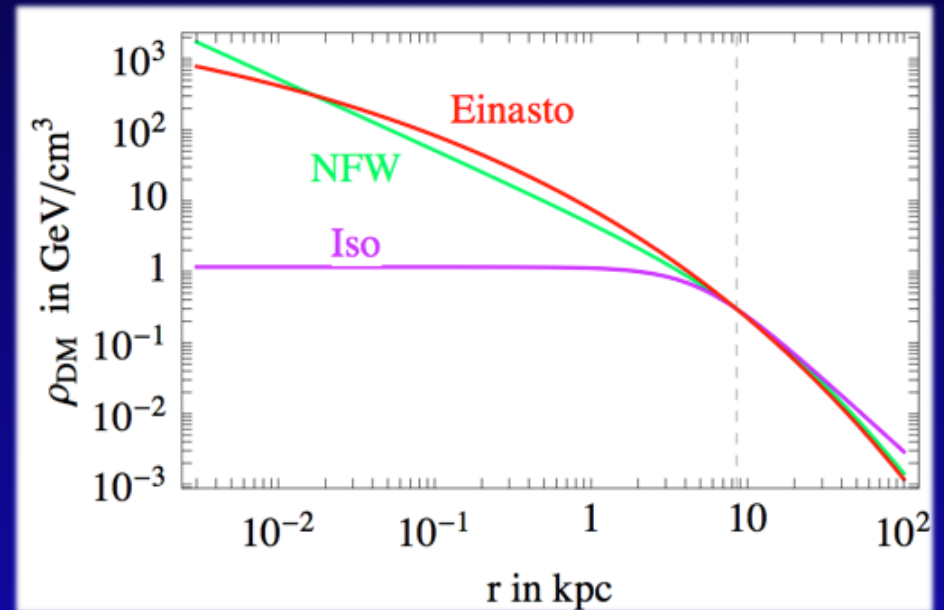


A story of Λ CDM the single halo

A “universal” DM profile?



(not in scale!)



NAVARRO-FRENK-WHITE

$$\rho(R) \propto \frac{R_s}{R} \left(1 + \frac{R}{R_s} \right)^{-2}$$

Direct and indirect searches of WIMP DM *complementary to colliders*

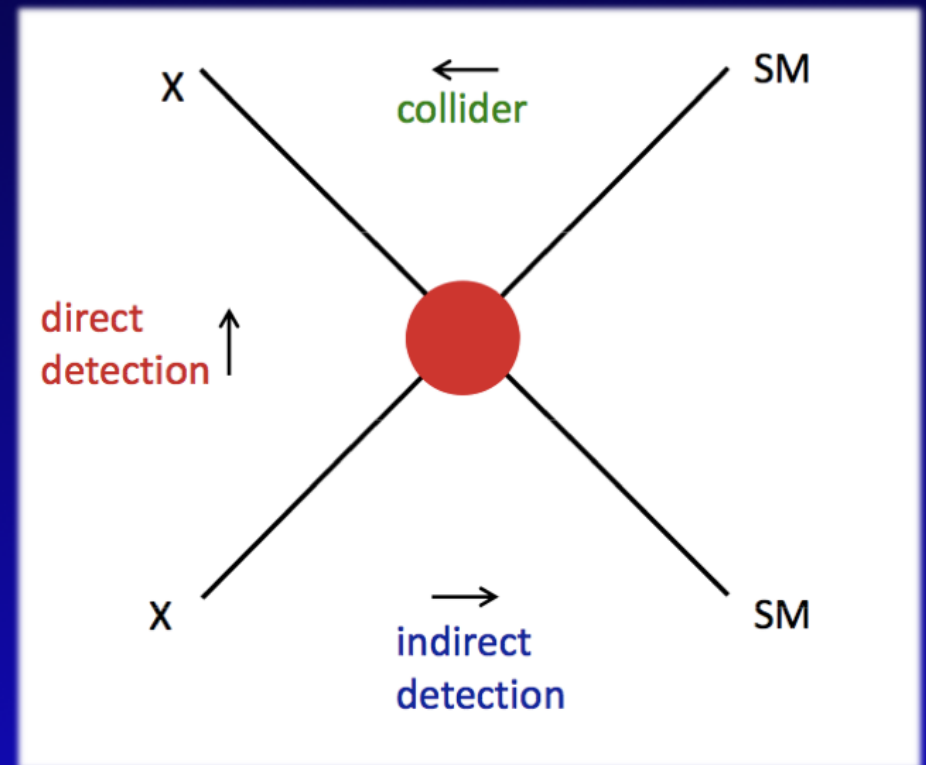
Direct detection:

DM scattering against nuclei, recoil

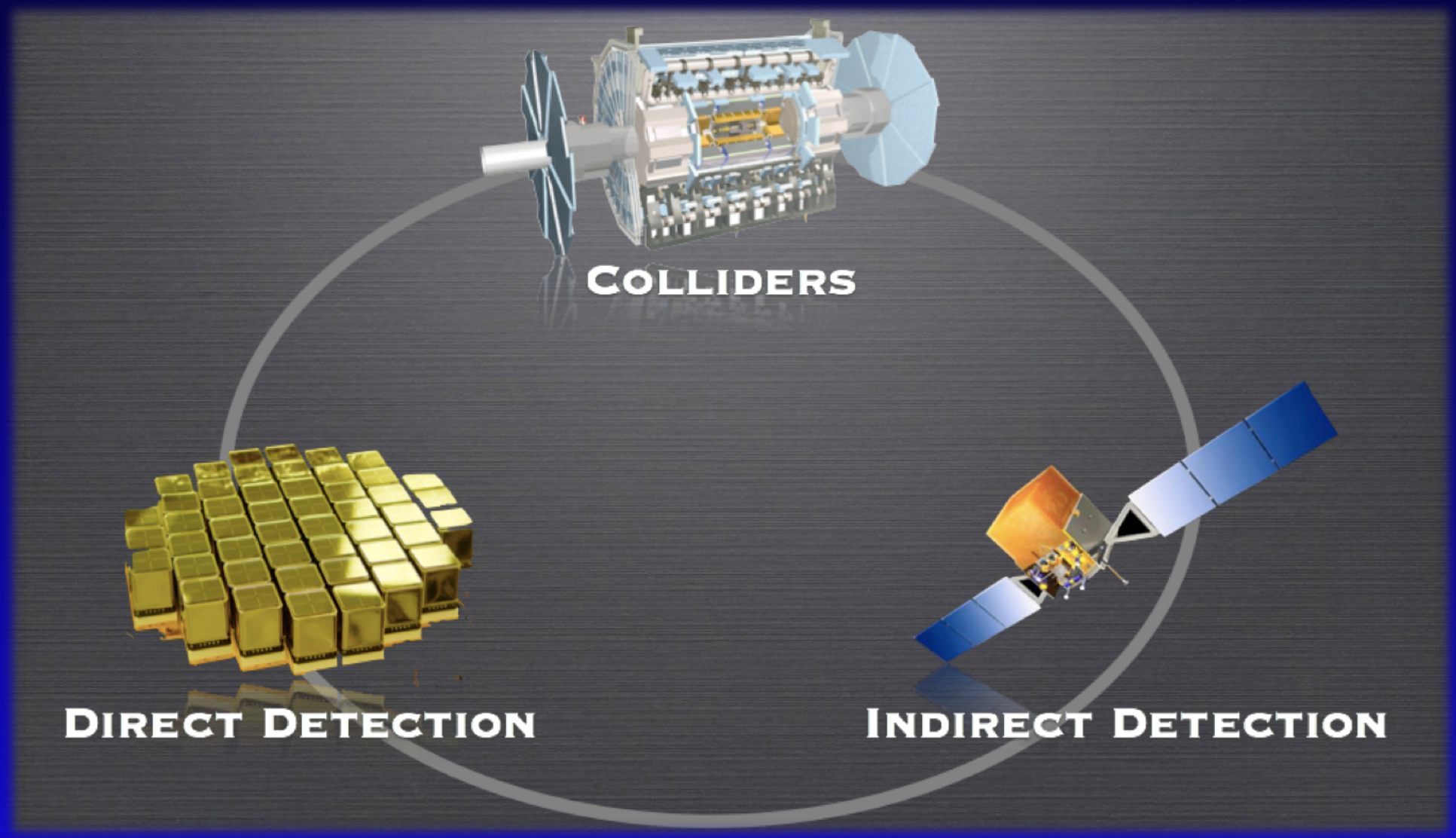
Indirect detection:

Annihilation in astrophysical enviro.
Observation of SM products of annih.

Production at LHC

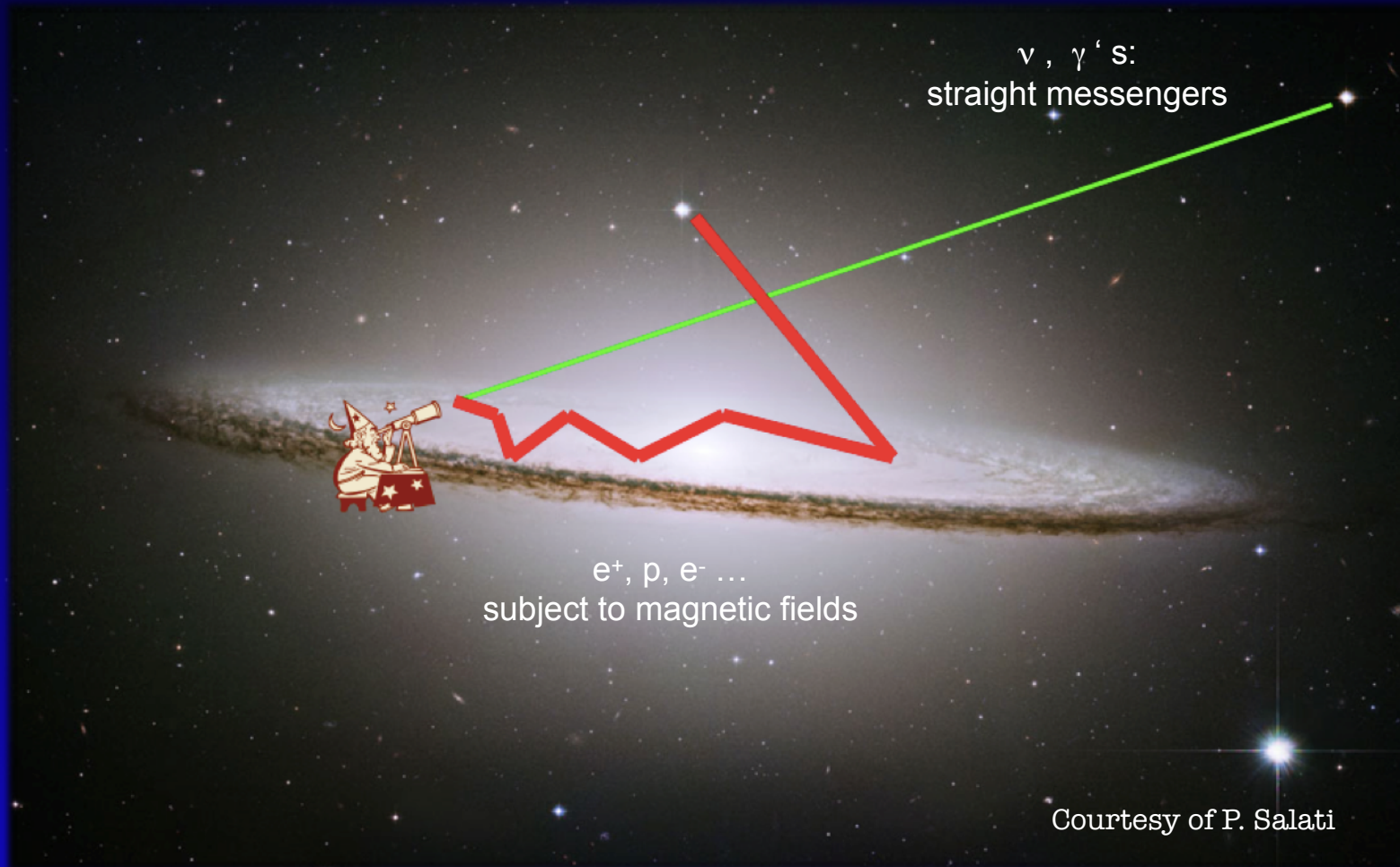


Roundabout of complementarity (for WIMP DM)



Indirect Detection: principles and dependencies

$$\chi + \chi \rightarrow q\bar{q}, W^+W^-, \dots \rightarrow \gamma, \bar{p}, \bar{D}, e^+ \text{ \& } \nu's$$



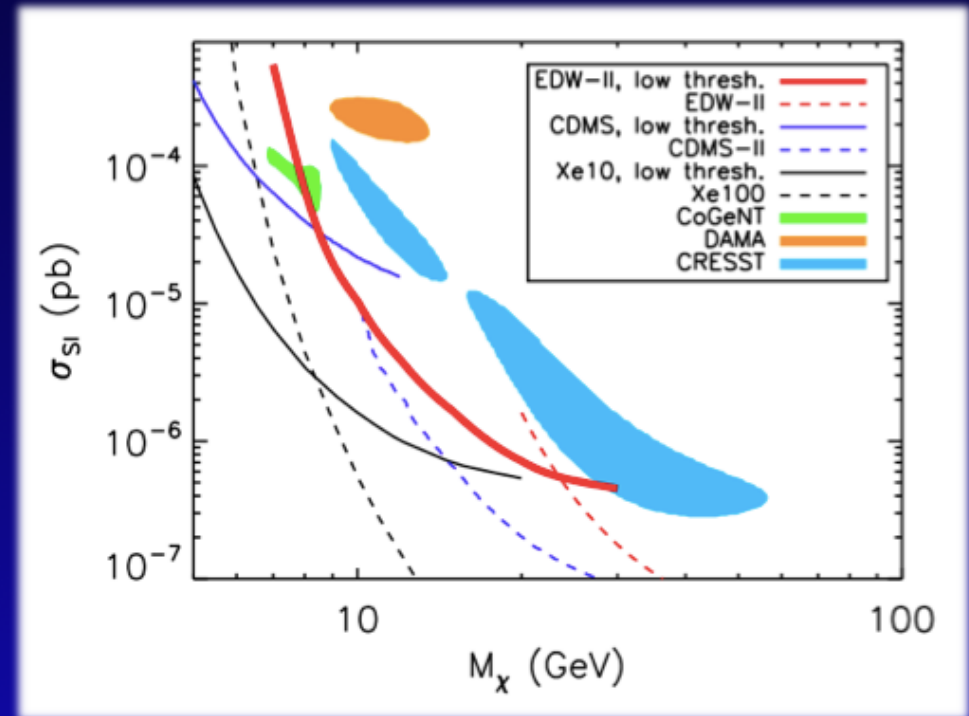
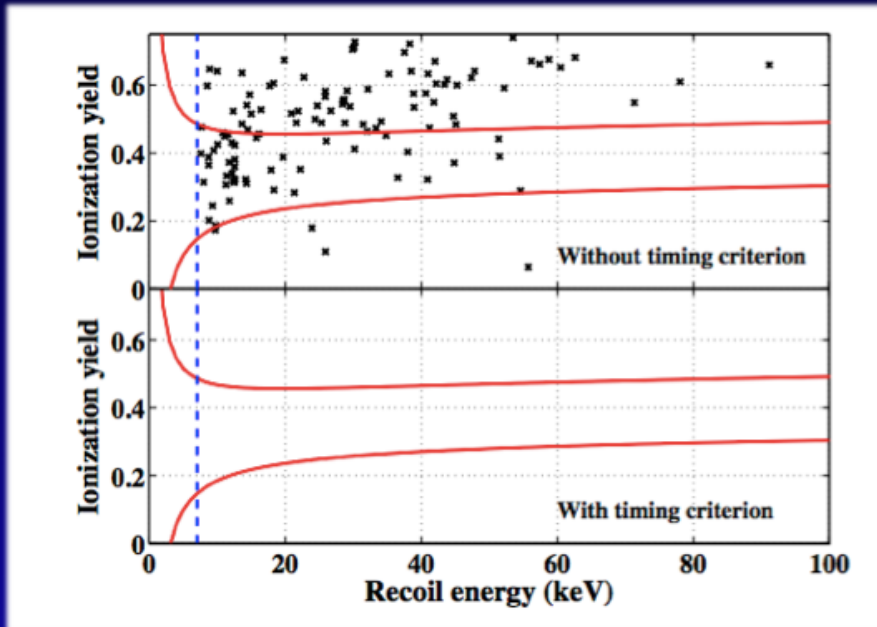
$$F_i \propto \frac{1}{4\pi d^2} B_i \frac{\langle \sigma v \rangle}{m_\chi} \int \rho^2(r) dV$$

Direct Detection: principles and dependencies (curiosity finally satisfied, thanks for waiting)

from this



to this

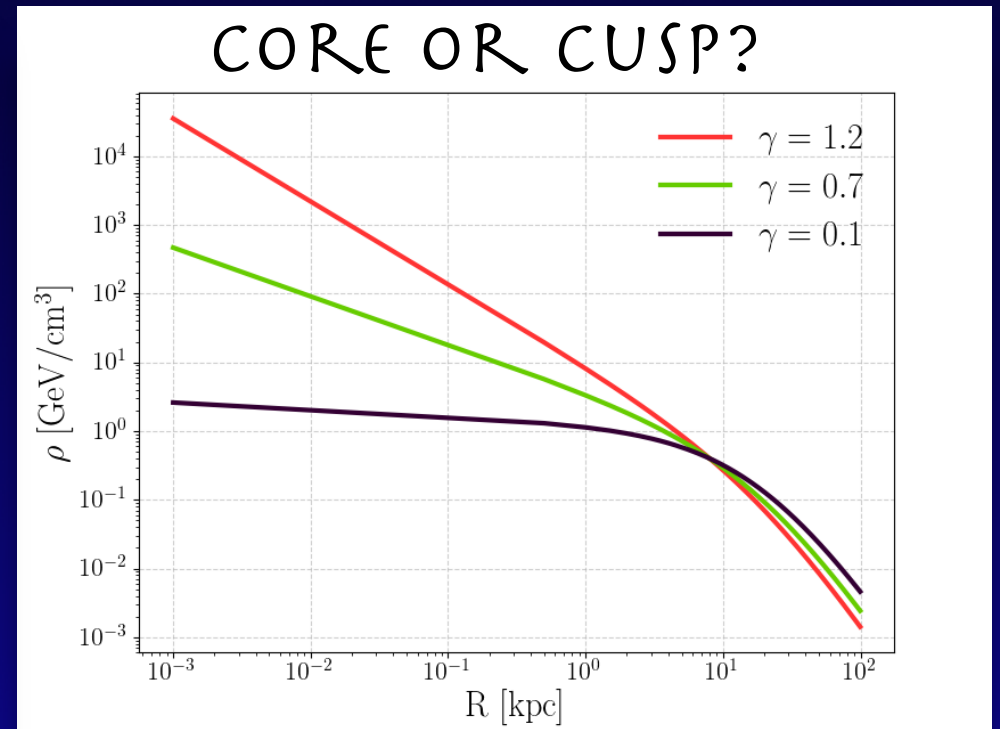
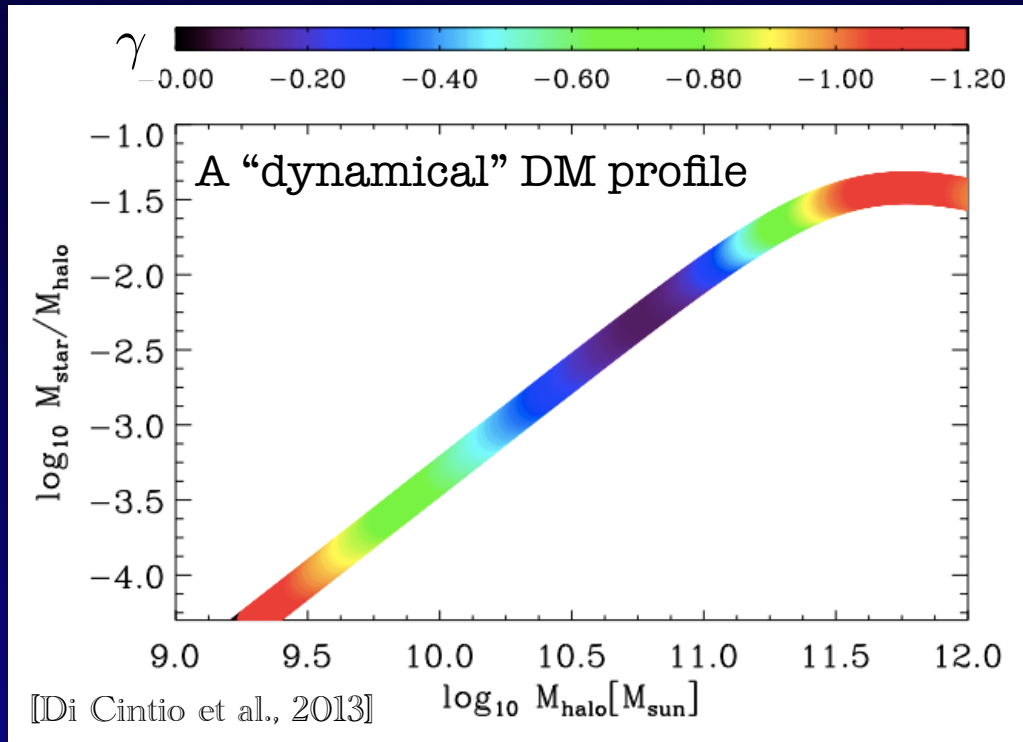


you need this

$$\frac{dR}{dE} \propto \frac{1}{\mu^2} \frac{\sigma_{\chi}}{m_{\chi}} \rho_0 \eta(v, t)$$

A story of Λ CDM

III. the dark matter distribution



generalized NFW

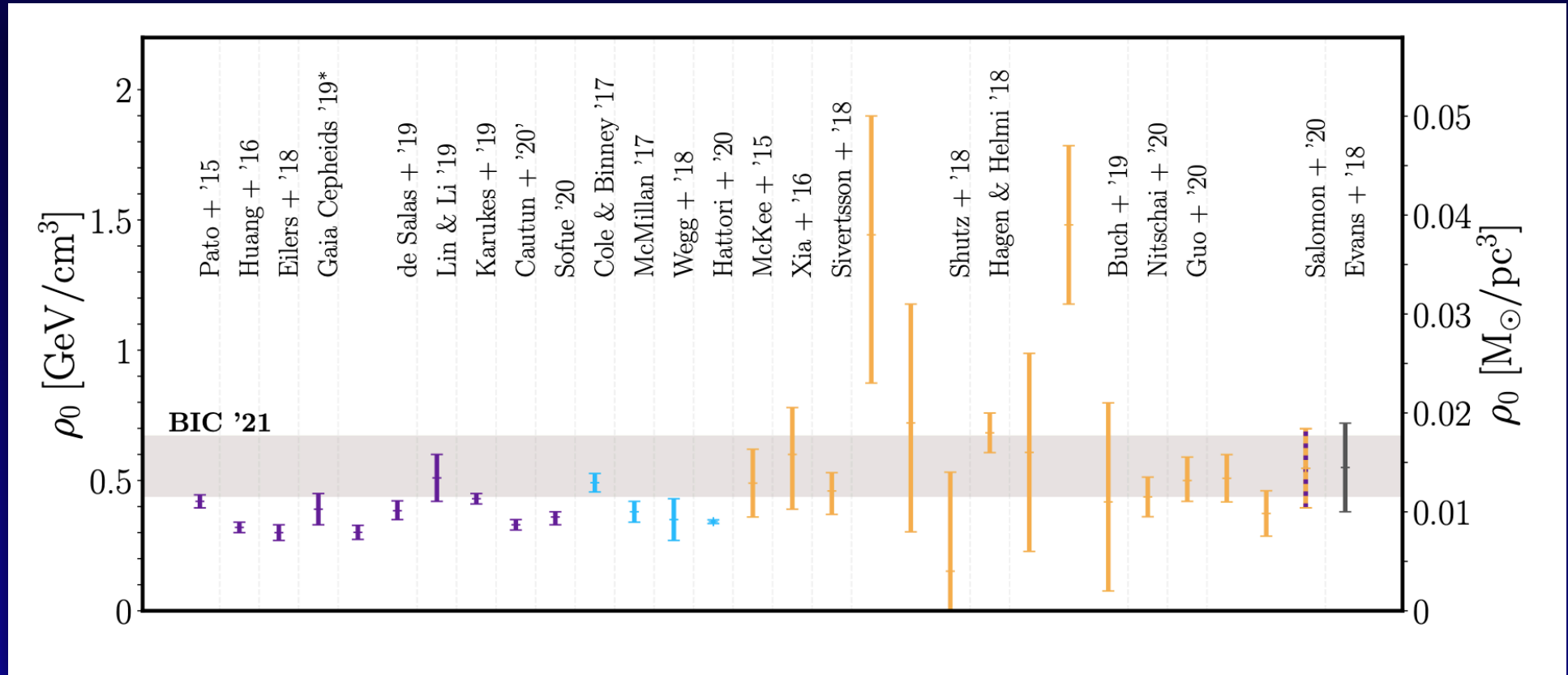
$$\rho_{DM}(R) \propto \rho_0 \left(\frac{R}{R_s} \right)^{-\gamma} \left(1 + \frac{R}{R_s} \right)^{-3+\gamma}$$

DM density at the Sun / around the MW = ??
From data, not theory/simulations



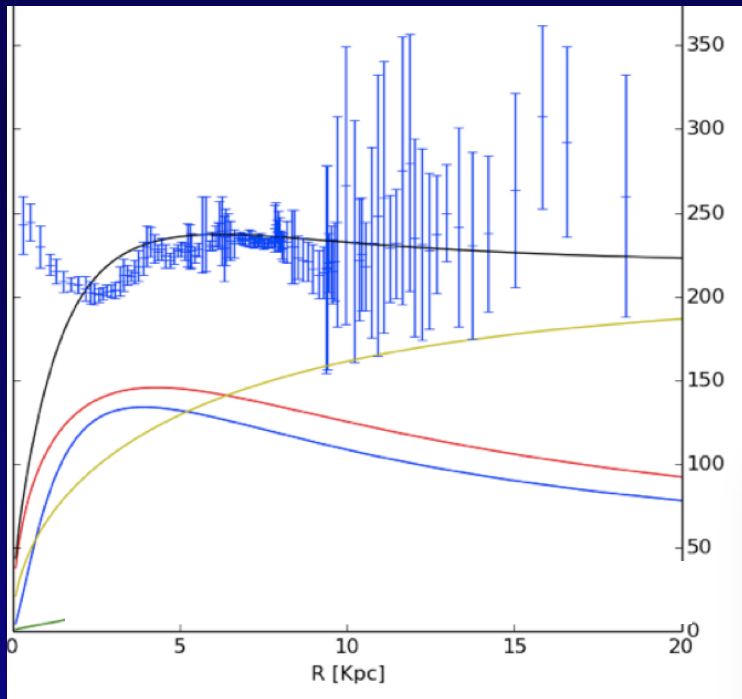
From data, not theory/simulations

Empirical determination of local DM density: recent determinations



Inferring the DM distribution in disk galaxies: the Rotation Curve method

Fitting a pre-assigned shape on top of luminous

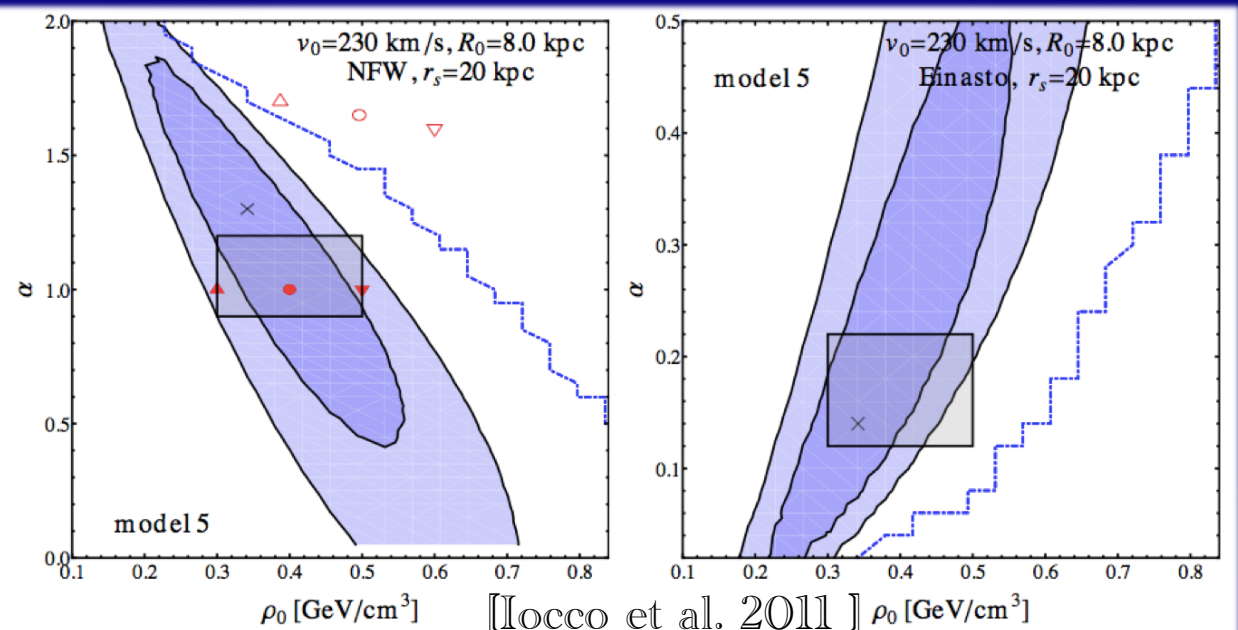


gNFW

$$\rho_{DM}(R) \propto \rho_0 \left(\frac{R}{R_s} \right)^{-\gamma} \left(1 + \frac{R}{R_s} \right)^{-3+\gamma}$$

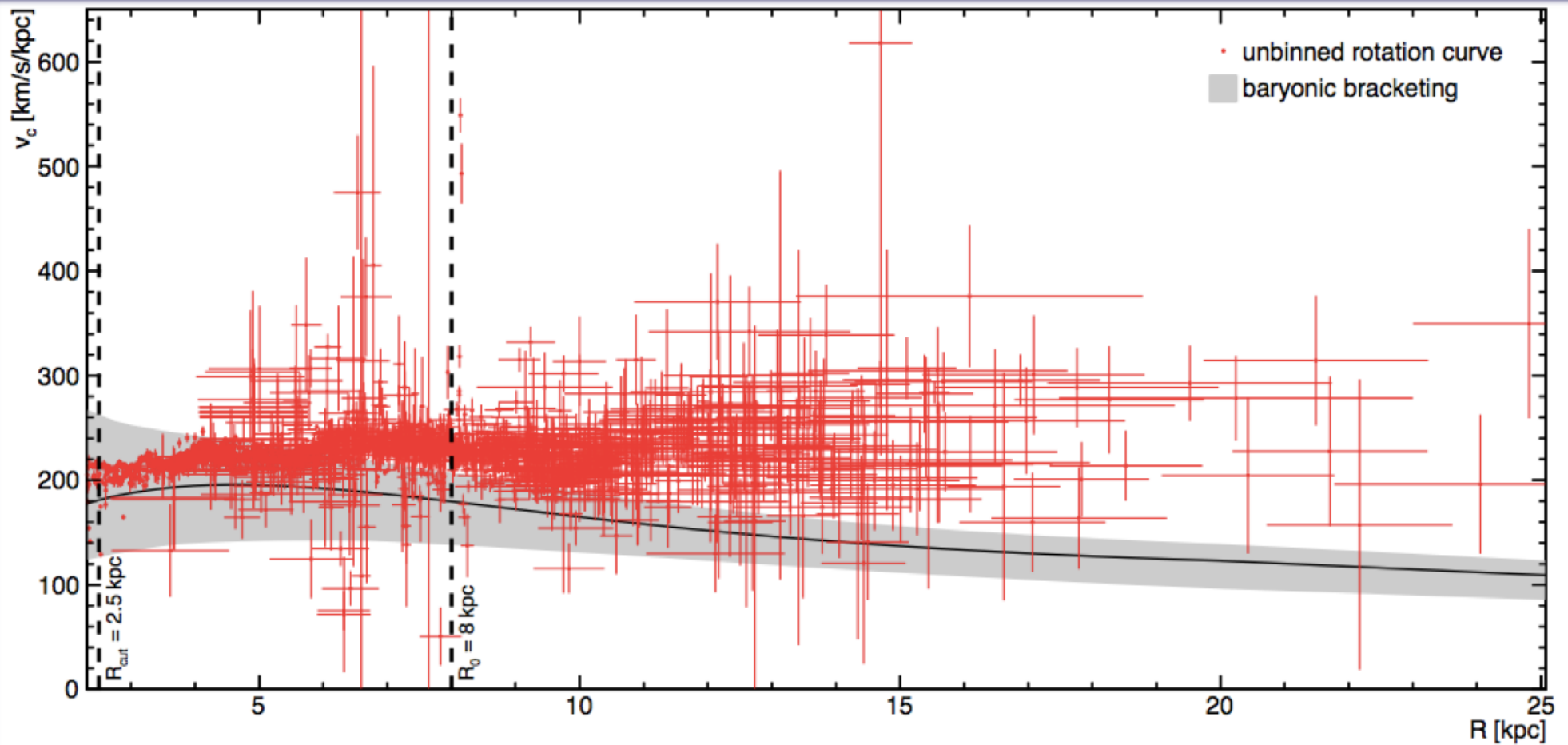
Einasto

$$\rho_{DM}(R) \propto \rho_0 \exp \left[-\frac{2}{\gamma} \left(\left(\frac{R}{R_s} \right)^\gamma - 1 \right) \right]$$



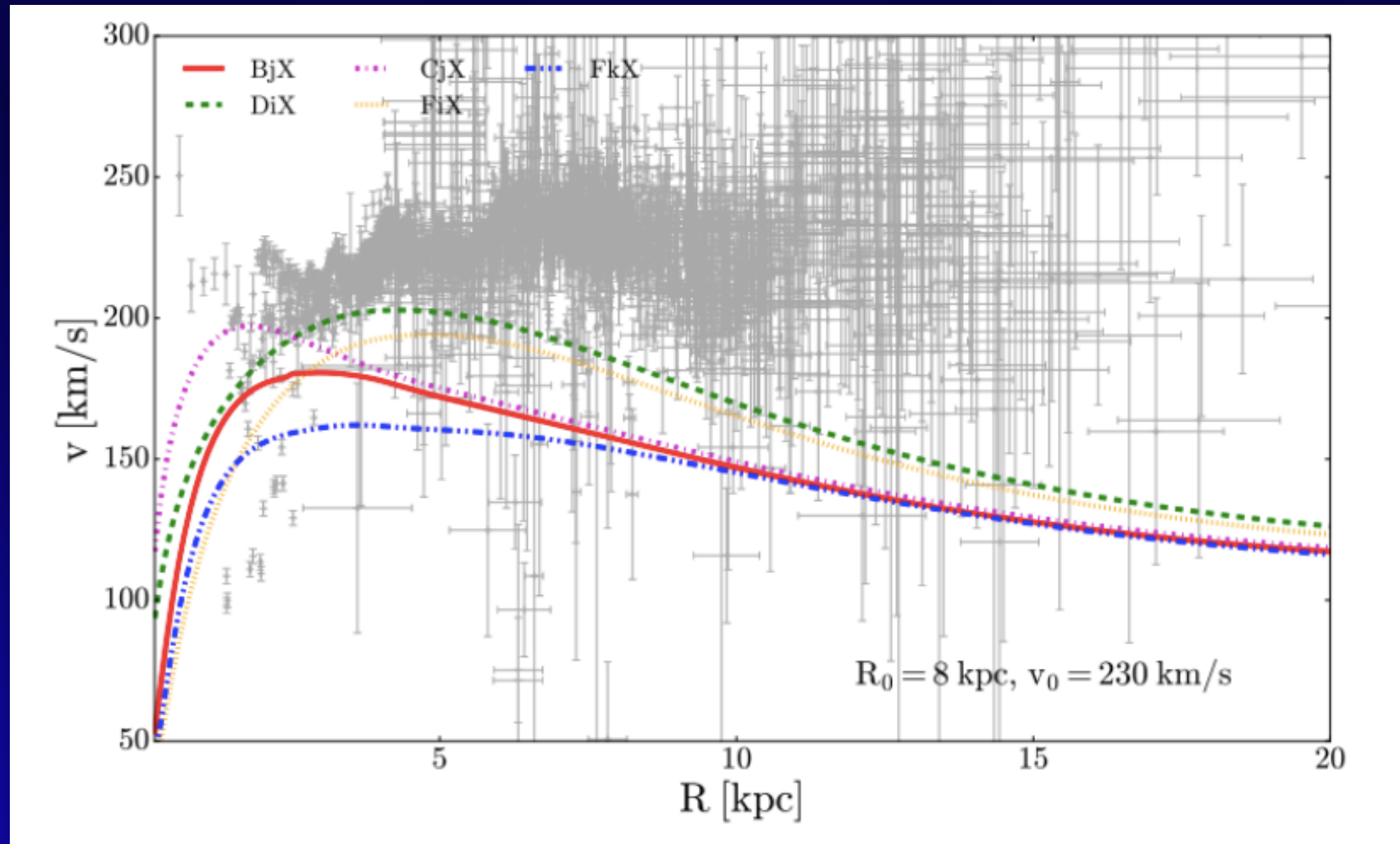
[many authors, e.g.
Iocco et al. 2011]

The Rotation Curve method, an example: the Milky Way

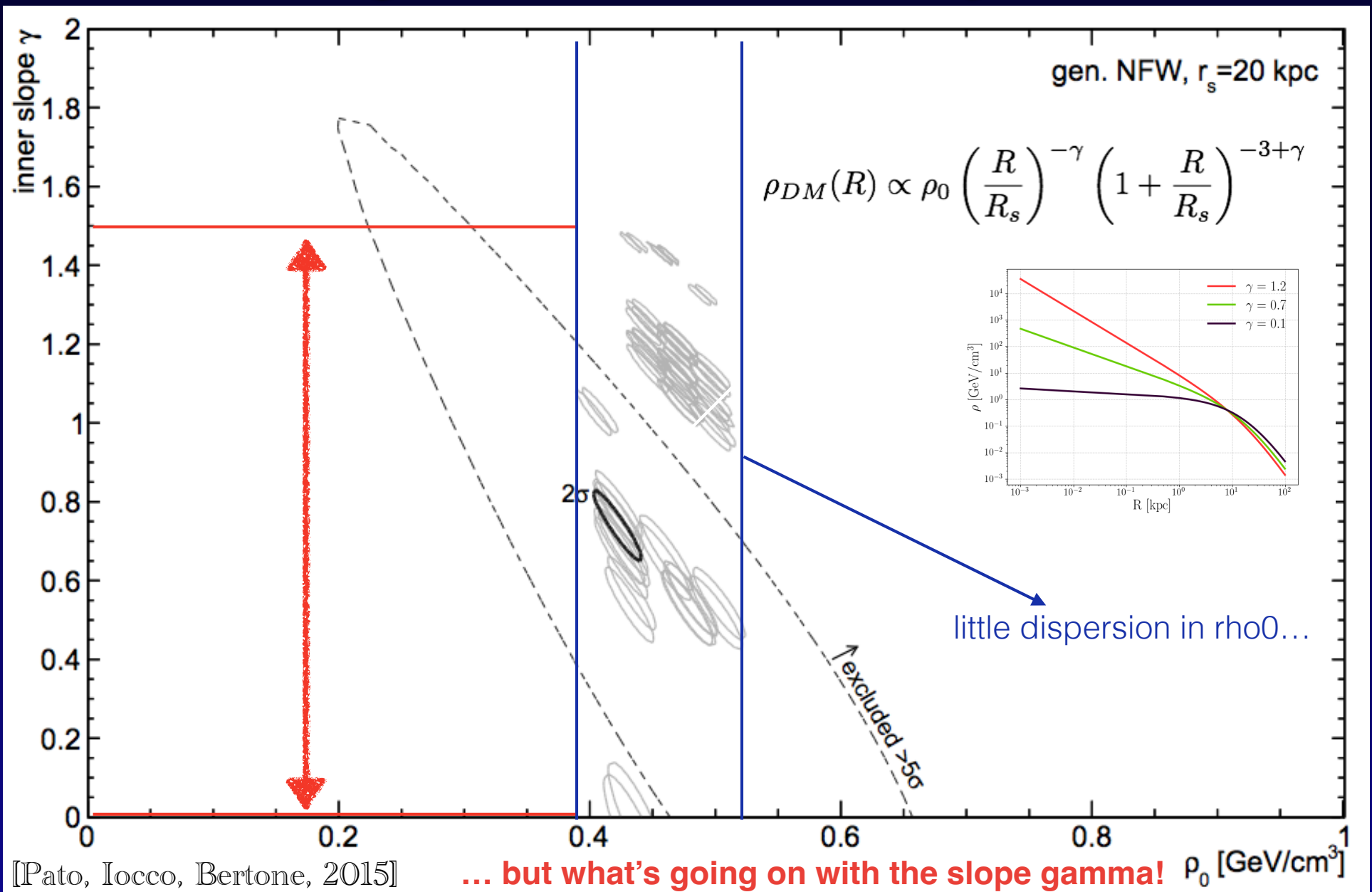


Systematic uncertainties

(luminous component)

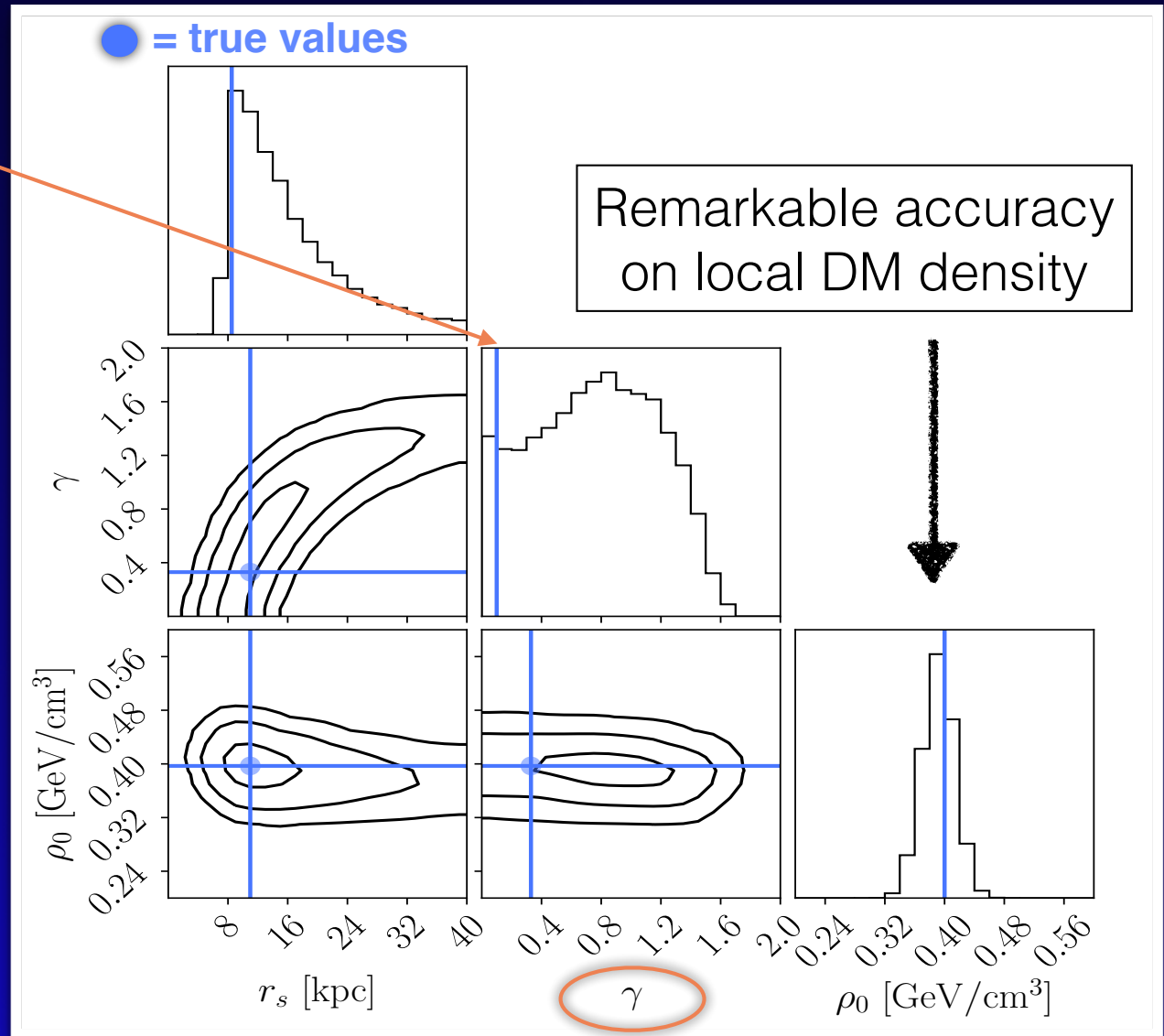
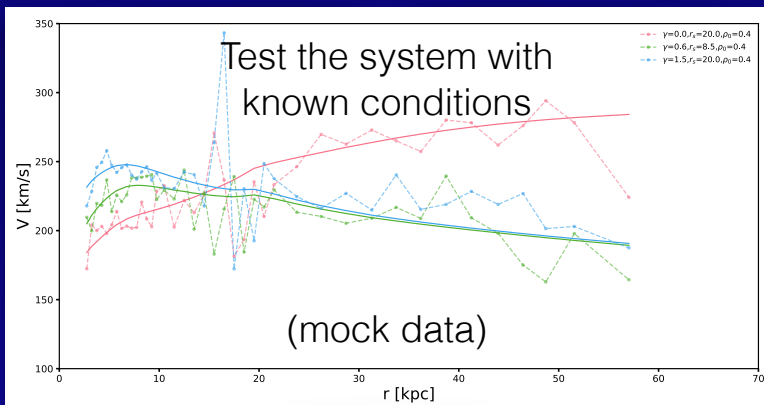
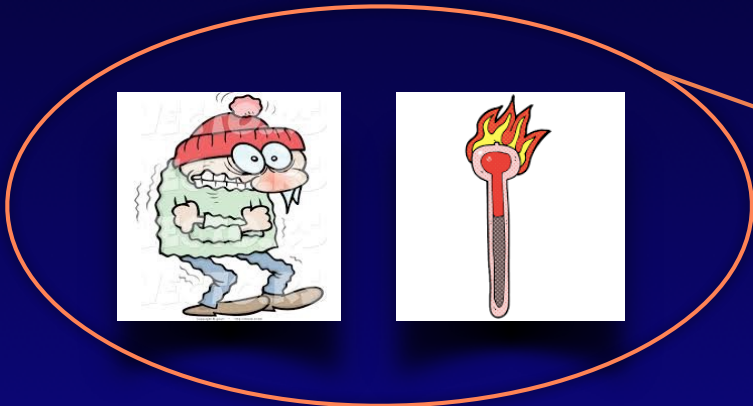


Extracting the DM density structure

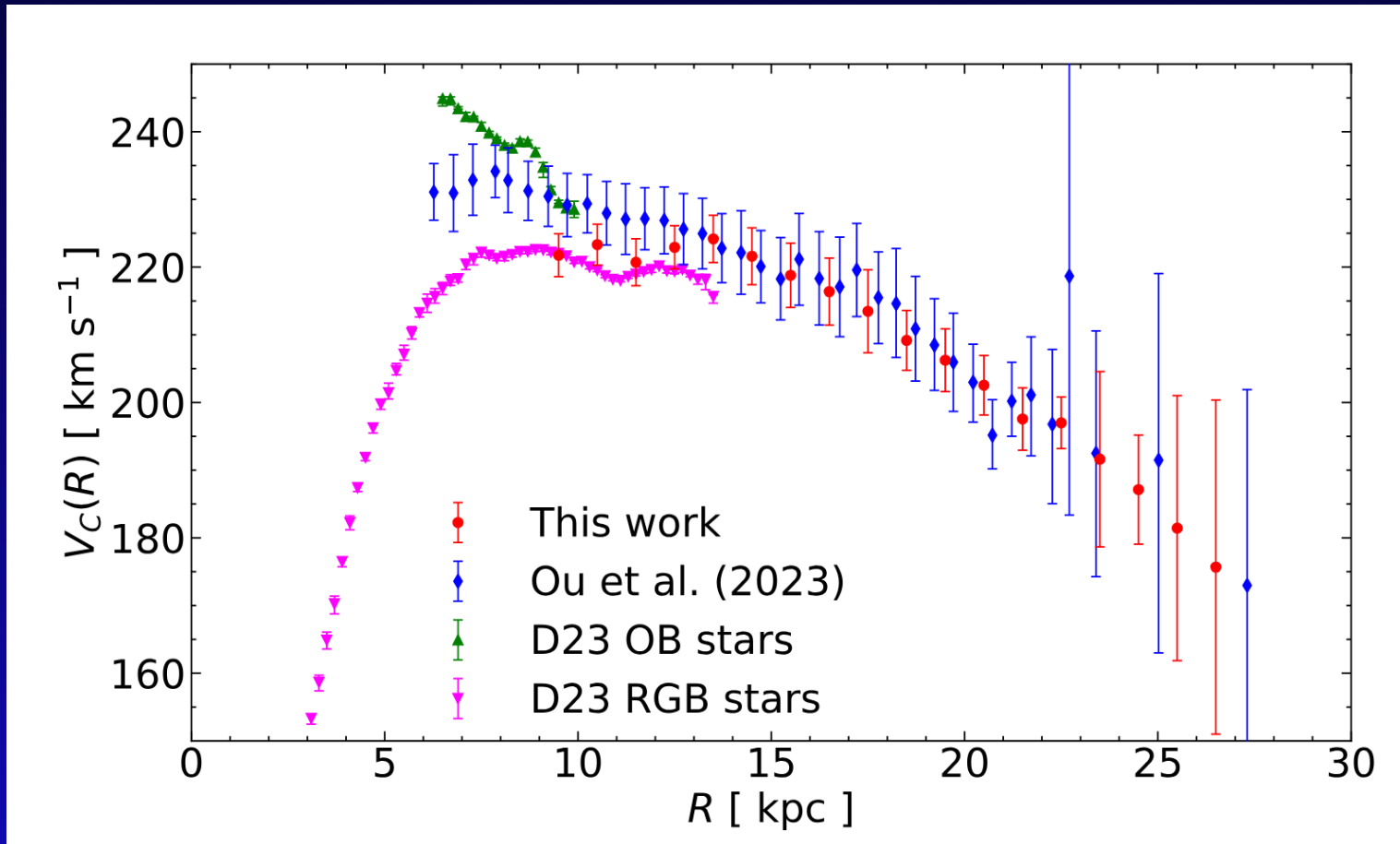


What to do of our measurement?

(Our instrument is very precise. Is it accurate?)

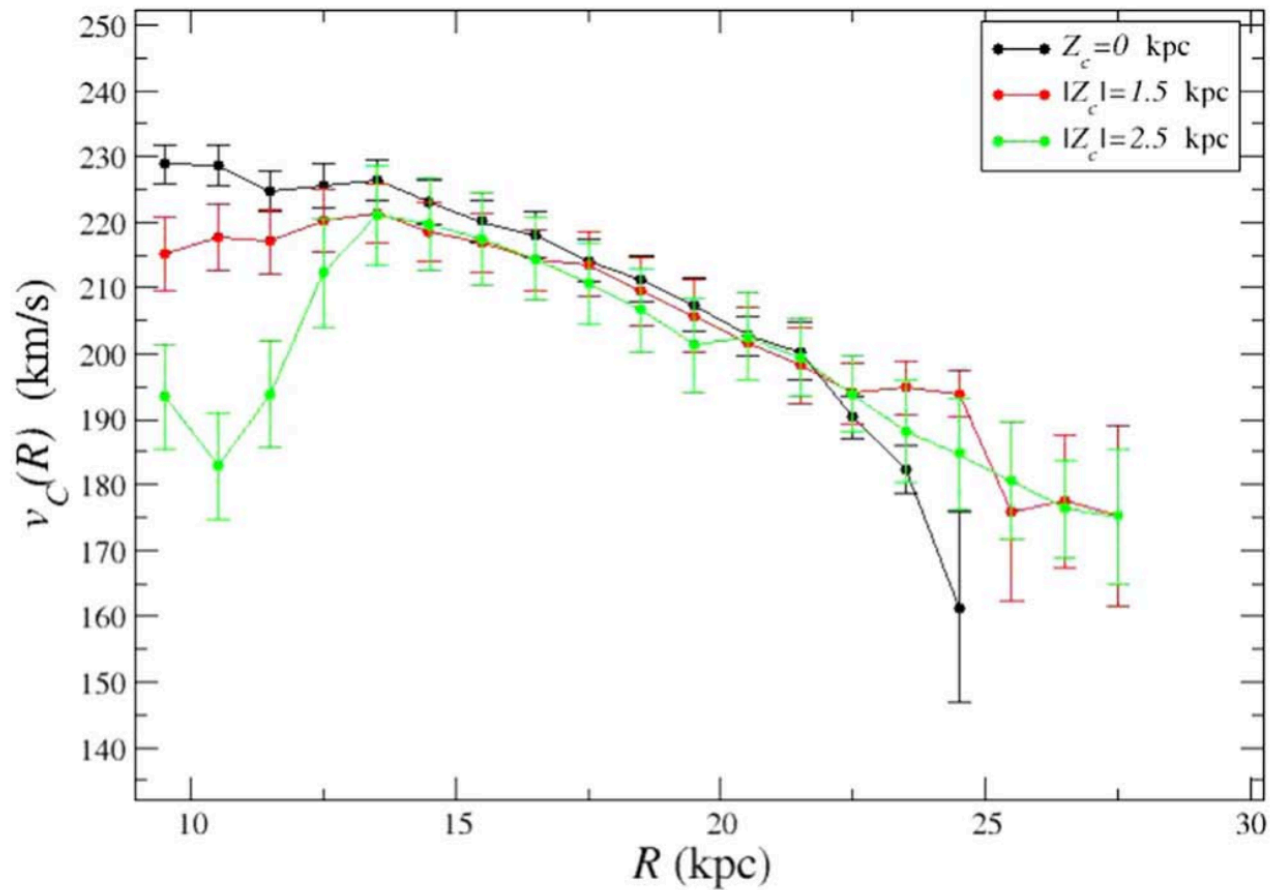


Enters GAIIA



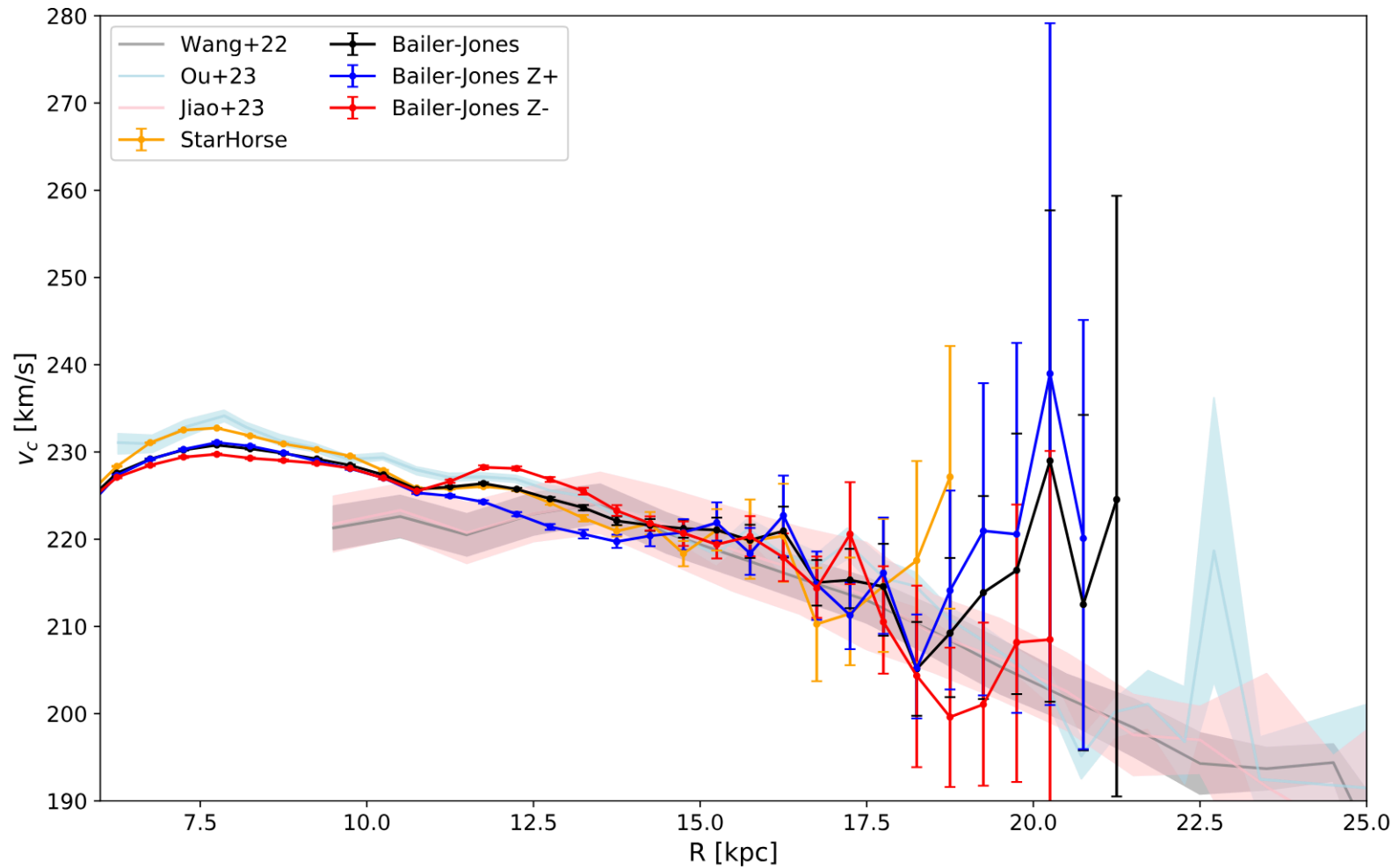
Jiao et al. '23

Enters GAIYA



Wang et al. '22

Enters GAIIA



Helmi et al. '24

Discussurus

- What implications of new RC on DM profile?
- Any (dominant) effect of GAIA on stellar disk ==> DM profile?
- M. Benito and I working on it, wanna join? (dirty work to do)