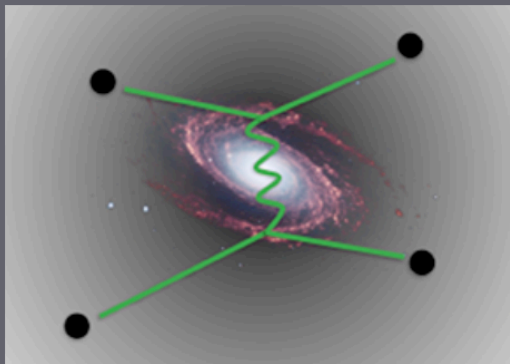




Valencia Workshop on the Small-Scale Structure of the Universe and Self-Interacting Dark Matter

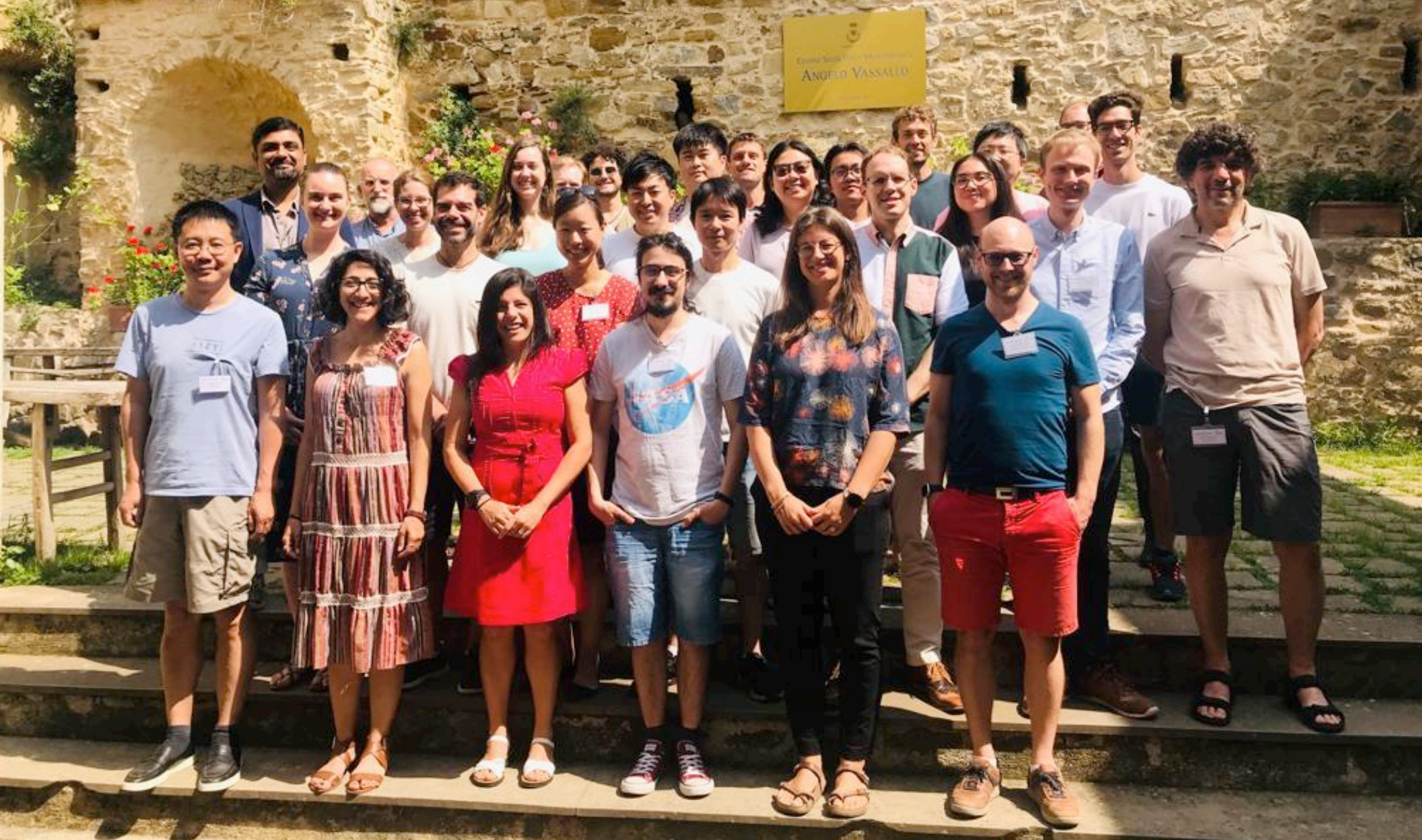
June 9-12, 2025; ~115 Participants



Self-Interacting Dark Matter: Models, Simulations and Signals, June 19-30, 2023, Pollica, Italy; ~55 participants



POLLICA
**PHYSICS
CENTRE**







Stream people are good drinkers; three people, seven bottles

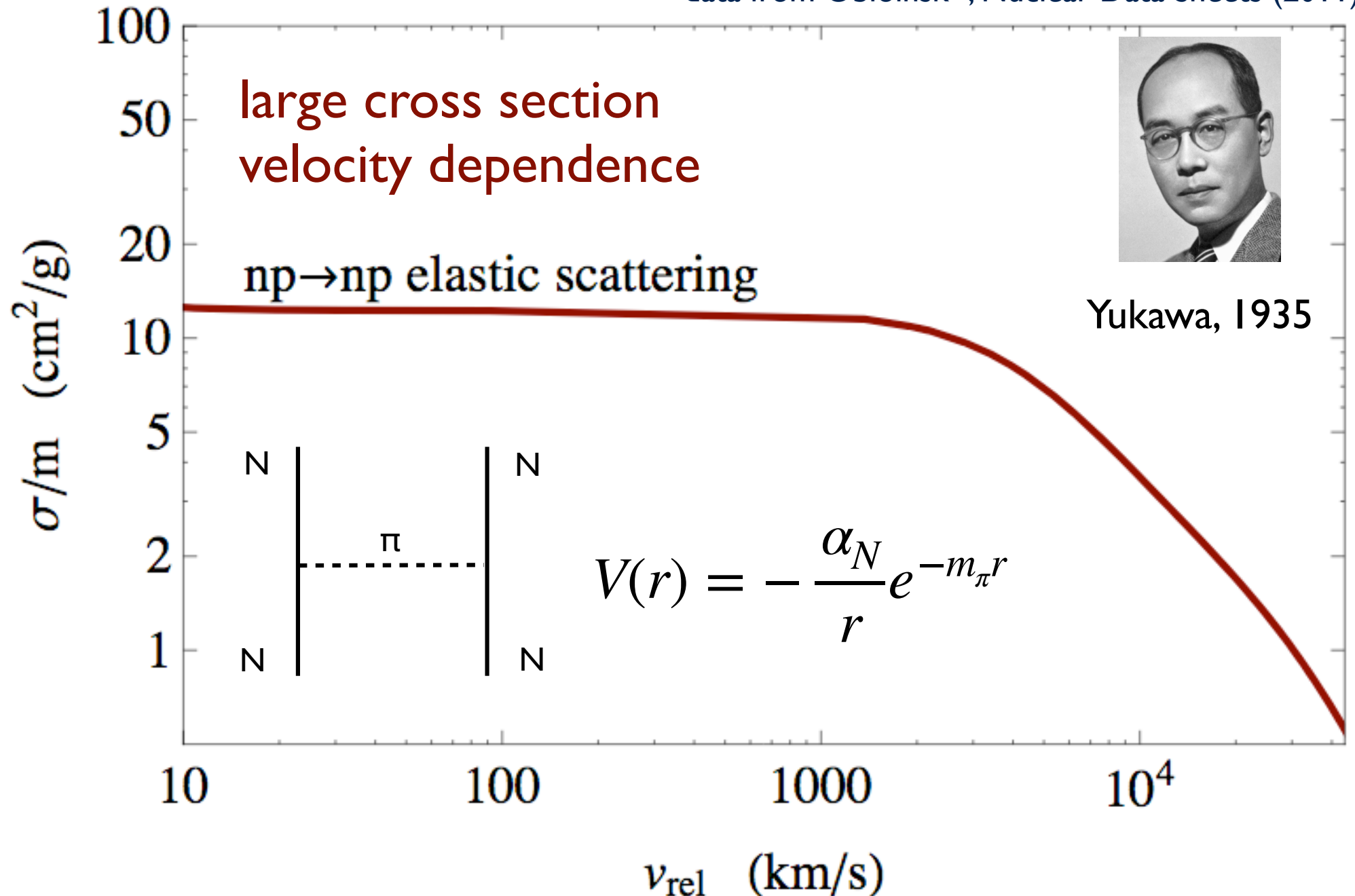
The Latest Developments in Understanding the Universe's Small-Scale Structure and the Nature of Dark Matter

- Numerical simulations
- Strong lensing systems
- Particle physics models
- Stellar streams; dwarf/satellite galaxies

Many thanks to all the speakers and discussion moderators for their contributions!

Nuclear Interactions

data from Obloinsk+, Nuclear Data Sheets (2011)





Halo-Shape and Relic-Density Exclusions of Sommerfeld-Enhanced Dark Matter Explanations of Cosmic Ray Excesses

Jonathan L. Feng, Manoj Kaplinghat, and Hai-Bo Yu

Department of Physics and Astronomy, University of California, Irvine, California 92697, USA

(Received 15 December 2009; published 15 April 2010)

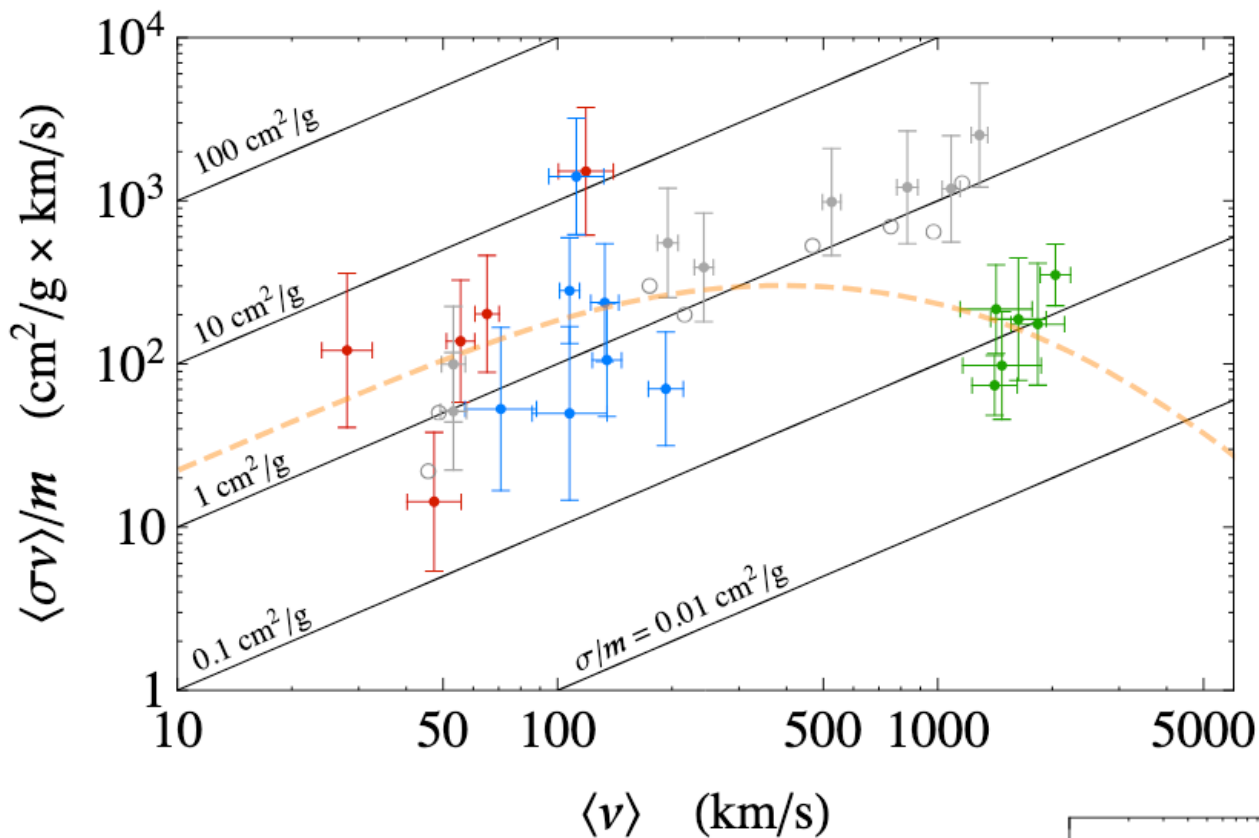
$$V(r) = \pm \frac{\alpha_\chi}{r} e^{-m_\phi r}$$

“For $m_\phi \sim 100$ MeV, the force’s range is only 10 fm, but, as we show below, the implied cross section is still large enough to play a role in galactic dynamics.”

The dark force may be described by a gauge theory just like the electromagnetic, weak, and strong forces

$$\alpha_{\text{EM}} \approx 1/137 \quad \alpha_{\text{QCD}} \approx 0.3 \quad \alpha_\chi \approx 0.01 - 1 \quad (?)$$

In simulations, we often consider smaller values, because simple analytical formulas exist for the cross section in this regime



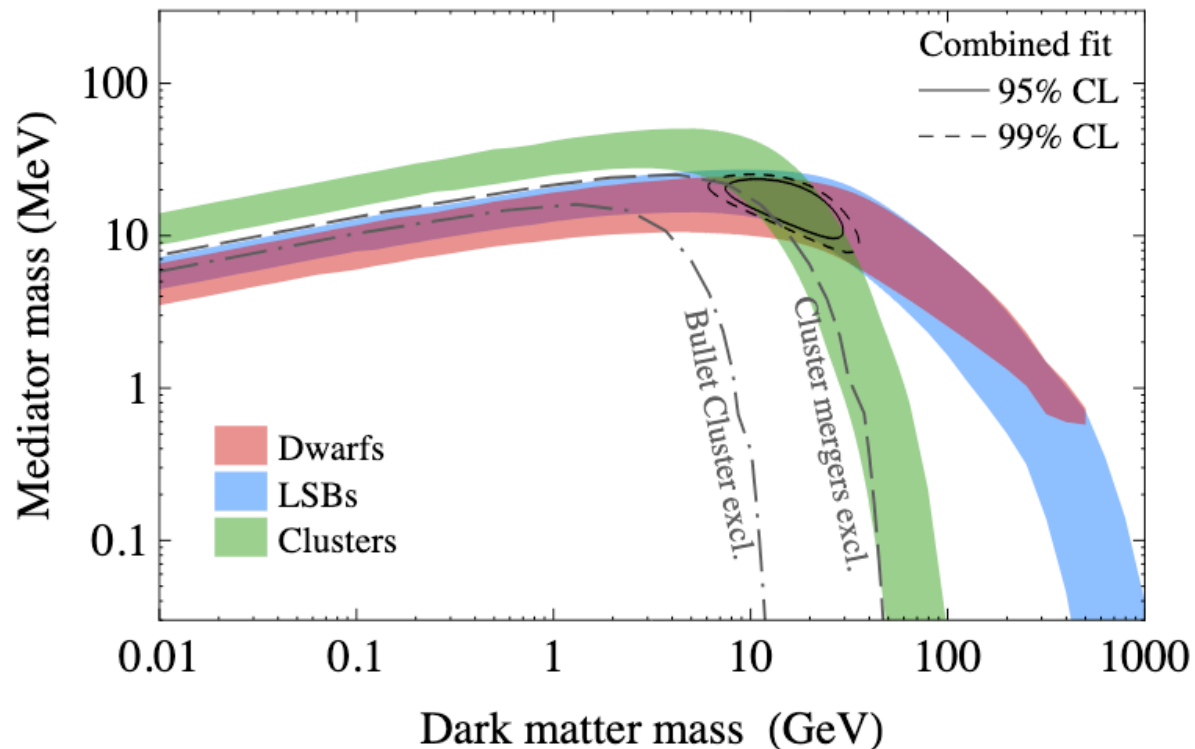
$$\alpha_\chi = \alpha_{\text{EM}} = 1/137$$

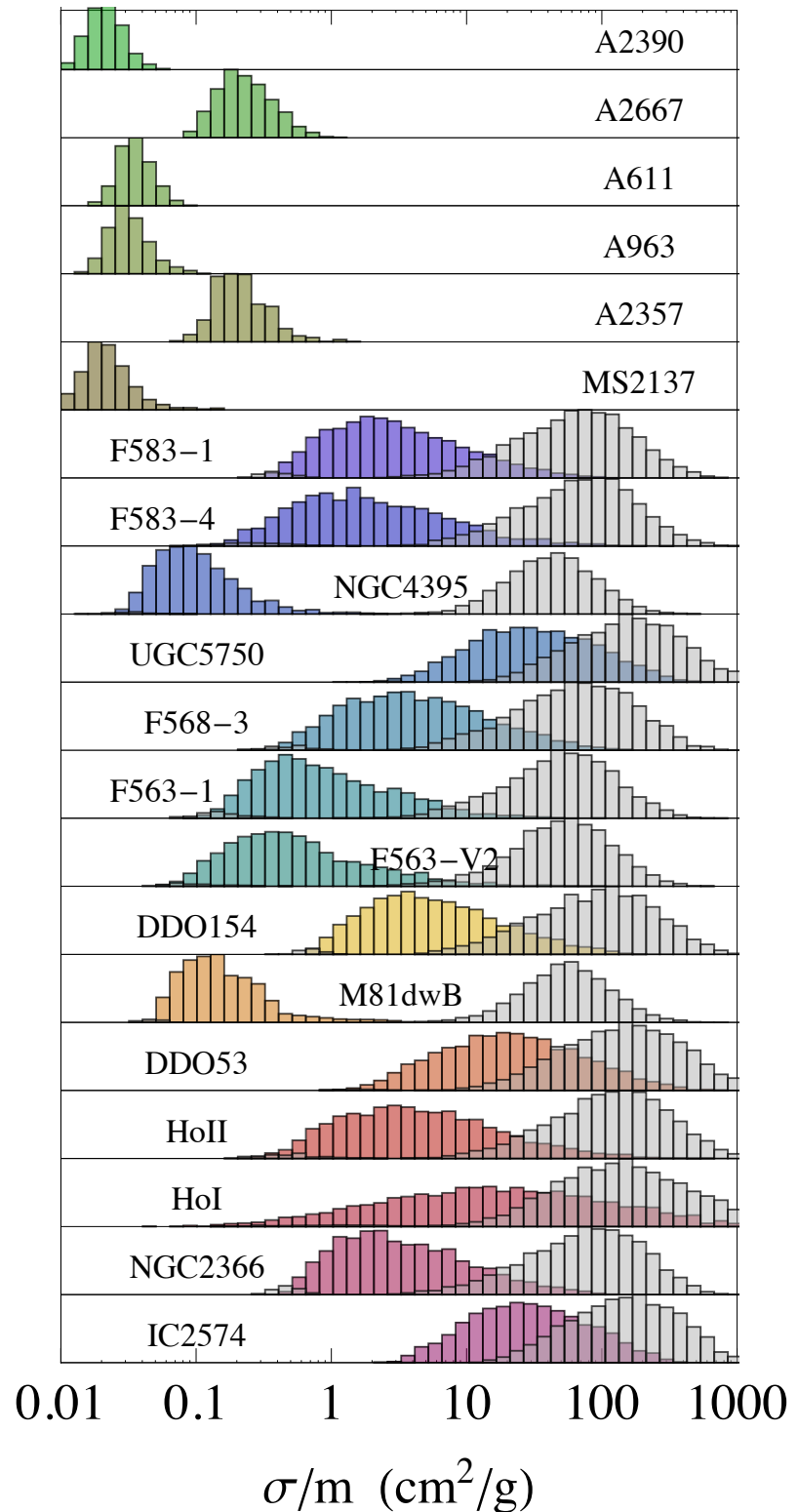
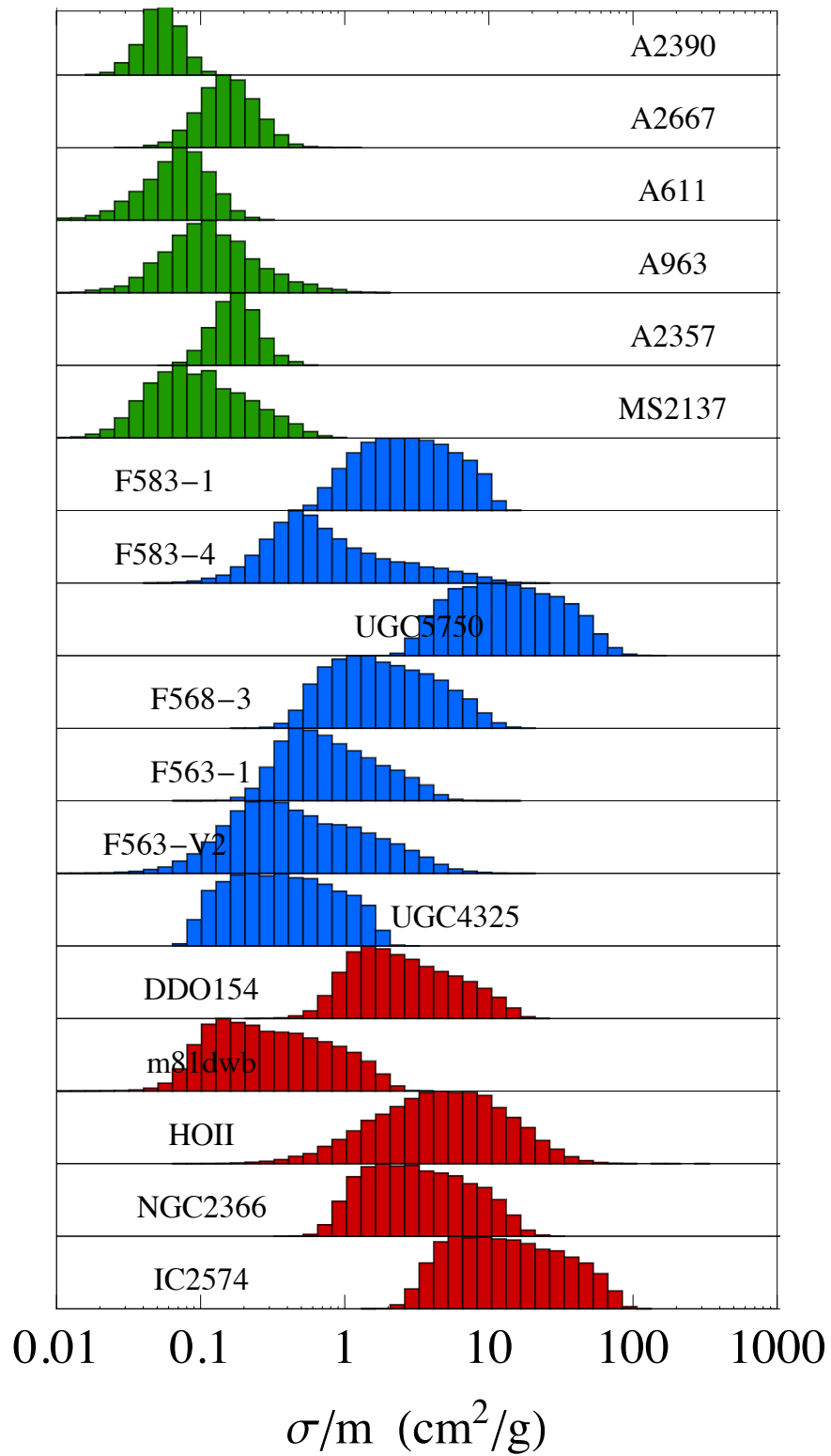
Suppose there are positive measurements on the cross section on two different halo mass scales

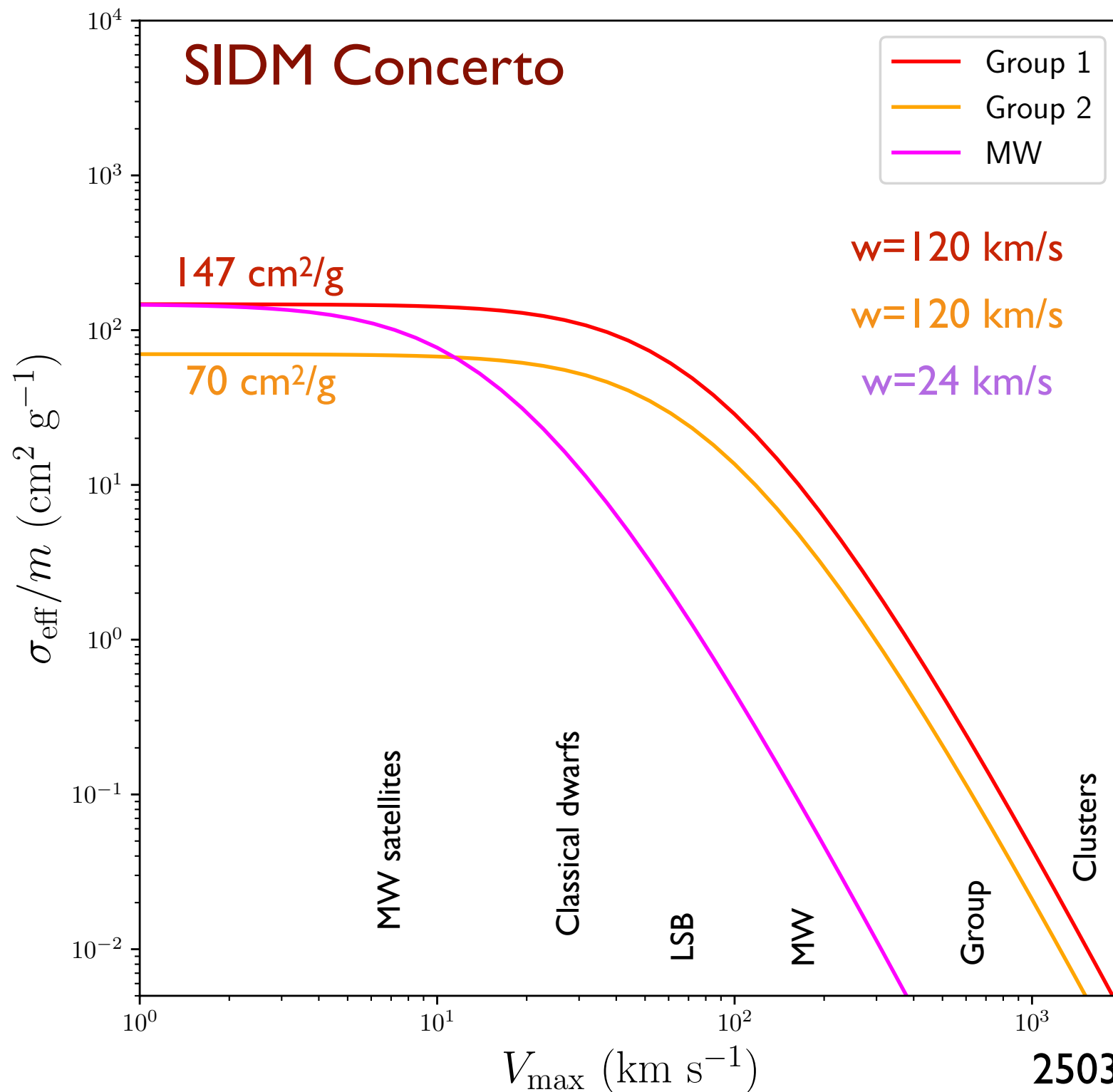
1508.03339

We can determine the dark matter particle mass and the mediator mass completely!

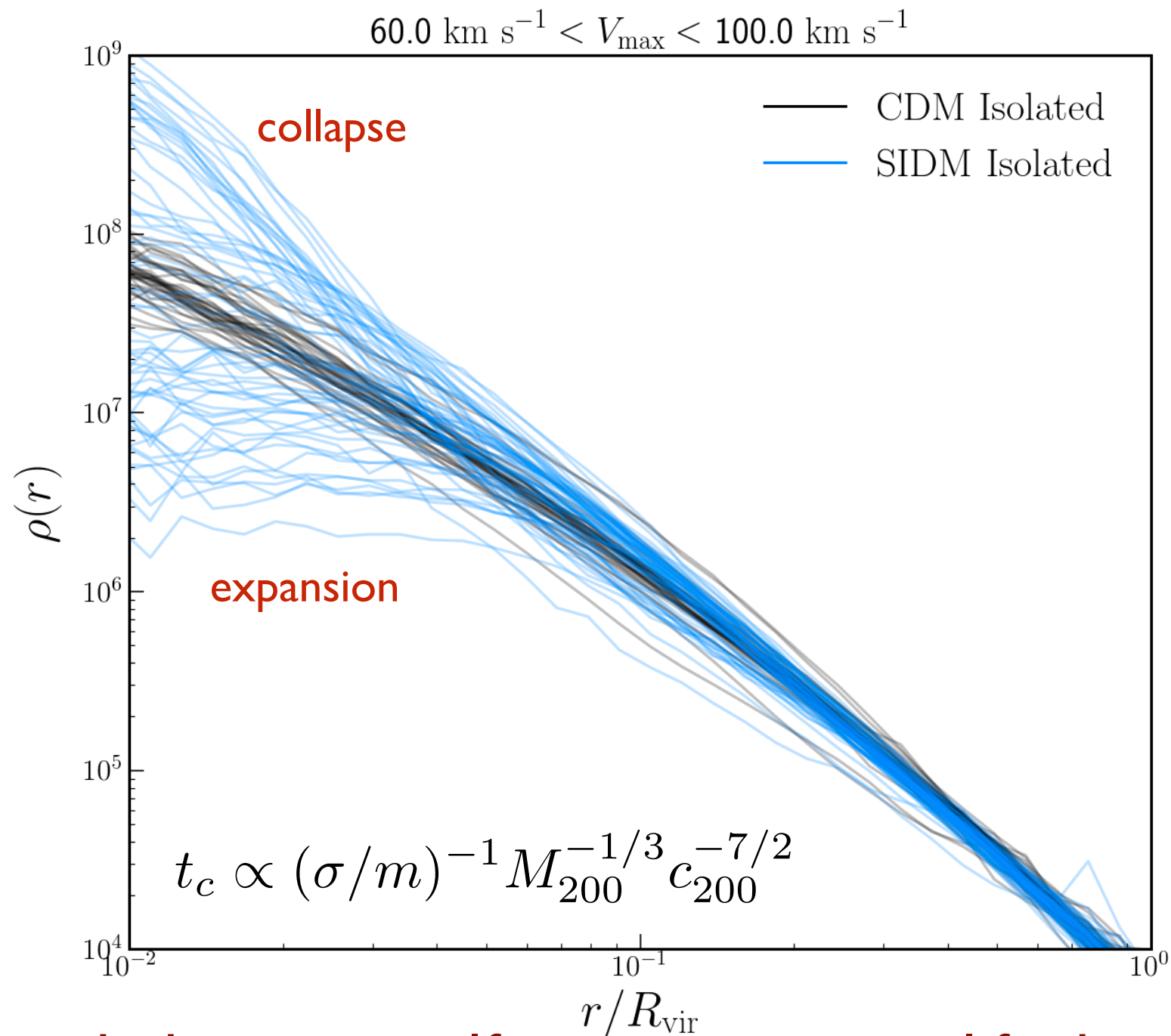
Nightmare scenario is not hopeless





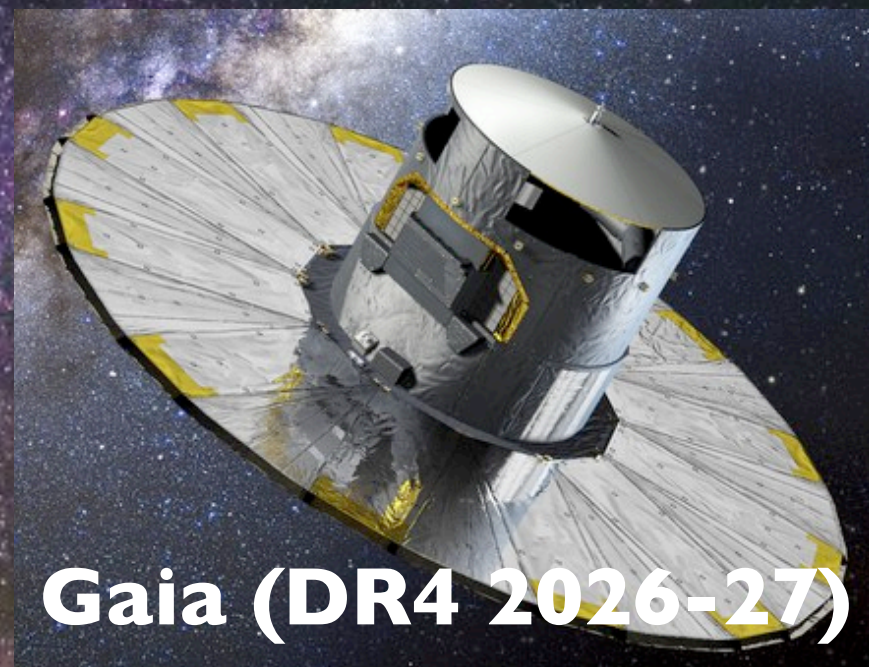
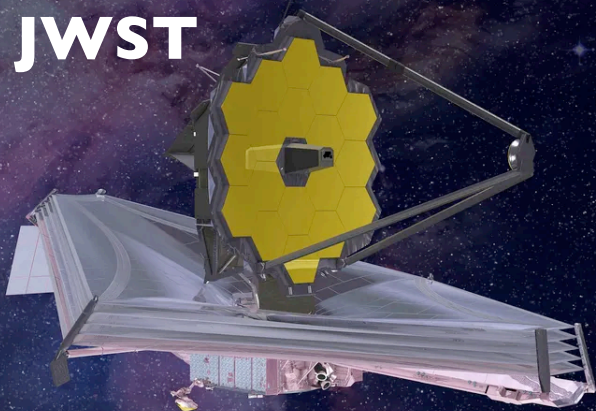


2503.10748



Strong dark matter self-interactions amplify the diversity encoded in the scatter of the halo concentration

JWST



Gaia (DR4 2026-27)

Rubin/LSST (2025)



VIA (2027)



Views from Valencia

Maria A. Lugaro¹ and Susanne Höfner² **Your Name**

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email: ~~m.lugaro@phys.uu.nl~~

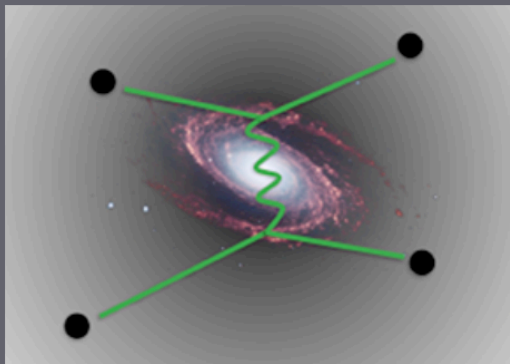
²Dept. of Astronomy & Space Physics, Uppsala University,
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email: ~~hoefner@astro.uu.se~~

Suggestions from AI:

- Structure by Topics: four major topics, each contributes to one page
- Content Focus: summarize key challenges and opportunities as discussed
- Moderator Involvement: moderator of each session assists in drafting and review summery

Recommend a location for the 2027 program
(exciting results from LSST/Rubin)

Canary Islands, Estonia, Elba Island,
Sicily, Tunisia, Munich, Chengdu (China),
Iceland, Greenland, a small village in
Japan...



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**Thank You
Safe Travels
See You in 2027**