Probing the nature of dark matter in galaxy scales

Masashi Chiba (Tohoku Univ)

Thank you very much for the support of these publications!

1. “Origin of highly r-process-enhanced stars in a cosmological zoom-in simulation of a Milky Way-like galaxy”, Hirai, Y. incl. M.C. 2022, MNRAS, 517, 4856
2. “Existence of tidal tails for the globular cluster NGC 5824”, Yang, Y. incl. M.C. 2022, A&A, 667, A37
3. “The Missing Satellite Problem outside of the Local Group. II. Statistical Properties of Satellites of Milky Way-like Galaxies”, Nashimoto, M. incl. M.C. 2022, ApJ, 936, 38
4. “Dark matter halo properties of the Galactic dwarf satellites: implication for chemo-dynamical evolution of the satellites and a challenge to ΛCDM”, Hayashi, K. incl. M.C. 2022, arXiv:2206.02821
5. “The diversity of core-halo structure in the fuzzy dark matter model”, Chan, H.-Y. Jowett. incl. M.C. 2022, MNRAS, 511, 943
6. “Constraints on dark matter distribution in dwarf spheroidal galaxies based on the 4th-order Jeans analysis”, Wardana, M. Dafa. 2022, Master thesis (supervised by M.C.)
7. “The Global Structure of the Milky Way's Stellar Halo Based on the Orbits of Local Metal-poor Stars”, Sato, G. & M.C. 2022, ApJ, 927, 145

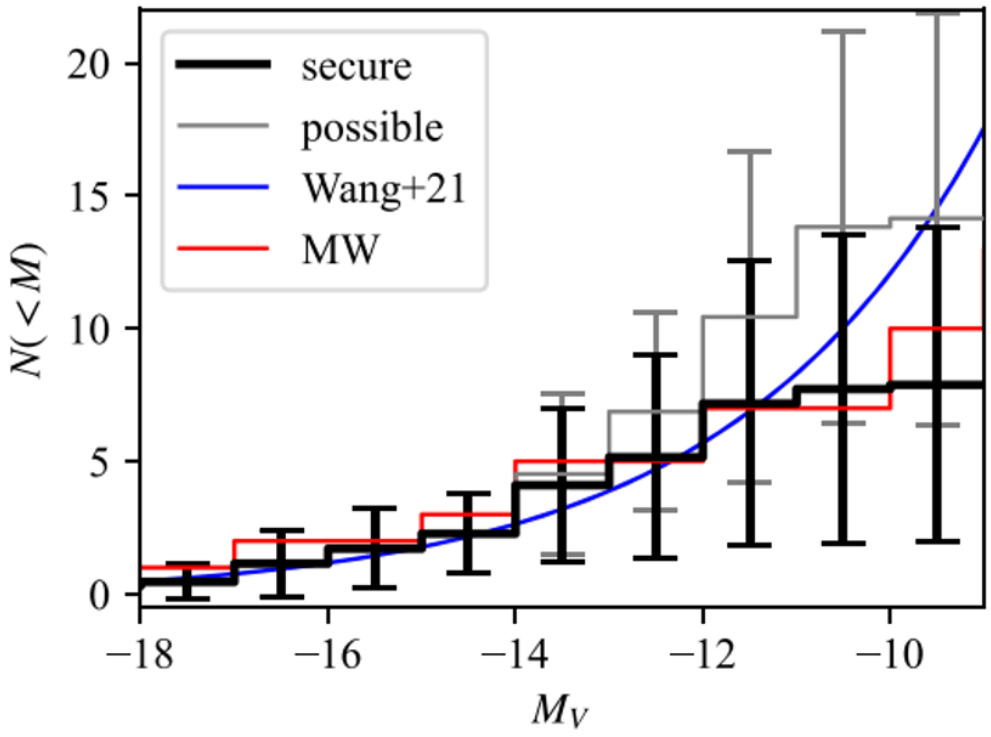
The Missing Satellite Problem outside of the Local Group

Nashimoto M., Tanaka M., Chiba M. et al. 2022, ApJ

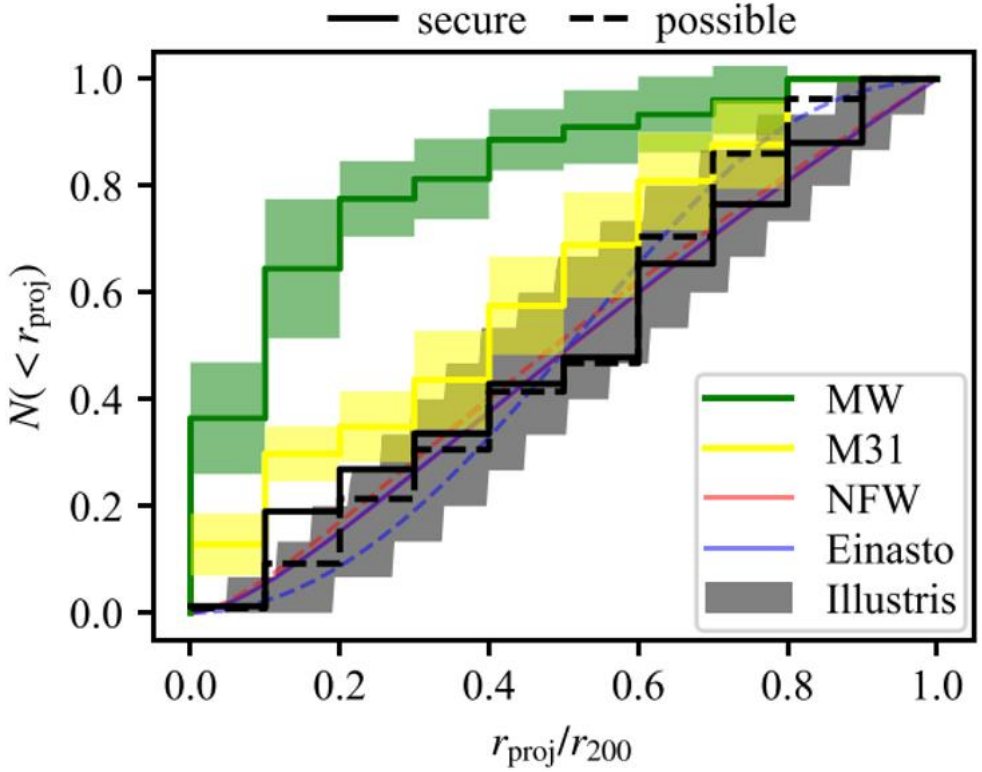
Nashimoto-san

51 secure dwarf satellites are detected within the virial radius of 9 host galaxies

Cumulative LF of the detected dwarf satellites



Normalized cumulative distributions of the projected distance



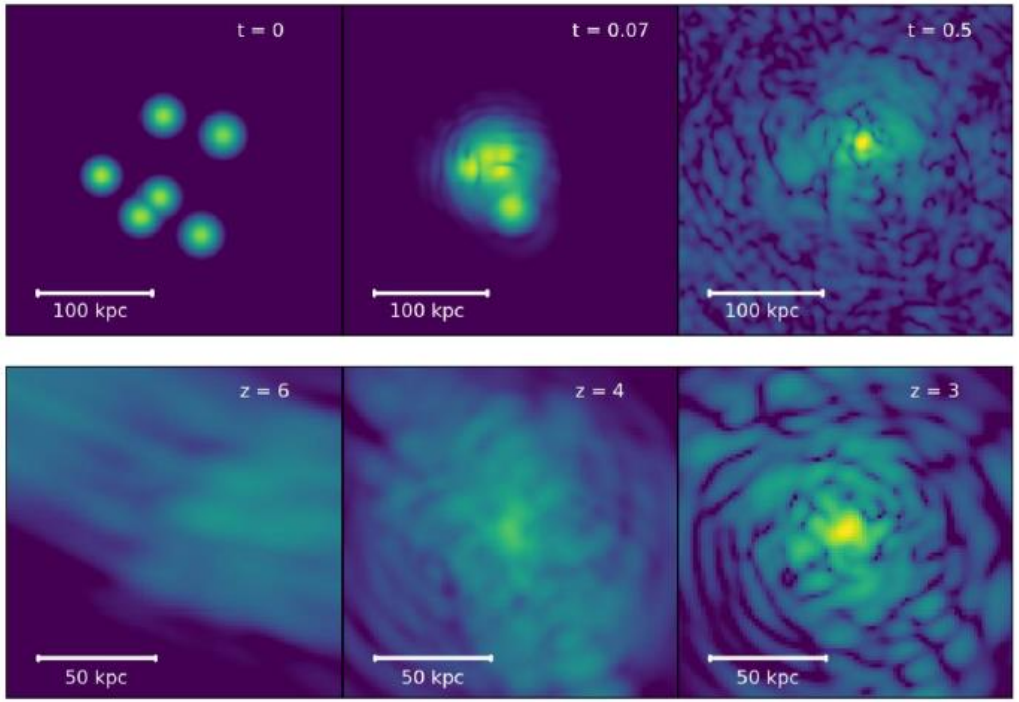
These satellite galaxies show no sign of concentration or alignment in contrast to MW!

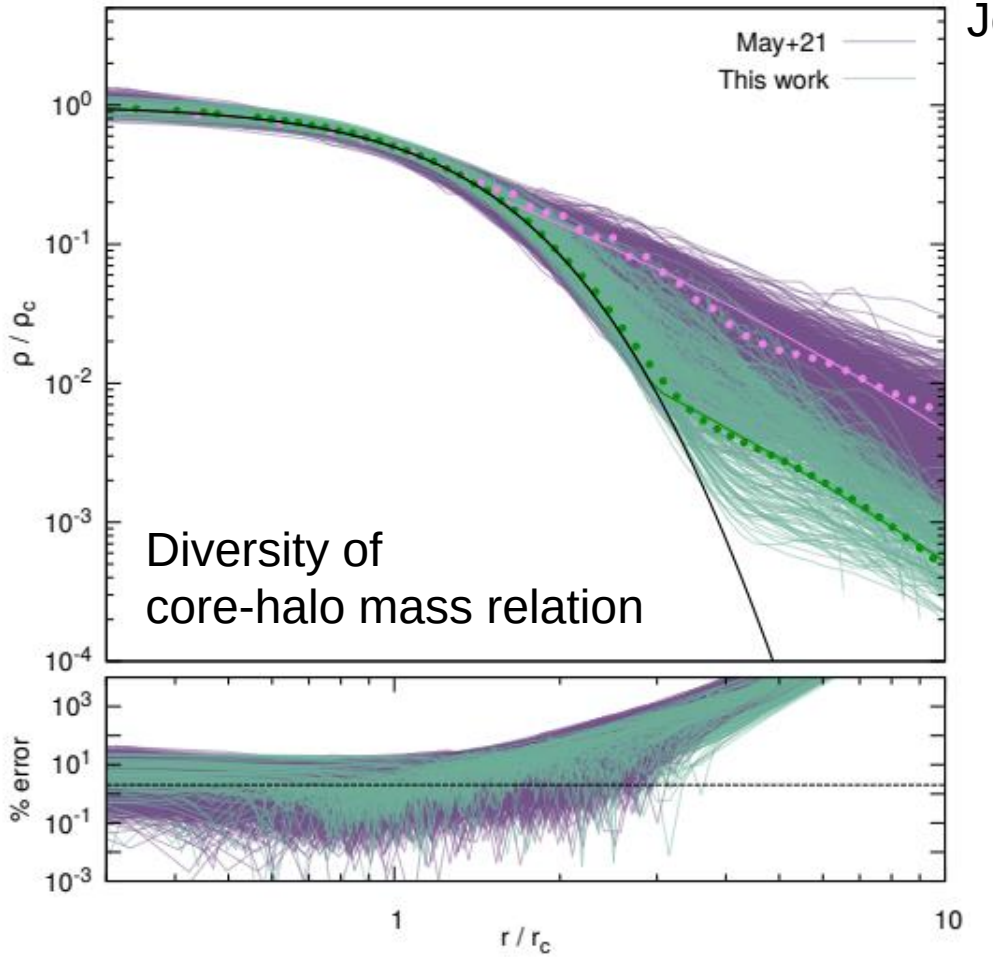
The diversity of core-halo structure in the fuzzy dark matter model

Jowett Chan, Ferreira E., May S., Hayashi K., Chiba M. 2022, MNRAS

Jowett Chan

$m = 1 \times 10^{-22}$ eV/c^2





This diversity needs to be considered for DM measurements in dwarf satellites!

Jeans analysis of dwarf satellites based on high-order velocity moments

Dafa Wardana (D1), Chiba M., with Hayashi K. (Dafa's Master thesis)

Dafa Wardana

Core/cusp problem in dwarf satellites

Need to break the mass-anisotropy degeneracy in the 2nd-order Jeans analysis of V_{los} distribution by analyzing the 4th-order velocity moment – our goal!

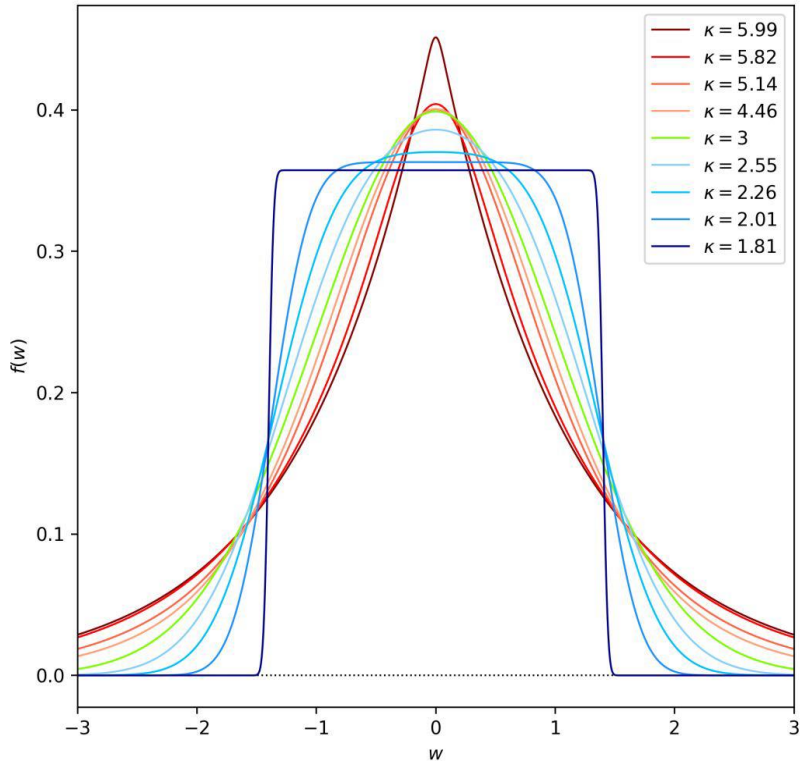
Application of this method to Subaru/PFS data
⇒ DM profile

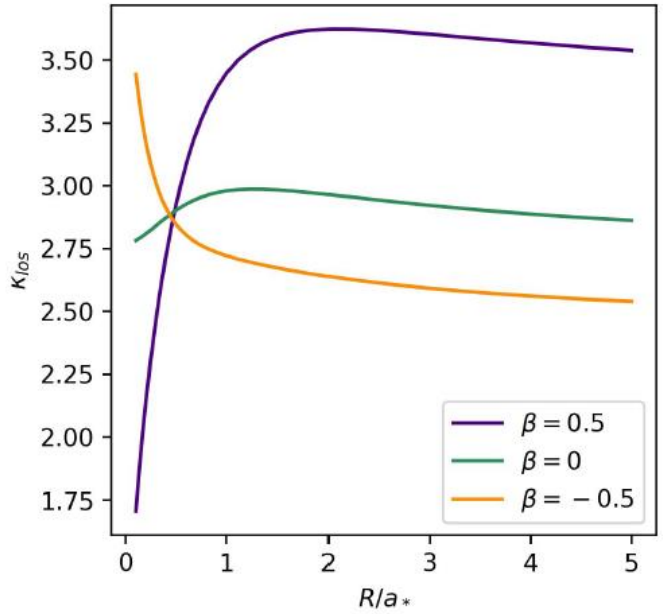
4th order velocity moment:

$$\overline{v^4} = \int dv\,(v-\bar{v})^4 f(v)$$

Kurtosis:

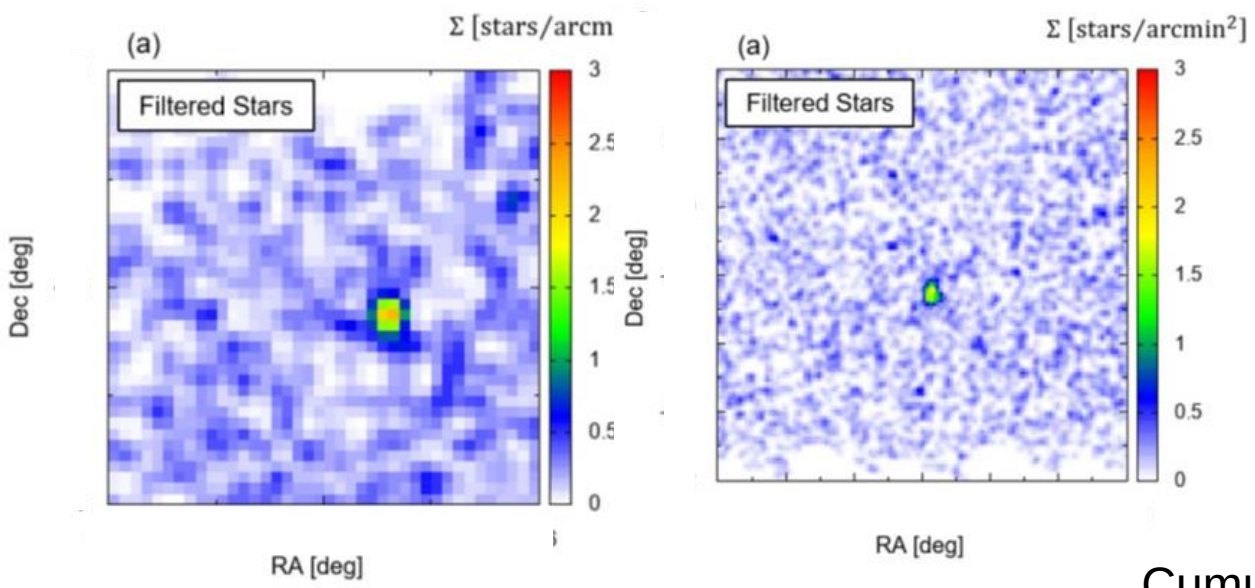
$$\kappa = \frac{\overline{v^4}}{(\sigma^2)^2}$$





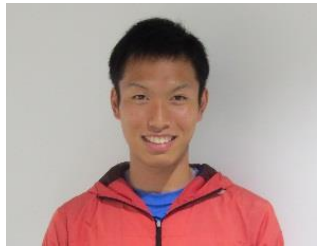
This non-Gaussianity in V_{los} provides velocity anisotropy, thus the most likely DM profile!

Work/paper in progress



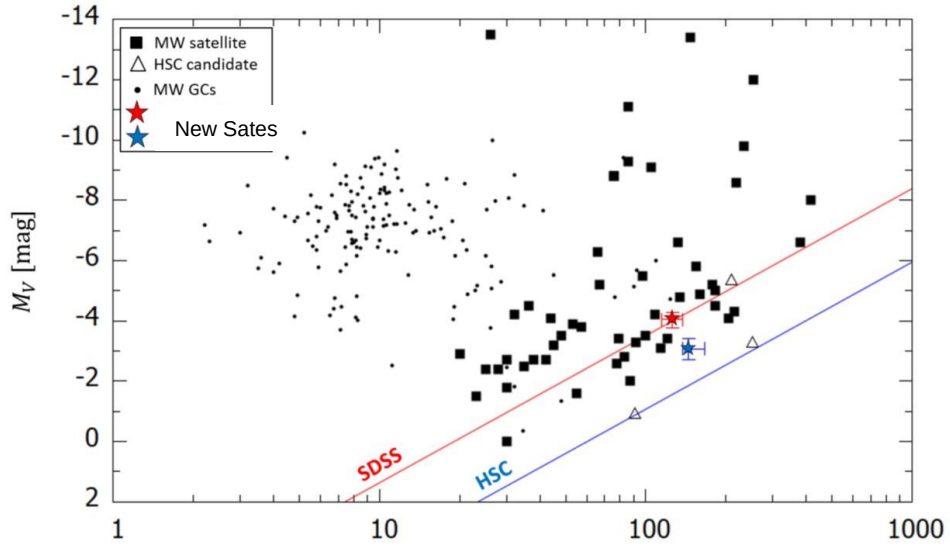
Discovery of yet more MW satellites from HSC-SSP data and implications for missing satellites problem in the MW

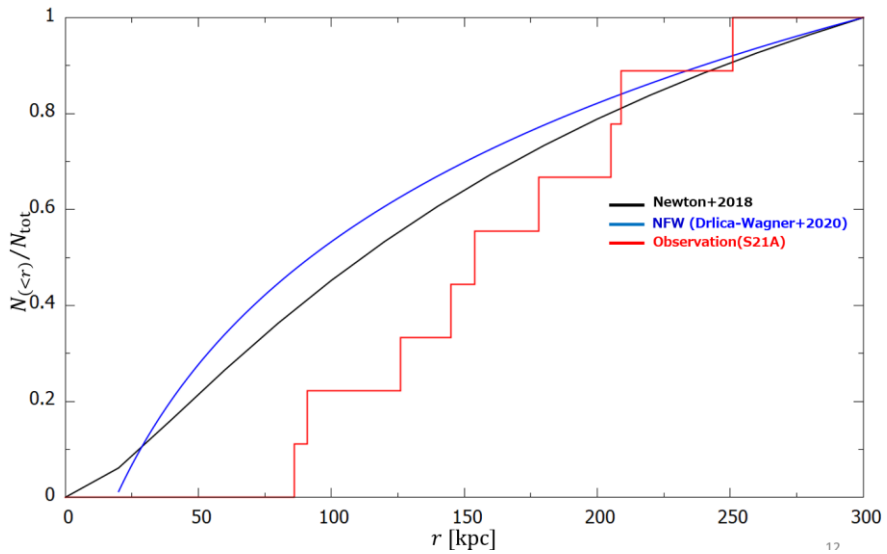
Homma, D., Chiba, M. et al.
in preparation



Homma-san

Cumulative radial distribution





Other works also
in progress:
- Schwarzshild modeling of MW dwarf satellites with Nakamura (M1)
- Mapping lensing images by CDM subhalos with Sakata (M1)