

# InDark: Inflation, Dark Matter and the Large-scale Structure of the Universe

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INFN Units: BO-FE-GE-LNGS-MI-PD-PR-RM2-TO-TS

On behalf of the InDark group in Torino

A. Diaferio, L. Ostorero, S. Camera, F. Pace

## MAIN TOPICS OF RESEARCH

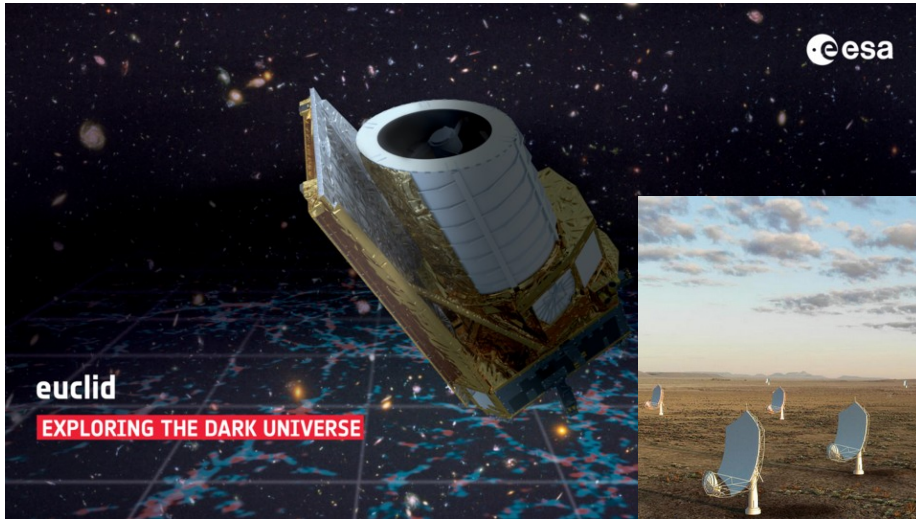
- 1. Inflation and primordial universe*
- 2. Dark matter and light relics*
- 3. Dark energy and modified gravity*
- 4. Cosmological observables as a probe of fundamental physics*
  - 4.1 Cosmic microwave background*
  - 4.2 Cosmic structures*
  - 4.3 Cosmological gravitational waves*

## FOCUS OF THE RESEARCH

- *Theoretical investigation of inflation models*
- *Cosmological and particle physics properties of DE models*
- *Testing General Relativity: alternative models of gravity and their impact on cosmological observables*
- *Numerical (simulations) and analytical techniques to study the non-linear evolution for DM density perturbations to reach the accuracy required by future generation galaxy surveys*
- *Development of new statistical algorithms for present and future CMB and LSS datasets*
- *Analysis of present CMB and LSS datasets to put constraints on inflationary models and models of DE/MG*
- *Complementary tests of LSS*
- *Hydrodynamical simulations of massive neutrinos on LSS as a probe of cosmology and fundamental physics*
- *DM distribution in galaxy halos and consequences for DM search experiments*
- *Predictions of indirect signatures of DM candidates, in connection with experiments, such as, e.g., FERMI, PAMELA and AGILE*

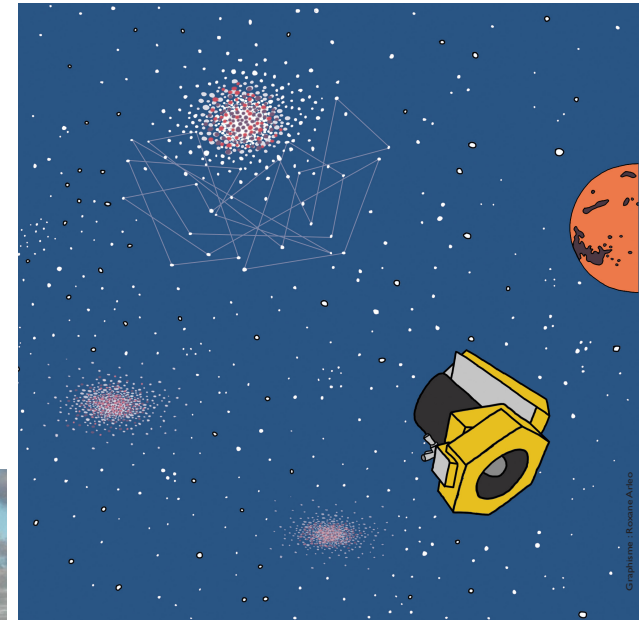
## Involved in

- **Theia**: the next generation astrometric space mission (after Gaia) [Ostorero, Diaferio]
- **Euclid space telescope** [Camera, Pace]
- **Square Kilometer Array** [Camera]
- **HectoMAP redshift survey** [Diaferio]



**THEIA**

Microarcsecond Astrometric Observatory



## Faint objects in motion : the new astrometry frontier

Proposal for a medium size mission opportunity in ESA's science programme (M5) mission

Theia lead proposer : Prof Céline Boehm

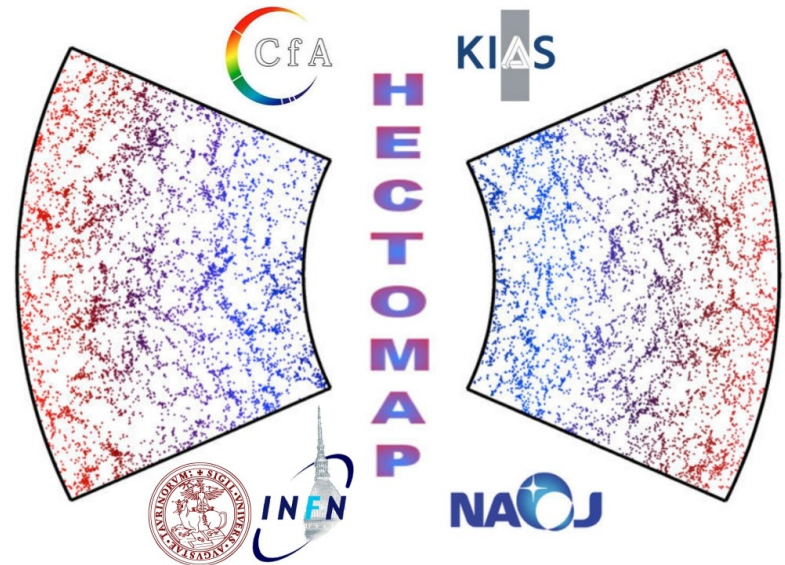
## MAIN RESULTS in 2022-23

- **Dark matter and light relics - Distribution of dark matter in the Milky Way and dwarf galaxies**
  - A new method to probe the shape of the dark matter halo of the Milky Way with hypervelocity stars (P.I. L. Ostorero: Gallo et al 2022)
- **Dark energy and modified gravity - Refracted gravity, Modified Newtonian Dynamics (MOND)**
  - A new test to probe modified Newtonian dynamics (MOND) with hypervelocity stars (P.I. L. Ostorero: Chakrabarty et al 2022)
  - Dynamics of dwarf galaxies in  $f(R)$  gravity (P.I. A. Diaferio: de Martino et al 2023)
  - Covariant formulation of refracted gravity (P.I. A. Diaferio: Sanna et al 2023)

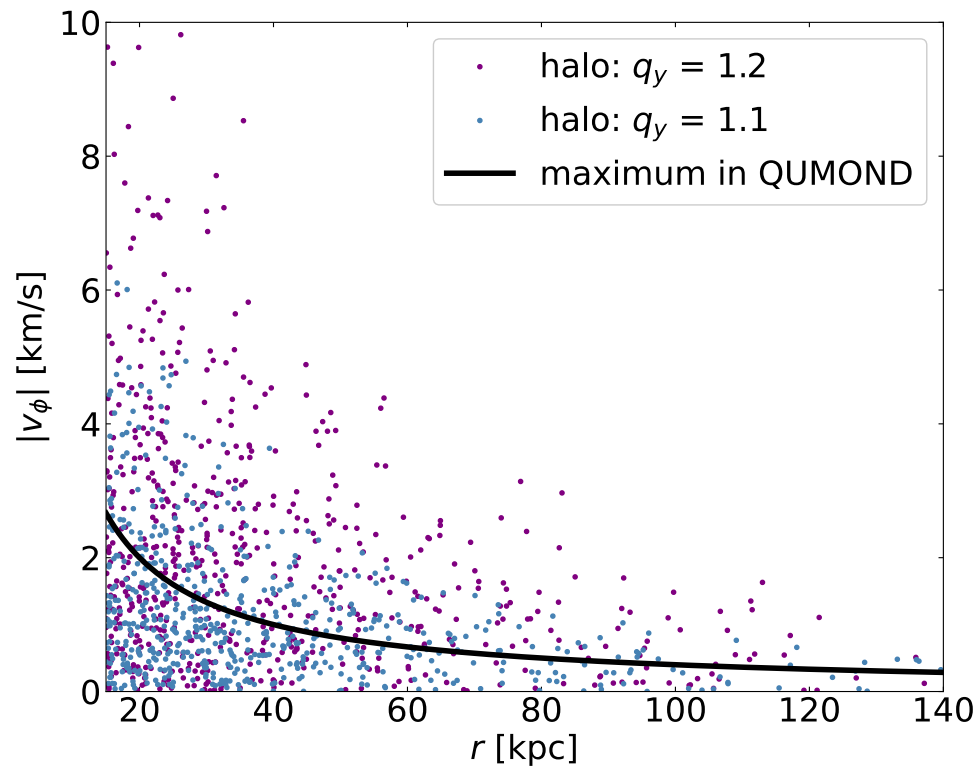
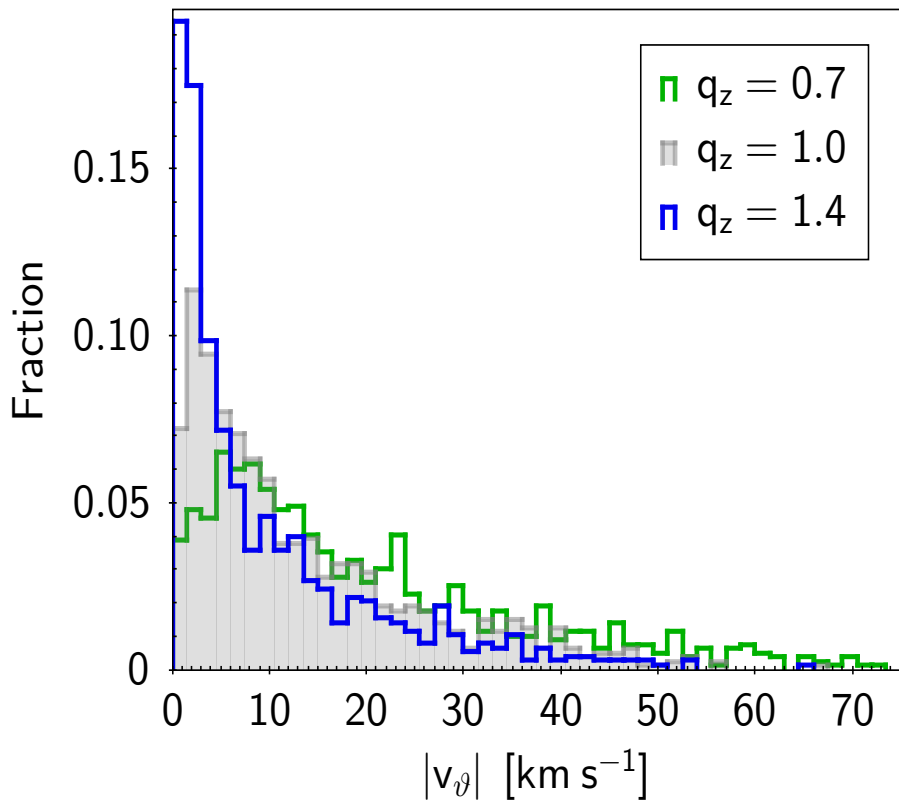


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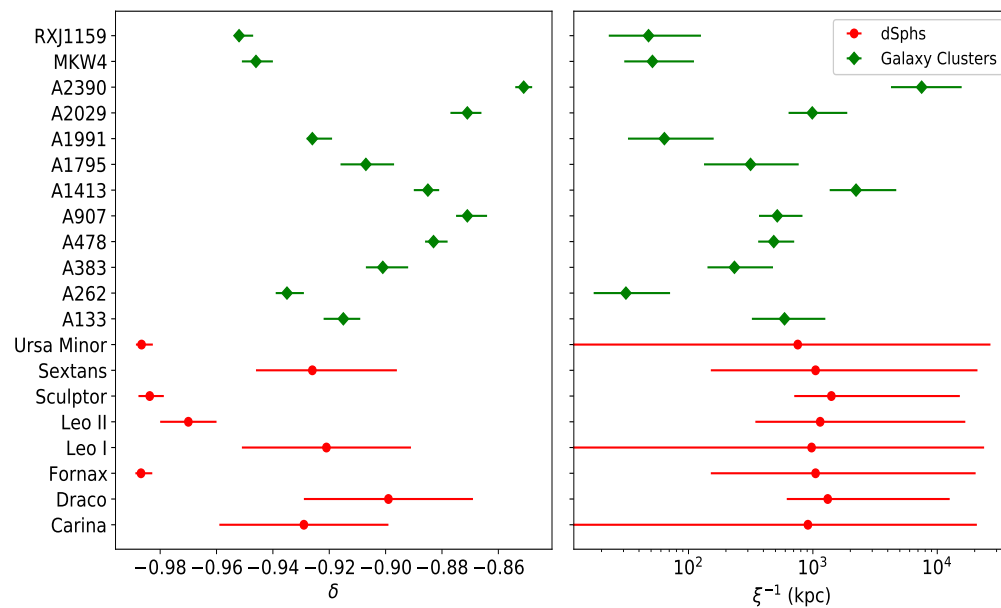
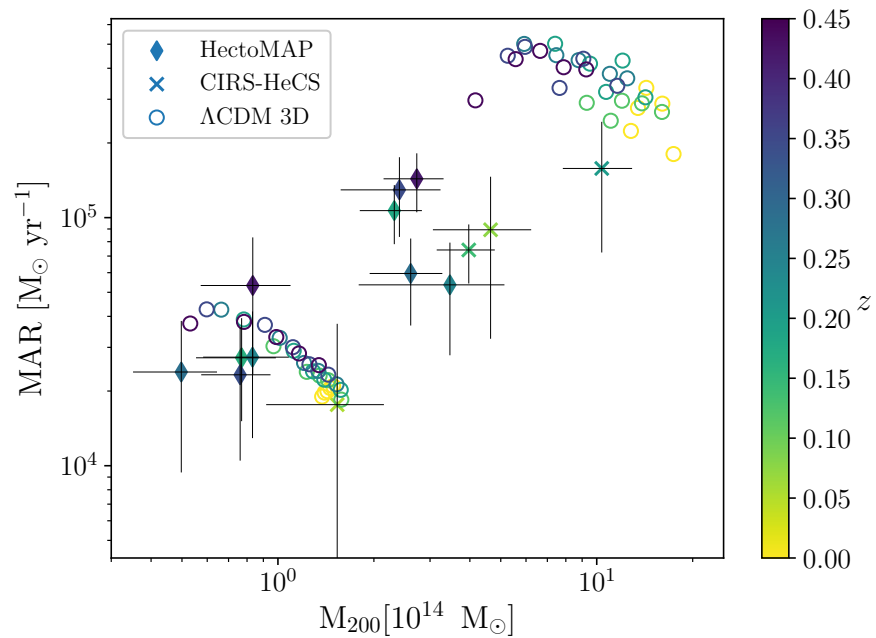
- **Cosmological observables as a probe of fundamental physics - Dynamics of galaxy clusters, Large-scale structures**
  - **Measurement of the mass accretion rates of the HectoMAP clusters of galaxies: test of the model of structure formation** (P.I. A. Diaferio: Pizzardo et al 2022)
  - **Model-independent constraints on clustering and growth of cosmic structures** (P.I. S. Camera: Tanidis and Camera 2023)
  - **Tidal virialization of dark matter haloes with clustering dark energy** (P.I. F. Pace: Pace and Schimd 2022)



# HYPERVELOCITY STARS



# Galaxy and Galaxy clusters





# Dark energy and cosmic growth

