

Nicolò Massari | Letter

A hitchhiker of the cosmos

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Dear Euclid Consortium committee,

I am writing to express my interest and motivation to become a member of the Euclid project, specifically to join the Weak Lensing (WL) and Strong Lensing (SL) Science Working Groups alongside my supervisor Dr. Raphael Gavazzi. During my masters I have worked on a Gaussian processed based Bayesian hierarchical model of weak lensing maps at field level with Prof. Alexandre Refregier and Dr. Tilman Tröster. Recently, I have started a PhD with Dr. Raphael Gavazzi at the Laboratoire d'Astrophysique de Marseille, where I will be working on flexion lensing, with the goal of contributing to the analysis of Data Release 1 (DR1) scheduled for October 21, 2026.

Traditional weak lensing analysis measures convergence (κ) and shear (γ), which arise from second derivatives of the lensing potential and manifest as changes in galaxy ellipticity. However, as demonstrated by Bacon et al. (2006)¹, flexion is the significant third-order weak gravitational lensing effect responsible for the weakly skewed and arc-like appearance of lensed galaxies.

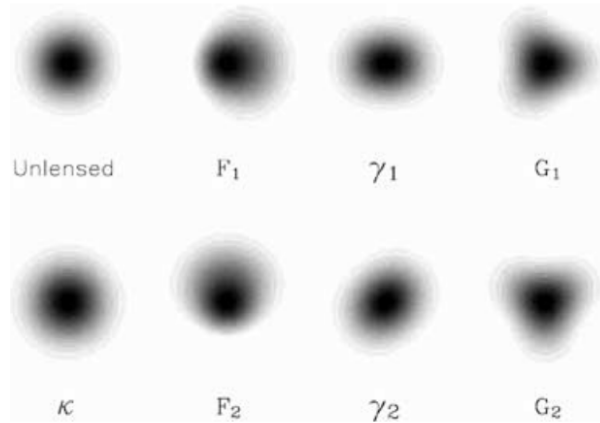


Figure 1: from Bacon et al. illustrates the hierarchy of lensing distortions with increasing spin values: convergence (spin-0), first flexion F (spin-1), shear (spin-2), and second flexion G (spin-3).

I will develop an analysis framework that:

- Validates the methodology using hydrodynamical simulations
- Extends existing 3×2 pt pipelines to include flexion correlation functions and cross-correlations with shear

The output I hope to achieve is:

- Detect dark matter substructure in galaxy groups and clusters
- Measure dark matter halo concentrations with factor-of-three improvements in precision
- Test modified gravity theories with these additional constraints

I am excited about the prospect of contributing to the largest weak lensing survey yet covering more than a third of the sky, and can't wait to collaborate.

Best regards,
Nicolò Massari

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¹D. J. Bacon, D. M. Goldberg, B. T. P. Rowe, A. N. Taylor, Weak gravitational flexion, Monthly Notices of the Royal Astronomical Society, Volume 365, Issue 2, January 2006, Pages 414–428, <https://doi.org/10.1111/j.1365-2966.2005.09624.x>