The quest for precision cosmology with eROSITA: new simulations and methods

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EUROPEAN ASTRONOMICAL SOCIETY ANNUAL MEETING

Outline

- Introduction about eROSITA

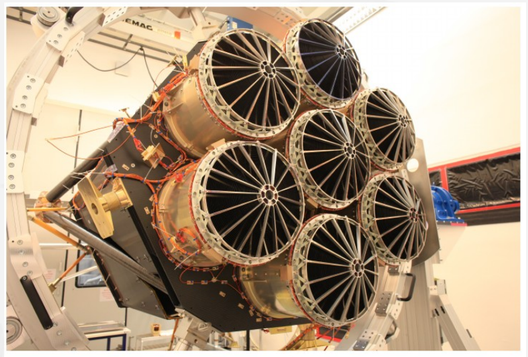
- The eRASS1 digital twin

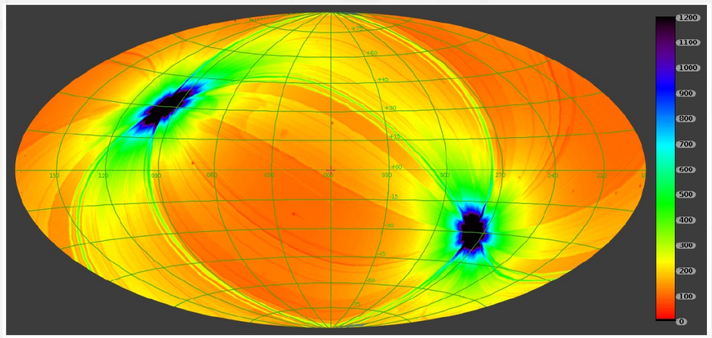
Completeness and Purity → Selection Function

- The clustering of eRASS1 clusters

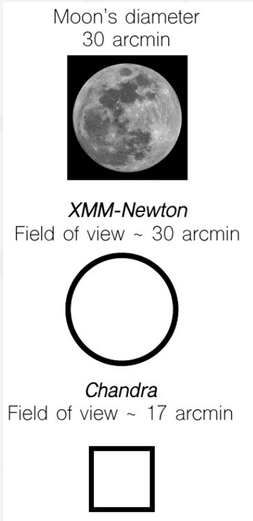
Galaxy groups satellite fraction

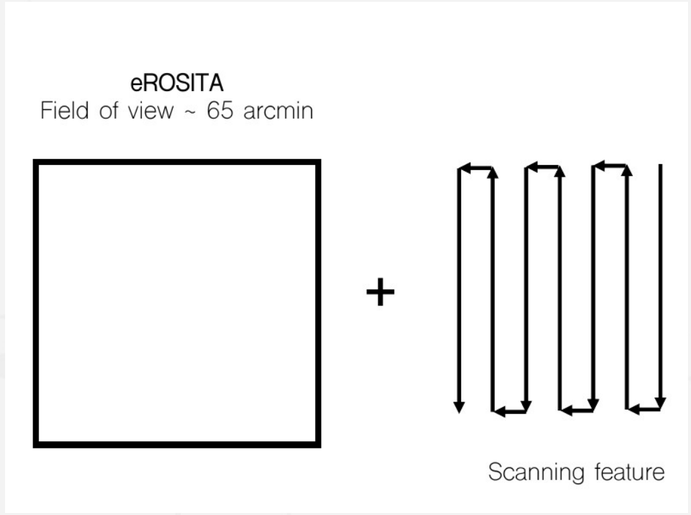
eROSITA

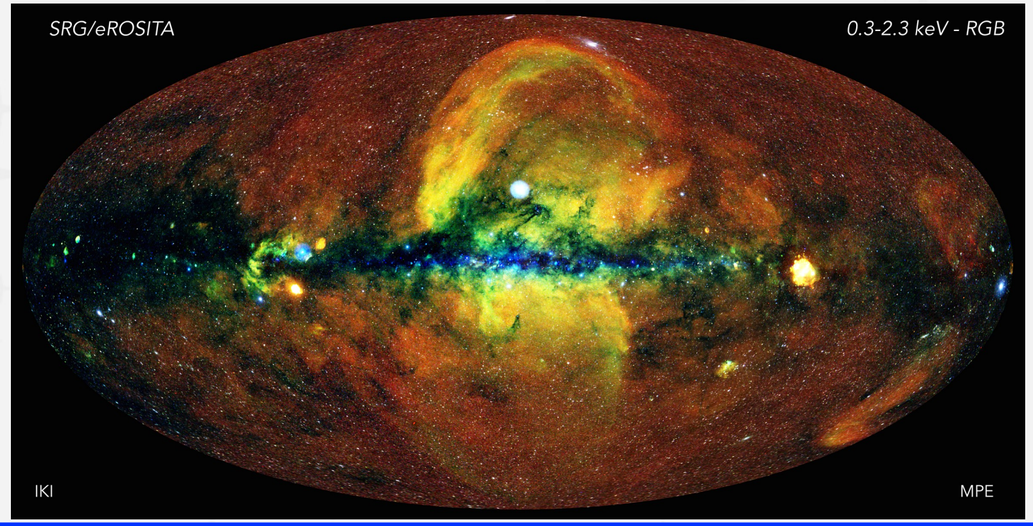




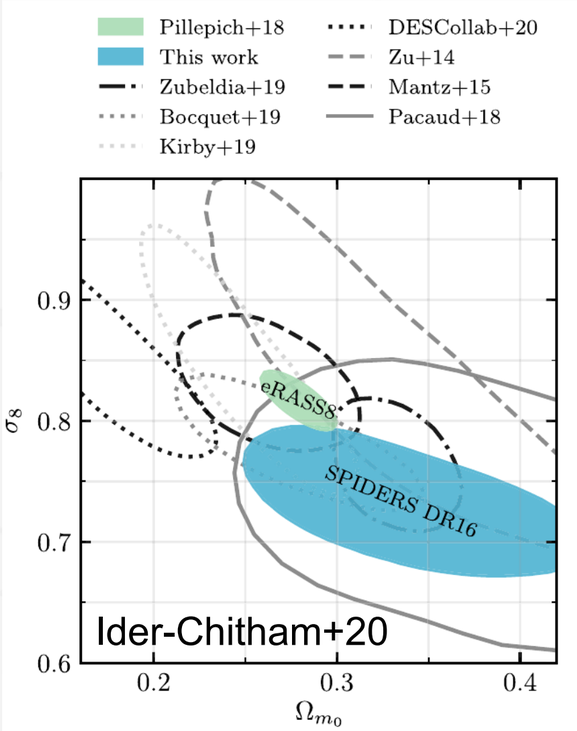
- Soft X-ray telescope on SRG (Predehl+21)
- Launched 13th July 2019
- CalPV phase (eFEDS) https://erosita.mpe.mpg.de/edr/
- All sky scans (eRASS:n), DR1 in fall
- 3e6 AGN, 1e5 clusters → cosmology (Merloni+12)



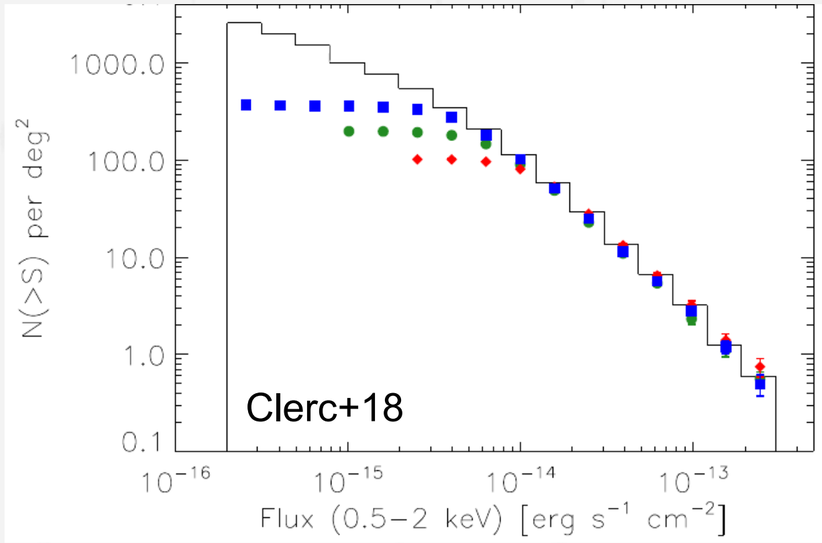




The eRASS1 digital twin



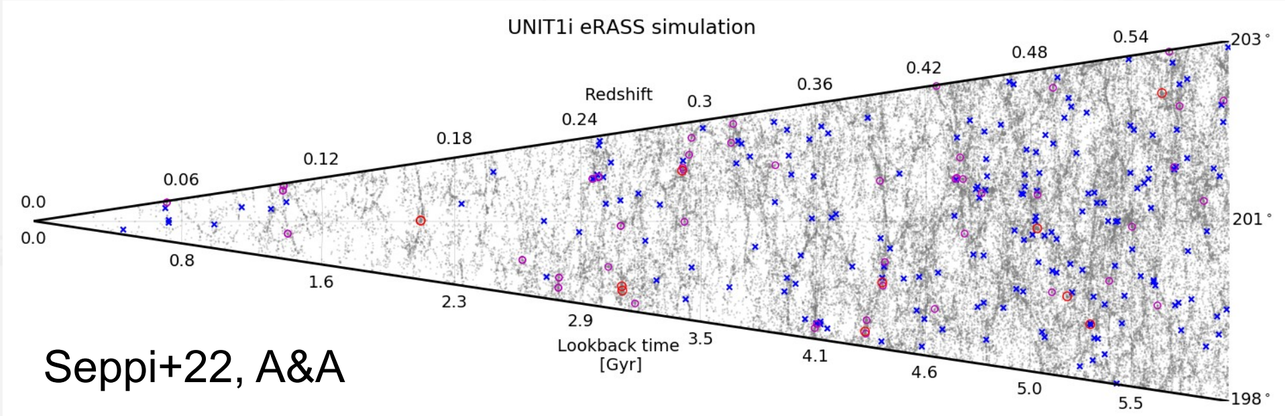
- **WHY DO WE NEED SIMULATIONS?**
  - Selection function
  - Understand uncertainties
  - Properties of the source catalog
  - Optimize source detection
  - X-ray properties



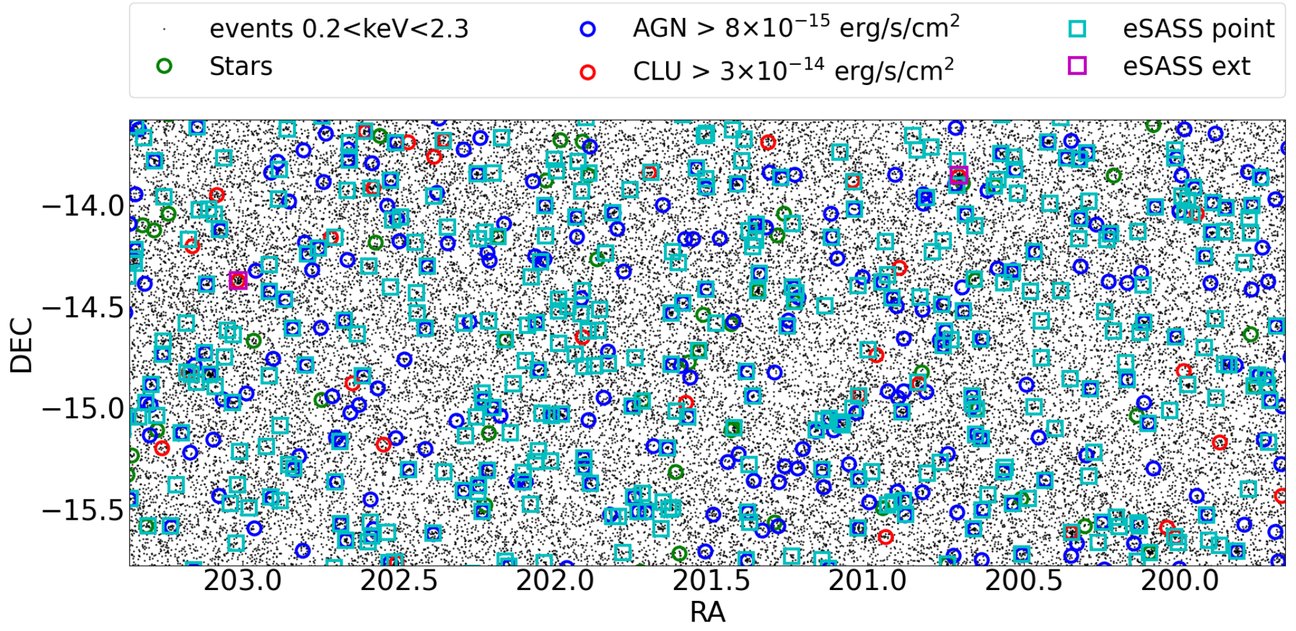
The eRASS1 digital twin

- **FORWARD MODEL**

- DMO light cones (UNIT, Chuang+19)
- Truthful models for clusters, AGN (Comparat+19,20)
  - SIXTE + eSASS
- Photon based matching



Seppi+22, A&A



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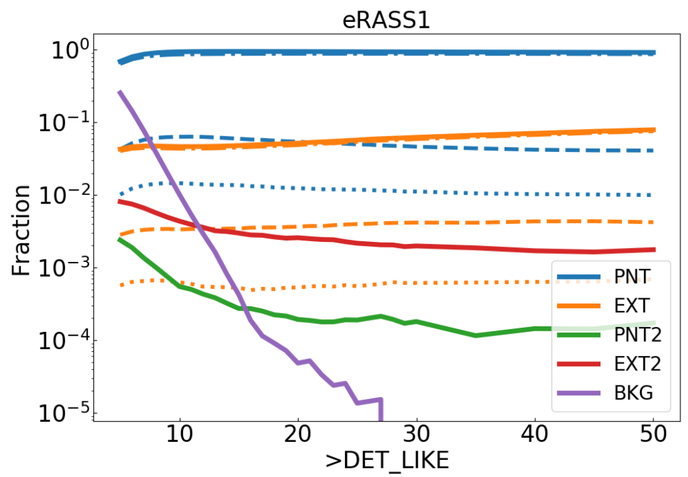
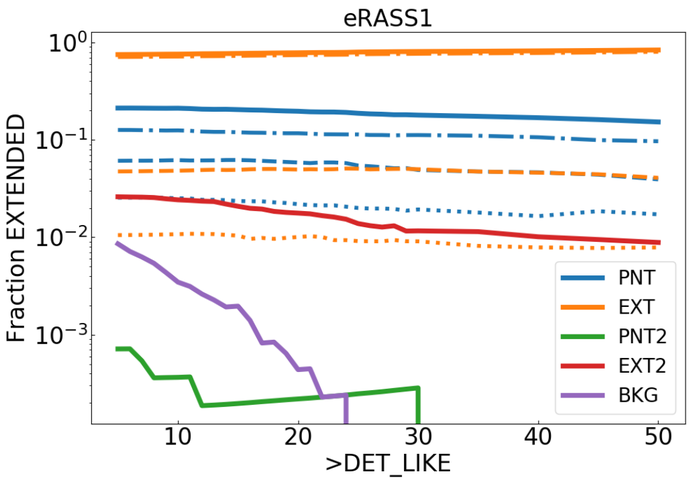
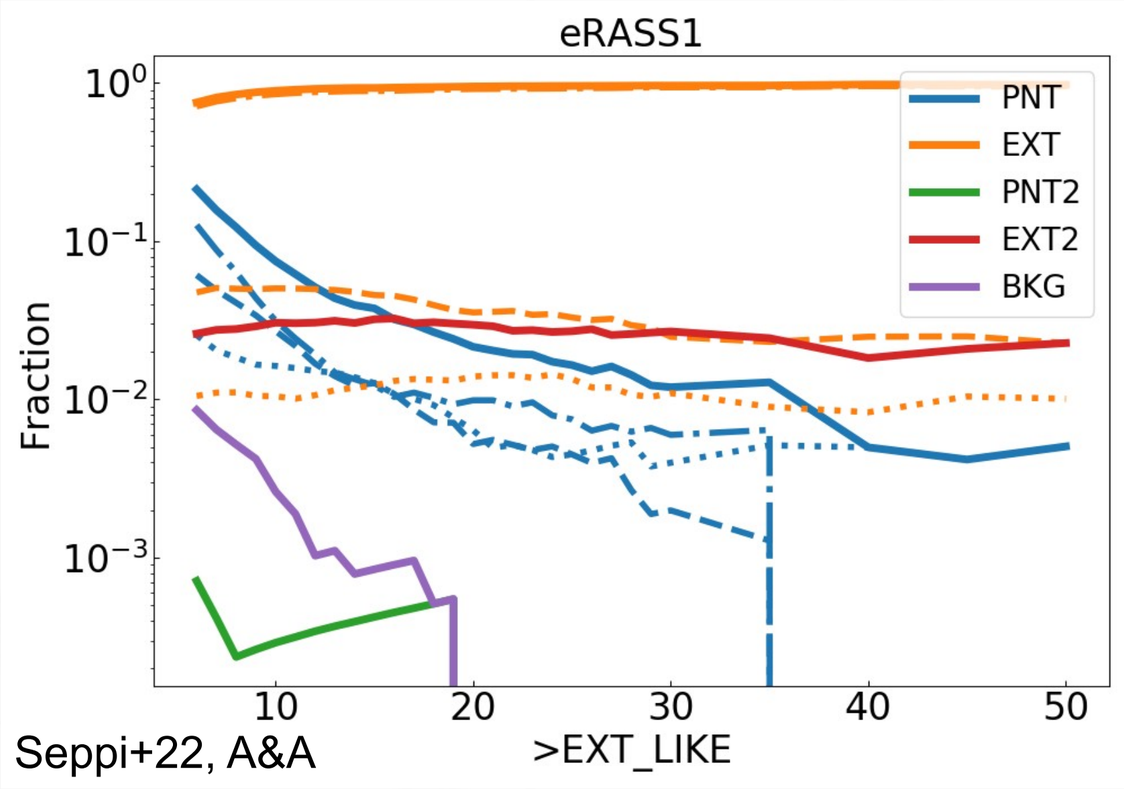
The source catalogue

- **Populations vs DET_LIKE**



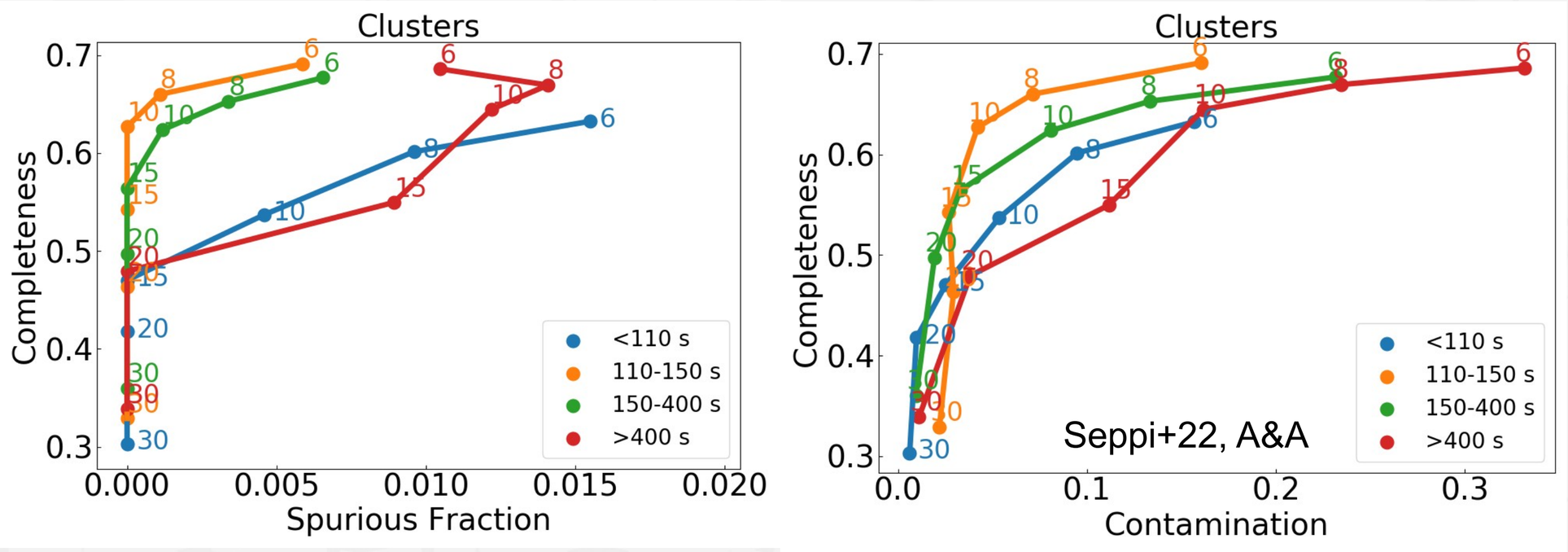


- **Populations vs EXT_LIKE**



Completeness — Purity

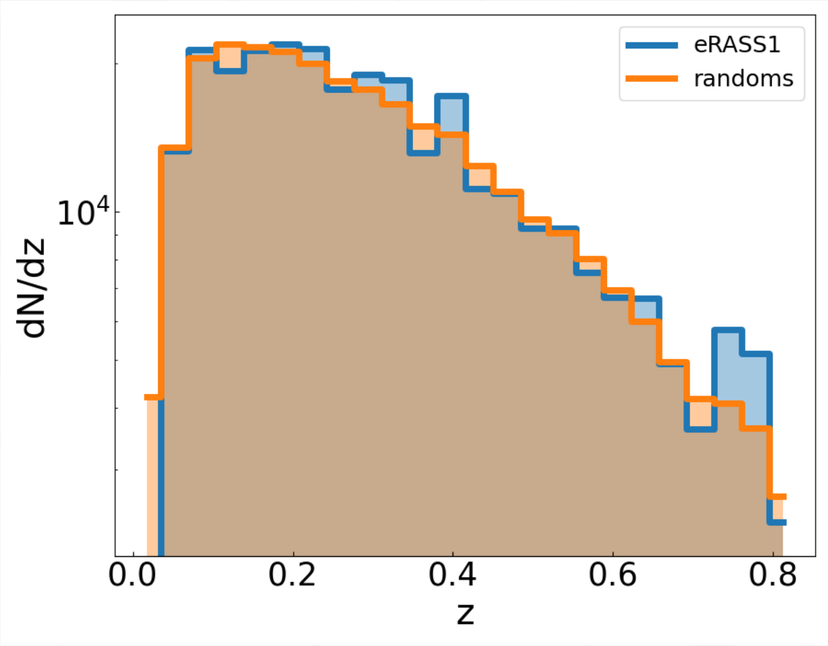
- Combine completeness, spurious fraction and contamination

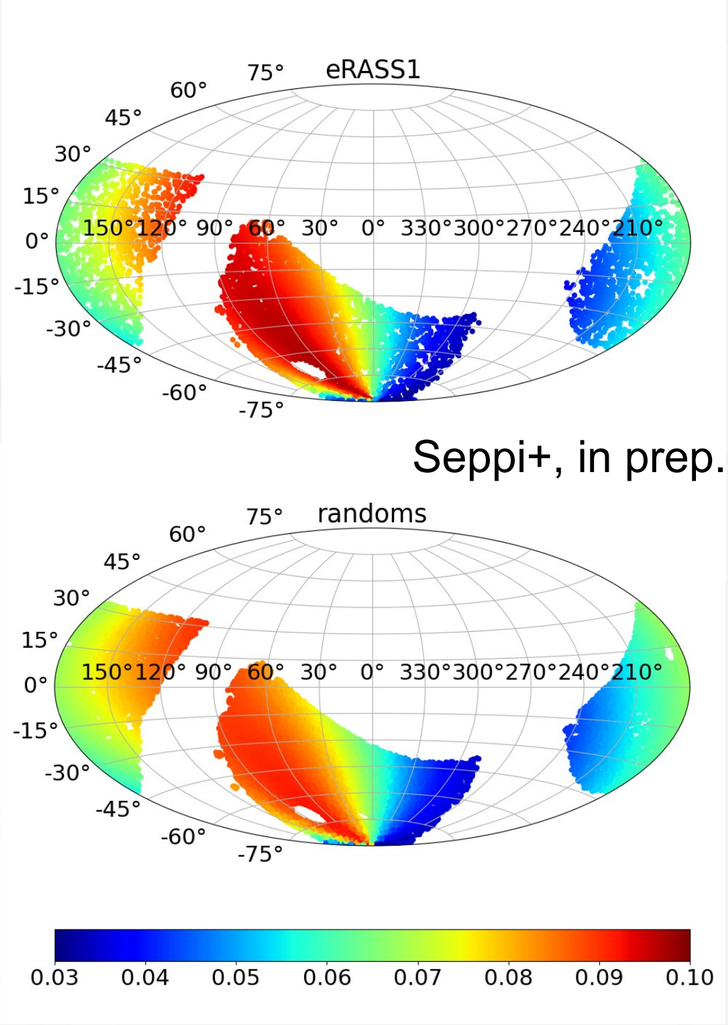


- We understand our source catalogue, we can model the selection function!

The clustering of eRASS1 clusters

- Complementary probe to the main cluster count experiment
  - Investigate satellite groups
- Random catalogue for 2PCF follows the selection function





Seppi+, in prep.

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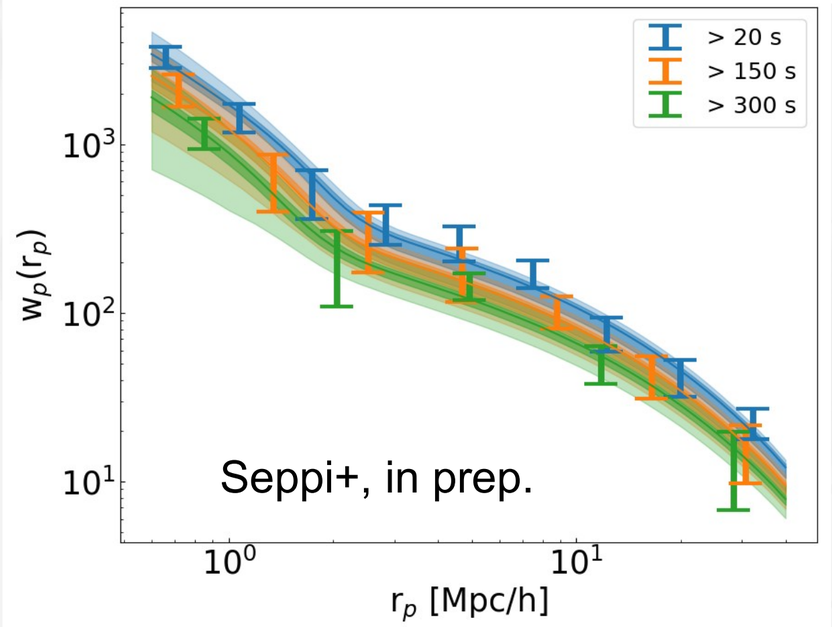
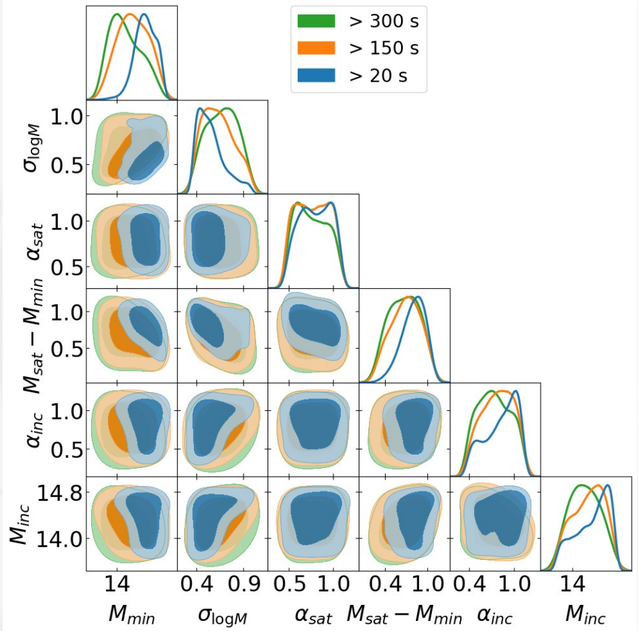
HOD interpretation

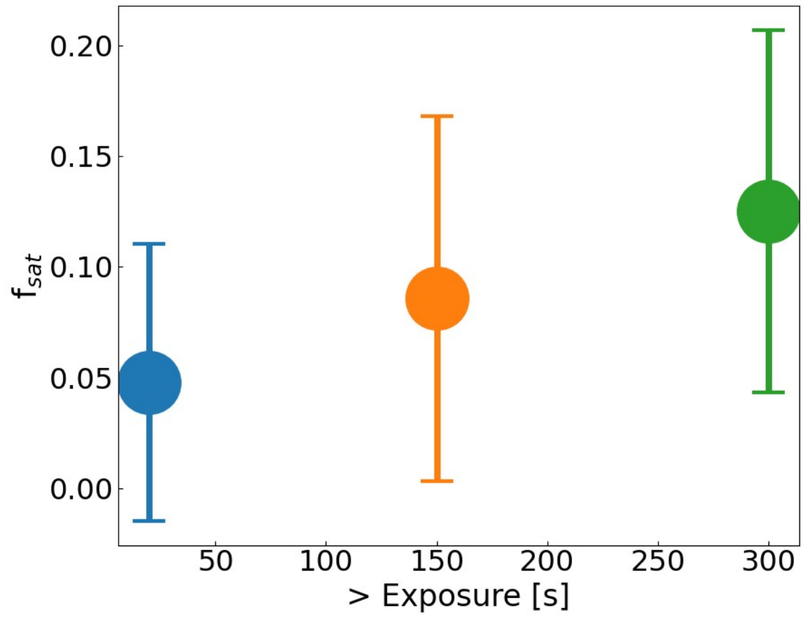
- Fit 2pcf with HOD models (Darkquest (Nishimichi+19), AUM (More+15))
  - Satellite fraction increases with depth

PRELIMINARY!

selection	<z>	N	Area [deg^2]	Volume [Gpc^3]	density [10^{-7}Mpc^{-3}]
T_{EXP} > 20 s	0.328	6494	12 791	30.59	2.12
T_{EXP} > 150 s	0.348	4073	4 828	11.55	3.53
T_{EXP} > 300 s	0.372	1699	911	2.18	7.81



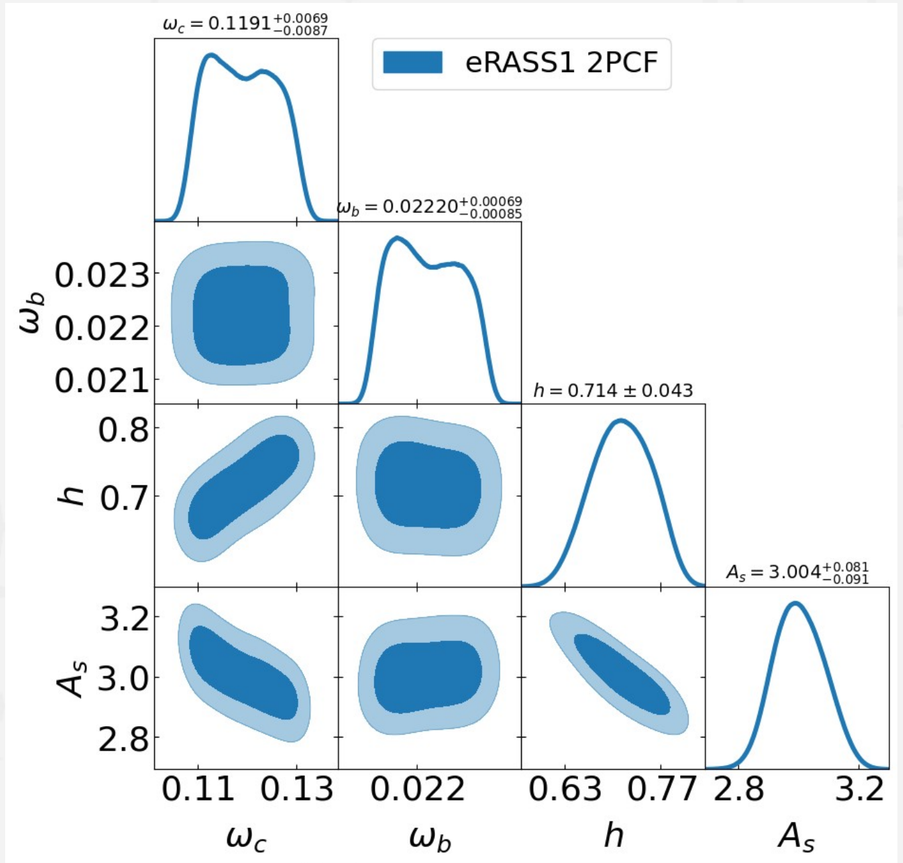




Cosmological implications

PRELIMINARY!

- Focus on the > 20 s cluster sample
- Fix HOD results (no assumption on halo bias!)
- To combine with main eRASS1 cluster counts



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Conclusions

- **Forward modeling of the eRASS1 sky**
- Provides direct understanding of the eRASS1 source catalogue
- Allows accurate and precise modeling of the selection function

- **The clustering of eRASS1 clusters**
- Evaluate the fraction of groups hosted by massive clusters
- Additional probe to improve the eROSITA cosmological constraining power