Detecting Galaxy Groups in the local Universe during the eROSITA era

Ilaria Marini
European Southern Observatory, Germany

P. Popesso (ESO)
G. Lamer (MPE)
K. Dolag (USM / MPA)
V. Biffi (INAF)
S. Vladutescu-Zopp (USM)
A. Dev (UWA)
V. Toptun (ESO)
E. Bulbul (MPE)
J. Comparat (MPE)
N. Malavasi (MPE)
A. Merloni (MPE)
T. Mroczkowski (ESO)
G. Ponti (INAF/MPE)
R. Seppi (U. Geneva)
S. Sheeram (MPE)
Y. Zhang (MPE)

May 7, 2024 - “Some like it hot” (MIAPbP)
Looking for galaxy groups...

Driver+22
Looking for galaxy groups…
Looking for galaxy groups...
Hydrodynamical Lightcone (Magneticum) of the local Universe

Box size: 352 (cMpc/h)³
$M_{DM} = 6.9 \times 10^8$ Msun

WMAP7 cosmology

N-Body/SPH modelling

Radiative Cooling (Wiersma+09)
Star Formation (Springel+03)
SMBH evolution (Hirschmann+14)
& AGN feedback
Hydrodynamical Lightcone (Magneticum) of the local Universe

Gas Particles (apec)
AGNs (zpowerlaw)
Binaries (zpowerlaw)
eFEDS background (Liu+22)

Cosmological z-distortion
Doppler Effect
Projection Effects
Galactic Absorption

Biffi+12,13,18; Vladutescu-Zopp+23
Observation or Simulation?
Observation or Simulation?

eRASS:4

Magneticum

Courtesy: G. Lamer
EFEWDS

Extended sources

Point sources

after eSASS run
Matching and completeness of the catalogue

\[ \frac{N_{\text{MATCHED}}}{N_{\text{TOT}}} \]

Spurious = 5%, 3% and 2% (EXT= 3, 6, 10)
Luminosity Function

EXTENDED SOURCES:

POINT SOURCES:
Luminosity Function

EXTENDED SOURCES:
The undetected galaxy groups
The undetected galaxy groups

Emissivity = $n_e^2 \Lambda(T, Z)$

Electron density

Cooling function
The undetected galaxy groups

\[ \Delta L_{500} = \frac{L_{500}}{L_{500}(M_{500})} \]
The undetected galaxy groups

$\log M_{200}$ in $10^{13.5}$ Msun

0.5-2.0 keV
The undetected galaxy groups

Emissivity = $n_e^2 \Lambda(T, Z)$

Electron density

Cooling function

$\log M_{200}$

$L_{500}$ [erg s$^{-1}$]
The undetected galaxy groups

Entropy: $K = \frac{T}{n_e^{2/3}}$
The undetected galaxy groups

Entropy: $K = \frac{T}{n_e^{2/3}}$
Conclusions

- **(X-ray) Lightcone of the local Universe**
  Self-consistent treatment of astrophysics
  (hydrodynamical simulations)

- **(Optical) Lightcone of the local Universe**

- Stacking analysis for undetected in eRASS1
  [see next talk :-( ) ]

Validate previous results
(Seppi+23, Liu+22)

Control of systematics
for stacking undetected
(Popesso+23)

Selection Effect
(e.g., Entropy)

What is next?

- **(Optical) Lightcone of the local Universe**

Ilaria Marini
ilaria.marini@eso.org