Clusters of Galaxies: Cosmology & Astrophysics

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R₅₀₀ - limit for XMM/Chandra R₂₀₀ - limit for Suzaku (LEO) 3R₅₀₀ - limit for Planck SZ stack



X-COP (Ghirardini+18)



^{291.20 291.00 290.80 290.60 290.40 290.20 290.00 289.80 289.60 289.40} Right ascension















A3158

-12.60



139.60 139.40 Right accession 139.20 139.00

Hydra A/A780



10.60 10.40 Right ascension 11.00 10.80 10.20 10.00 9.80





207.40 207.20 207.00 Right ascension 207.80 207.60 206.80 205.60



125.00 124.80 124.60 124.40 124.20 124.00 123.80 Right ascension

An XMM-Newton Heritage Program Witnessing the culmination of structure formation in the Universe (PI: M. Arnaud & S. Ettori)

Building on the *Planck All sky* SZ effect survey, we plan to observe with *XMM*-*Newton (3 Msec over next 3 years)* the culmination of cosmic structure formation: **118 clusters, comprising an unbiased census of**

- the population of clusters at the most recent time (z < 0.2),
- the most massive objects to have formed thus far in the history of the Universe



ΑΤΗΕΝΑ

The formation and evolution of clusters and groups of galaxies

How and when was the energy contained in the hot intra-cluster medium generated?



Bulk motion and turbulent broadening of FeXXV Ka line.

With 100k-sec X-IFU exposure, 0^{+20} , 200 ± 5 , 400 ± 10 km/s can be resolved.

Thesis

- Properties of the galaxy cluster outskirts -where most of the mass is and accretion is taking placefrom present X-ray data and hydro-simulations
- Turbulence & coherent motion of the ICM: new window on the plasma physics through high resolution spectroscopy
- M_{tot} in galaxy cluster from scaling relations applied to X-ray, SZ & optical proxies: applications to present & future surveys (e.g. XXL, *XMM-Heritage*, eROSITA, Euclid, Athena)

Thesis work with S. Ettori

- Properties of the galaxy cluster outskirts from present X-ray data and hydro-simulations [e.g. "Resolving and counting subhalos in cluster's outskirts", ref. Meneghetti; "Observational constraints on analytic models for universal profiles of the ICM", ref. Brighenti; "Metal distribution in the ICM out to the viral radius ", ref. Brighenti]
- Turbulence & coherent motion of the ICM: new window on the plasma physics through high resolution spectroscopy [e.g. "ICM rotation as resolved with XRISM/Athena", ref. Nipoti; "Thermodynamical properties of ICM as resolved with XRISM/Athena", ref. Brighenti]
- M_{tot} in galaxy cluster from scaling laws applied to X-ray, SZ & optical proxies: applications to present & future surveys (XXL, *XMM-Heritage*, *eROSITA*, *Euclid*, *Athena*) [e.g. "Predictions & calibration of Mass-related scaling relations in eROSITA / Euclid", ref.
 Meneghetti; "2D map of the thermo-dynamical quantities in the Heritage targets", "The joint X-ray/SZ analysis of the most massive clusters in the Universe", ref. Brighenti/Gitti]