

Call for Expression of Interest (Eol) for the SKA-Athena Synergy Workshop

With the aim of identifying and developing potential scientific synergies between the Athena X-ray observatory mission, currently under study by ESA, and the Square Kilometre Array (SKA), the SKA-Athena Synergy Team (SAST) issues a Call for Expression of Interest (Eol) to invite the astrophysical community to propose contributions for the SKA-Athena Synergy Workshop. The final goal of this Workshop, that will be hosted by SKAO, Jodrell Bank, Manchester (UK), 24-25 April 2017, will be to provide input for a Synergy White Paper (SWP) about the scientific synergies between the Athena X-ray observatory and SKA and its precursors. The SAST is expected to deliver the SWP to the SKA Science Director and to ESA's Athena Science Study Team by October 2017 at the latest.

The involvement of the astrophysical community in this process will happen primarily through this Workshop. Interested scientists are invited to submit a < 1 page abstract of their proposed contribution for the workshop, indicating also title of the talk, author (PI) and co-authors, relevant synergy area. A first suggestion of major areas to be covered can be found at pag.2 of this call.

Eol should be sent to aco@ifca.unican.es by the **30th of November 2016**.

The SAST will review the submitted Eol considering the scientific merit of the proposed contribution, the required science areas of expertise, and secondly gender and nationality balance. At the end of this selection process the SAST is expected to send invitations to the Workshop to around 15-20 scientists.

The SKA-Athena Synergy Team:

R. Cassano (Chair of the SAST), R. Fender, C. Ferrari & A. Merloni

R. Braun (SKA Science Director)

X. Barcons (Athena Science Study Team)

SKA-Athena synergy topics

The following is a list of scientific synergy areas between Athena and SKA compiled by the SAST (*N.B.* science topics not in priority order).

- 1) Galaxy clusters and large scale structure
 - a) The effects of cluster weather on the intra-cluster medium (ICM) microphysical properties (such as turbulence, viscosity, magnetic fields and relativistic particles, etc...) will be revealed by the unique combination of high-resolution X-ray spectroscopy (*Athena*) and deep and high-resolution radio observations (*SKA*) of galaxy clusters;
 - b) Radio halos and relics as probe of the galaxy cluster merging process;
 - c) Radio halos and relics as tracers of the turbulent state of clusters and cluster merger shocks, respectively: learning about physics of particles acceleration by MHD turbulence and particle acceleration at shocks;
 - d) Radio relics and accretion shocks at the outskirts of galaxy clusters: going beyond the present view;
 - e) The detection of the cosmic web through radio and X-ray deep observations: continuum synchrotron radiation, HI (in absorption/emission), WHIM
 - f) Radio mini-halos at the cluster cores, probing turbulent re-acceleration in action in the "quiescent atmosphere" (see Hitomi Collaboration, 2016, *Nature*, 535, 117; for the Perseus cluster core) of relaxed clusters;
 - g) Search for high-*z* clusters using radio galaxies as beacons and following up the X-ray emission of the ICM.
- 2) Black Hole accretion and growth: AGN and X-ray Binaries
 - a) X-ray (accretion) vs radio (mechanical feedback) in large surveys, eg. the Athena multi-tiered survey;
 - b) Mechanical feedback: radio mode vs winds/outflows (& radiative feedback);
 - c) Mapping the radio jets and correlation with X-ray cavities;
 - d) Obscured accretion: use HI 21cm absorption to identify obscured (but radio powerful) AGN at high-*z* found in X-ray surveys;
 - e) AGN-galaxy co-evolution: SKA will provide SF-driven radio luminosity of all Athena radio-quiet AGN up to the epoch of AGN growth ($z \sim 2-3$). Vice versa, Athena (either via individually detected sources and stacking analysis) provide accretion-driven power in complete samples of galaxies above given SFR thresholds;
 - f) High-*z* Universe, reionization: cross correlation of residual XRB fluctuation with 21 cm maps: probe AGN population well into the reionization epoch;
 - g) studies of stellar mass black holes and neutron stars: connection of accretion states to mode and power of relativistic jets, connection to AGN and black hole scaling laws.
- 3) Transients
 - a) Tidal Disruption Events: triggering and localisation independently by both facilities, studies of the radio jet modes of TDEs;
 - b) High-*z* GRBs;
 - c) Exploration of the unknown - radio follow up of serendipitous field X-ray transients (of which there will be a LOT), and vice versa Physics of X-ray Binaries.