NuSTAR and Swift on a very bright, hard X-ray source

Thanks to its better sensitivity and spatial resolution, NuSTAR allows us to investigate the E>10 keV properties of nearby galaxies. We now know that starburst galaxies, containing very young stellar populations, have X-ray spectra which drop quickly above 10 keV. We extend our investigation of hard X-ray properties to an older stellar population system, the bulge of M31. The NuSTAR and Swift simultaneous observations reveal a bright hard source dominating the M31 bulge above 20 keV, which is likely to be a counterpart of Swift J0042.6+4112 previously detected (but not classified) in the Swift BAT All-sky Hard X-ray Survey. This source had been classified as an XRB candidate in various Chandra and XMM-Newton studies; however, since it was not clear that it is the counterpart to the strong Swift J0042.6+4112 source at higher energies, the previous E < 10 keV observations did not generate much attention. The NuSTAR and Swift spectra of this source drop quickly at harder energies as observed in sources in starburst galaxies. The X-ray spectral properties of this source are very similar to those of an accreting pulsar; yet, we do not find a pulsation in the NuSTAR data. The existing deep HST images indicate no high mass donors at the location of this source, further suggesting that this source has an intermediate or low mass companion. The most likely scenario for the nature of this source is an X-ray pulsar with an intermediate/low mass companion similar to the Galactic Her X-1 system. We will also discuss other possibilities in more detail.

Author(s): Mihoko Yukita[1], Andrew Ptak3, Thomas J. Maccarone[6], Ann E. Hornschemeier3, Daniel R. Wik[1], Katja Pottschmidt3, Vallia Antoniou5, Frederick K. Baganoff[2], Bret Lehmer7, Andreas Zezas5, Patricia T. Boyd3, Jamie Kennea4, Kim L Page[8]
Institution(s): *1. Johns Hopkins University, 2. MIT, 3. NASA/GSFC, 4. Penn State University , 5. SAO, 6. Texas Tech University, 7. University of Arkansas, 8. University of Leicester*

110.03 – Global MHD simulations of cosmic ray driven galactic winds

Galactic outflows play an important role in galactic evolution. Despite their importance, a detailed understanding of the physical mechanisms responsible for the driving of these winds is lacking. In an effort to gain more insight into the nature of these flows, we perform global three-dimensional magneto-hydrodynamical simulations of an isolated starbursting galaxy. We focus on the dynamical role of cosmic rays injected by supernovae, and specifically on the impact of the streaming and anisotropic diffusion of cosmic rays along the magnetic fields. We find that these microphysical effects can have a significant effect on the wind launching and mass loading factors depending on the details of the plasma physics. Cosmic rays stream away from the densest regions near the galactic disk along partially ordered magnetic fields and, in the process, accelerate more tenuous gas away from the galaxy. For cosmic ray acceleration efficiencies broadly consistent with the observational constraints, cosmic rays are likely to have a notable impact on the wind launching.

Author(s): Mateusz Ruszkowski[2], Hsiang-Yi Karen Yang[1], Ellen Gould Zweibel3
Institution(s): *1. University of Maryland, 2. University of Michigan, 3. University of Wisconsin*

110.04 – Chandra Galaxy Atals - Global Hot Gas Properties

The hot gas in early type galaxies (ETGs) plays a crucial role in understanding their formation and evolution. As the hot gas is often extended to the outskirts beyond the optical size, the large scale structural features identified by Chandra (including jets, cavities, cold fronts, filaments and tails) point to key evolutionary mechanisms, e.g., AGN feedback, merging history, accretion/stripping and star formation and its quenching. In our new project, the Chandra Galaxy Atlas, we systematically analyze the archival Chandra data of ~100 ETGs to study the hot ISM. Using uniformly derived data products with spatially resolved spectral information, we will present gas morphology, scaling relations and X-ray based mass profiles and address their implications.

Author(s): Dong-Woo Kim[2], Craig Anderson[2], Douglas J. Burke[2], Giuseppina Fabbiano[2], Antonella Fruscione[2], Jennifer L. Lauer[2], Michael L. McCollough[2], Douglas Morgan[2], Amy Mossman[2], Ewan O'Sullivan[2], Alessandro Paggi[2], Ginevra Trinchieri[1]
Institution(s): *1. INAF, 2. Smithsonian Astrophysical Observatory*

110.05 – The Morphology of Nearby Ultraviolet Galaxy Halos

We have detected diffuse ultraviolet light around highly inclined galaxies within 100 Mpc, and around galaxies within 25 Mpc we can characterize its structure. The morphology of the diffuse light often corresponds to diffuse H-alpha and X-ray emission and is found above the central regions of galaxies as well as above regions with strong star formation. In some cases, brighter regions of diffuse ultraviolet light correspond to cold dust seen with Herschel. The most plausible explanation is that we are seeing extragalactic reflection nebulae, in which case the UV light traces the dust distribution and underlying star formation. The dust masses implied by the extragalactic flux are comparable to the dust in galaxy disks; if the dust-to-gas ratio is constant, then these galaxies expel about as much gas as they contain.

Author(s): Edmund J. Hodges-Kluck[1], Joel N. Bregman[1], Julian Cafmeyer[1]
Institution(s): *1. University of Michigan*

110.06 – X-ray Mass Profiles from Chandra Galaxy Atlas

We present preliminary results of a Chandra/XMM-Newton joint analysis on a sample of three Early Type Galaxies (ETGs, namely NGC4649, NGC4636 and NGC5846). X-ray observations of the hot ISM is used to measure the total enclosed mass assuming hydrostatic equilibrium, and compasion with mass distributions obtained through optical kinematics data of globular clusters and planetary nebulae yields informations about disturbances in the ISM distribution due to nuclear activity, merging history, etc. Our analysis makes use of the Chandra Galaxy Atlas (CGA) data products - exploiting the unmatched spatial resolution of the ACIS detectors to reveal fine ISM features and disturbances in the inner galactic regions - and XMM-Newton data - relying on the large field of view of EPIC detector to extend the mass profiles to larger radii. We then measured the mass profiles in various pie sectors to separate different gas features (e.g., discontinuity and extended tail) and compared them with GCs/PNe based mass profiles. The X-ray mass profiles of NGC4649 show a generally relaxed morphology and, in agreement with previous analysis, the comparison with the optical mass profiles shows a significant deviations on parsec scale likely due to non-thermal pressure linked to nuclear activity. In significantly disturbed cases (NGC4648 and NGC5846) where we found discontinuities and extended tails, we found that the mass profiles are over-estimated toward the compressed discontinuity and under-estimated toward the extended tails, similar to inflow and outflow cases. These preliminary results are promising toward an extended analysis of the whole CGA sample in order to study the distribution of gas temperature and metal abundances in the ISM, and to investigate scaling relations between ETG global quantities like ISM temperature, luminosity and total mass.

Author(s): Alessandro Paggi[2], Dong-Woo Kim[2], Craig Anderson[2], Douglas J. Burke[2], Giuseppina Fabbiano[2], Antonella Fruscione[2], Jennifer L. Lauer[2], Michael L. McCollough[2], Douglas Morgan[2], Amy Mossman[2], Ewan O'Sullivan[2], Ginevra Trinchieri[1]
Institution(s): *1. INAF-Osservatorio Astronomico di Brera, 2. Smithsonian Astrophysical Observatory*

110.08 – Search for Gamma-ray Emission from Dark Matter Annihilation in the Small Magellanic Cloud