XMM Newton : The Next Decade

Summary Talk

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Goals of the Workshop:

- Summary of current knowledge including major achievements
- Identify the scientific topics of the highest importance and impact
- Identify observing programs of maximum long term value for the whole community

XMM Newton : imaging & spectroscopy
(no polarisation)

Physical Processes:

- Spectroscopy and its implications
- The plasma problem
- Accretion onto black holes
- Nonthermal emission

=> Total of 48 review, contributed and solicited presentations and a comparable number of poster presentations.

Introductory Talks:

- 2 talks at the start **(Schartel, Palmar)**
- XMM Newton can operate efficiently for at least the next decade
- Funding of XMM Newton operations will cease in 2013
- Oversubscription (x 6-7)
- Need to secure the future

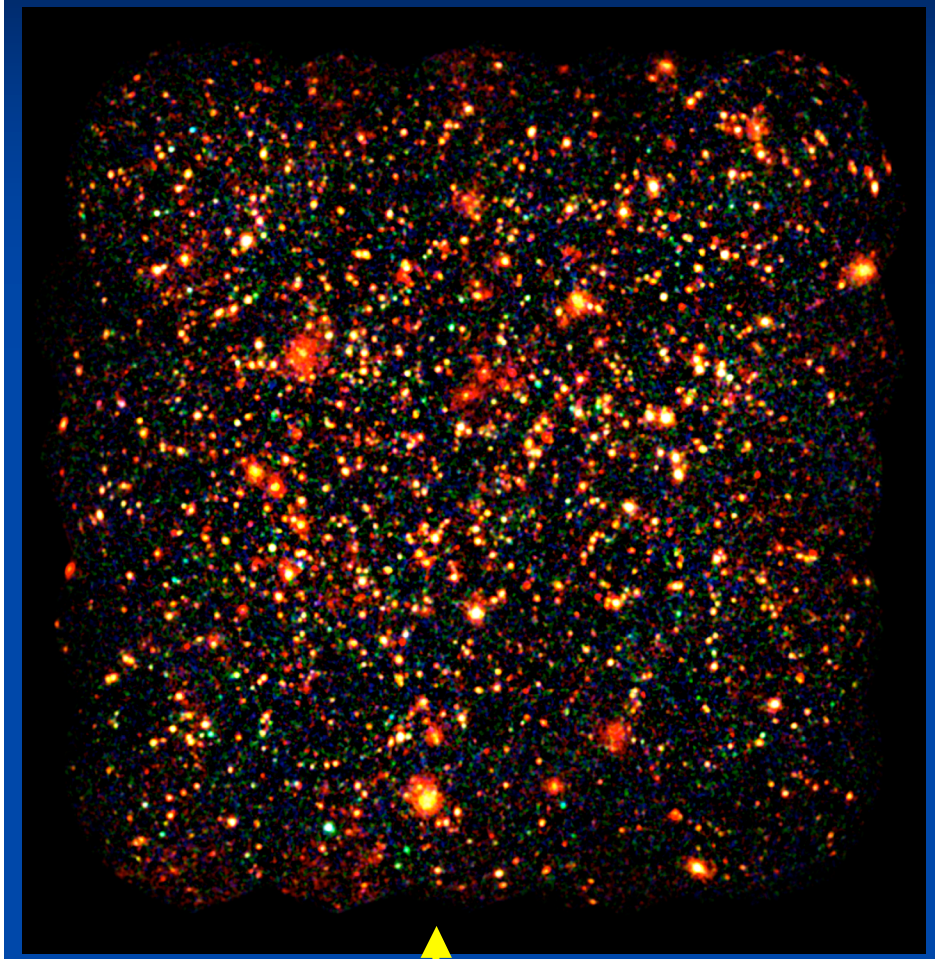
Cosmology, Extragalactic Surveys and WHIM

- Search for the missing baryons **(Barcons)**: Missing baryons (4.5% in total, 2.5% in clusters) are predicted to be in the WHIM filaments. Detection of the intervening absorption with XMM and Chandra is controversial.

- Extragalactic surveys **(Comastri)**: Scientific cases for an extremely wide survey and an ultradeep pointing.

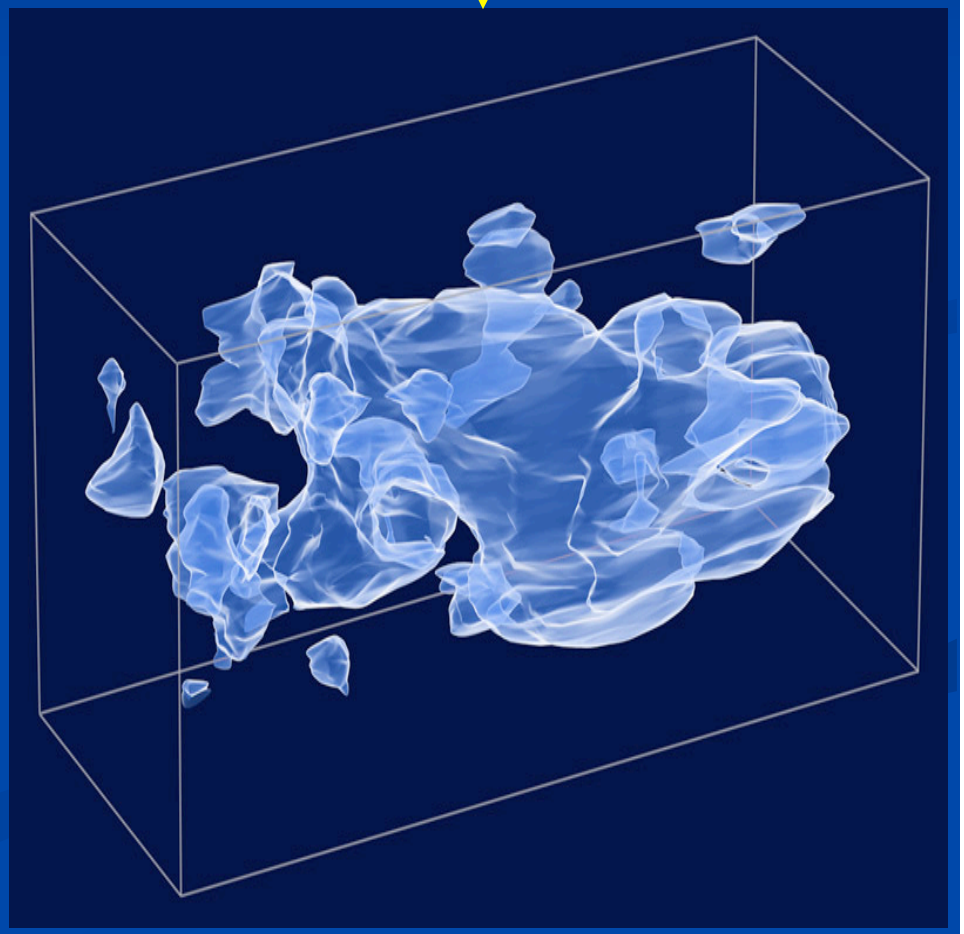
- XMM Newton survey of infrared/submm fields **(Alexander)**: Unique parameter space here to be exploited.

- XMM Newton Cosmos results and perspectives **(Brusa)**: Largest XMM program, covered 2 square deg.



Full XMM-Newton coverage of the COSMOS field

3D map of Dark Matter



- Contiguous and serendipitous surveys with XMM Newton **(Watson)** : Pointed observations gives ≈ 80 square deg/year (1/500 of the sky), contrast with new large area surveys.
- Highly obscured AGN with Spitzer and XMM Newton **(Fiore)** : Use extreme 24μm and optical criteria to select Compton thick sources from the SWIRE fields. Follow-up observations of targeted sources in X-rays (*astro-ph*/02052864)
- Beyond the Lockman hole **(Carrera)** : Deep observation to reach the confusion limit of XMM Newton in 5-10 keV band (2Ms). Number of unabsorbed and absorbed AGN are almost equal.

- Getting the most from XMM Newton **(Romer + XCS collaboration)** :

  (a) large area (200 square deg) of a continuous survey in SDSS strip 82

  (b) slew survey covering ≈ 1000 square deg

  (c) better spectroscopy of XCS clusters

- Clusters in deep XMM Newton surveys **(Finoguenov)** : Role of XMM Newton aberrations in establishing cluster cosmology in $1 < z < 3$ when dark energy dominated the universe.

Clusters of Galaxies

- Statistical Properties of Clusters of Galaxies **(Bohringer)** : Census of the cluster population from flux limited X-ray surveys. Studies of clusters at higher redshift ($z \sim 1$) require a large program.

- XMM Newton large program in which 33 luminosity selected clusters ($z < 0.2$) were observed **(Pratt)** : Results given in density, temperature and entropy, and compared with a sample of 22 clusters at $0.4 < z < 0.6$.

- Deep RGS observations of Clusters **(Smith)** : The weak or non-detection of Fe XVII and other low temperature emission lines in the RGS from cooling flow clusters – do not cool. Only RGS can do relatively extended sources – few deep observations have been made of clusters.

- The XMM-LSS survey **(Pierre):** This is a large area (10 deg^2 at 5 x 10^{-15} $erg/s/cm^2$) and shallow XMM survey (10 ks pointings). Produced a large XMM cluster sample, AGN and multi-wavelength follow-up observations.
- XMM Newton and observational cosmology **(Lieu)** : Clusters with soft X-ray excess and WHIM. Soft excess may be non-thermal in origin (No OVII). Suggested new XMM observation. WMAP and ROSAT data on clusters. WMAP clusters barely have any SZ effect.
- Planck cluster survey **(Bartlett)** : XMM follow-up of sample of massive high redshift SZ clusters.
- SUZAKU observations of clusters **(Matsushita)** : Low background of SUZAKU enables accurate temperature of the intercluster medium.

Jee et al (astro-ph/0705.2171)

Ring of Dark Matter in Cluster Cl 0024+17

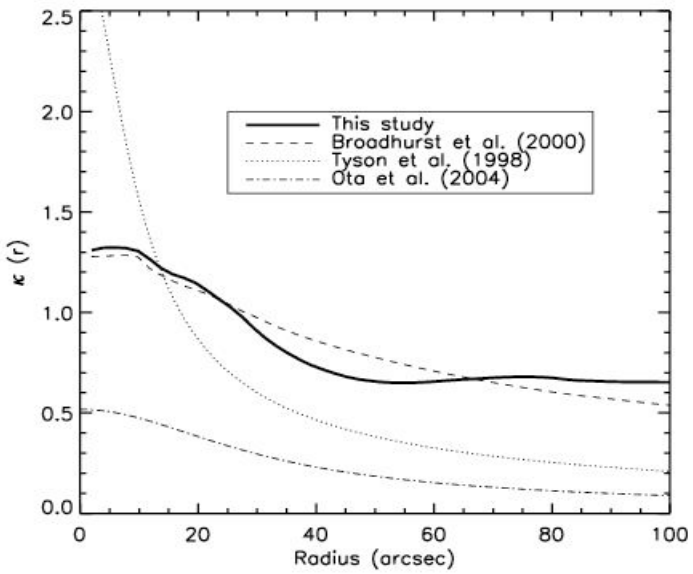


Fig. 11.— Density profiles of Cl 0024+17 from different studies. The overall shape of our radial density profile (*solid*) looks more striking when compared to the results of the previous studies. We transformed the results of Tyson et al. (1998) (*dotted*), Broadhurst et al. (2000) (*dashed*), and Ota et al. (2004) (*dot dashed*) using the current cosmological parameters. Note that Tyson et al. (1998) and Broadhurst et al. (2000) derived the mass density using strong-lensing while Ota et al. (2004) used *Chandra* X-ray observations. As already indicated by Ota et al. (2004), the X-ray mass is far less than the other three lensing results; a more recent X-ray analysis with XMM-Newton (Zhang et al. 2005) (omitted here) yields even slightly lower values. The low core densities ($\kappa < 1$) predicted by these X-ray analyses violate the fundamental condition of the strong-lensing, which requires a projected mass density greater than unity.

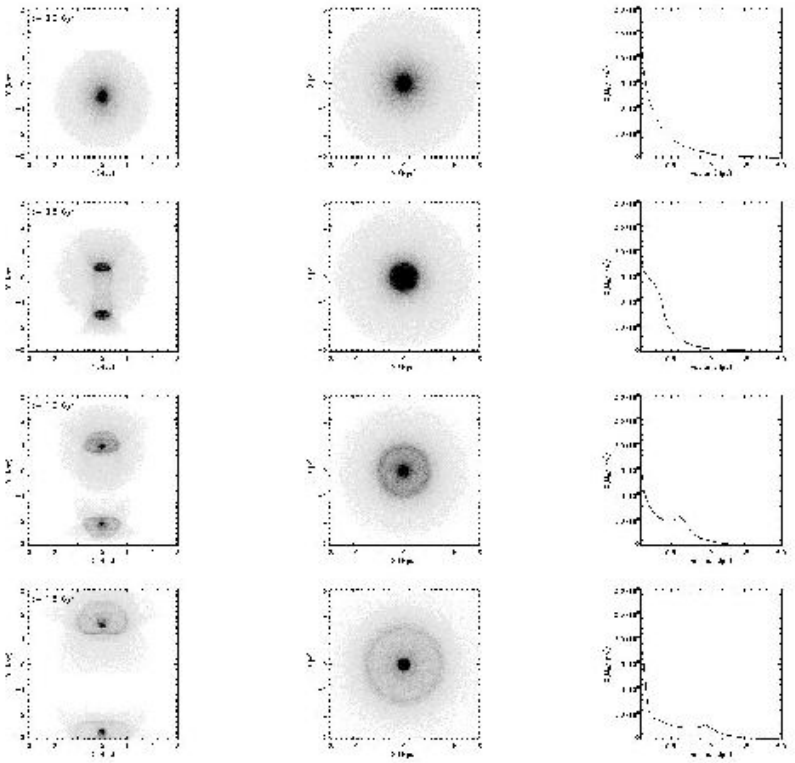


Fig. 15.— Numerical simulation of two colliding clusters. The mass ratio is set to 2:1 and both clusters follow a softened isothermal distribution (see text for parameters). Each row shows snapshots of the collisionless N-body simulation at a given epoch (t is a elapsed time since the core impact). Particle distribution is projected onto the $x-y$ plane (*left*; the plane containing the collision axis) and the $x-z$ plane (*middle*; viewed along the collision axis). We also illustrate the projected ($x-z$ plane) density profile in the right column. A radially expanding shell is visible in the shapshots ~ 1 Gyr after the core impact, which also produces a prominent "bump" in the radial mass profile.

Active Galaxies:

- Review of active galaxies **(Matt)**
- Broad iron lines **(Fabian)**
- Statistics of relativistic broadened lines in AGN **(de la Calle Perez)** : Studied 158 AGN in the XMM Newton archive

  (a) broad lines in 50% of XMM Newton spectra

  (b) no difference between type I and II sources

  (c) broad lines more common in low luminosity AGN

- XMM Newton and hard X-ray surveys of AGN **(Mushotzky)** : Swift BAT all sky survey provides an unbiased sample of active galaxies. INTEGRAL also provides a survey especially in the Galactic Plane. Follow-up observations with XMM, SUZAKU & Swift XRT provide accurate locations and spectra reveal Compton thick sources.

- High spectral resolution observations of AGN mainly with RGS **(Kaastra)**

- XMM Newton observations of AGN outflows **(Arav)** : AGN kinetic luminosity is a major contributor to the formation and evolution of SMBH, host galaxies and ISM. Outflows are detected as blueshifted absorption troughs in spectra.

- X-raying the circumnuclear matter in AGN **(Guainazzi)** : The combination of high resolution spectra with RGS and high spectral resolution with Chandra yield a clear picture of the geometrical distribution and nature of the gas. Some examples of extremely extended X-ray narrow line regions (> 1 kpc).

Galaxies and Galaxy Surveys:

- Galactic X-ray source populations in the disk, bulge and nuclear region etc **(Motch)** : Faint sources, this is only practicable in our galaxy. Large numbers of X-ray binaries that are not well constrained.
- XMM Newton survey of the Andromeda galaxy **(Pietsch)** : Ongoing survey of the entire disk of M31.
- Prospects of an XMM Newton survey of the SMC **(Haberl)** : About 25 fields have been observed by XMM in the SMC and yield an inventory of X-ray sources. Complete survey is very time consuming.
- Diffuse galactic X-ray emission from the disk, bulge and nucleus of our galaxy and other nearby normal galaxies **(Warwick)** : Future XMM mapping of the inner galaxy?

SNRs and the ISM:

- Comprehensive review of SNRs, PNe and Superbubbles **(Decourchelle)**
- Inhomogeneous metal abundances patterns in the Vela SNR **(Miceli)** : Survey of the Vela shell with XMM.
- Very high energy (VHE) gamma ray sources and X-ray observatories **(Pülhofer)** : About 40 VHE sources. Largest identified class is Pulsar Wind Nebula. "Dark sources" - are they accelerating primarily leptons or hadrons?
- Diffuse X-ray emission from the Galactic Centre with the X-ray spectrometer on SUZAKU **(Koyama)** :

  (a) majority of the X-ray emission is diffuse

  (b) origin of the 6.7/7.0 keV line is collisional ionization in a hot plasma

Compact Objects:

It is 40 years since the discovery of pulsars!

- Neutron star physics **(Caraveo)** : includes
  (a) Rotating hot spots
  (b) Variable non-thermal emission
  (c) Absorption features
  (d) Spectacular trails

- XMM results on the spectacular magnetic field dominated magnetars **(Mereghetti)**
- Constraints on the equation of state from observations of X-ray binaries including spectroscopic aberrations **(Jonker)**

- Ultraluminous X-ray binary sources and X-ray binaries **(Kaaret)**

- Observations of SgrA* which is a very underluminous X-ray source at ~10^{-8} L_{EDD} **(Porquet)** : Not all the matter is accreted into the massive BH. X-ray flares are believed to originate within a few Schwarzschild radii.

- Hydrodynamical and spectral simulations of HMXB winds **(Mauche)** : Compared the results of the model with X-ray emission lines from Vela X-1.

Stars and Star Forming Regions:

- Physics of star forming regions **(Montmerle)** : Two main physical processes
  1. magnetic loop reconnection and plasma confinement
  2. high speed shocks from magnetically channeled accretion and mass loss from jets hitting protostellar envelopes or molecular clouds.

- Spectroscopy of early type stars **(Rauw)** and young stars **(Guedel)** and cool stars **(Schmitt)**
- Life cycle and feedback processes in star formation **(Oskinova)**

- Results and perspectives on young stars and long look programs **(Sciortino)** : The origin of the emission from young stellar objects and its connection to circumstellar disks (type 0, type 1) is investigated.

- Darwin mission and the sustainability of life in X-ray irradiated planetary atmospheres **(Pollock)** : Darwin will search for habitable planets orbiting nearby stars in a sample of 79 F, G, K stars within 15 pc. Few of them have been observed with XMM. Need to determine the flaring and X-ray properties of these stars.

New Observing Modes and Strategies

- Timing Mode for bright sources **(Fritz)**
- Slew Survey **(Read)**
- Slow Scan Method
- XMM OM **(Page)**