XMM-Newton - Chandra Synergy: Maximizing their Future Science

Impact over the Next Decade

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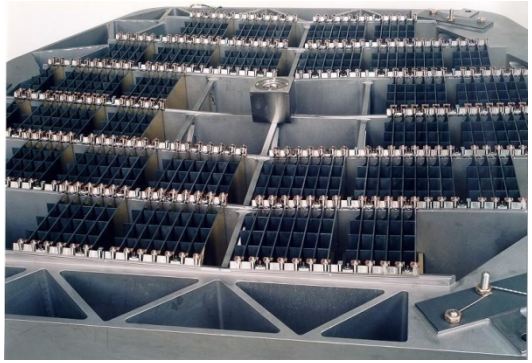
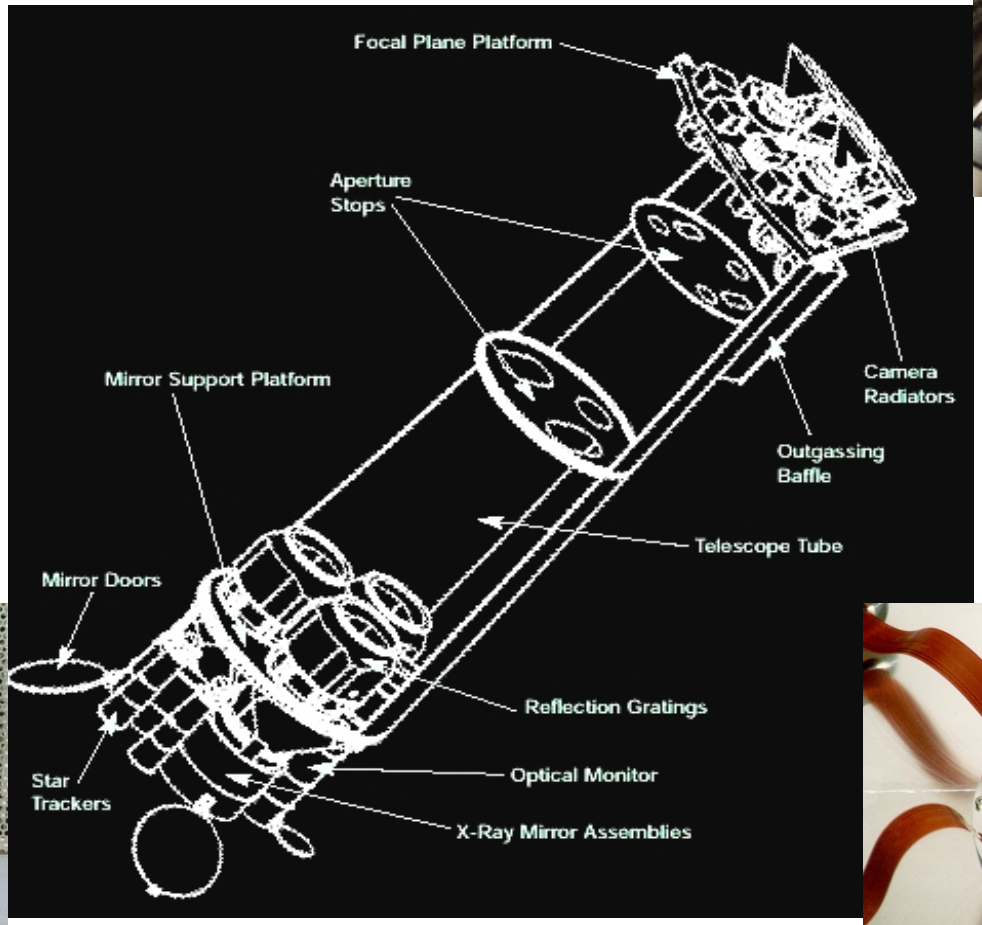
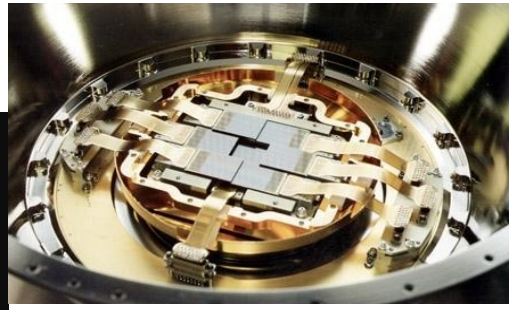
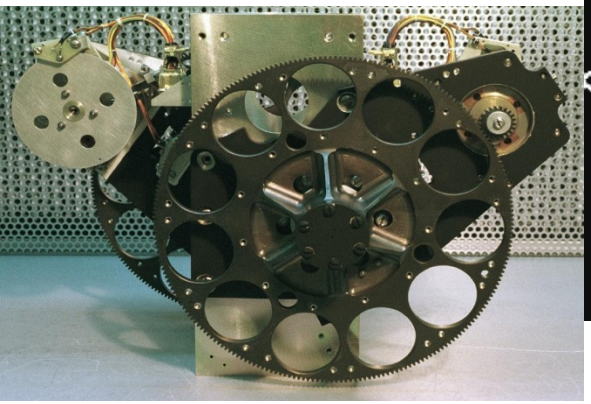
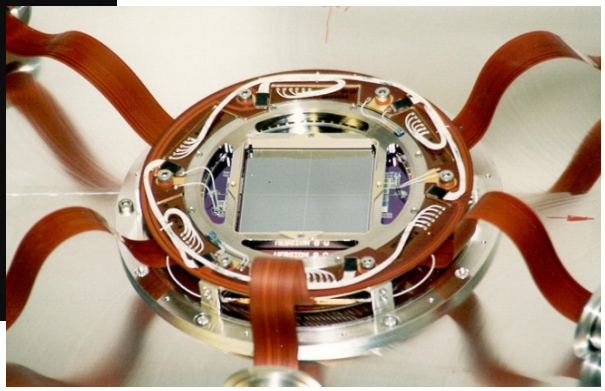
Instruments











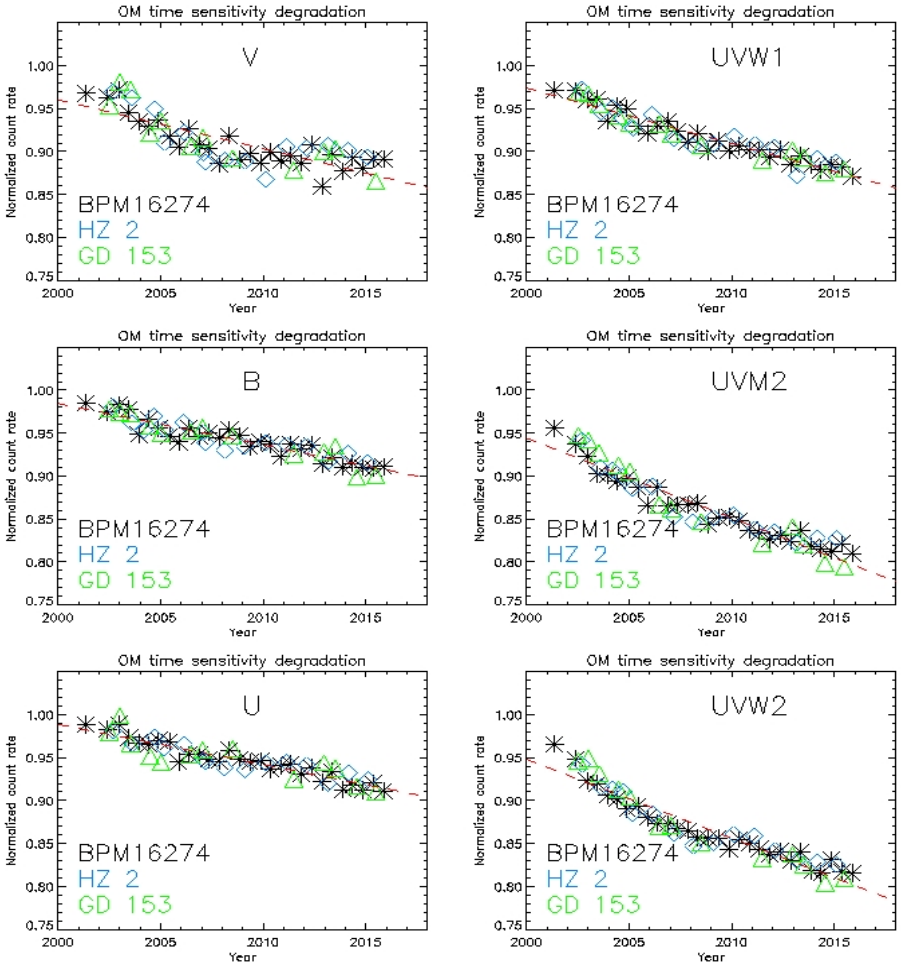
XMM-Newton

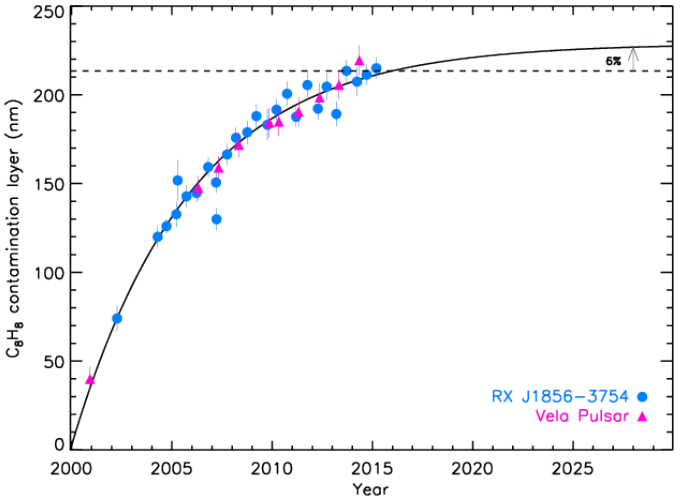
- 3 X-ray Mirror Modules
- Six simultaneously observing instruments:
  - 3 CCD cameras (one pn and two MOSs)
  - 2 spectrometers (RGS)
  - 1 optical Monitor (OM)

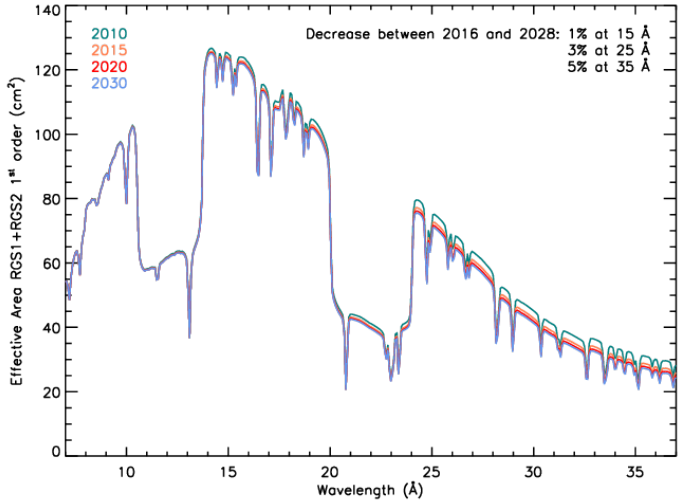
STATUS OF SPACECRAFT

- **Spacecraft status is very good**
- **All important systems are running on their primary unit, i.e. full redundancy still available.**
- **Currently 50.6 kg of fuel remain with usage of around <2.6 kg per year.**
- **The solar array is generating around 1850 W and between 800-1200W are used.**
- **All other systems susceptible to wear are in good condition**

STATUS OF OM & RGS

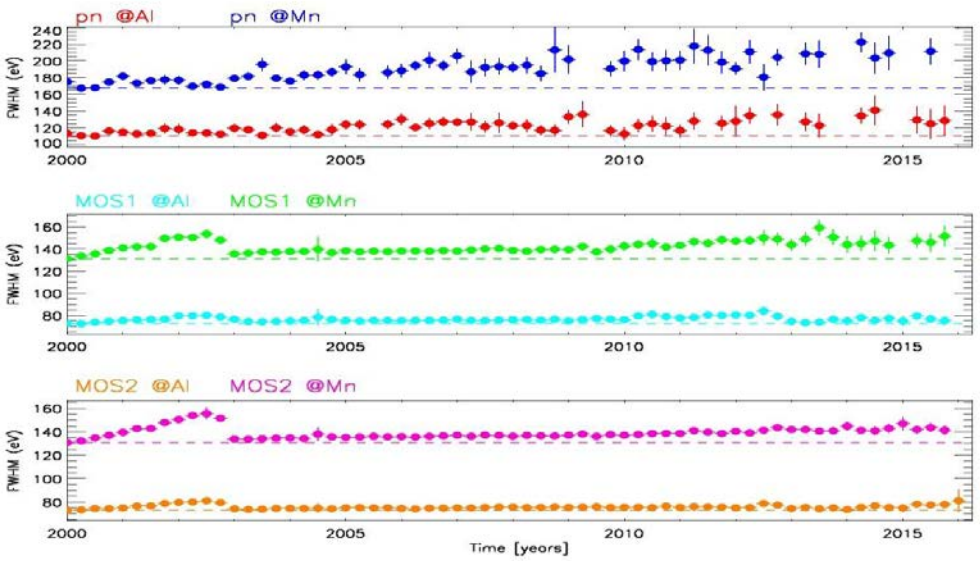


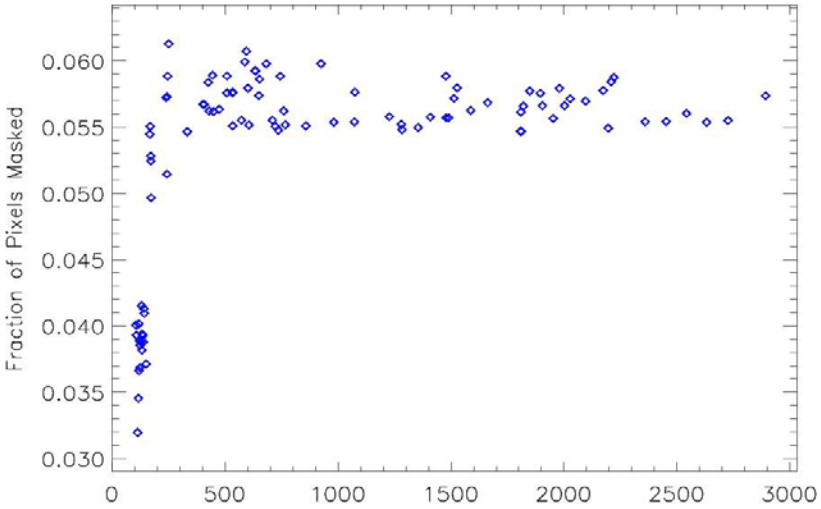


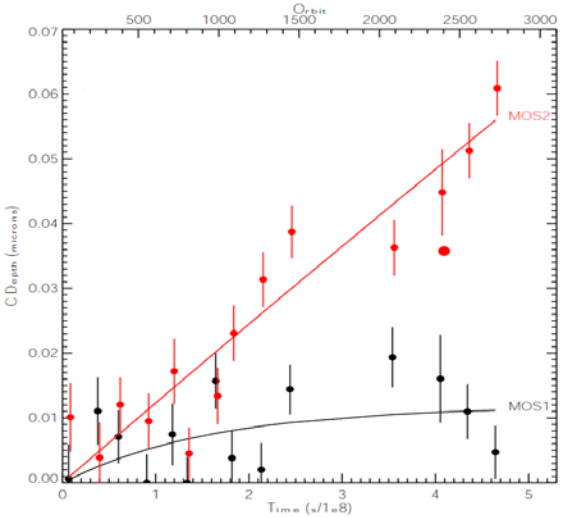


Courtesy A. Talavera (OM) and R. Gonzales (RGS)

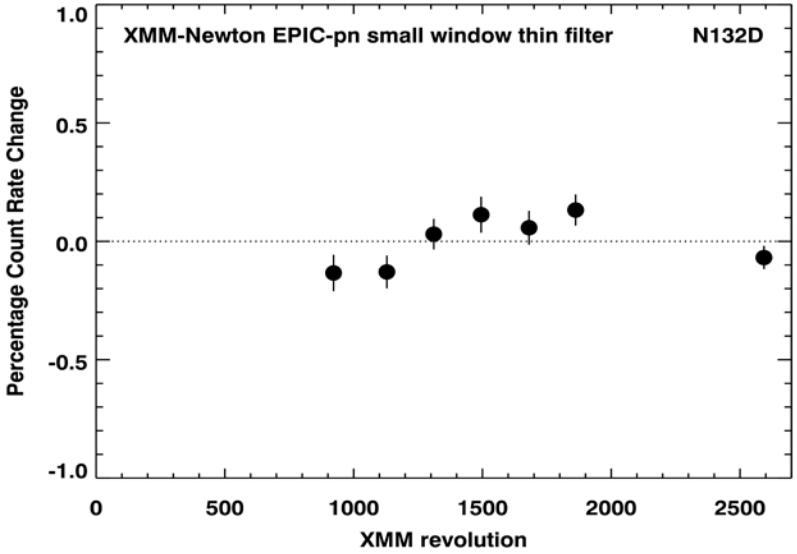
STATUS OF EPIC: Energy Resolution Evolution







Courtesy M. Smith
& M. Stuhlinger



EVOLUITON OF SCIENTIFIC STRATEGY

- **Scientific Strategy:**
  - **2006: TOO time budget expanded**
  - **2007: Workshop XMM-NEWTON THE NEXT DECADE**
  - **2007: Users' Group supports large and very large programs**
  - **2008: 1st observation of a very large program**
  - **2010: ~25% of A&B observing time to large and very large programs**
  - **2010: Planck Clusters**
  - **2012: ~45% of A&B observing time to large and very large programs**
  - **2013: 1.5 Ms simultaneous with NuSTAR**
  - **2016: up to 3.0 Ms simultaneous with NuSTAR**
  - **2016: Workshop XMM-NEWTON THE NEXT DECADE (May 2016)**
  - **Legacy Programs (~6 Ms over 3 years) & fulfill program**

- AO15 (started 1. May 2016):
  - ~45% of A & B time are large and very large programs
  - 1.5 Ms simultaneous with NuSTAR
  - 1.5 Ms of XMM-Newton time can be given out by the NuSTAR TAC
  - 1.7 Ms anticipated TOO (priority A & B)
  - 1.0 Ms anticipated TOO (priority C)
  - 877 ks / 100 ks joint Chandra (100 ks out of 400 ks)

Capabilities of Chandra and XMM-Newton

	Chandra	XMM-Newton
Visibility over Year	9 months	2.5 months
Effective Area	800 cm^2	2500 cm^2
Field-of-View	16’ x 16’	R = 15’
Spatial Resolution	0.5’’	6’’
Grating Spectroscopy	0.09 – 10 keV	0.35 – 2.5 keV
Spectral Resolution	200 - 1000	100 - 500

Synergies

- Chandra
  - Small deep fields
  - Densly populated regions
  - Detailed structure
  - Deep high S/N high-resolution spectra
- XMM-Newton
  - Large Areas
  - Large Objects
  - High S/N Spectra
  - Archive of high-resolution spectra

Joint Chandra / XMM-Newton progam

- Up to 400 ks ➔ 233 observations
- All classes of objects from Jupiter to distant clusters for galaxies
- Large/frequent joint programs:
  - Search for transients in dense populated regions (Galactic Centre, M31)
  - Monitoring of specific pulsars
  - (later) Long (monitoring) AGN observations
  - (recently) Clusters of Galaxies

Joint research versus joint programs

- Many, maybe even most, studies use Chandra and XMM-Newton data
- Only a small fractions of the used data of these studies are provided by joint programs
- Joint programs are essential for variable sources

General experiences with joint research / programs I

- Joint research / programs are most successful if the same physical object can be measured by different means:
  - Novae in nearby galaxies (Chandra positon, XMM-Newton spectra, both light curve)
  - Structure of clusters of galaxies (XMM-Newton overall picture and outskirts, Chandra centre and detailed structure)
  - Hot gas in clusters of galaxies (X-ray and SZ)
  - Particle acceleration in flares of stars , shock fronts in SN, & clusters of galaxies (X-ray and radio)
  - Physics of 6.4 keV iron complex , i.e. fluorescence emission, absorption, reflection) (EPIC pn (0.2-10keV) and NuSTAR (3-80 keV)
  - Warm gas and winds in AGN (X-ray and UV spectra)

General experiences with joint research / programs II

- Not every joint program is successful, i.e. receiving (many) proposals
- X-ray “people” are generally very open to other wavelengths and make good use of joint programs
- Every proposal for joint observations needs a physical motivated hypothesis!
- Joint TOO observations can lead to unforeseen conflicts (XMM-Newton-NuSTAR TOO may compete with a Chandra-NuSTAR TOO)

Future of Chandra XMM-Newton joint programs

- Increase available observing time to 1Ms ➔ would allow large joint programs
- TOO

Future of Chandra XMM-Newton joint programs

- Scientific topics have an half-life time of 3 AO
  - S/N ~ $\sqrt{(\text{time})}$

➔ It is hard / impossible to predict where science goes

➔ We have to keep a careful eye on the physical and astronomical developments and adopt the structure and policy accordingly