

High Energy And Non-thermal emission

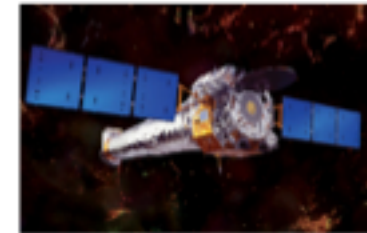
- X-ray and Gamma-ray observations
 - How it's done
 - Quantifying the waves
- Multi-wavelength emission processes in the cosmos
 - Synchrotron emission
 - Bremsstrahlung
 - Compton & Inverse compton
 - Interesting sources

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X-ray Observation



XMM-Newton
Launched 1999
0.1 to 15 keV
Resolution 6"
Large FOV

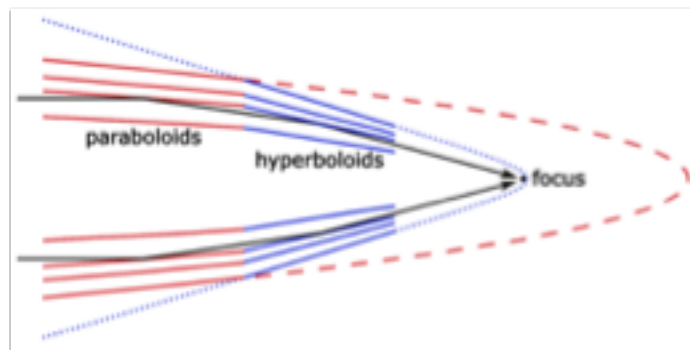


Chandra
Launched 1999
0.2 to 10 keV
Resolution 0.5"
Small FOV

NOT diffraction limited (surface accuracy limits!)

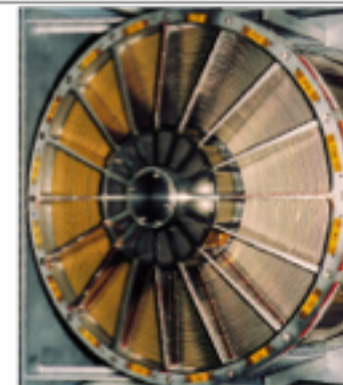
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Light Collection at X-rays



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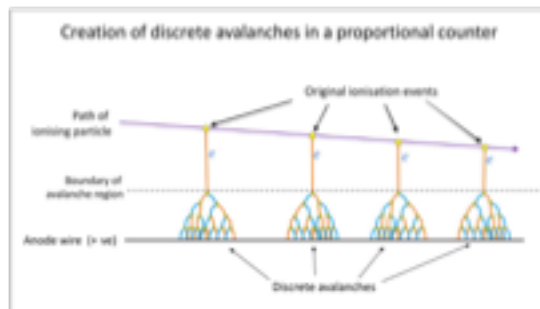
XMM Nested Mirrors



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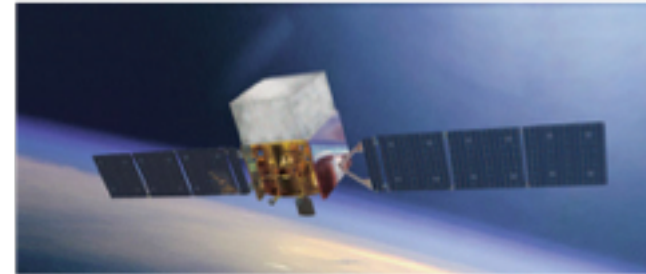
X-ray Detectors

- Photon rates low enough to count/trace individual events.
- X-ray: Gas photoelectric-based detectors



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Gamma-rays

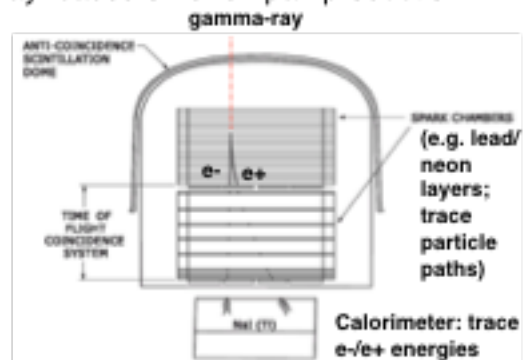


Fermi
Launched 2008
150 keV to 300 GeV
Poor resolution: ~ 1 deg
Large FOV: 6500 deg²

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Gamma-ray Detectors

- Photon rates low enough to count/trace individual events.
- Gamma-ray: based on e^-/e^+ pair production.



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Emission Mechanisms

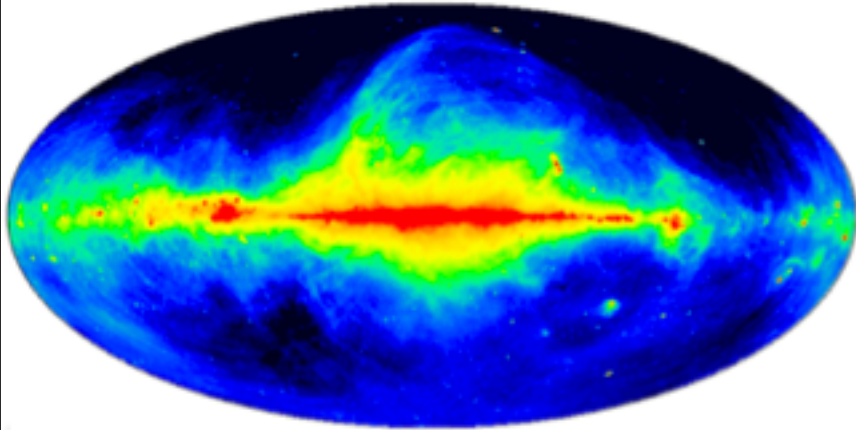
Main idea: ACCELERATED ELECTRONS.

- Non-thermal
 - Synchrotron
 - Bremsstrahlung
 - Compton / Inverse compton
 - Spectral lines
 - Pulsar emission (unknown process)
- Thermal
 - Blackbody

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All-sky 1GHz (synchrotron)

1420 MHz



Stockert 25m and Villa Elisa 25m

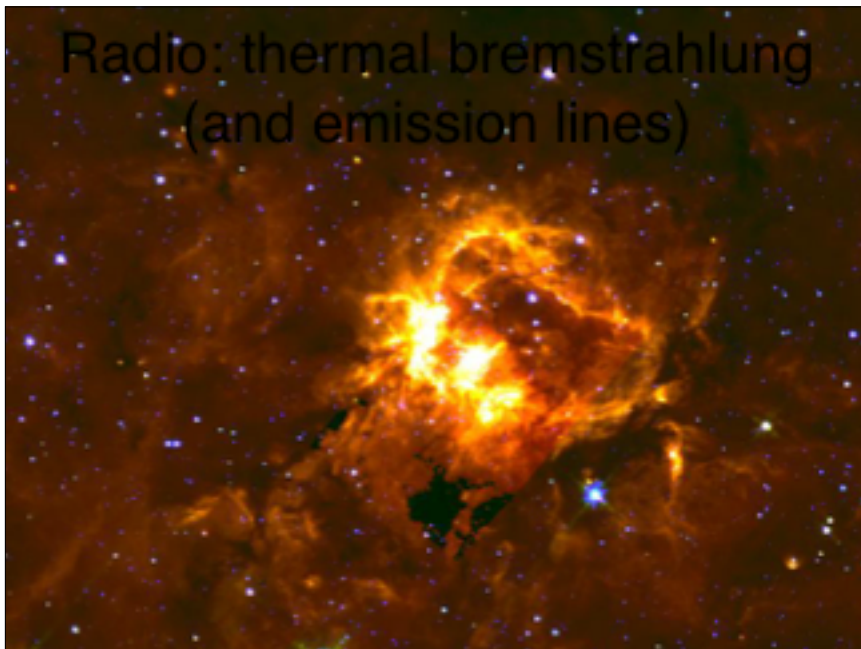
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Optical: star-forming region



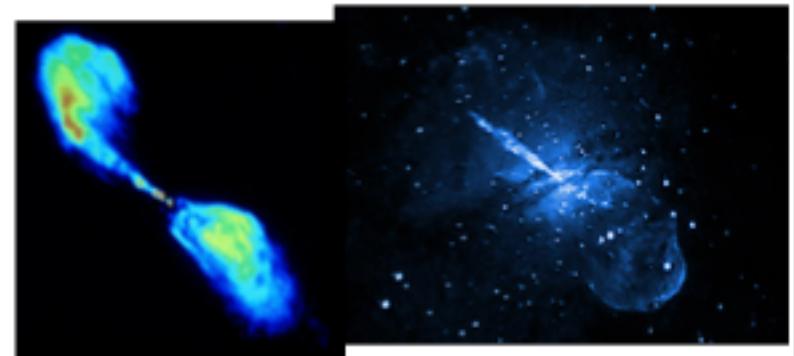
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Radio: thermal bremsstrahlung (and emission lines)



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Inverse Compton



1GHz radio image
(Very Large Array)

keV X-ray image
(Chandra)

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Visible Light - La Silla
Infrared - Spitzer
Radio - VLA
X-Ray - Chandra

What emission mechanism dominating these wave bands?

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Active Galactic Nuclei

Jet
Narrow Line Region
Broad Line Region
Black Hole
Accretion Disk
Obscuring Torus

Intensity
Wavelength (Angstroms)

III Zw 2
[O II] 3727
[Ne III] 3969
[O II] 4343
H β 4861
Fe II 4570
H γ 4686
[O III] 5007
Fe II 5320
[O III] 5300

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Höruchi et al (2005)

Radio Flux Density (Jy)

Right Ascension (J2000)

Jet origin (Supermassive black hole)

0.5 pc

~0.5 Mpc

L. Faein, CSIRO

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