CENTER FOR ASTROPHYSICS
HARVARD & SMITHSONIAN

Working for a big astronomical mission: the Chandra X-ray Center example

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Re[incontri] di Fisica Partenopea

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My CV

Laurea ("Vecchissimo ordinamento", 2004) - Prof. Longo

Multi-wavelength global photometric properties of the cluster of galaxies Abell 85

Dottorato di Ricerca (Ciclo 24, 2007) - Prof. Longo

The large scale structure of the nearby Universe

Assegnista di ricerca (2008-09) - Prof. Longo

Assegnista di ricerca @ Universita' di Padova (2009-10)

Postdoc @ Smithsonian Astrophysical Observatory (2010-15)

Assegnista di ricerca (2015-16) - Prof. Paolillo

Staff astronomer @ Smithsonian Astrophysical Observatory (2016-)

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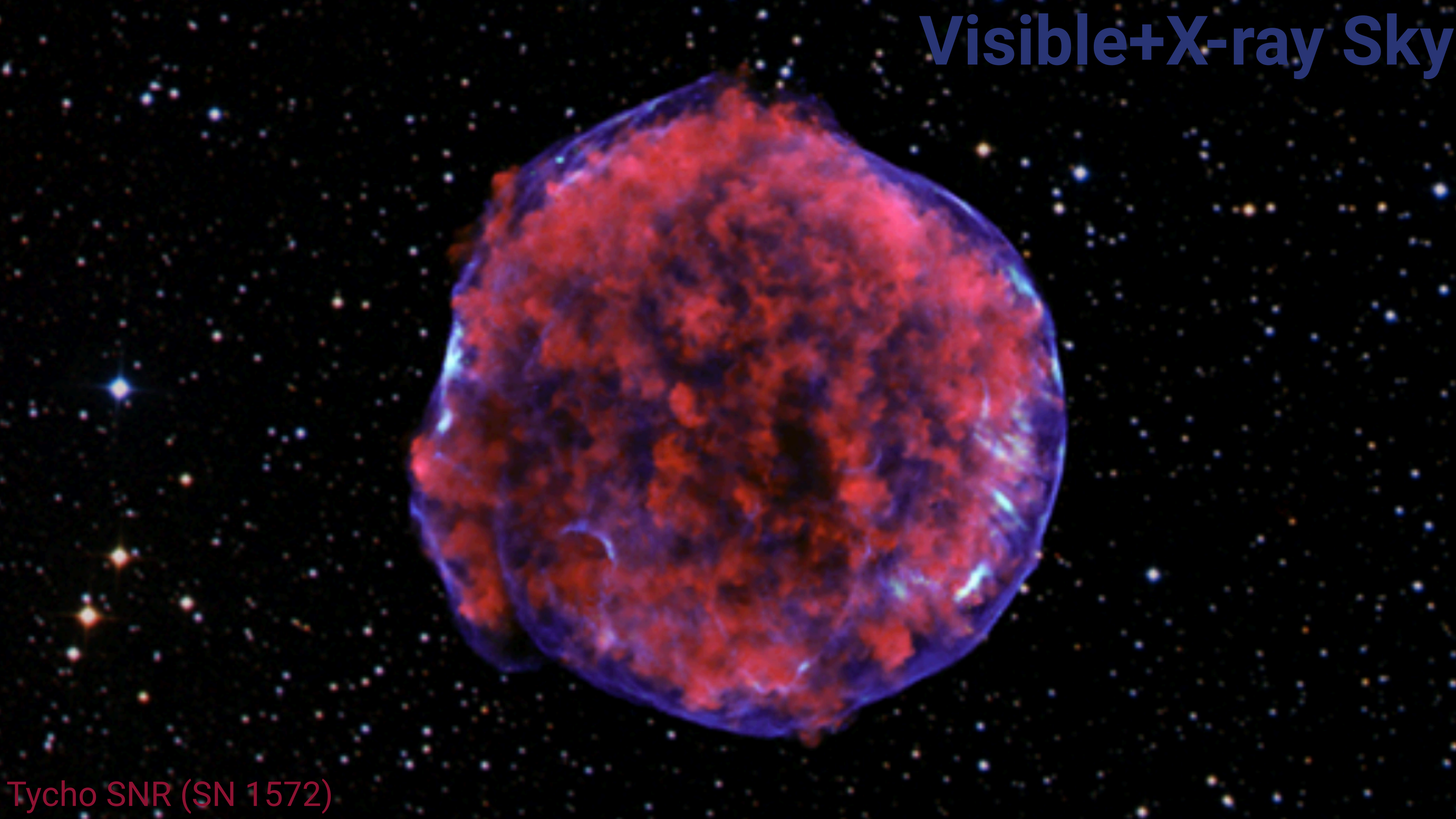
CGRO
HST
CHANDRA
SIRTF
gamma
x-ray
visible light
infrared

Why X-rays are special

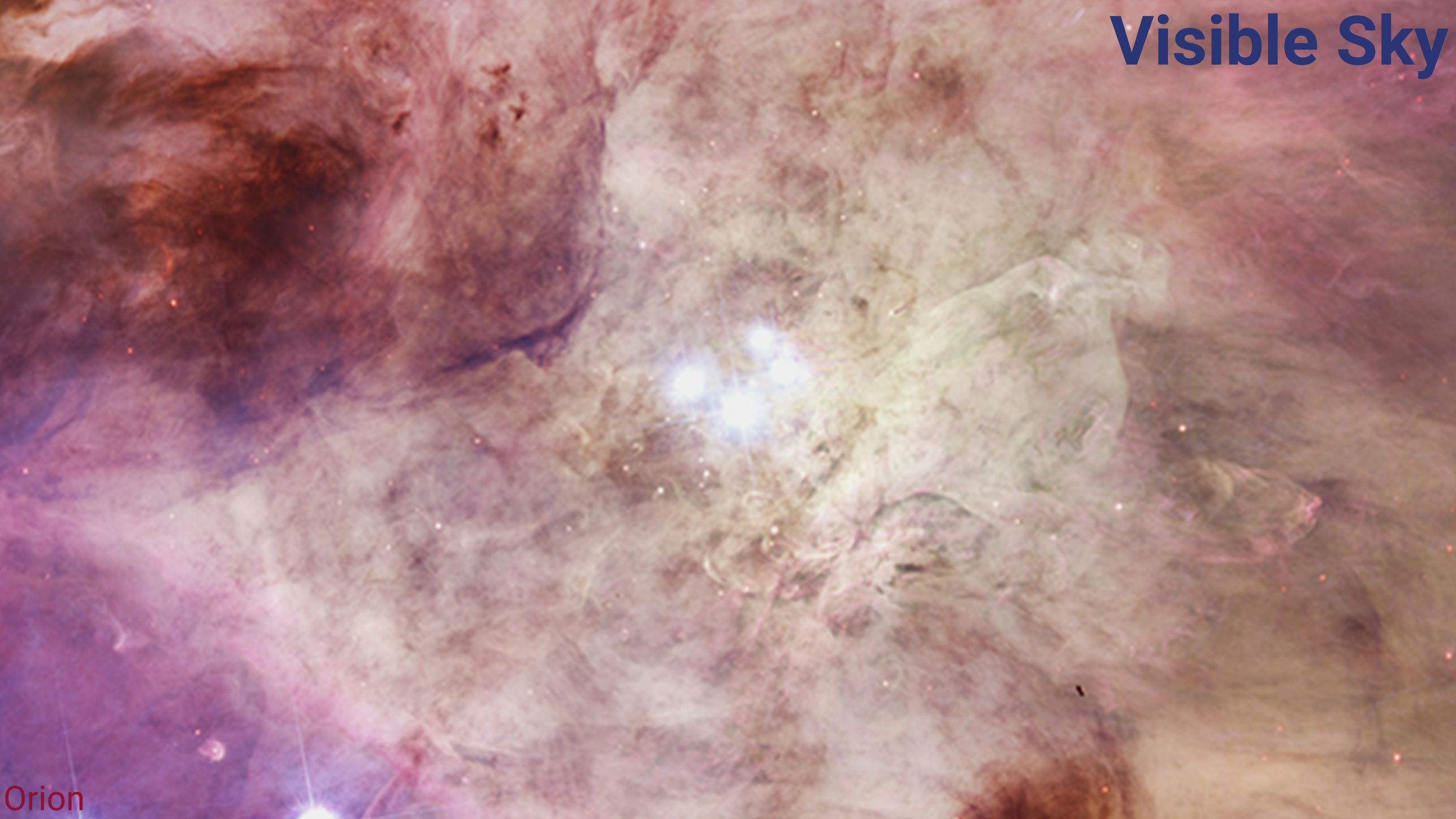
“...this radiation reveals the existence of astrophysical processes where matter has been heated to temperatures of millions of degrees or in which particles have been accelerated to relativistic energies..... high energy phenomena play a crucial role in the dynamics of the Universe.”

Riccardo Giacconi - 2002


Visible Sky
Tycho SNR (SN 1572)


Visible+X-ray Sky
Tycho SNR (SN 1572)

Visible Sky



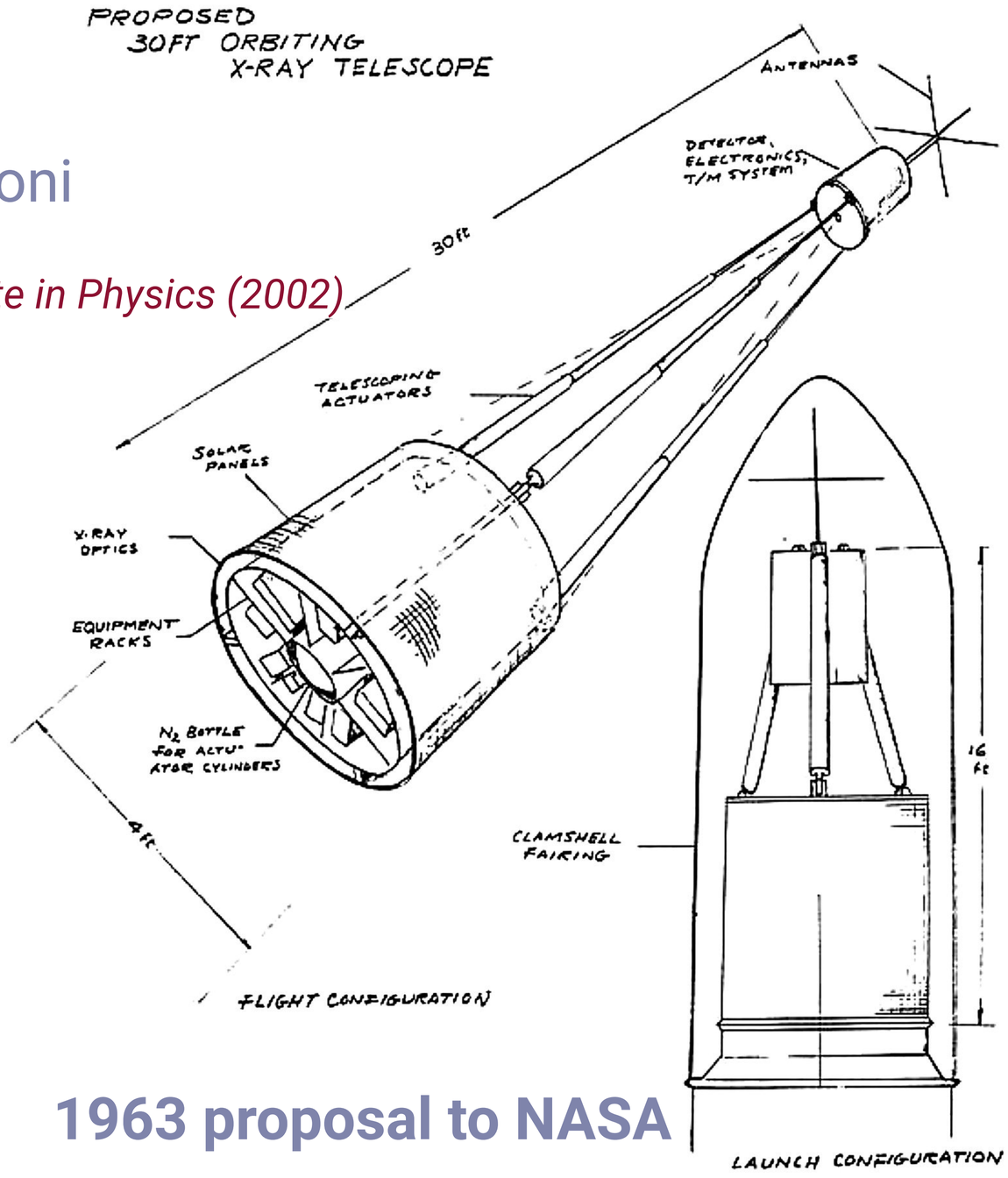

X-ray Sky
Orion

X-ray visionaries

Riccardo Giacconi

1931-2018

Nobel laureate in Physics (2002)

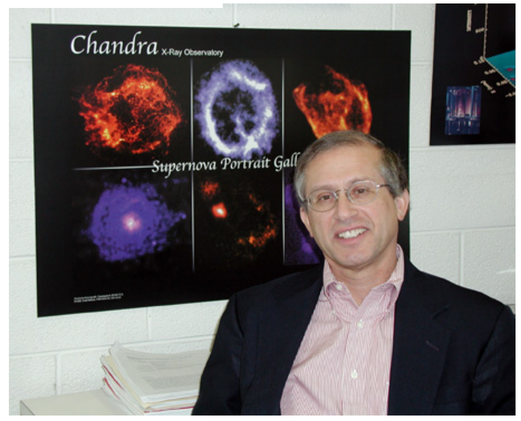


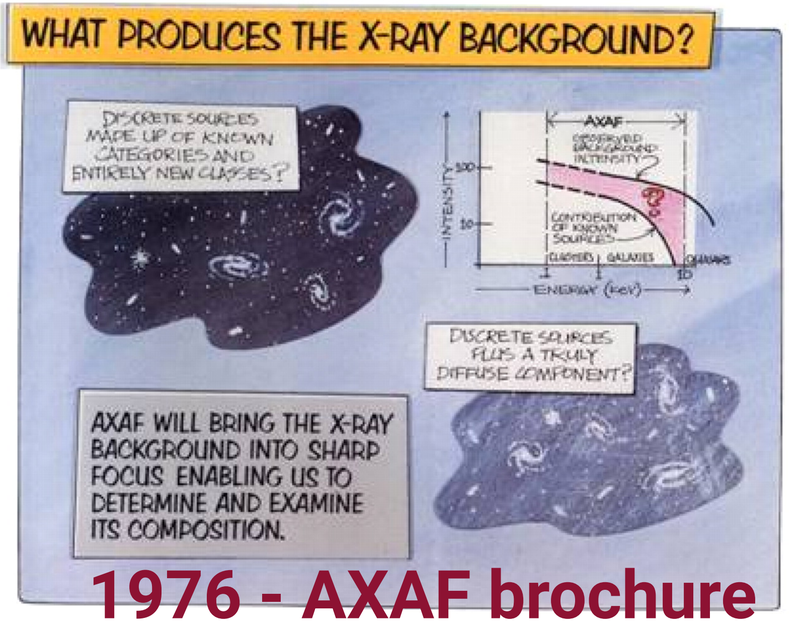
1963 proposal to NASA

Harvey Tanambaum

Instrumental for AXAF approval

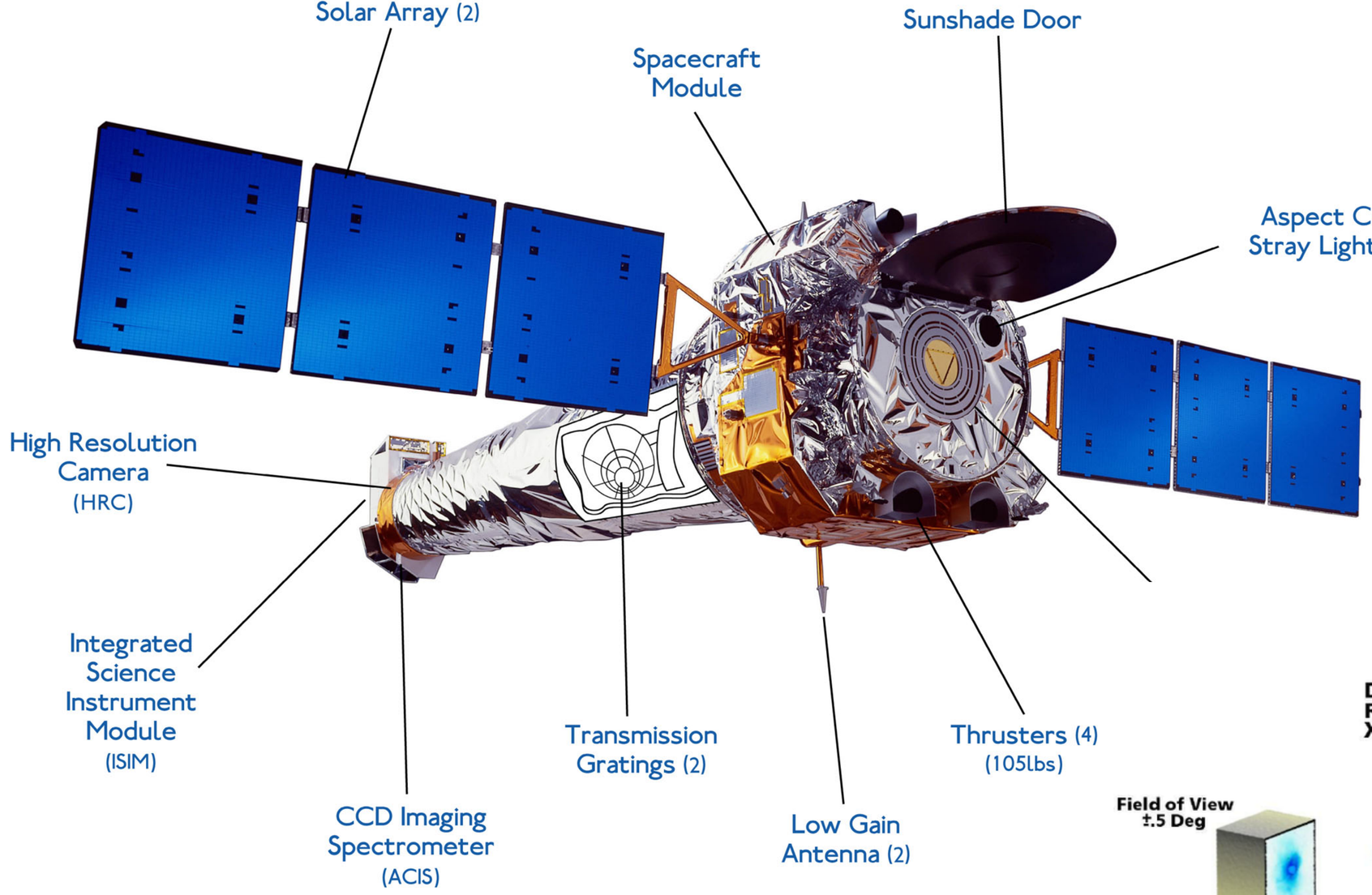
First CXC director





1976 - AXAF brochure

One of a kind



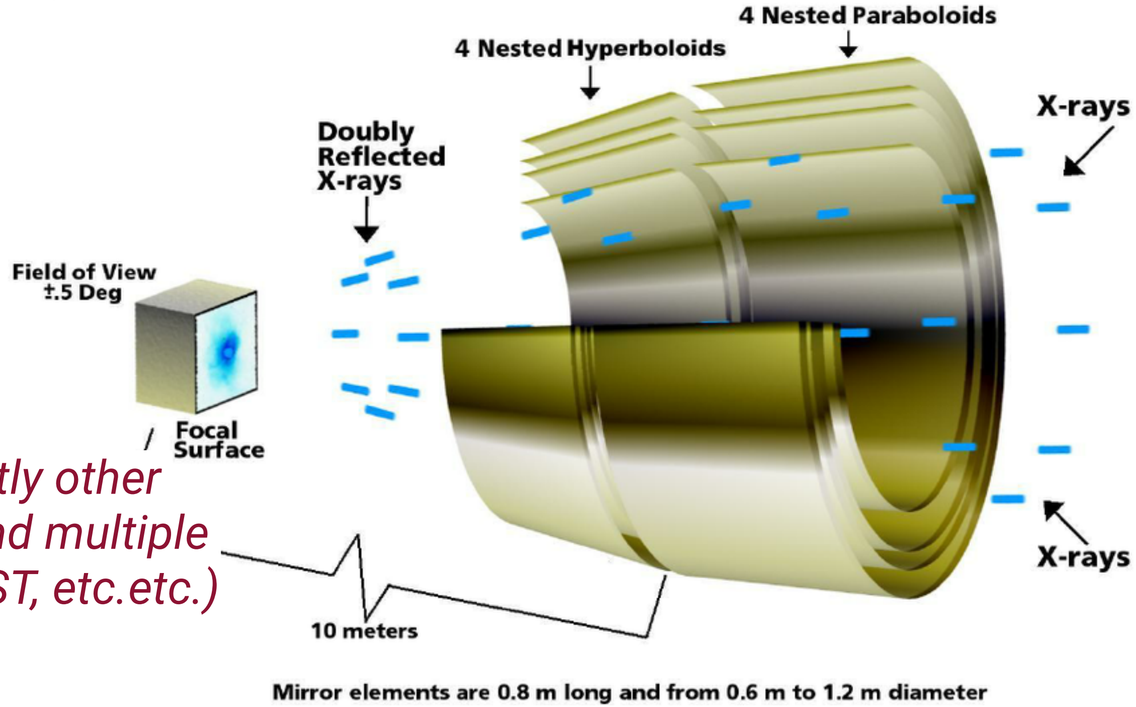
High Sensitivity

Larg-ish collecting area

Very low background

Spatial Resolution

0.5" on-axis



Chandra specs make it a unique probe that complements perfectly other old and new X-ray missions (ROSAT, XMM-Newton, eROSITA), and multiple generations of observatories in other energies (Spitzer, HST, JWST, etc.etc.)

The launch

23 July 1999

Chandra science over 25 years

Populations of X-ray sources: resolved star clusters, X-ray binaries in nearby galaxies, ULXs

Supernova Remnants: shocks, morphology, temperature maps, time-evolution

Transients: SNs, GRBs, TDEs, GW counterparts, etc.

Milky Way: mapping of the central region, resolving star clusters, Sgr A* variability

Galaxies: morphology of warm/hot medium, complex X-ray morphology in starbursts, outflows, low accretion, AGN detections

AGN and quasars: obscuration, morphology, iron line, quasars in clusters, X-ray jets, ISM interactions

Clusters of galaxies: morphology of diffuse emission, shocks, bubbles, energetics, mass, evolution, cosmology

Feedback: clusters, intermittent activity, energetics, outflows and jets, interactions

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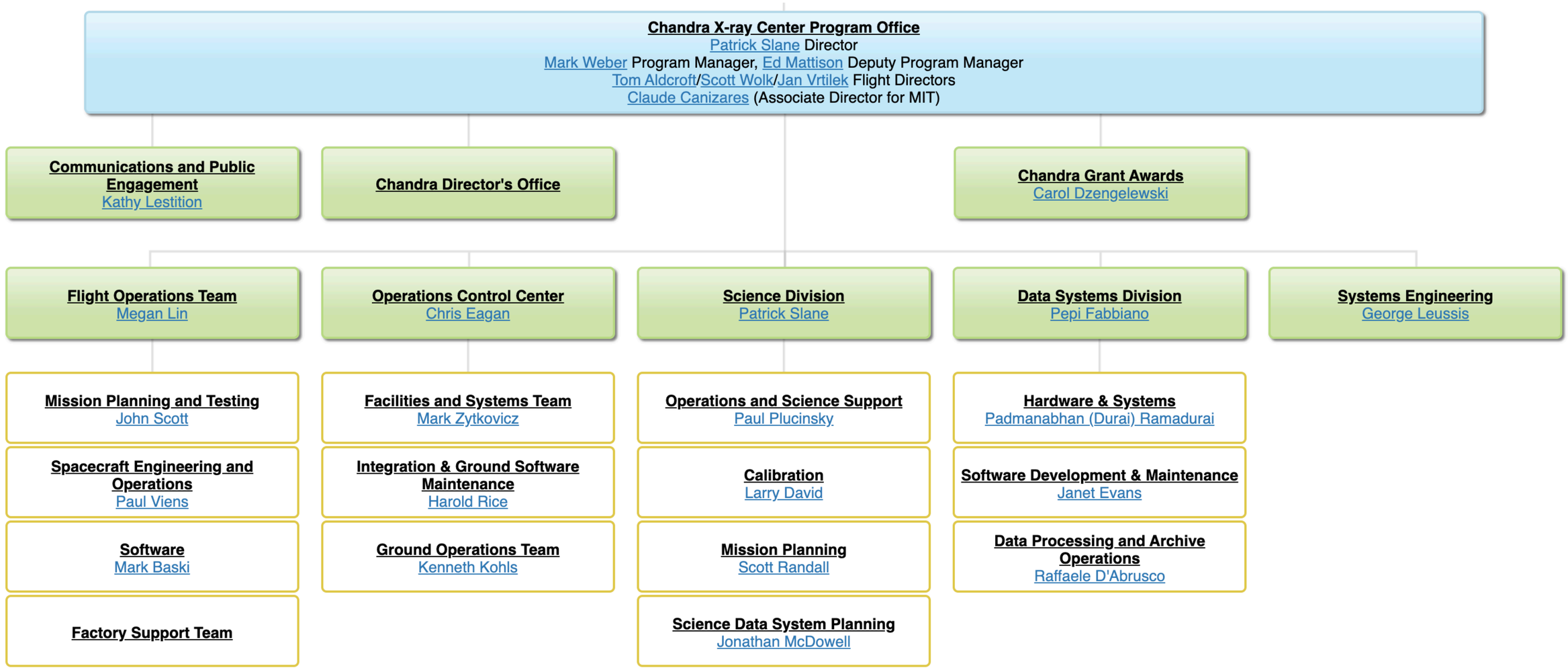
The Chandra X-ray Center

The Chandra X-ray Center



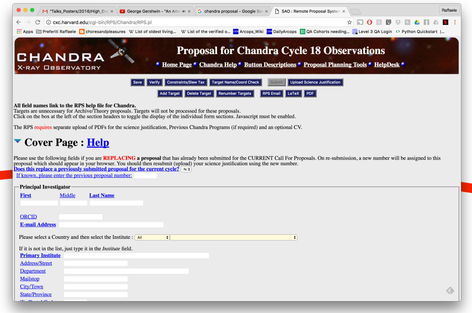
The Chandra X-ray Center

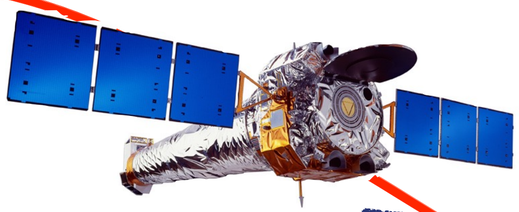
225 people strong! (~170 FTEs)

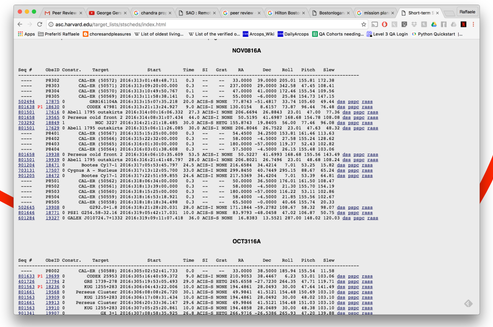
47 scientists (mostly X-ray astronomers, but not all of them)

Administrators, IT specialists, engineers, computer scientists, data aid/specialists...

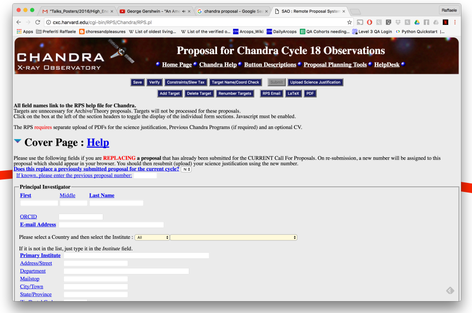
Data lifecycle

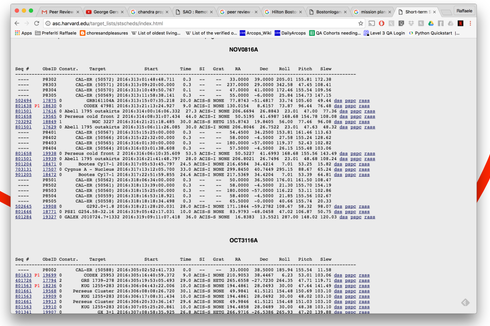






My team





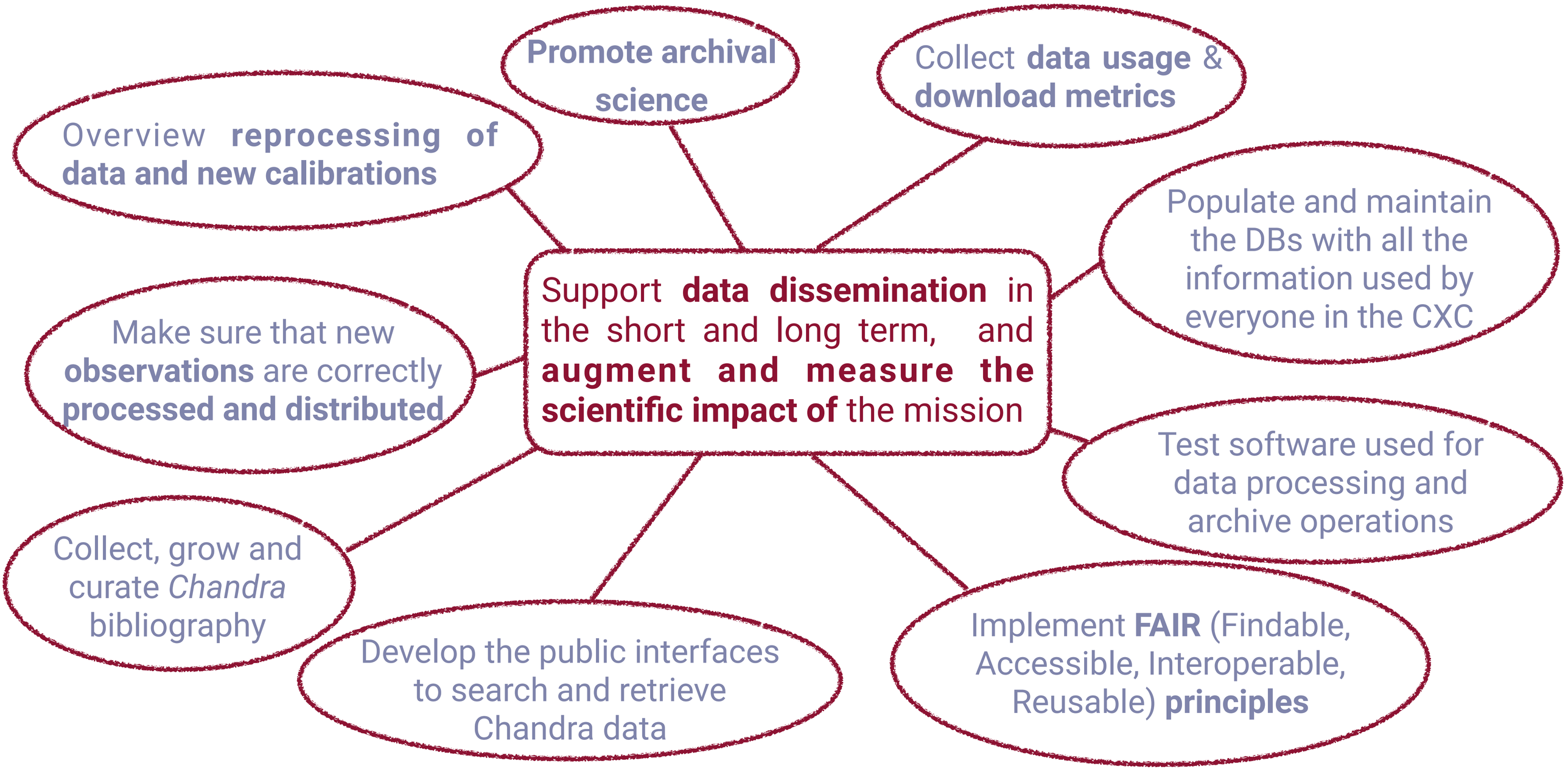
DPAOps

3 scientists

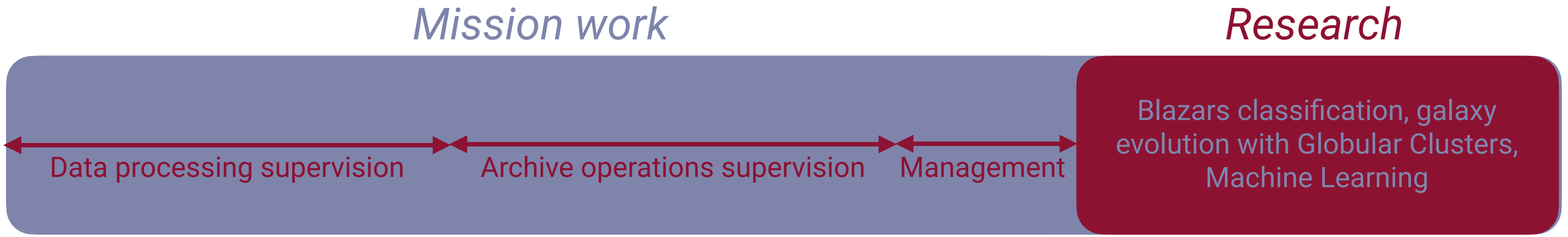
4 data operators

2 programmers

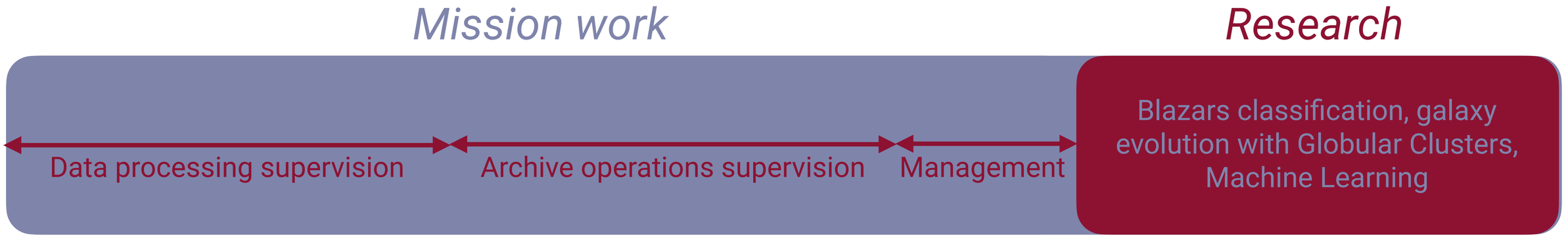
Our goals

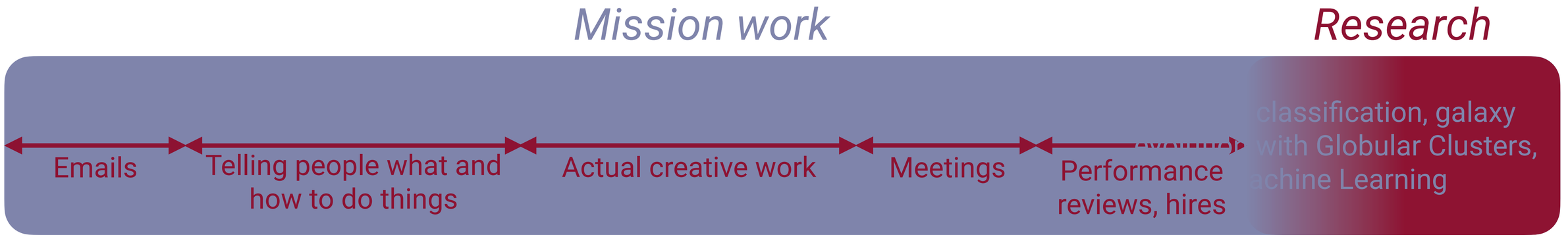

Promote archival science
Collect data usage & download metrics
Overview reprocessing of data and new calibrations
Populate and maintain the DBs with all the information used by everyone in the CXC
Support data dissemination in the short and long term, and augment and measure the scientific impact of the mission
Make sure that new observations are correctly processed and distributed
Test software used for data processing and archive operations
Collect, grow and curate Chandra bibliography
Develop the public interfaces to search and retrieve Chandra data
Implement FAIR (Findable, Accessible, Interoperable, Reusable) principles

What I should do...



What I should do...





...and what I do

Pros

Learn a lot about a lot of interesting things!

Science: with major multi-goal missions, you can learn about multiple distinct research areas

And more: engineering, detectors, software, hardware, management

Stimulating environment

Never get bored.

Spacecraft issues are fun! (if they can be fixed)

Transferable skills

Expertise is usually recyclable and is valued by new missions

Openings towards non academic/research oriented private sector

Access to observational facilities

Mileage may vary and competition may be fierce, but inside knowledge helps writing better proposals

Develop professional communication strategies

Learn to work/collaborate with people with different backgrounds, priorities, etc.

Cons

Limited time for research

Most scientists working for NASA-funded missions have ~30% of their time paid to do research

Scientific productivity takes a hit; may affect career downstream

No teaching

Can't get paid for teaching! If you really want to teach, you need to do it for free

Missions end and you may be out of a job

Mission centers not directly managed by NASA are closed at the end of mission

Landscape is complex and very institution-dependent. European agencies usually better at employee's retention

Is this for you?

(Based on my personal experience, so arbitrary and probably wrong!)

Would you trade depth for breadth?

Being able to tackle and work new problems/ideas/methods is a plus

But with limited resources (time/attention/intelligence), that comes with a cost of being unable to delve deeply in most topics

Are you a team player?

Without a strong "esprit de corps" and a shared set of values, it can be difficult to feel personally accomplished for the success of the mission.

How does it feel making "big discoveries" by someone else possible, with little to no personal reward?

Can you work on someone else's terms?

Our training as scientists is focused on being good at establising our own goals and schedules

Many times, in this type of jobs you are told what to do and when by someone else


Thank you!