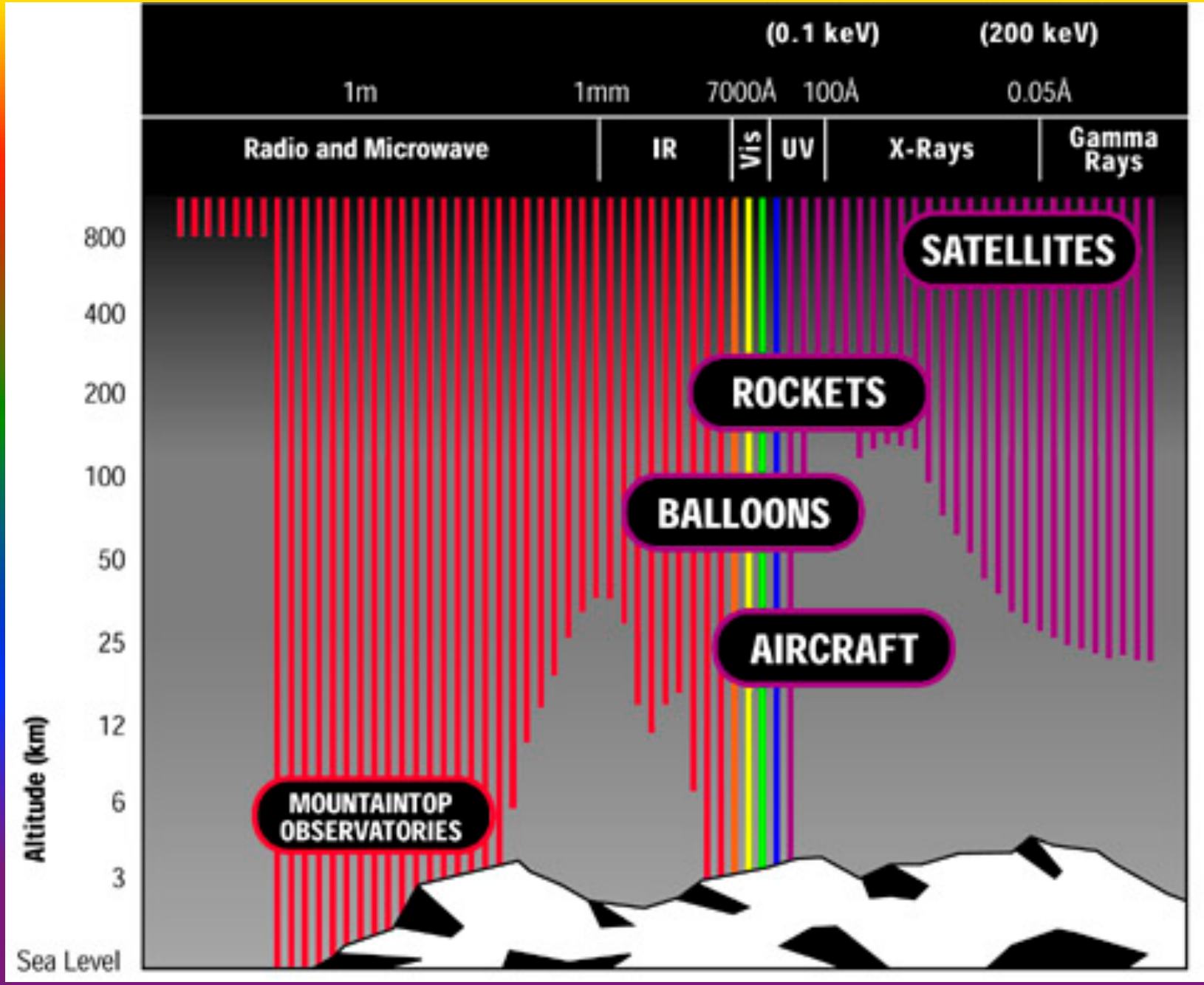
UV and X-ray Perspectives

Martín A. Guerrero



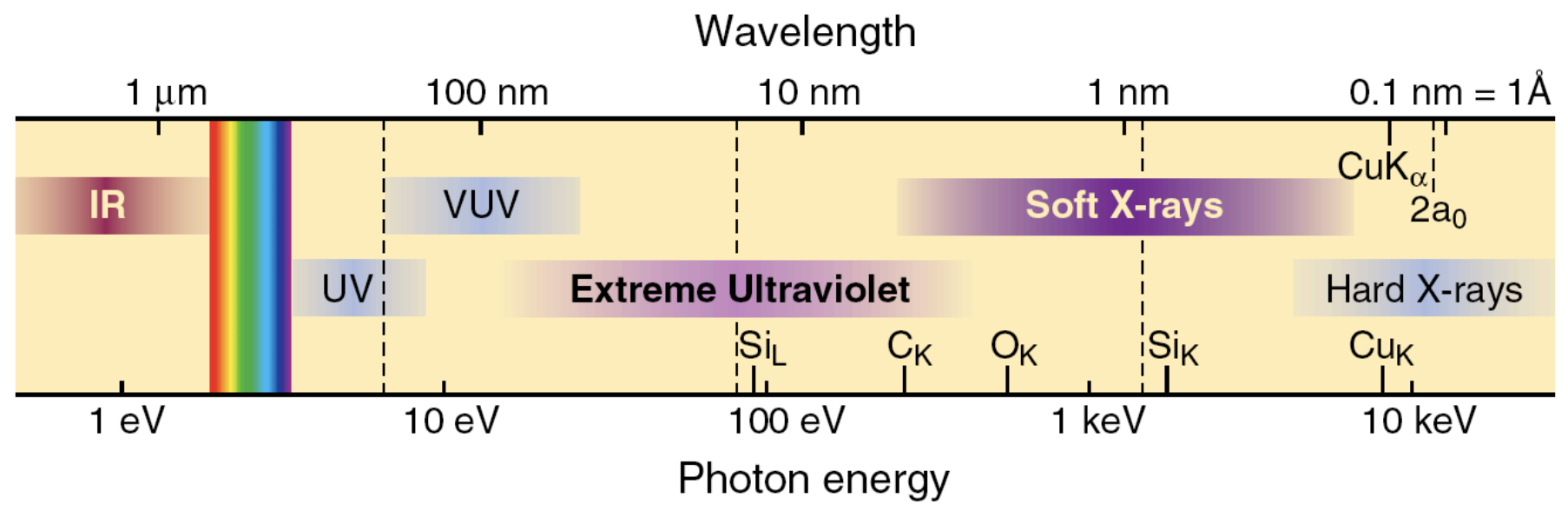
A talk at the Workshop Estallidos 2015
Granada, May 13 2015




(0.1 keV)
(200 keV)
1m
1mm
7000Å
100Å
0.05Å
Radio and Microwave
IR
Vis
UV
X-Rays
Gamma Rays
800
400
200
100
50
25
12
6
3
Sea Level
Altitude (km)
SATELLITES
ROCKETS
BALLOONS
AIRCRAFT
MOUNTAINTOP OBSERVATORIES

Going UV

UV domain 100–3200 Å

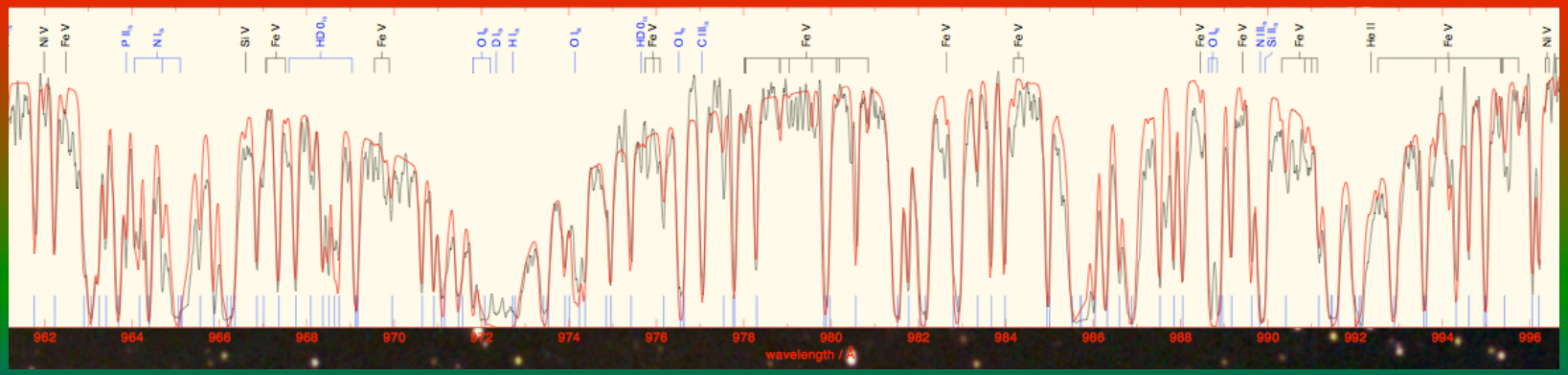


Optics efficiency: Special coatings

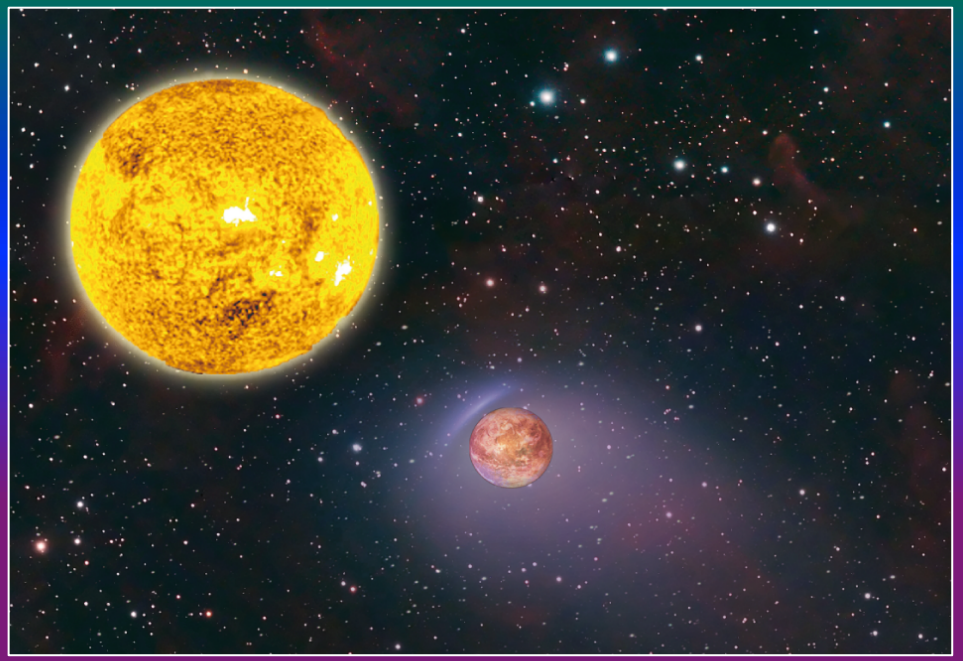
Detector sensitivity: CCD no longer the best option

Going UV

UV absorption/emission by molecules



Exoplanet transits



Going UV

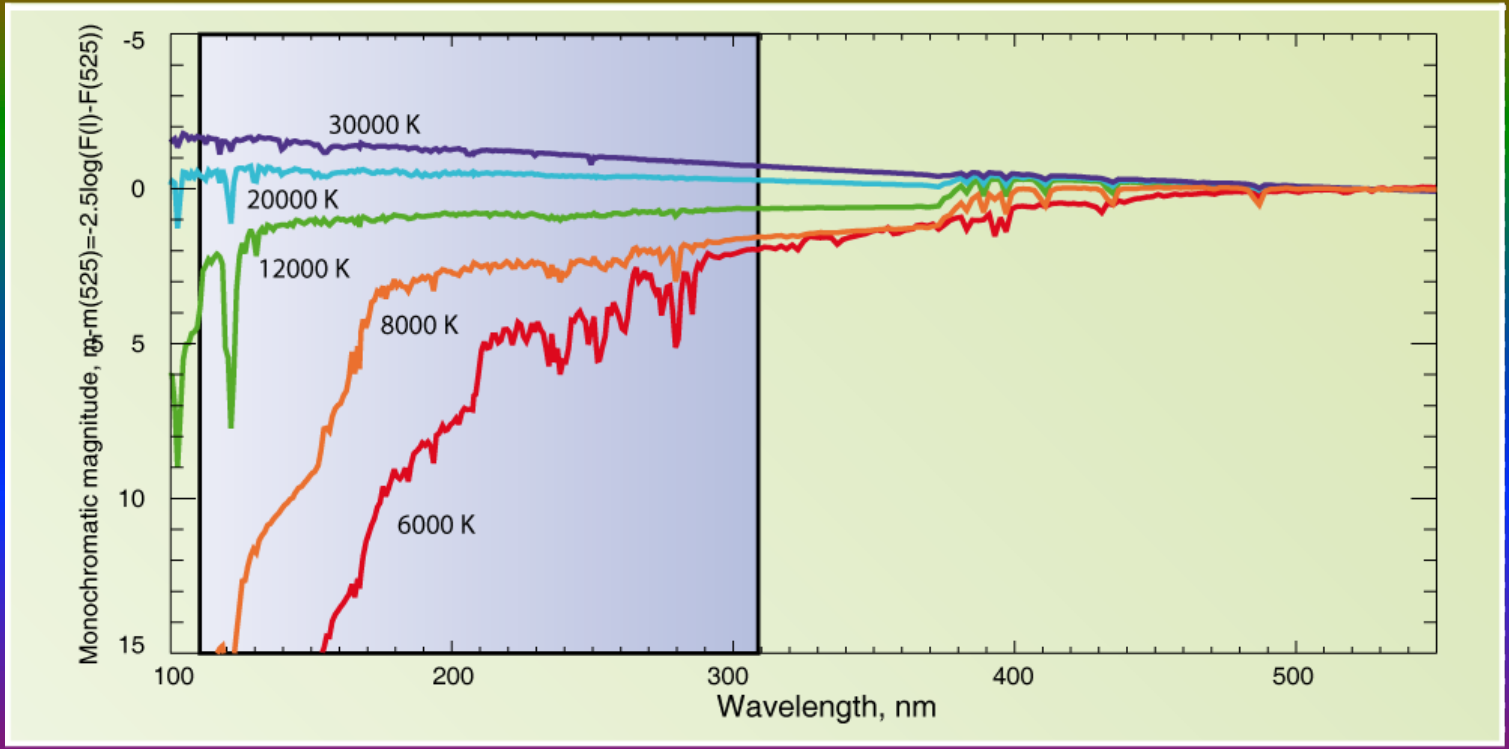
UV lines of high-excitation ions of C, N and O

UV in violent phenomena of accretion and jets



Going UV

UV is the signature of hot, young, massive stars



Going UV

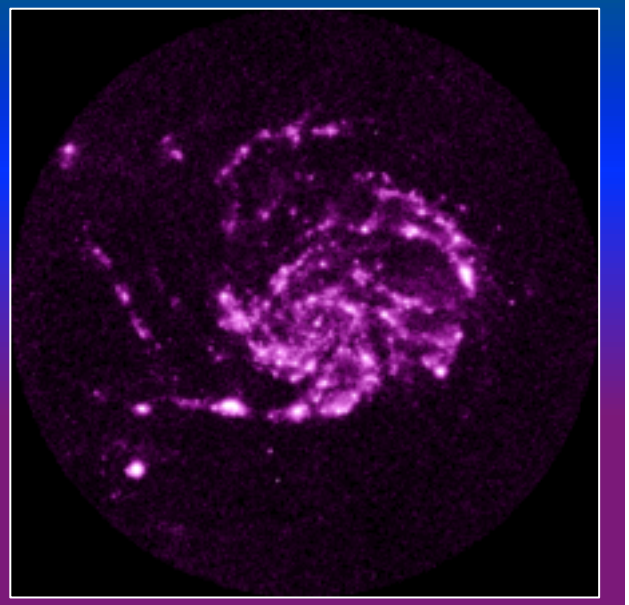
UV is the signature of hot, young, massive stars



The Andromeda galaxy, as seen by GALEX

Where we stand and where we go: UV

ANS: Astronomical Netherlands Satellite	1974-1976
IUE: International Ultraviolet Explorer	1978-1996
HUT: Hopkins Ultraviolet Telescope	1990, 1995
FUSE: Far-Ultraviolet Spectroscopic Explorer	1999-2007
GALEX: Galaxy Evolution Explorer	2003-2013
HST COS and STIS	



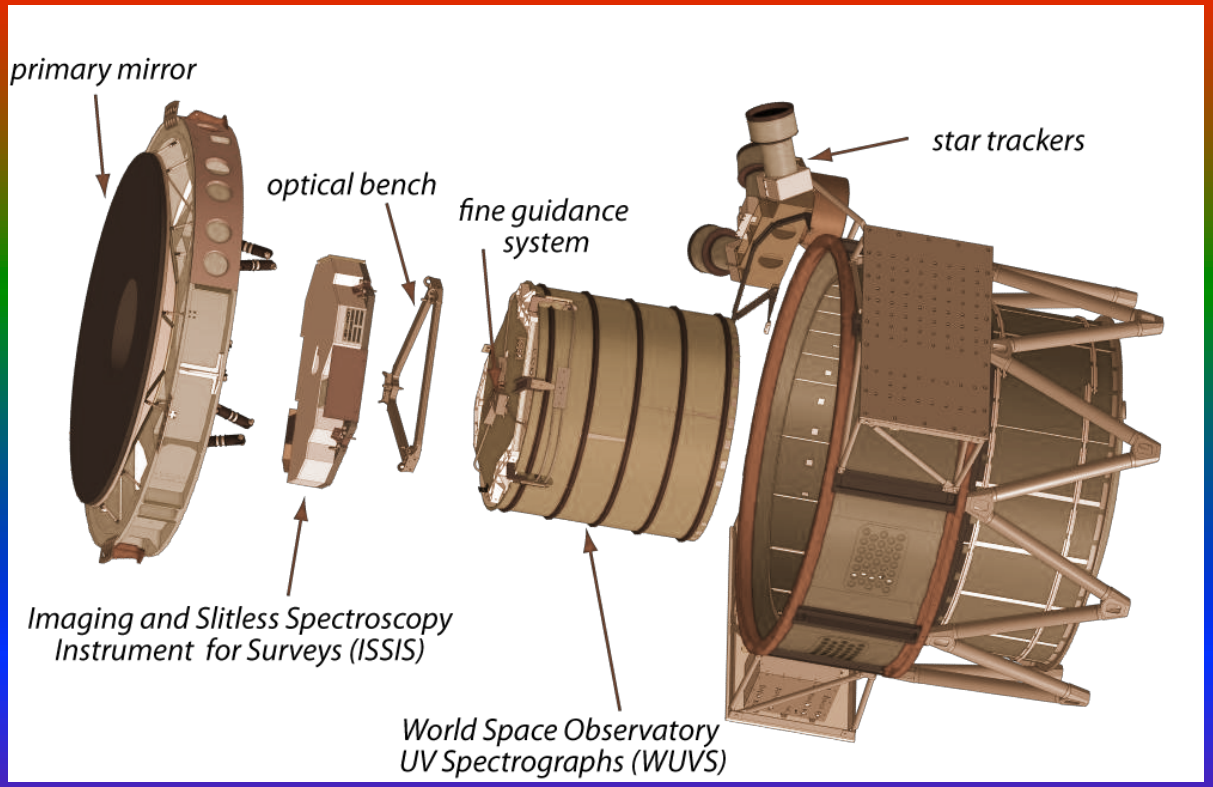
Good perspectives for Spanish UV Astronomy



Spanish PI: Ana Inés Gómez de Castro (UCM)

WSO-UV: World Space Observatory

1.70m telescope



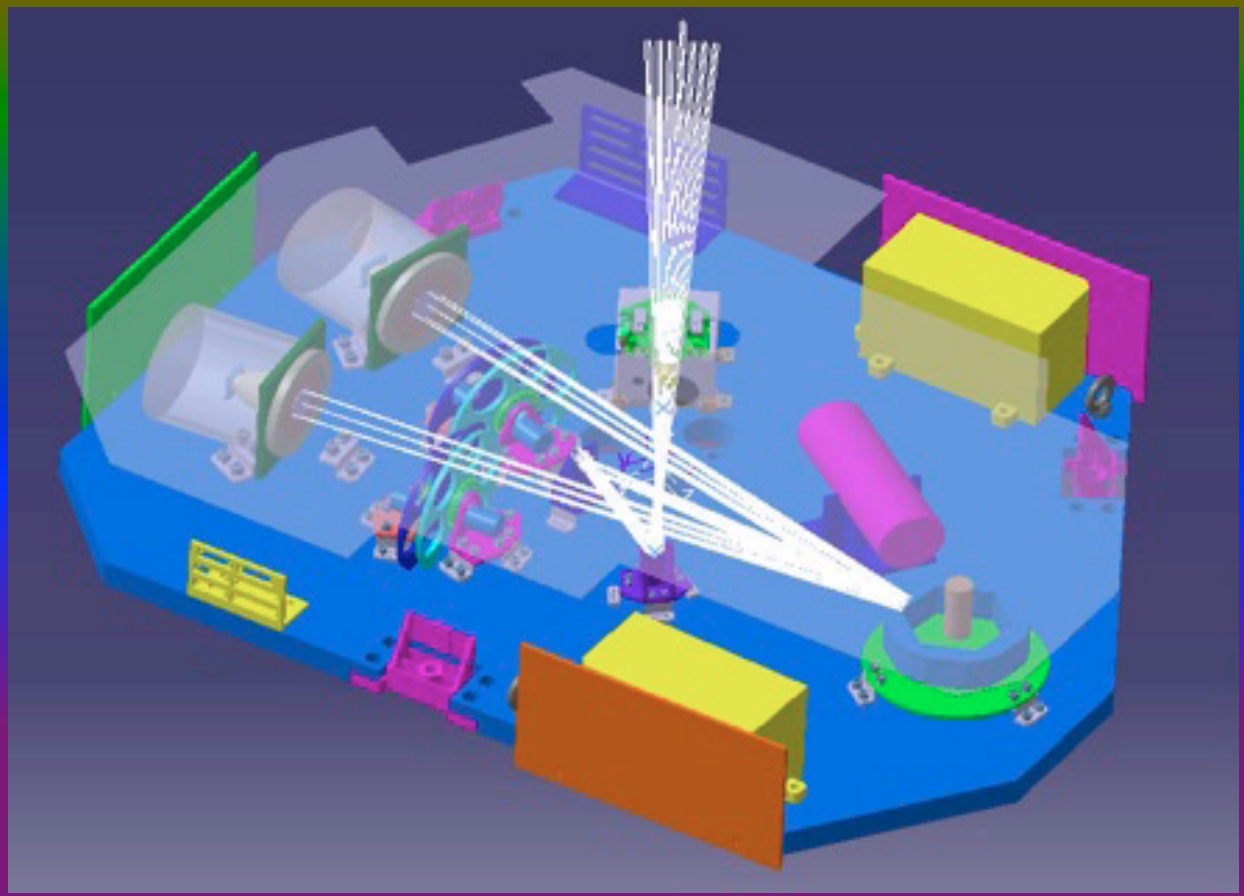
Very similar capabilities (or better) to those of *HST* and its UV instruments COS and STIS

WSO-UV: World Space Observatory

0.1 arcsec resolution, FoV 1.3 arcmin

Far-UV channel: 115-176 nm, R=500

Near-UV channel: 185-320 nm, R=500



ISSIS

WSO-UV: World Space Observatory

WUVS (WSO-UV Spectrograph):

Two high resolution spectrographs (R=50,000)

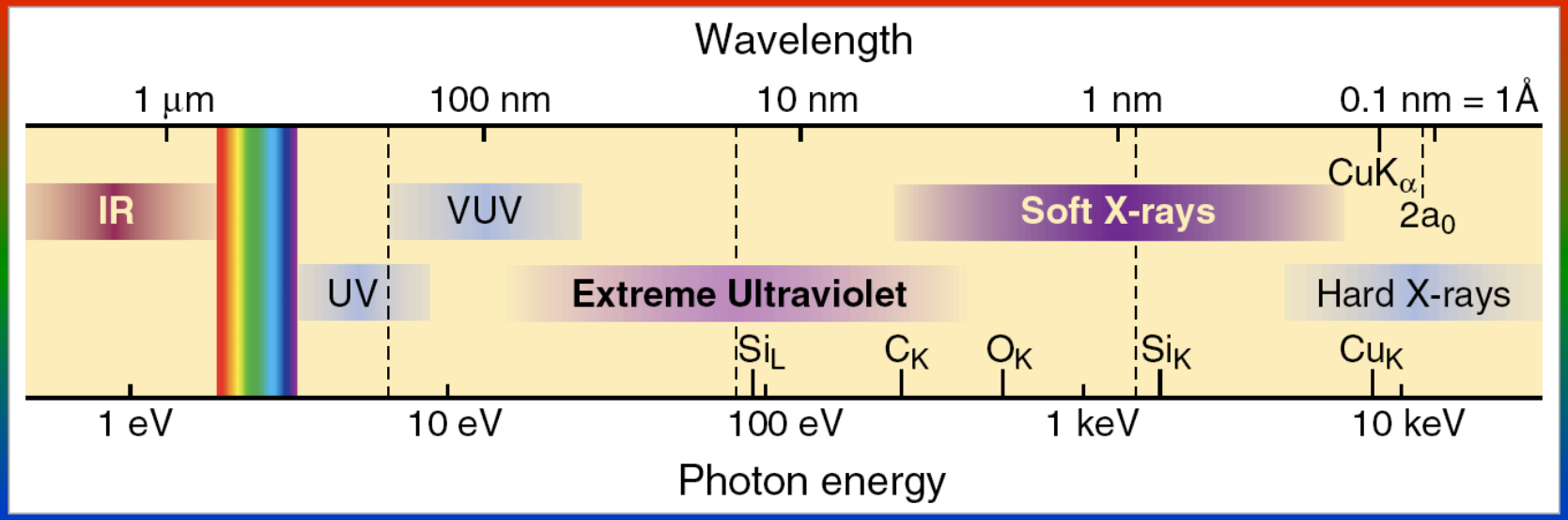
- UV range: 115-176 nm
- Near-UV range: 174-310 nm

One long-slit spectrograph (LSS, R=1,200)

- Spectral range: 115-310 nm

Going X-ray

$0.1\ \text{keV} \leq E \leq 12.4\ \text{keV} \quad \Leftrightarrow \quad 0.1\ \text{Å} \leq \lambda \leq 100\ \text{Å}$

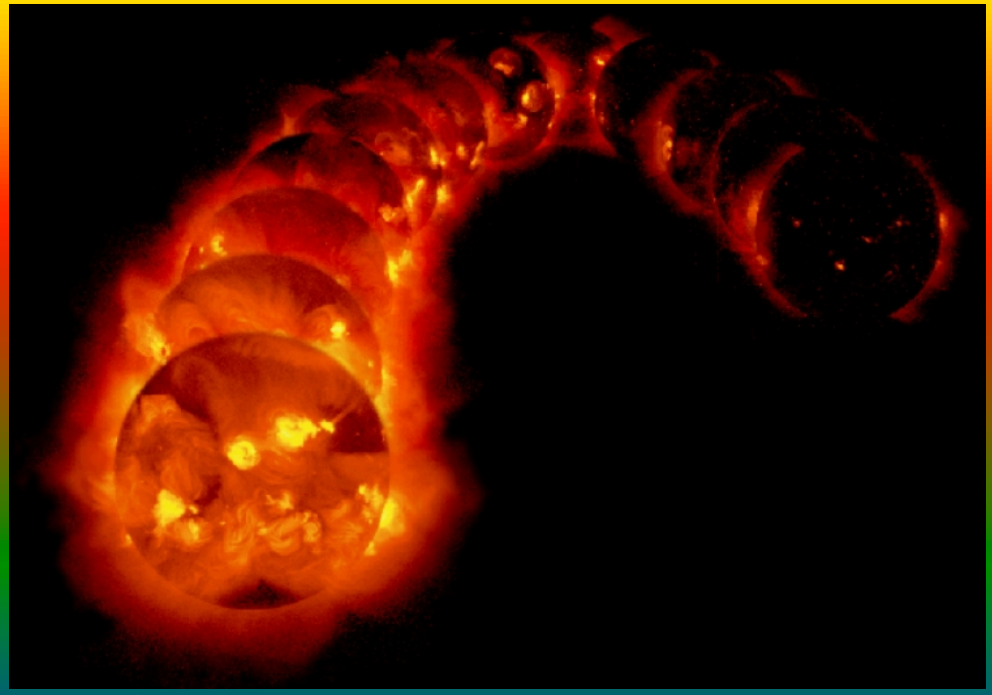


$E = k_B T_e \geq 0.1\ \text{keV} \Rightarrow T_e \geq 1 \times 10^6\ \text{K}$

Going X-ray

Coronal activity:

Solar cycle

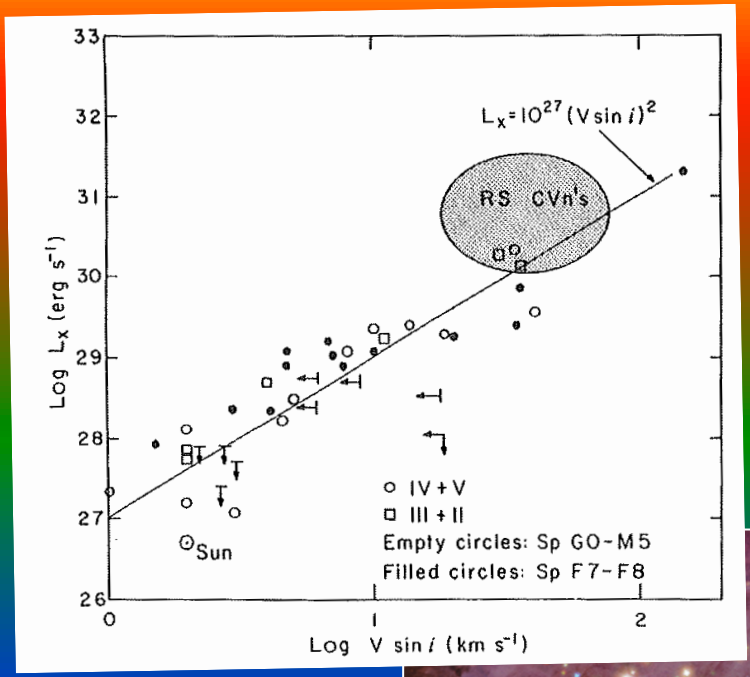


Accretion:

Compact sources



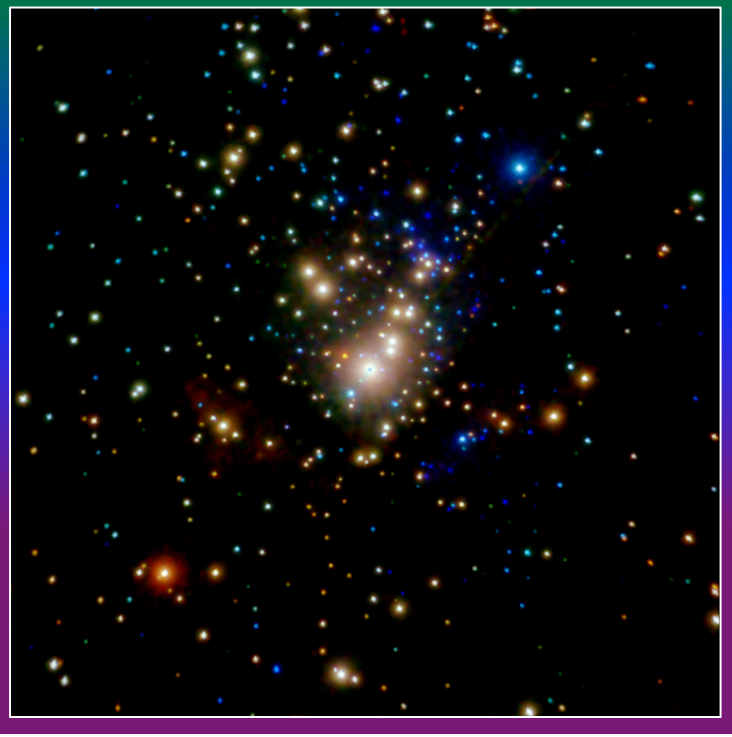
Going X-ray



Coronal activity and accretion important among YSOs

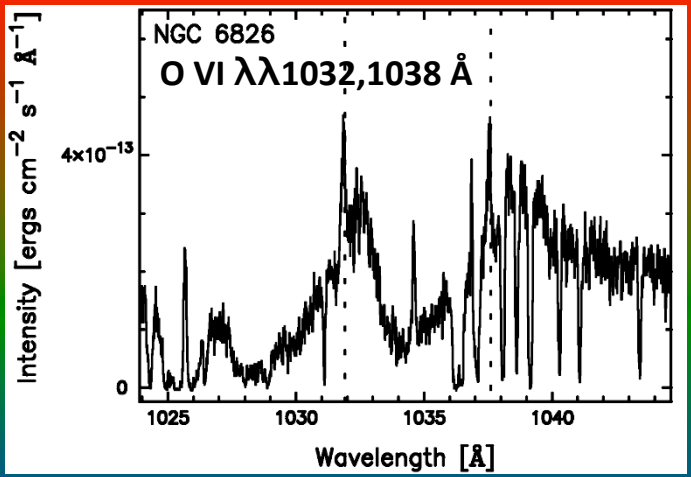
Orion Nebula star cluster



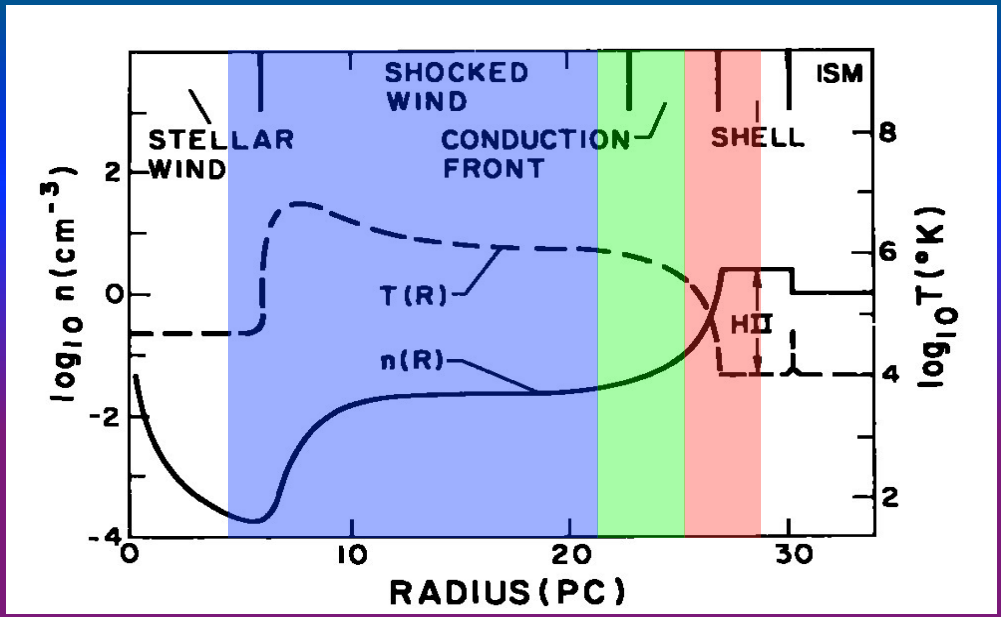


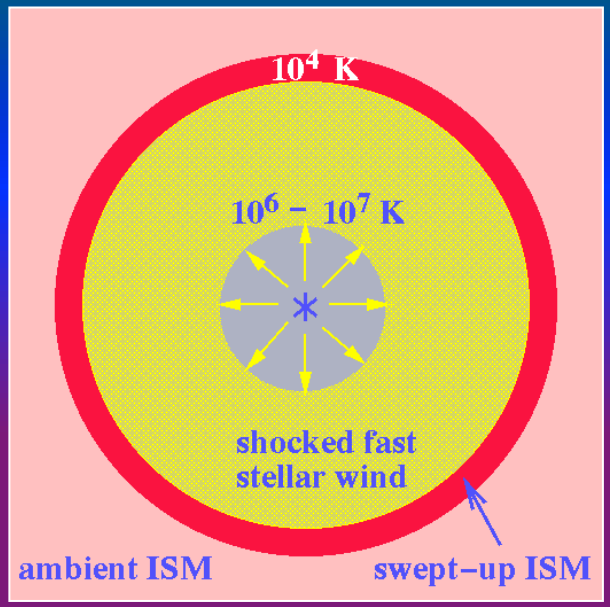
Going X-ray - stellar winds at multiple scales

Planetary nebulae









Going X-ray - stellar winds at multiple scales

Planetary nebulae

ChanPlaNS:
all PNe ≤ 1.5 kpc



Kastner et al. 2012

Ruiz et al. 2013

Freeman et al. 2014

Montez et al. 2015

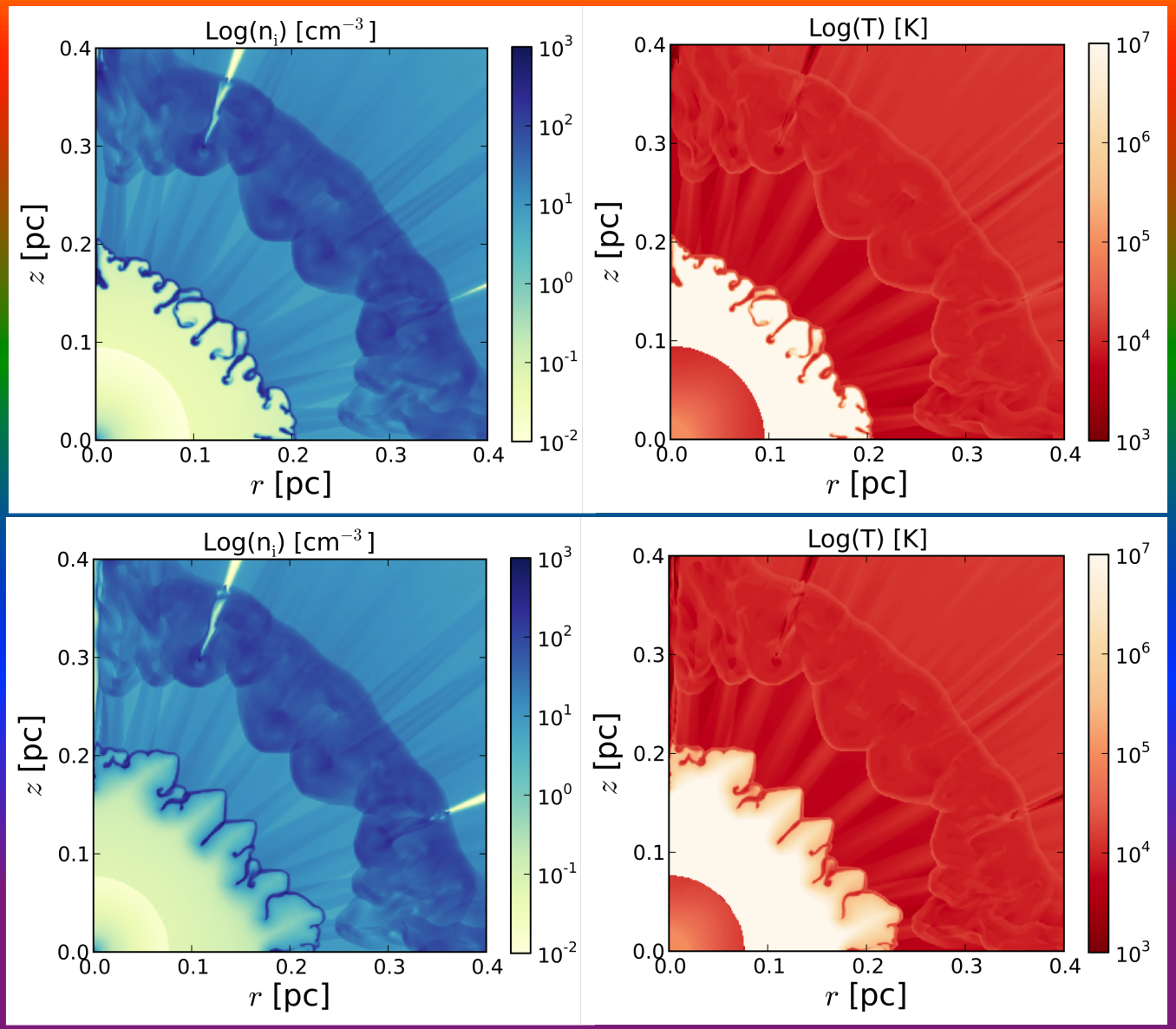
Going X-ray - stellar winds at multiple scales

Modelling PN:

turbulent mixing,

heat conduction,

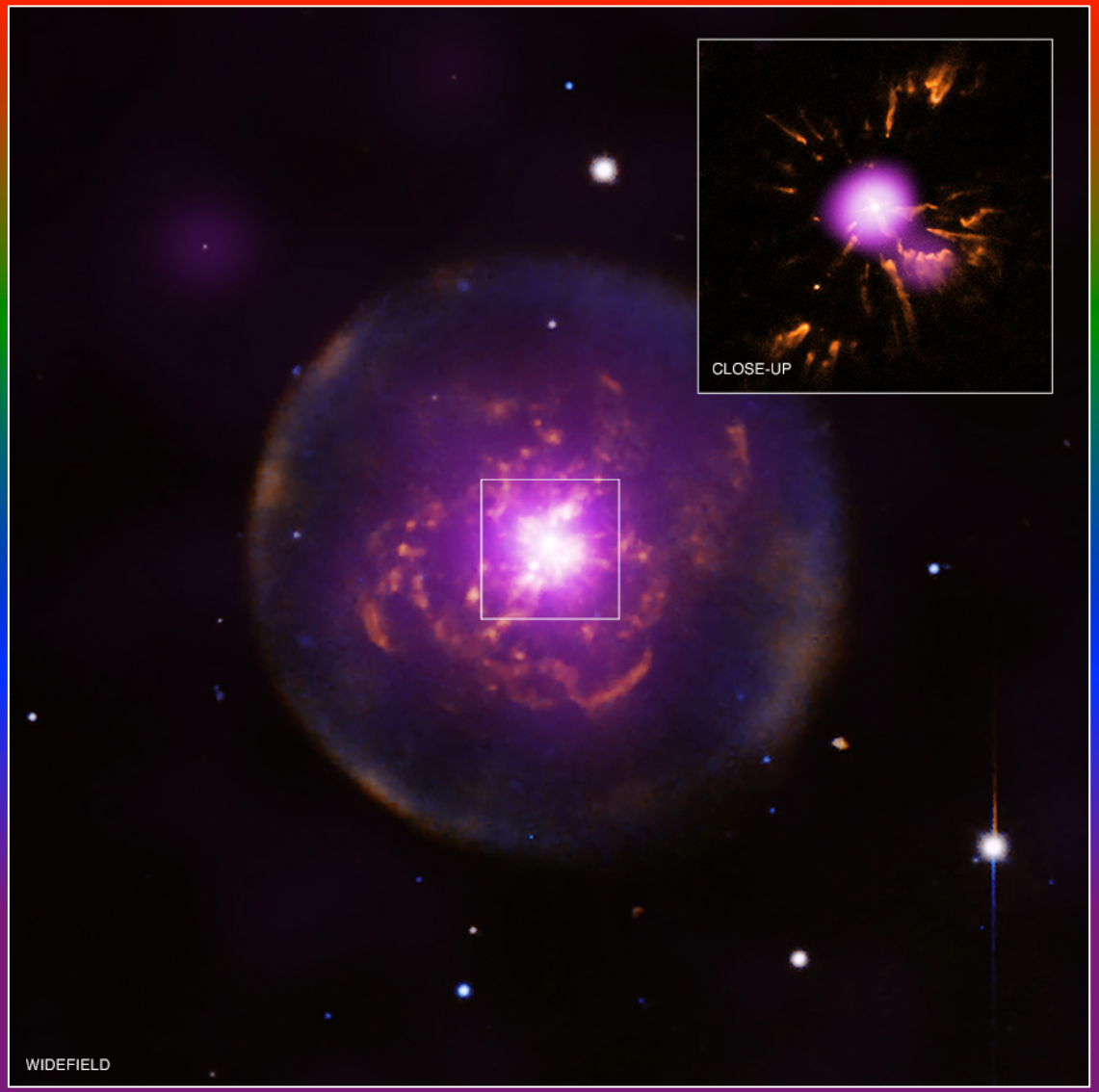
magnetic field



Toalá & Arthur 2014

Going X-ray - stellar winds at multiple scales

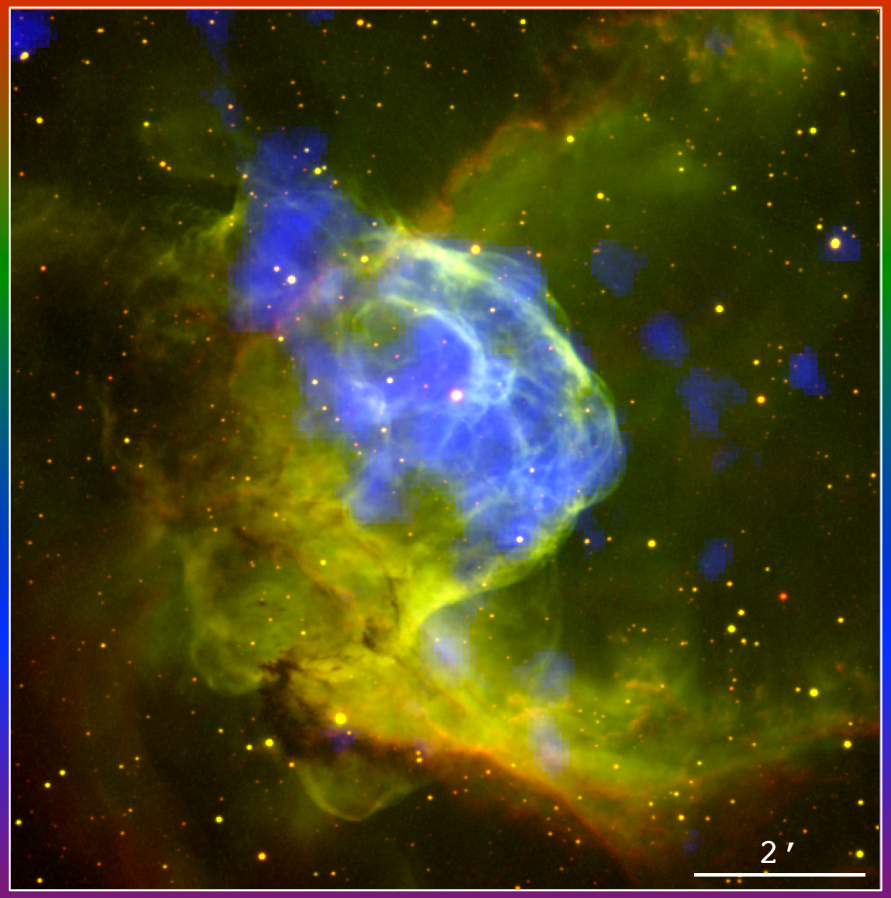
Dusty winds in born-again PNe



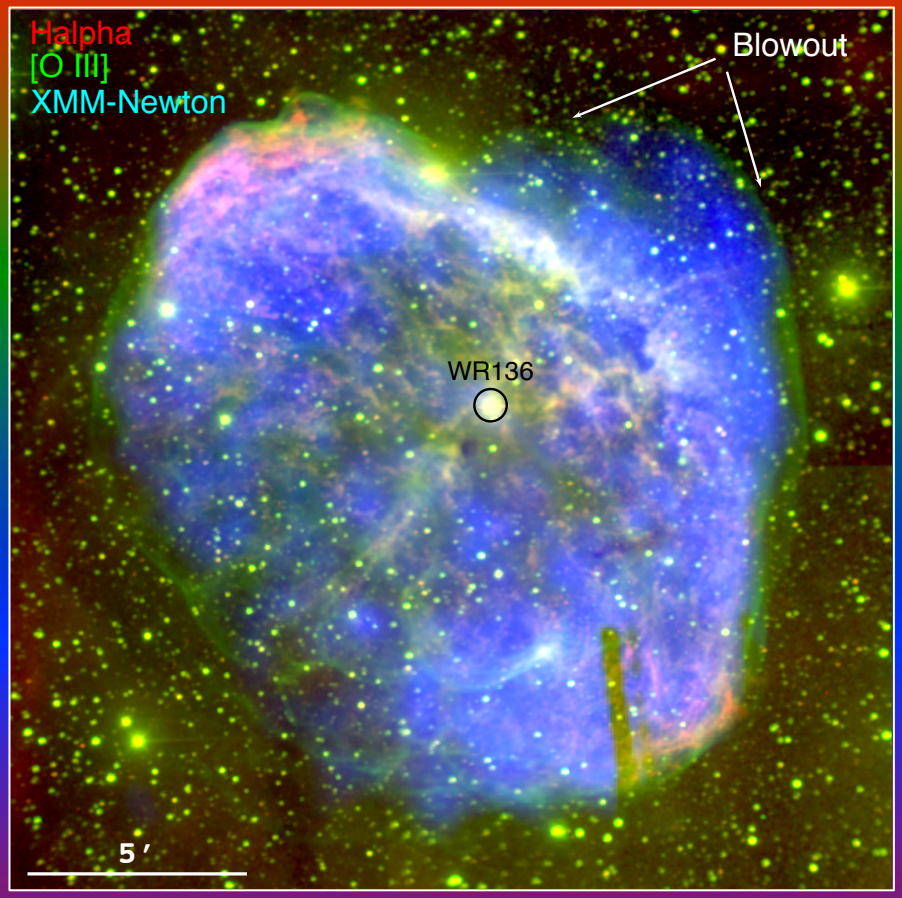
Guerrero et al. 2013

Going X-ray - stellar winds at multiple scales

Wolf-Rayet wind-blown bubbles



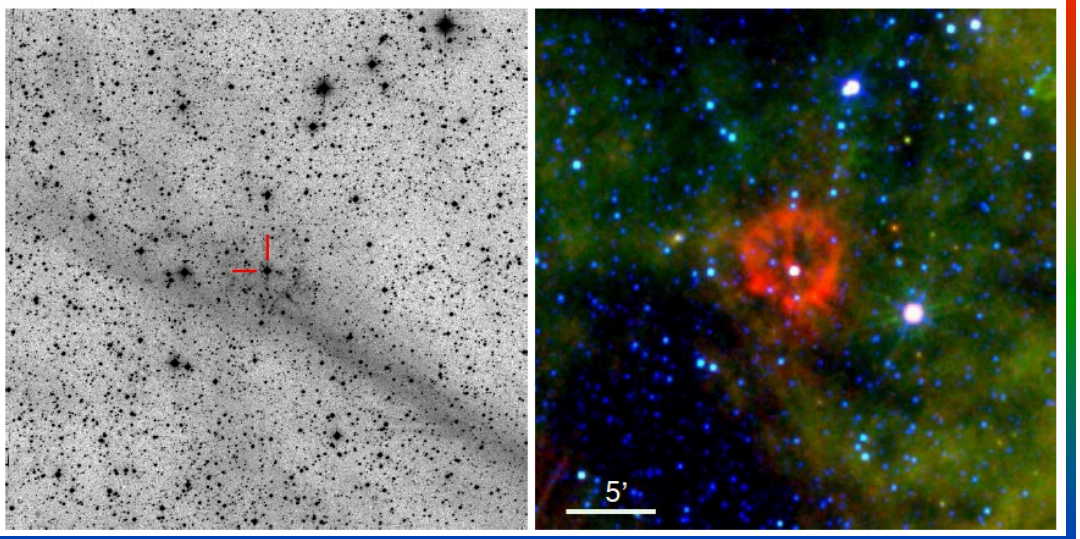
NGC 2359 (Toalá et al. 2015a)

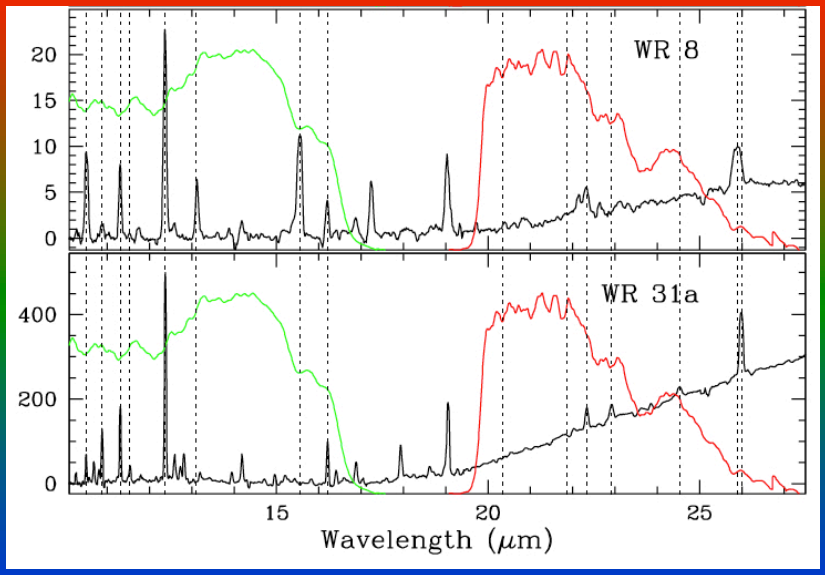


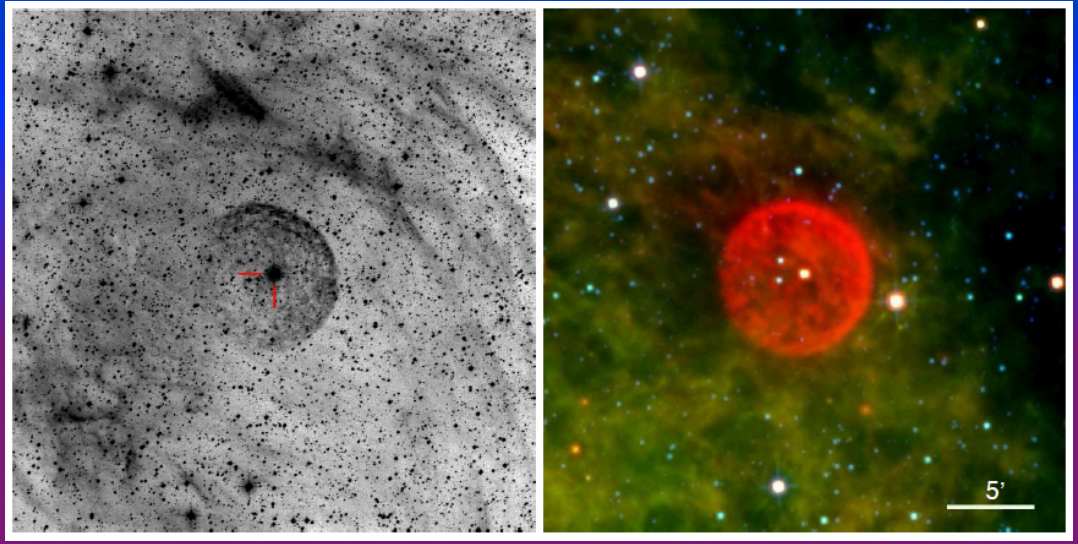
NGC 6888 (Toalá et al. 2014, 2015b)

Going X-ray - stellar winds at multiple scales

Wolf-Rayet wind-blown bubbles







Toalá et al. 2015c

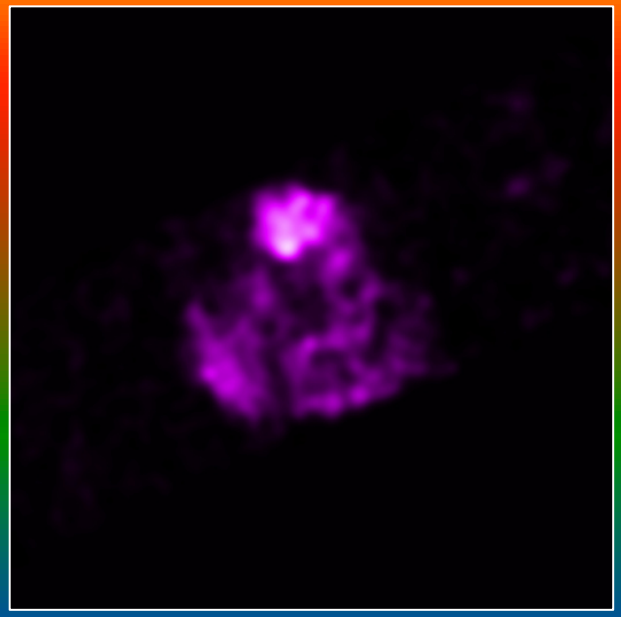
Going X-ray - stellar winds at multiple scales

Supershells

DEM L50

Jaskot et al. 2011

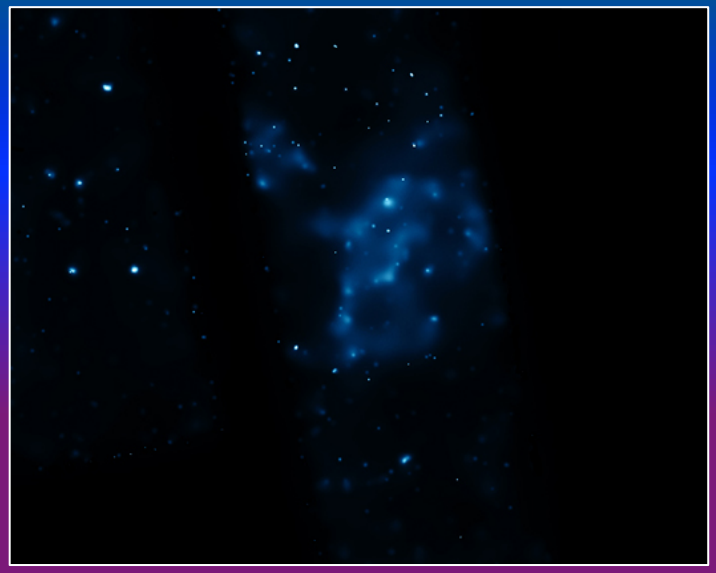




N44

Jaskot et al. 2010



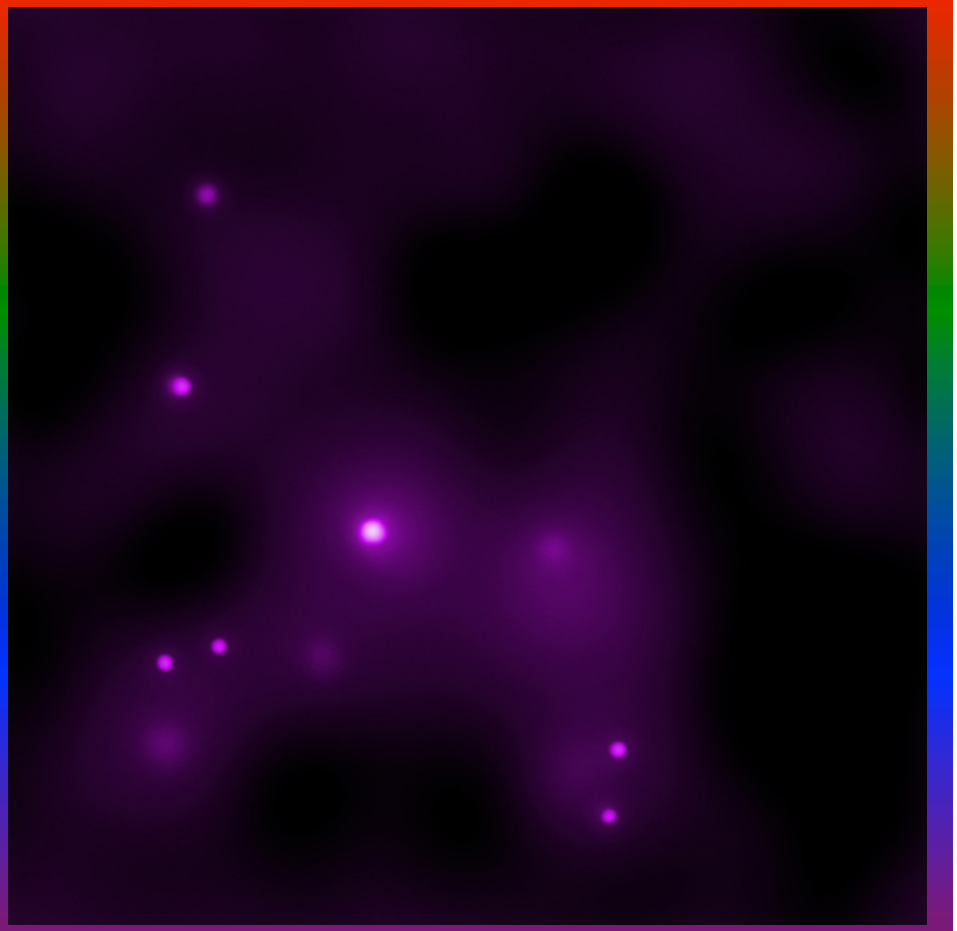


Going X-ray - stellar winds at multiple scales

Also in the SMC



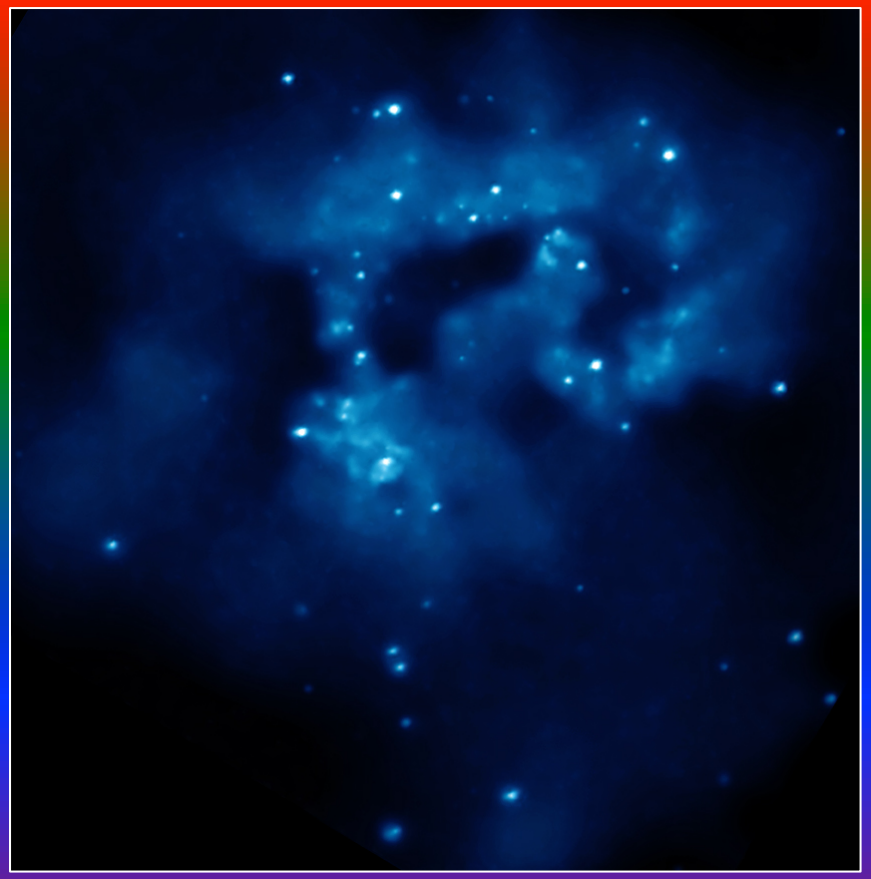
NGC 602 Oskinova et al. 2013



Going X-ray - stellar winds at multiple scales

Diffuse galactic emission: adding the effects of bubbles





The Antennae Glxs

Metz et al. 2004; Baldi et al. 2006a,b

Star clusters can (super SCs $>10^5$ $M_\odot$) or cannot (young <100 Myr low-mass SCs) power the X-ray emission

What's ahead?

Since 1999, *Chandra* and *XMM-Newton* have been the workhorse of X-ray Astronomy

Early 2016 ASTRO-H (JAXA & NASA)

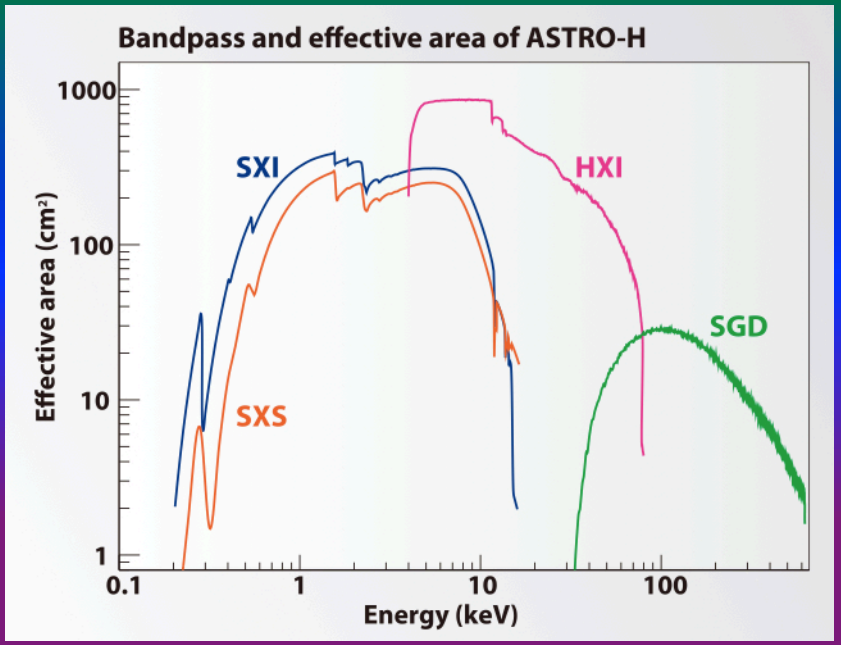
X-Ray Telescope (XRT): spatial resolution of 1.3'

Soft X-ray Spectrometer (SXS): with a X-ray Calorimeter Spectrometer (XCS) with energy resolution of 7 eV (0.3—12 keV)

Soft X-ray Imager (SXI): 35'x35' FoV

Soft Gamma-ray Detector (SGD)

Hard X-ray Imager (HXI)



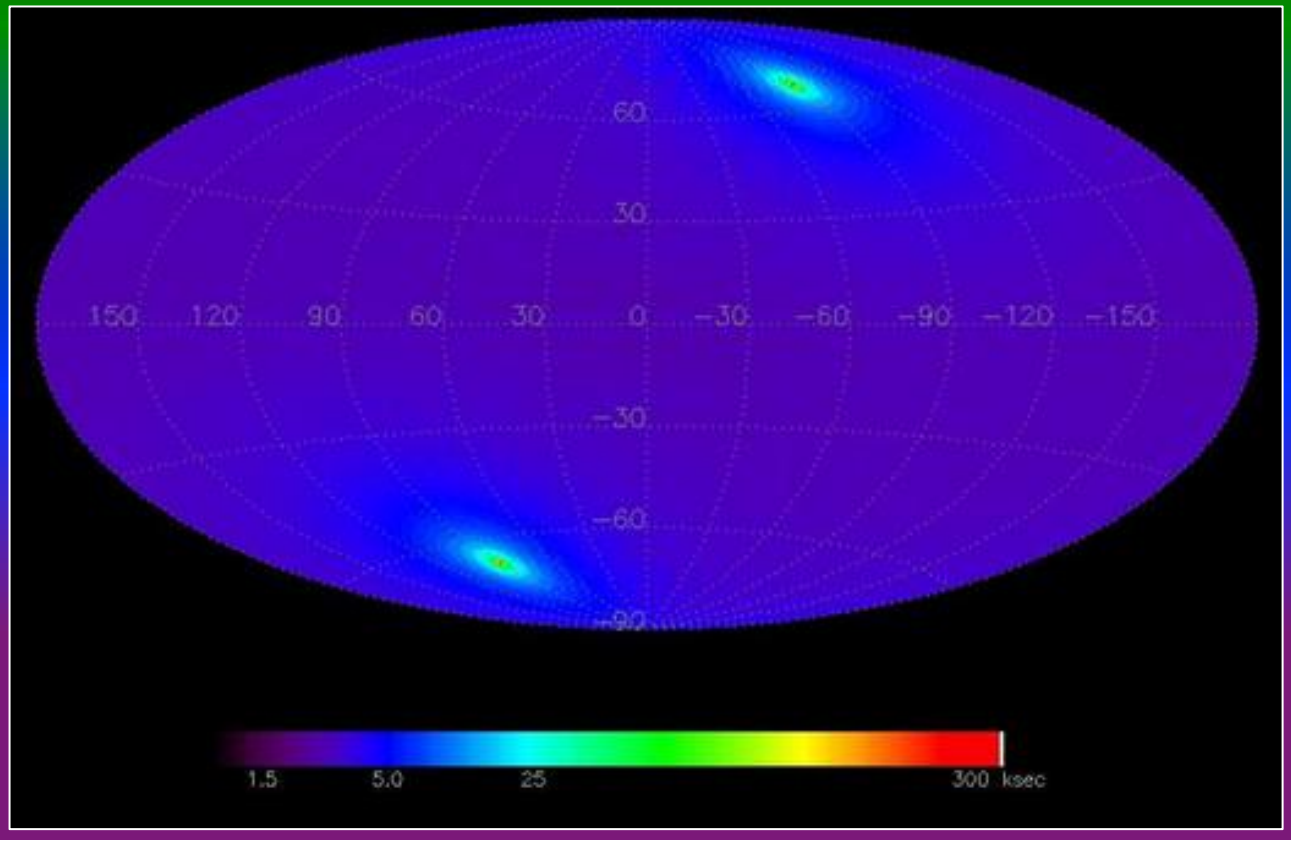
What's ahead?

Late 2016: SGR-eROSITA (Germany & Russia)

The Spectrum-X-Gamma includes e-ROSITA (extended Roentgen Survey with an Imaging Telescope Array)

e-ROSITA will perform a sensitive all-sky X-ray survey

20 times more sensitive than ROSAT RASS



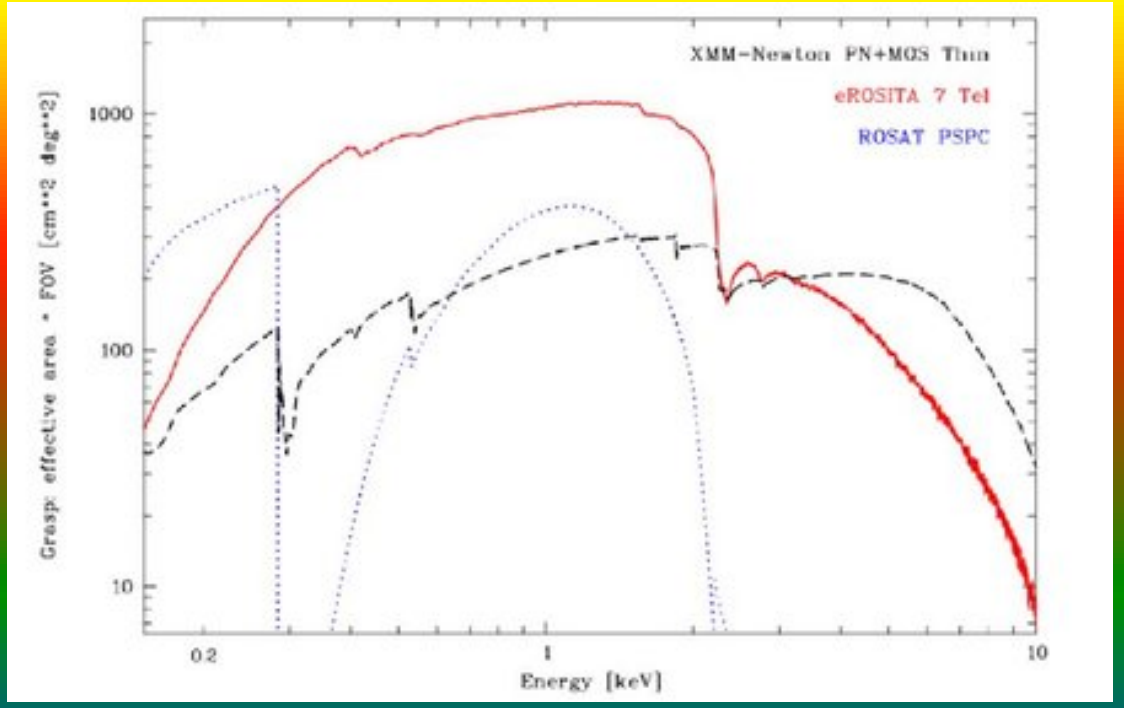
What's ahead?

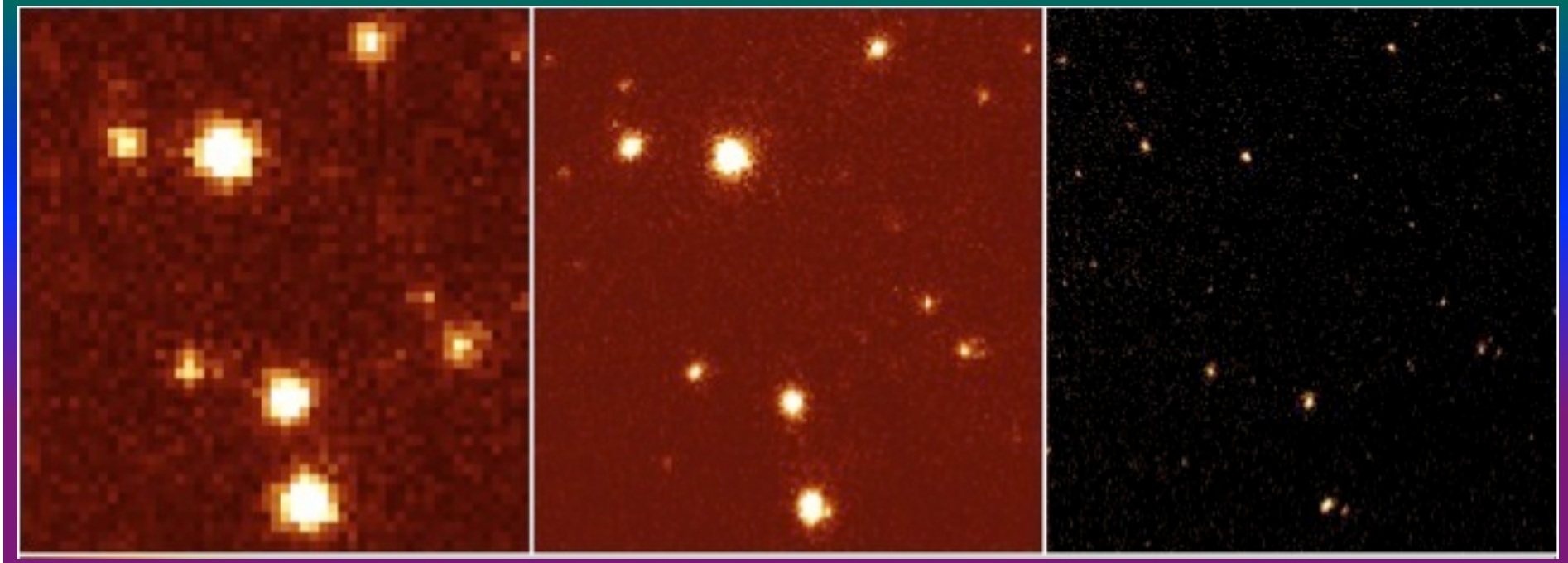
e-ROSITA

HEW ~ 16"

FoV ~ 1° ⦸

e-ROSITA – XMM – Chandra





What's ahead?

By 2028 ... **Athena:** the Advanced Telescope for High-Energy Astrophysics (Athena), the second Large-class mission (L2) in ESA's "Cosmic Vision 2015-25" program

To be placed into an L2 halo orbit

Nominal five-year lifetime

With the largest X-ray mirror ever flown:

2 m^2 @ 1 keV

0.25 m^2 @ 6 keV

Great angular resolution:

5" HEW @ <7 keV

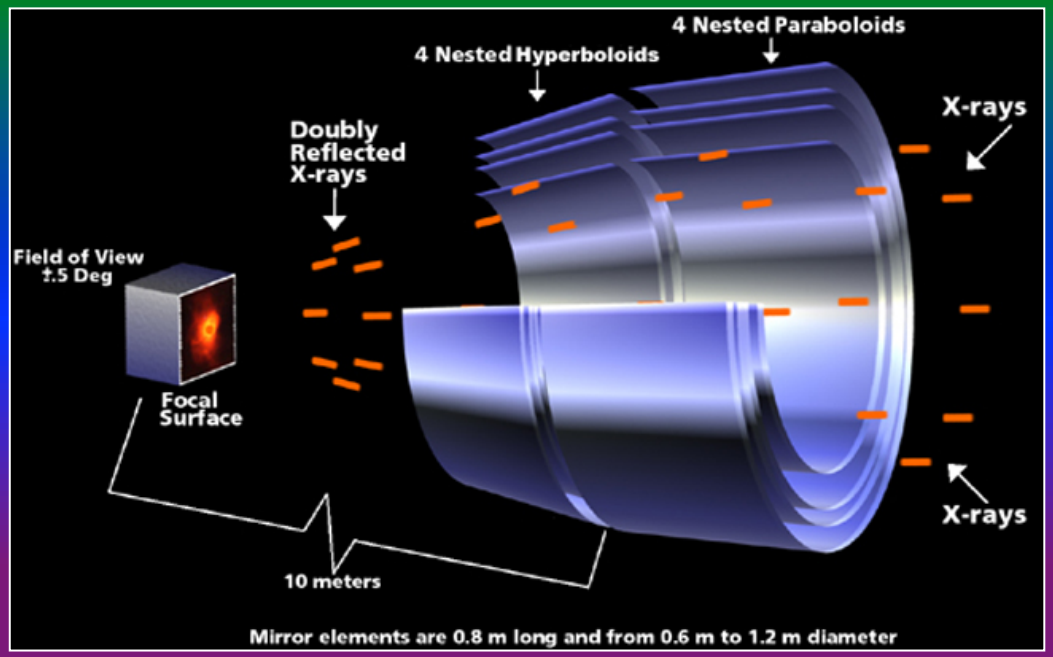
Large field of view:

40'-50'

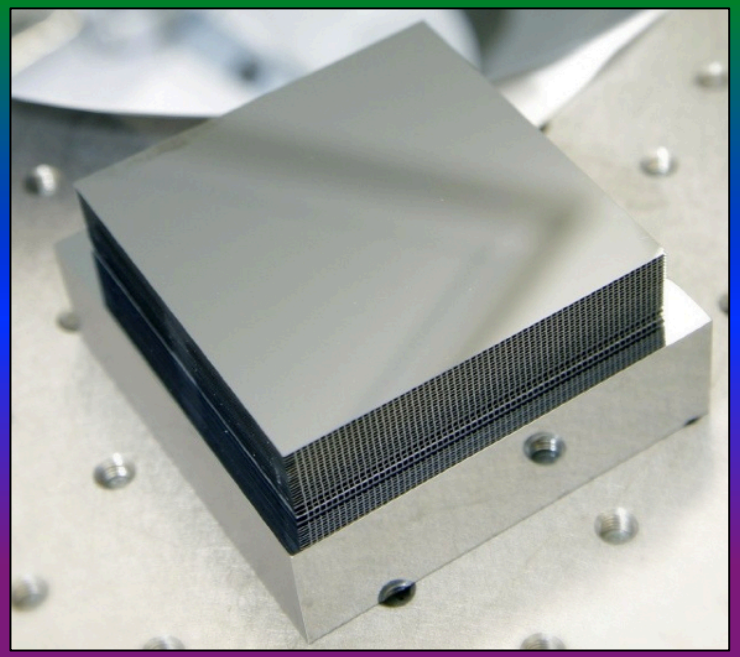
Athena's innovative optics

Combination of large area, high angular resolution and large field of view made possible using the Silicon Pore Optics (SPO) technology

Chandra Type I Walter mirror



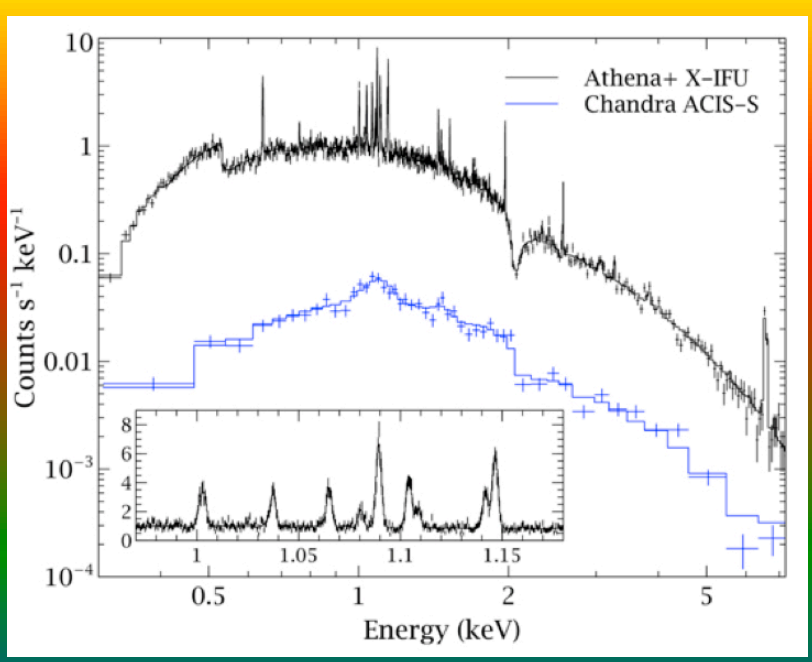
SPO



Athena's instruments

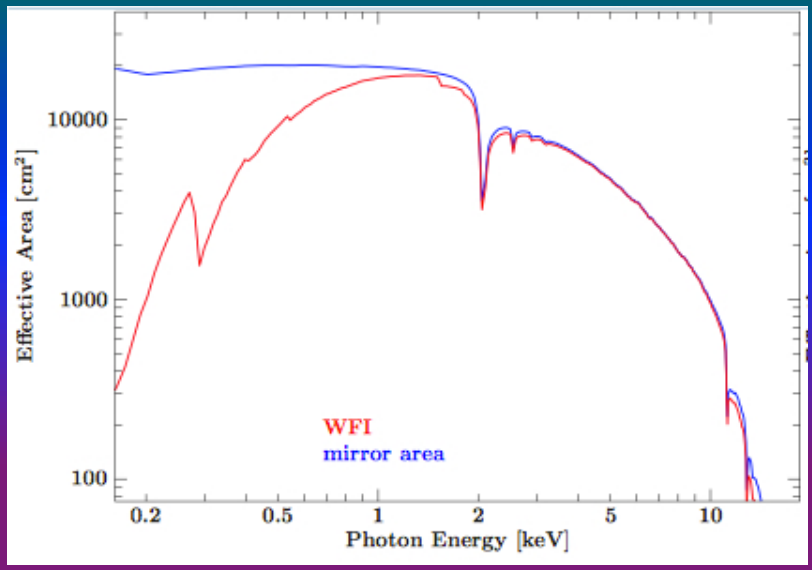
X-ray Integral Field Unit (X-IFU), a cryogenic imaging spectrometer

- Energy range: 0.3 - 10 keV
- Energy resolution: 2.5 eV
- FoV: 5'



Wide Field Imager (WFI), an active pixel CCD instrument

- Energy range: 0.1 - 12 keV
- Energy resolution <150 eV
- FoV: 50'x50'
- Spatial resolution <5"




GOOD
things
ARE GOING
to HAPPEN