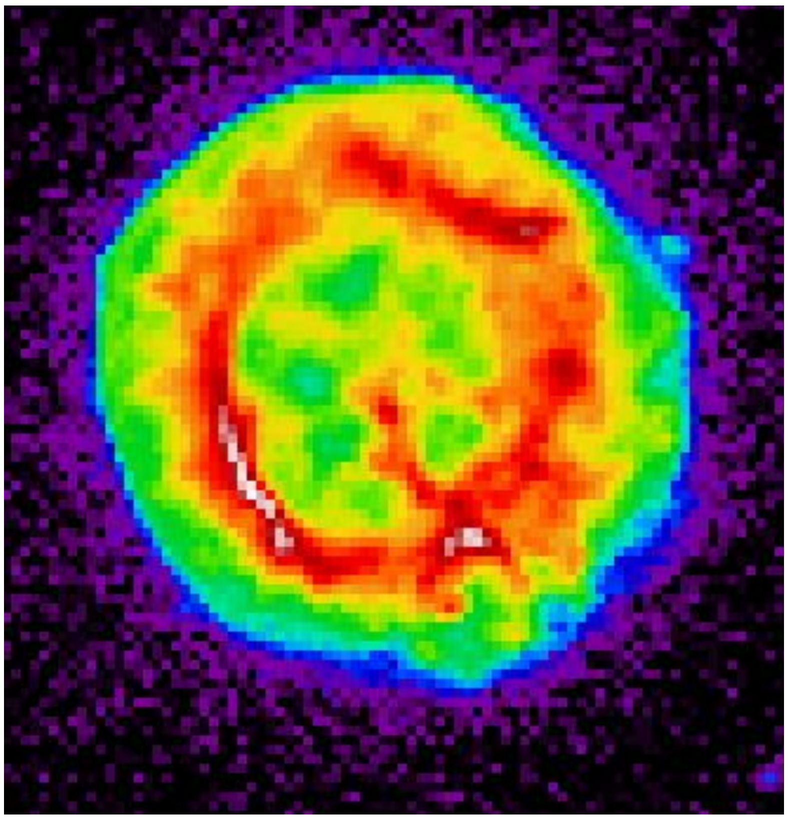
Primary and Secondary Standards for Thermal SNRs

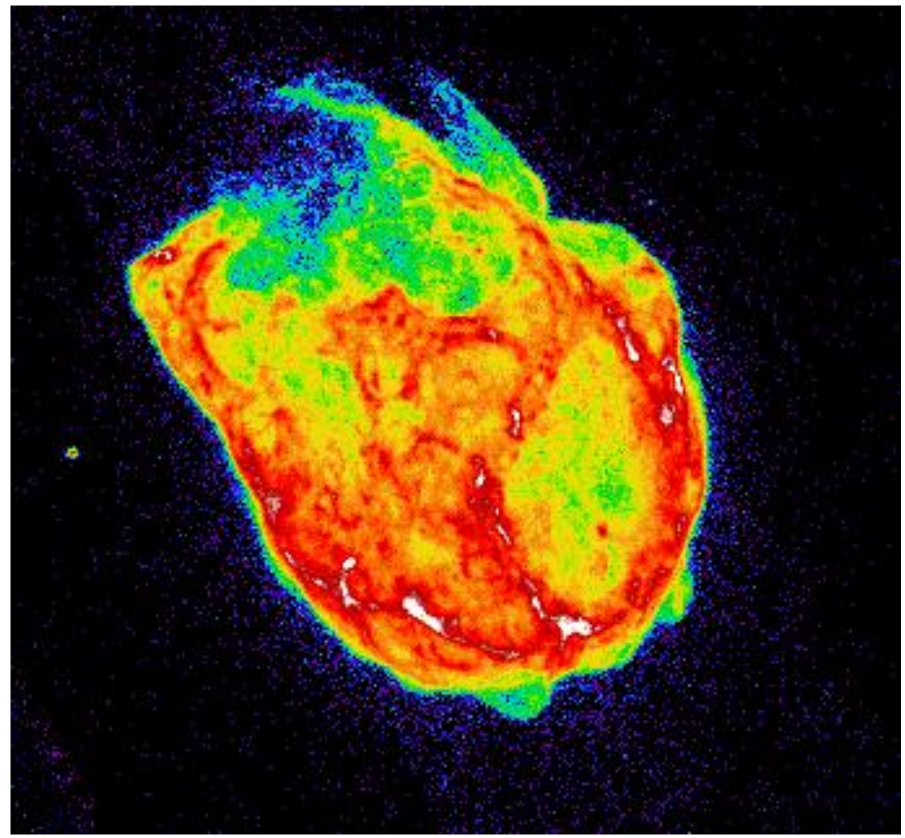
An Assigned Talk #2

E0102: X-ray brightest in the SMC
0.77X0.77 arcmin, 13X13 pc
t ~ 2,000 yr (Finkelstein et al. 2006)
L_X(0.3-10.0 kev) = 2.5×10^{37} ergs s^{-1}
compact object? Vogt et al. 2018
"O-rich" core-collapse SNR



ACIS 0.35-8.0 keV

N132D: X-ray brightest in the LMC
1.7X2.3 arcmin, 25x33.5 pc
t ~ 3,000 yr (Morse et al. 1996)
L_X(0.3-10.0 kev) = 1.0×10^{38} ergs s^{-1}
no compact object
"O-rich" core-collapse SNR



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Chandra X-ray Observatory

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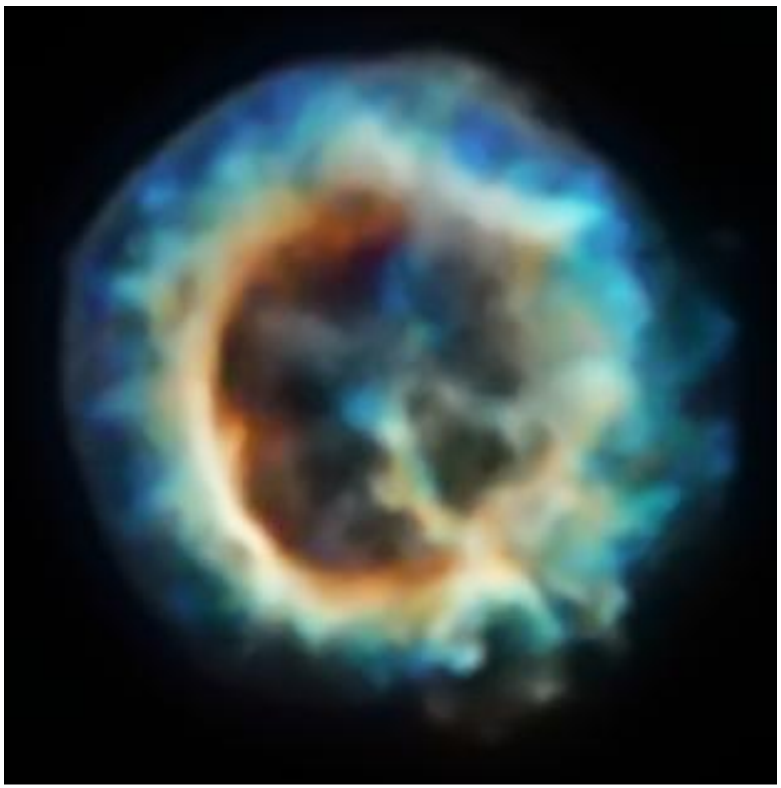

Red (0.3-0.5 keV), Green (0.5-0.75 keV)
Blue (0.75 – 7.0 keV)

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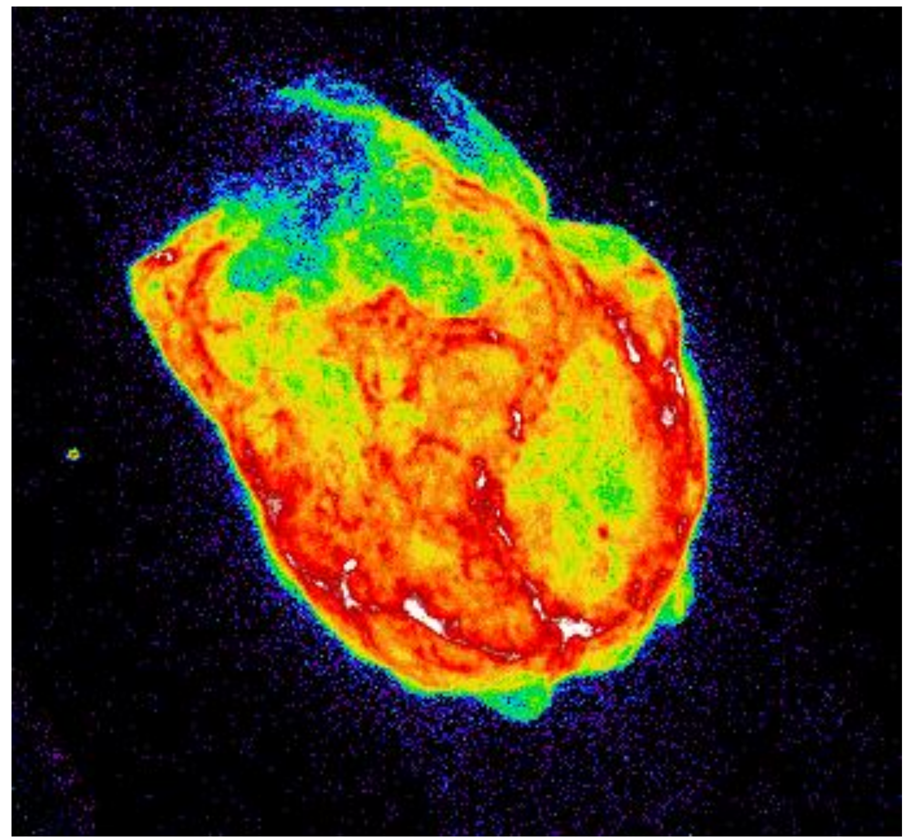

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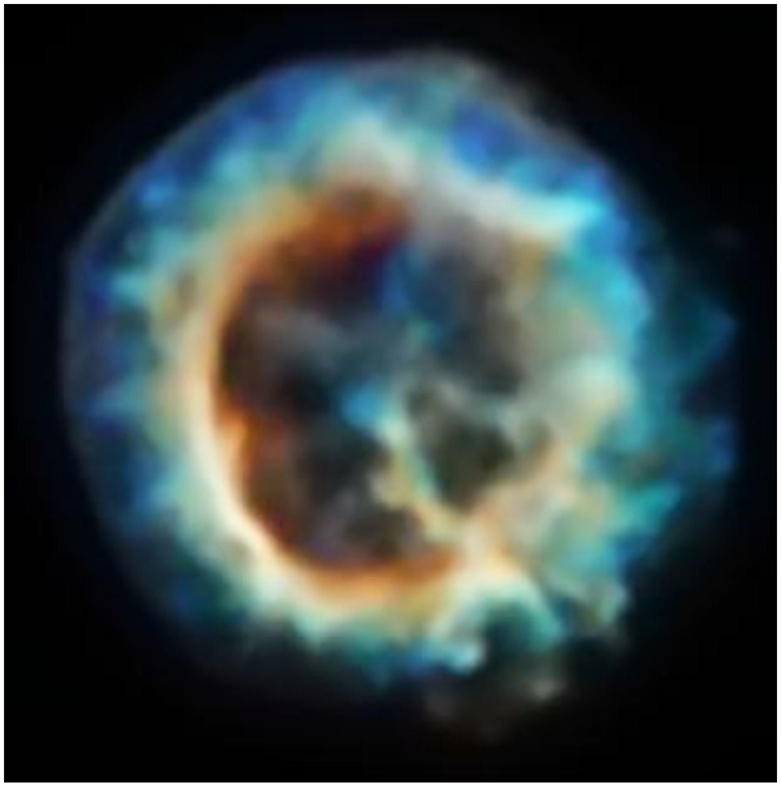

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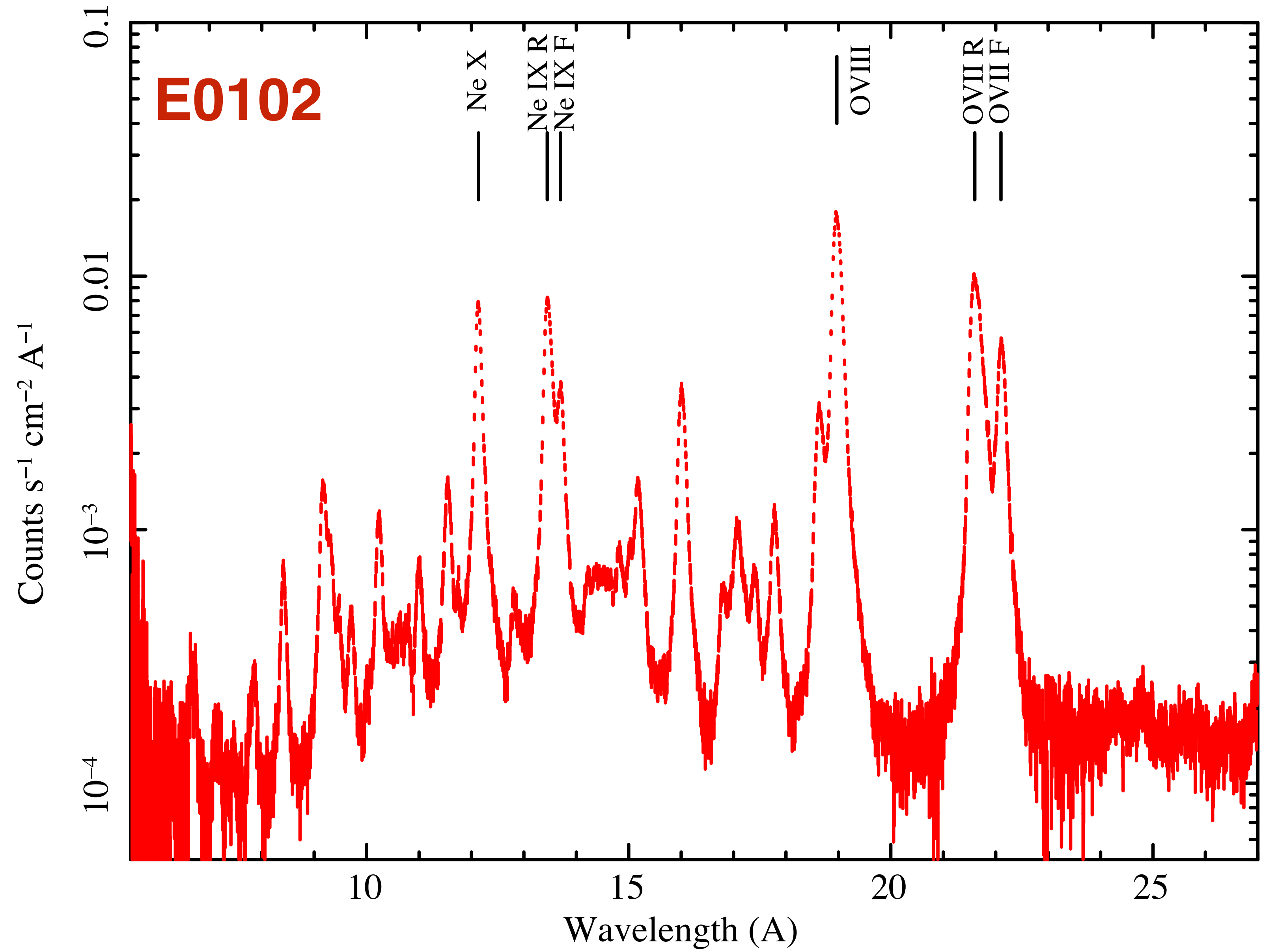
Red (0.3-0.75 keV), Green (0.8-1.1 keV), Blue (1.1 – 2.0 keV)

RGS Spectra of E0102 & N132D

XMM RGS Courtesy A. Pollock (ESAC)



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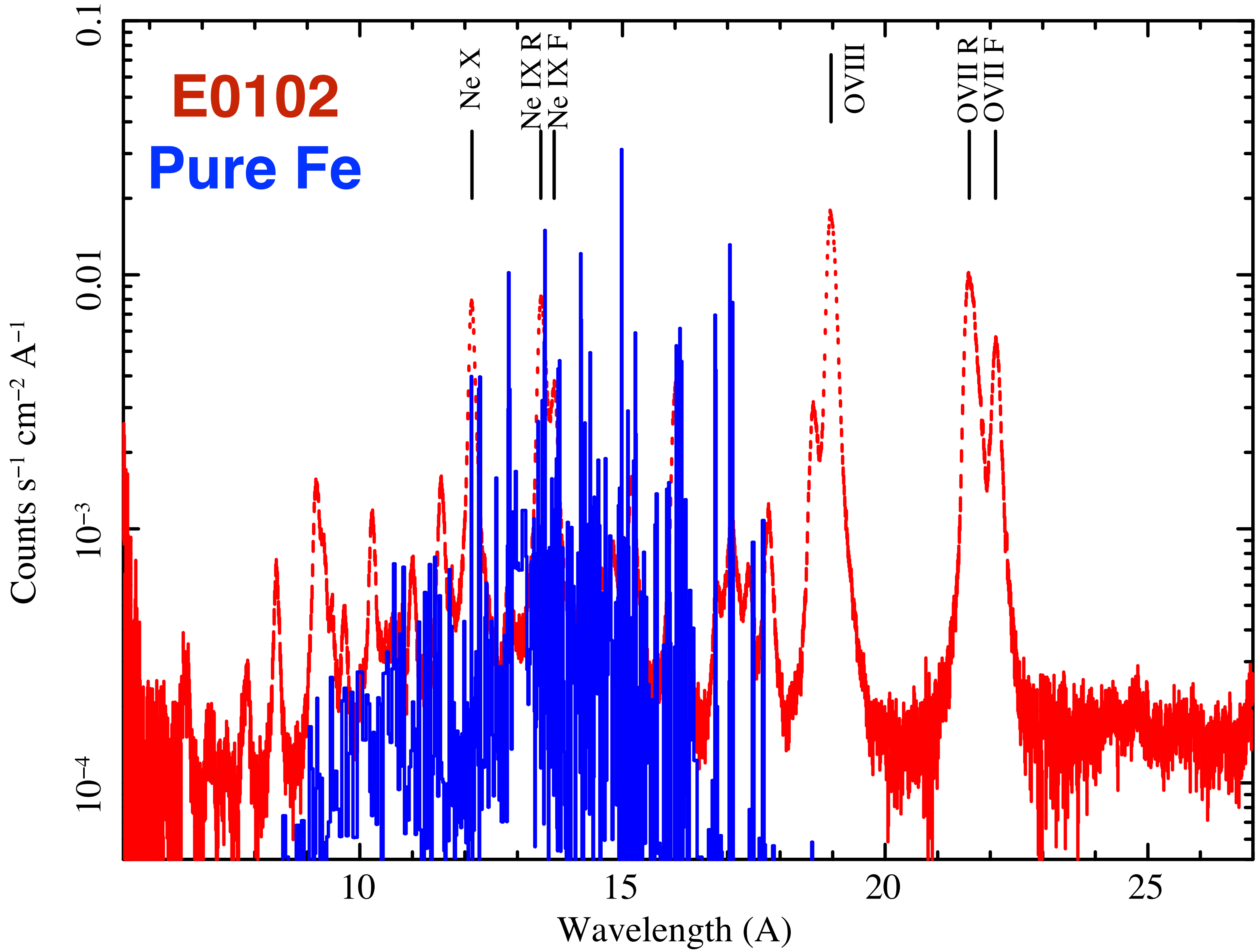

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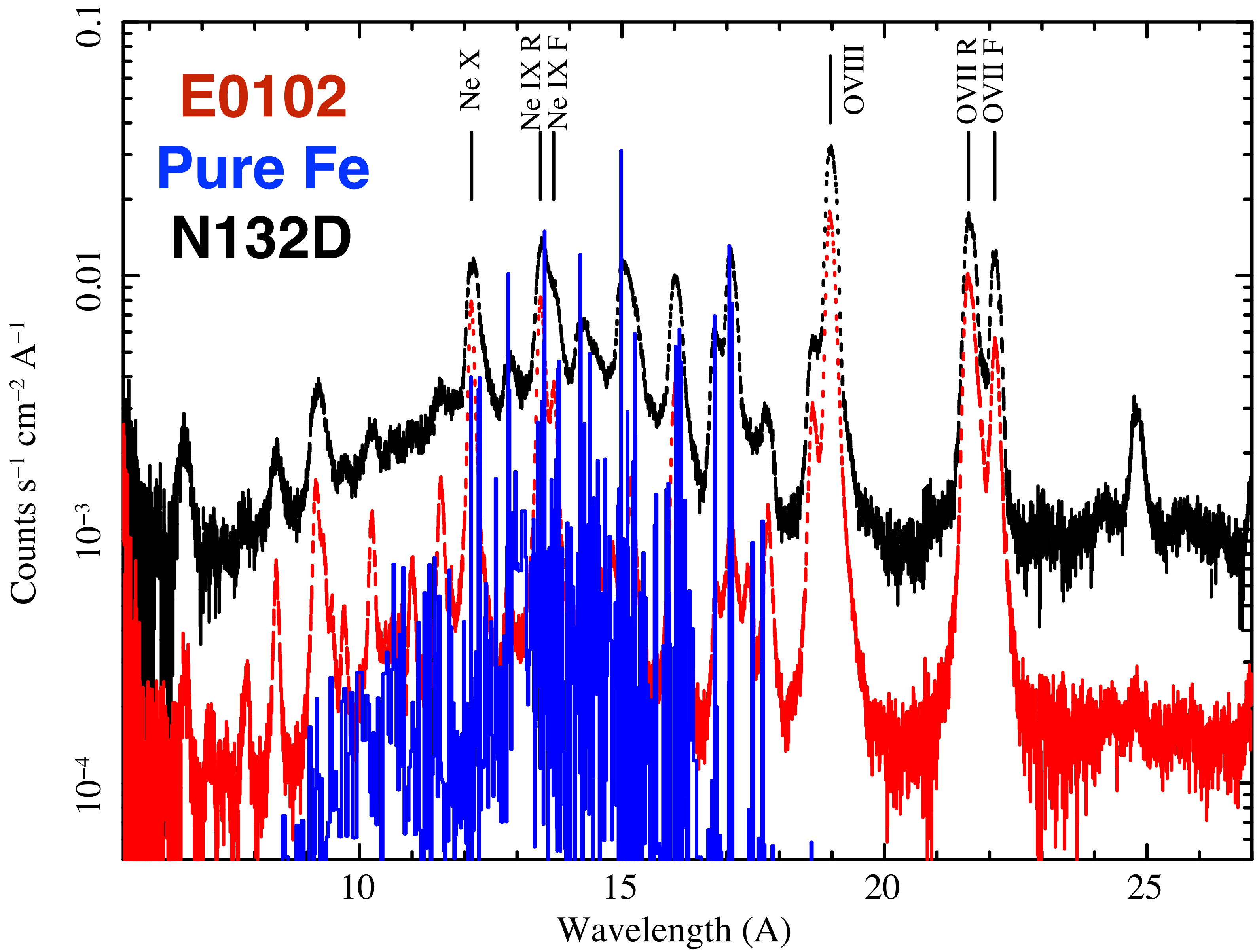


Significant Fe in N132D's spectrum. Very little or no Fe in E0102's spectrum.

Primary Calibrators

- extended objects which minimize pileup
- but not too large so that uncertainties in the off-axis telescope response become important
- line-rich spectra that have been characterized by the XMM RGS and/or Chandra HETG
- “bright” for Chandra and XMM, there is some pileup in the Chandra data

IACHEC Standard Candle SIMPUT files

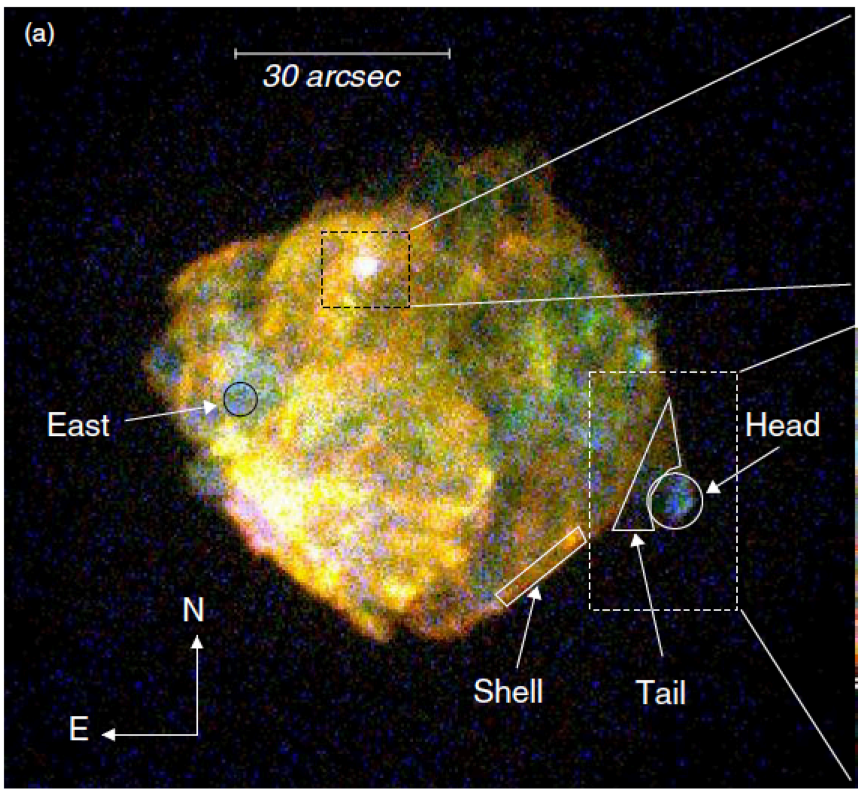
- Work Project (WP) within the AHEAD project taken on by Sembay at Leicester University (LU)
- SIMPUT: A File Format for SIMulation inPUT (Schmid, C, Smith, R, Wilms, J, http://hea-www.harvard.edu/heasarc/formats/simput-1.1.0.pdf)
- Encodes spectral, imaging and timing information in format that can be read by simulators such as SIXTE (http://www.sternwarte.uni-erlangen.de/research/sixte/index.php)
- LU have produced SIMPUT files for 1E0102, N132D and RXJ156. Spectral models comes from IACHEC WGs. Image information on SNRs from Chandra images supplied by IACHEC Thermal SNRs WG.
- Simplification in that single spectrum assumed for whole remnant (i.e. no spectral-imaging information as yet).
- Assumed usage is for Athena simulations via SIXTE etc. but also another WP within AHEAD is using these as input to GEANT4 based raytracing codes for the Athena mirror.

Chandra X-ray Observatory

Secondary Calibrators

- the thermal SNRs WG has just begun to think about this
- Hiroya Yamaguchi suggests N49 as a possible replacement for N132D as it 3-4 fainter than N132D and is slightly larger, 2.6X2.6 arcminutes, so pileup will be reduced, and it has a relatively strong lines of Mg, Si, S, Ar, Ca, and Fe

N49 Park et al. 2012



N49 Uchida et al. 2015