1 Summary

- Common Name: Tycho’s
- Distance: 2.4 kpc (Chevalier et al., 1980)
- Center of X-ray emission (J2000): (00 25 19.9, 64 08 18.2)
- X-ray size: 8.7’x8.6’

1.1 Summary of Chandra Observations

<table>
<thead>
<tr>
<th>Sequence</th>
<th>Obs ID</th>
<th>Instrument</th>
<th>Exposure$_{\text{eff}}$ (ks)</th>
<th>Exposure$_{\text{f}}$ (ks)</th>
<th>Date Observed</th>
<th>Aimpoint (J2000) (α, δ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>500002</td>
<td>115</td>
<td>ACIS-235678</td>
<td>48.4</td>
<td>48.4</td>
<td>2000-09-20</td>
<td>(00 25 27.6, 64 09 14.7)</td>
</tr>
</tbody>
</table>

Exposure$_{\text{eff}}$ → Exposure time of un-filtered event file
Exposure$_{\text{f}}$ → Exposure time of filtered event file

Images are incomplete (ACIS-S3 covers most of the remnant while some eastern part is covered by ACIS-S2.)
No background light-curve filtering.

1.2 Chandra Counts and Fluxes

<table>
<thead>
<tr>
<th>Region</th>
<th>Energy Range (keV)</th>
<th>Signal (counts)</th>
<th>Rate (counts s$^{-1}$)</th>
<th>$F_{\gamma}$ (ergs cm$^{-2}$ s$^{-1}$)</th>
<th>$F_{\text{X}}$ (ergs cm$^{-2}$ s$^{-1}$)</th>
<th>$L_{\text{X}}$ (ergs s$^{-1}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>total?</td>
<td>0.3 - 10.0</td>
<td>4.691e+06</td>
<td>9.697e+01</td>
<td>5.12e-10</td>
<td>1.99e-09</td>
<td>1.37e+36</td>
</tr>
<tr>
<td>(115)</td>
<td>0.3 - 2.1</td>
<td>4.055e+06</td>
<td>8.382e+01</td>
<td>3.01e-10</td>
<td>1.76e-09</td>
<td>1.21e+36</td>
</tr>
<tr>
<td></td>
<td>2.1 - 10.0</td>
<td>6.425e+05</td>
<td>1.328e+01</td>
<td>2.12e-10</td>
<td>2.36e-10</td>
<td>1.62e+35</td>
</tr>
</tbody>
</table>

- $N_{\text{H}} = 0.63 \times 10^{22}$ cm$^{-2}$
- Assumed distance: 2.4 kpc (Chevalier et al., 1980)
- $n_{\text{H}}$ was derived by fitting the low energy spectrum with one thermal plasma model.
- Flux value given above is NOT from whole SNR.

1.3 Nearby Sources

<table>
<thead>
<tr>
<th>Obs ID</th>
<th>Position (J2000)</th>
<th>Size</th>
<th>Net Count</th>
<th>Count rate</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>115</td>
<td>(00 24 29.9, 64 09 03.1)</td>
<td>&lt; 3.8”</td>
<td>48.4</td>
<td>1.00e-03</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(00 24 37.1, 64 10 59.4)</td>
<td>&lt; 2.7”</td>
<td>70.6</td>
<td>1.46e-03</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(00 24 40.7, 64 20 32.1)</td>
<td>&lt; 16.2”</td>
<td>414.0</td>
<td>8.56e-03</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(00 24 51.4, 64 17 25.3)</td>
<td>&lt; 8.7”</td>
<td>71.2</td>
<td>1.47e-03</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(00 24 52.5, 64 11 32.5)</td>
<td>&lt; 2.7”</td>
<td>14.7</td>
<td>3.04e-04</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(00 25 02.5, 64 13 51.4)</td>
<td>&lt; 3.3”</td>
<td>33.4</td>
<td>6.90e-04</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(00 25 58.0, 64 19 49.1)</td>
<td>&lt; 20.1”</td>
<td>39.0</td>
<td>8.06e-04</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(00 26 21.5, 64 12 11.4)</td>
<td>&lt; 12.6”</td>
<td>130.0</td>
<td>2.69e-03</td>
<td></td>
</tr>
</tbody>
</table>

(note) 1. This nearby source list is incomplete.
All the above sources are originally from the "src2.fits" file which is distributed with standard chandra processing.
Only sources with significant count rate and which are clear to visual inspection are included.
2. The size given above is the size of the region used in detecting that source.
3. For each source, background was subtracted from annular region around the source.

1.4 References

2 Fit Detail

- See spectrum page for used regions.

2.1 Total:
- soft energy region (0.3-1.6keV) was fitted with thermal plasma model
- Abundance of O, Ne, Mg, Fe were thawed and abundance of other O-like element were set to 0.

\[
\text{source} = (\text{xswabs} \times \text{xsvapec})
\]

\[
\text{reduced } \chi^2 = 115.712
\]

\[
\text{nh} = 0.6348 \times 10^{22}/\text{cm}^2
\]

2.2 Total:
- Same as above, showing all the energy range

\[
\text{source} = (\text{xswabs} \times \text{xsvapec})
\]

\[
\text{reduced } \chi^2 = 2662.81
\]

\[
\text{nh} = 0.6348 \times 10^{22}/\text{cm}^2
\]

2.3 Total:
- Addition to above model, several gaussian and a power model were added.

\[
\text{source} = (\text{xswabs} \times (((((\text{xsvapec} + \text{gauss1d}) + \text{gauss1d}) + \text{gauss1d}) + \text{gauss1d}) + \text{powlaw1d}))
\]

\[
\text{reduced } \chi^2 = 98.8075
\]

\[
\text{nh} = 0.6348 \times 10^{22}/\text{cm}^2
\]

3 Chandra Images : Band Images

- Left : raw image, binned by 1x1 pixel
- Right : gaussian smooth version of above (σ = 2 pixel)

3.1 Wide Band Images

Total : 300-10000 eV

3.2 Soft Band : 300-2100 eV
3.2 Band images used in true color image.

Red: 300-950 eV

Green: 950-2650 eV

Blue: 2650-7000 eV
3.3 Misc.

: 1250-1410 eV

: 4080-6160 eV

: 1580-2080 eV

: 6160-6700 eV

acis_E1250−1410_FLUXED.fits_0

acis_E1580−2080_FLUXED.fits_0

acis_E6160−6700_FLUXED.fits_0

acis_E1580−2080_FLUXED_G2.fits_0

acis_E6160−6700_FLUXED_G2.fits_0

acis_E4080−6160_FLUXED.fits_0
4 Chandra Images: True Color

- Individual images are adaptively smoothed.
- Warning: the adaptive smoothing process sometimes produces artifacts.
- Convolution method: fft
- Kernel type: gauss
- Significance (min, max): (3, 5)

RED: 300-950 eV
GREEN: 950-2650 eV
BLUE: 2650-7000 eV

5 Chandra Spectrum

- Images show Regions used to extract spectra
- Regions with red strikes are excluded

5.1 ObsID 115

- Background was subtracted from the region around the SNR.
6 Radio Image
- left: radio image
- right: chandra x-ray image with radio contour lines

1.375 GHz
- Image from Reynoso et al. (1997)
- 1 GHz flux density: 56 Jy (citep GREEN 2001)

7 Images from Survey Missions
- Left: Chandra Image (0.3-10 keV)
- Center: Images from SkyView with the same scale
- right: Images from SkyView with a reduced scale

ROSAT PSPC (1.0 deg): X-ray (0.1-2.4 keV)

IRAS 12 micron: Infrared (12 micron)

IRAS 25 micron: Infrared (25 micron)
IRAS 60 micron: Infrared (60 micron)

IRAS 100 micron: Infrared (100 micron)

CO survey: Radio (115 GHz)

NRAO VLA Sky Survey (NVSS): Radio (1.4 GHz Continuum)

Westerbork Northern Sky Survey (WENSS): Radio (325 MHz Continuum)

Digitized Sky Survey: Optical (J or E band images with a few exceptions)