Chandra's X-ray View of Massive Star-forming Regions

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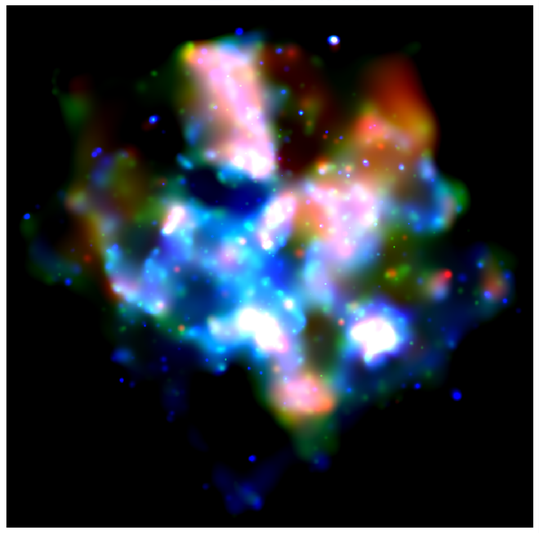
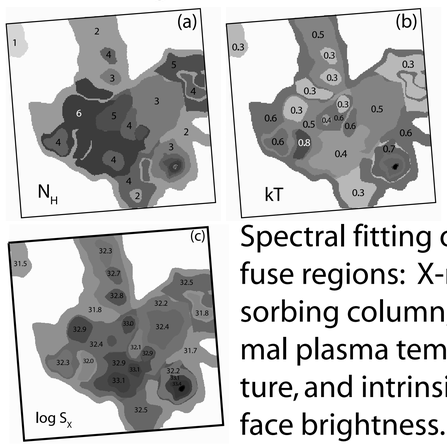
The Chandra X-ray Observatory is providing new insight into the structure, extent, and energetics of massive star-forming regions. Combining Chandra data with new visual and IR images gives a unique multiwavelength picture of these famous regions never before seen...

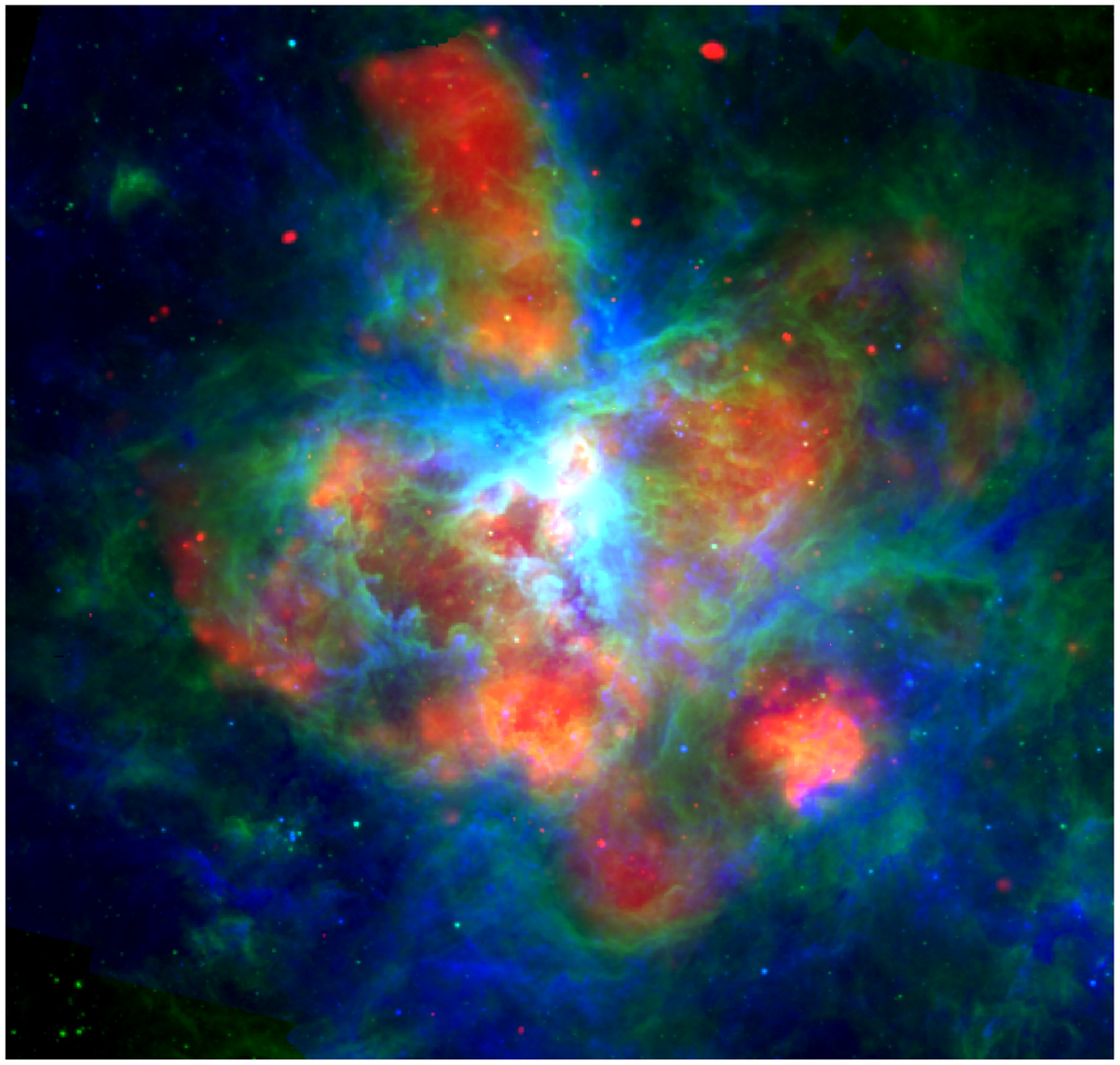
30 Doradus



Chandra/ACIS-I 0.5--0.7 keV, 0.7--1.1 keV, 1.1--2.3 keV; 110 ks. Bright, soft diffuse X-ray emission dominates the field; these are supernova-filled super-bubbles (e.g. Chu & Mac Low 1994).

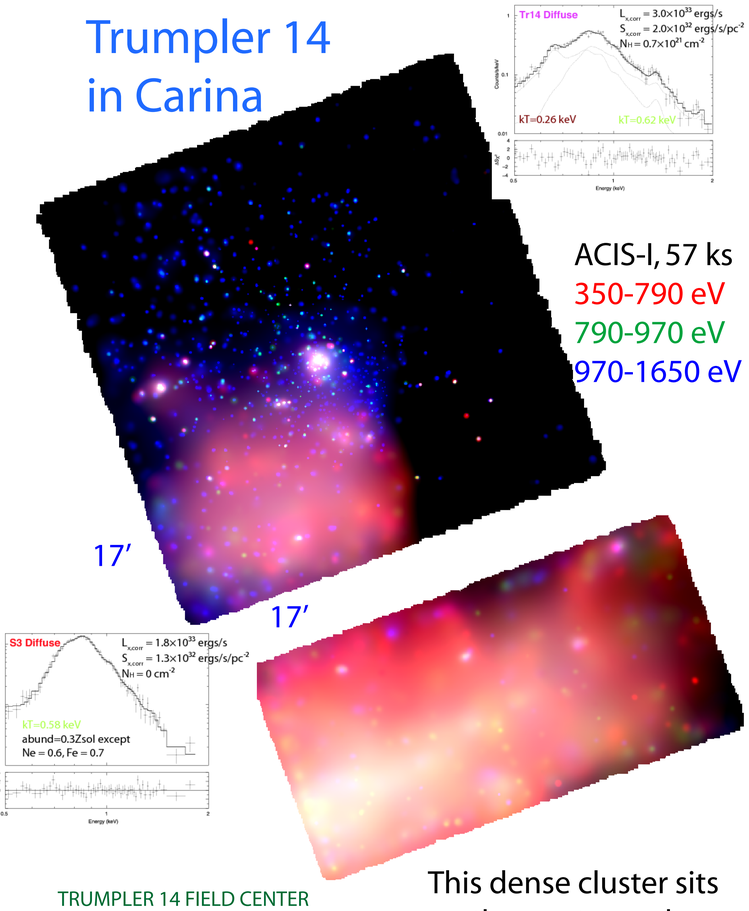


Spectral fitting of diffuse regions: X-ray absorbing column, thermal plasma temperature, and intrinsic surface brightness.



Chandra/ACIS-I 0.5--2 keV, 110 ks; MCELS H alpha (You-Hua Chu); Spitzer/IRAC 8 microns (Bernhard Brandl): 10 MILLION DEGREE GAS FILLS 30 DOR'S SUPERBUBBLES.

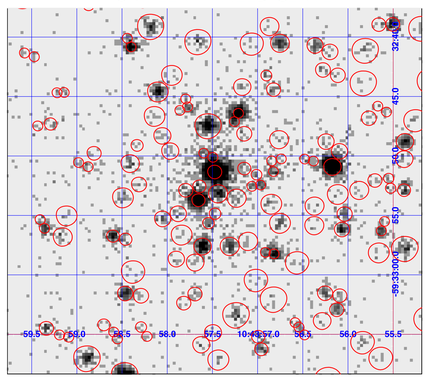
Trumpler 14 in Carina



ACIS-I, 57 ks
350-790 eV
790-970 eV
970-1650 eV

17′ 17′

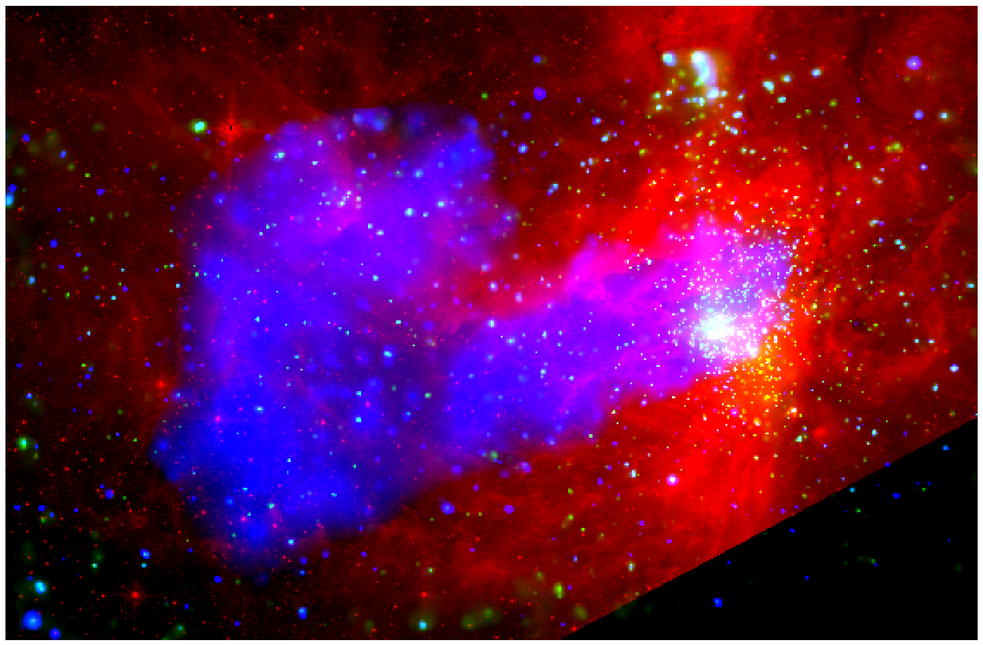
TRUMPLER 14 FIELD CENTER



This dense cluster sits on the western edge of the Carina I GMC. Chandra detects >1600 X-ray point sources in this short observation and serendipitously images bright diffuse emission off-axis that suggests a CAVITY SUPERNOVA REMNANT.

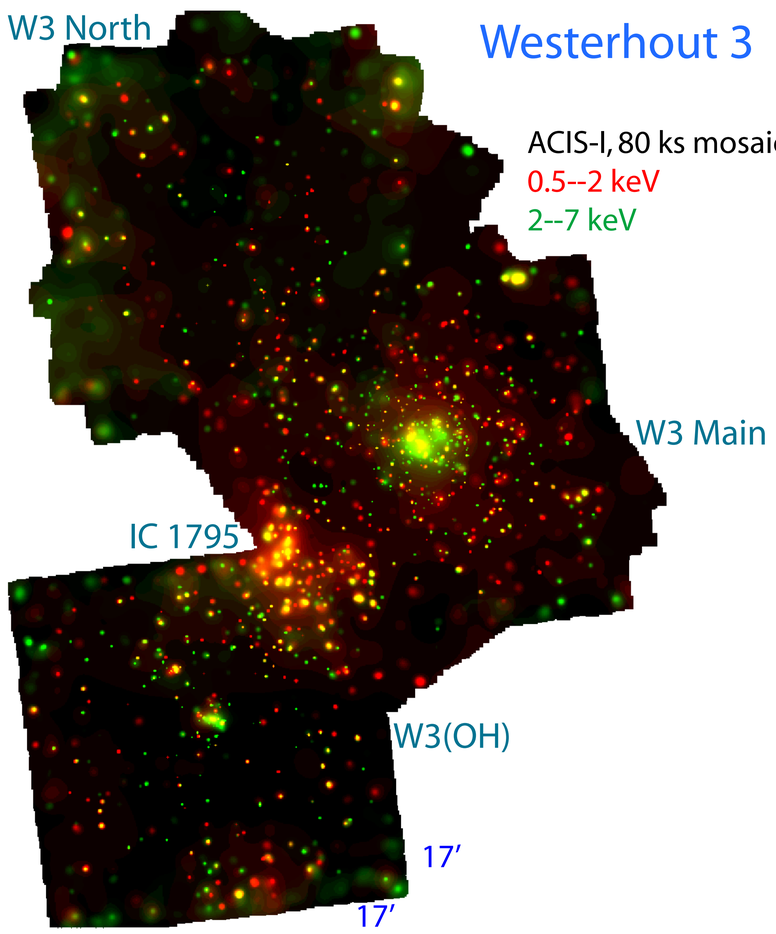
M17, The Omega Nebula

Chandra/ACIS-I 0.5--2 keV, 2--7 keV; Spitzer/IRAC [5.8], ~20′x30′ (~9x14 pc), 92 ks (cavity) + 230 ks (NGC 6618). Chandra finds >2000 X-ray point sources (mainly low-mass pre-main sequence stars plus more massive stars) and extensive diffuse emission (kT ~ 0.6 keV or 7 MK). Spitzer traces heated dust in the photoionization fronts. M17 is the closest giant HII region, D=1.6 kpc.



A FIRE-BREATHING DRAGON: the hot plasma generated by O stars winds appears to emanate from a fissure in this edge-on blister HII region and billow into a more open cavity to the east, outlined and sometimes absorbed by heated dust traced by Spitzer.

W3 North

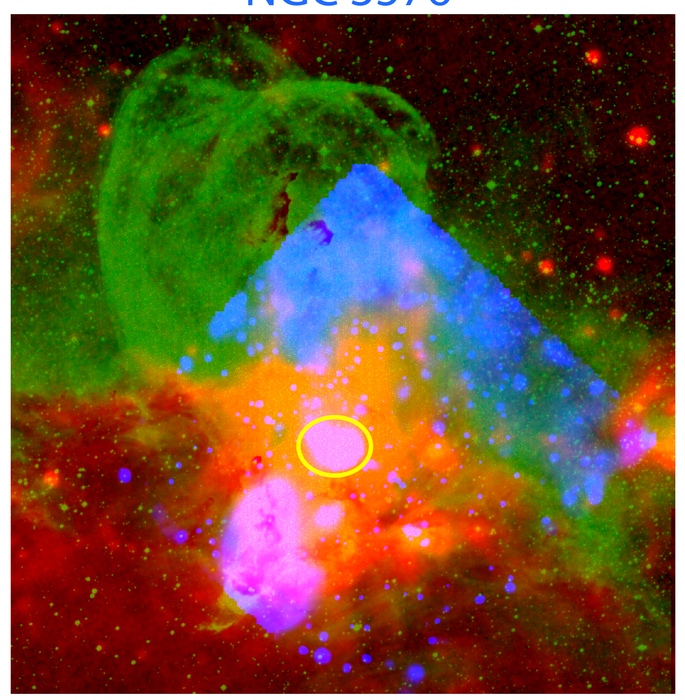


Westerhout 3

ACIS-I, 80 ks mosaic
0.5--2 keV
2--7 keV

Chandra finds >1300 sources: small embedded clusters in W3(OH), the populous, less-absorbed, older cluster IC 1795, >700 sources in a rich, large cluster around W3 Main, and notably NO CLUSTER IN W3 NORTH! This illustrates the population diversity possible in triggered star formation.

NGC 3576



MSX 8 micron, SuperCOSMOS H alpha, ACIS-I 0.5--2 keV. NGC 3576 is the second closest giant HII region (D=2.8 kpc) but the main sources of its ionization are unknown. It contains a very young, obscured massive cluster (yellow oval) powering a large-scale outflow and generating a mid-IR bipolar bubble. The large visual loops and prominent soft diffuse X-ray emission (kT ~ 0.6 keV) may trace this outflowing hot gas. Chandra finds deeply embedded, hard X-ray sources not seen at 3.5 microns; these are likely THE CLUSTER'S MISSING MASSIVE IONIZING STARS.