Thermal X-ray Emissions in the West Half of the LMC Superbubble 30 Dor C

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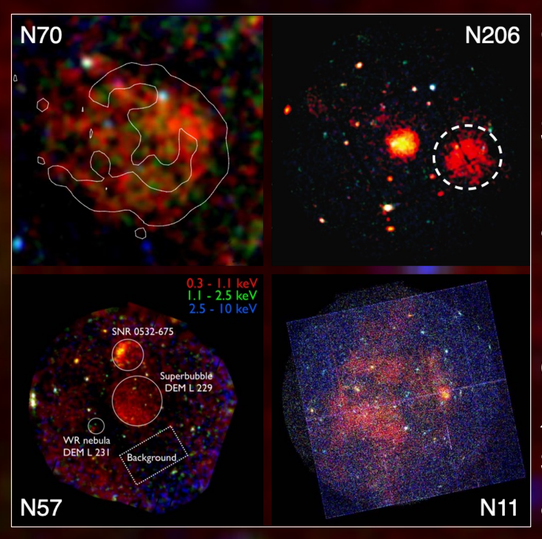
While 30 Dor C is a unique superbubble in the Large Magellanic Cloud for its luminous non-thermal X-ray emission, the thermal X-ray emission it emanates has not yet been thoroughly investigated and well constrained. Based on the separate ~1 Ms deep XMM-Newton and Chandra observations, we report the discovery of the thermally emitting plasma in some portions of the western half of 30 Dor C. The thermal emission can be reproduced by a collisional-ionization-equilibrium plasma model with an average electron temperature of ~0.4 keV. We find a significant overabundance of the intermediate-mass elements such as O, Ne, Mg, and Si, which may be indicative of a recent supernova explosion in 30 Dor C. Dynamical properties in combination with the information of the OB association LH 90 suggest that the internal post-main-sequence stars dominate the power of the superbubble and blow it out in the past ~1 Myr.



N70: De Horta+ 2014, N206: Kavanagh+ 2012,
N57: Ramírez-Ballinas+ 2019, N11: Nazé+ 2004

Unique Bubble

Superbubbles are large structures powered by internal stellar winds and supernova explosions.

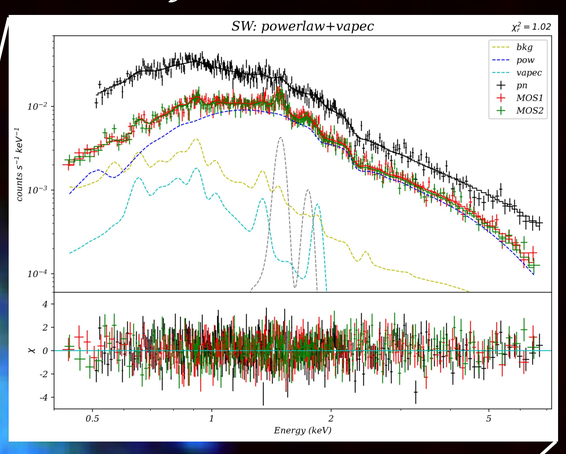
Normal SBs:
central-filled & thermal
30 Dor C:
shell-like, non-thermal, & TeV luminous

Non-thermal — Tracer of cosmic rays
Thermal — Accelerator properties

Thermal Emissions

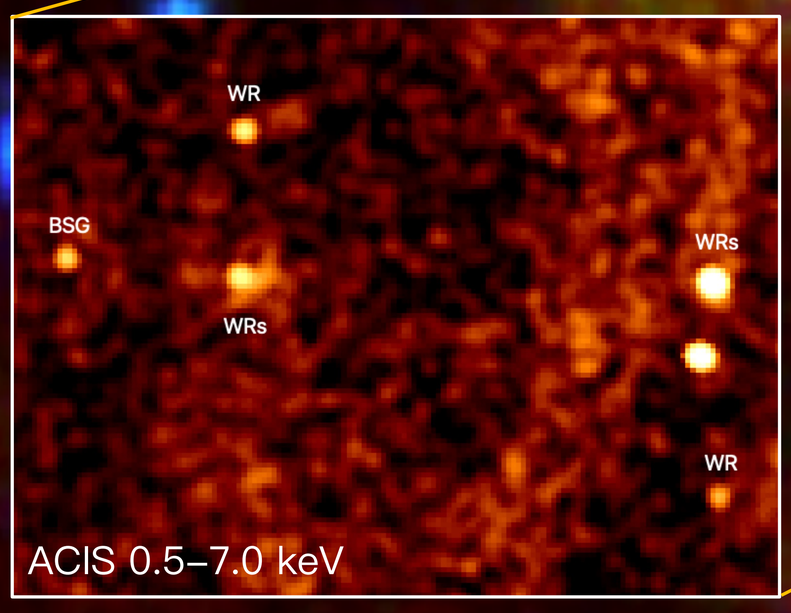
Southwest of 30 Dor C
Low foreground absorption?

Cool plasma (0.3–0.4 keV)
O, Ne, Mg, & Si enrichment
Evidence for recent SN(e)?



Why thermal emissions matter?

Thermal emissions of 30 Dor C would reveal its *evolutionary stage* and *energy input rate*.



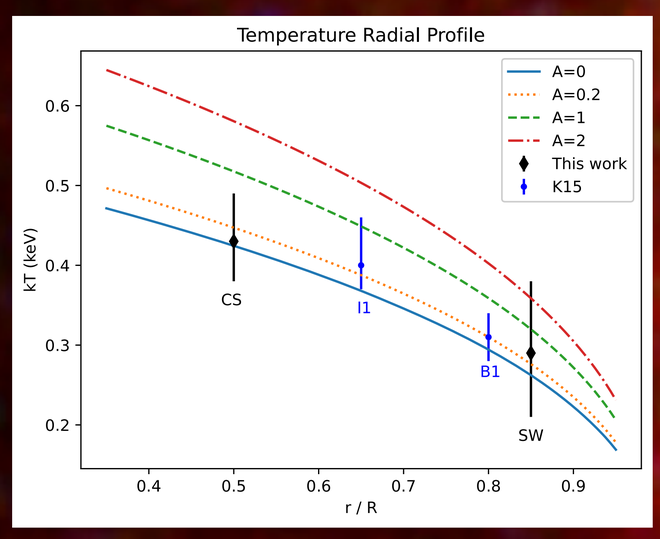
Stars in 30 Dor C

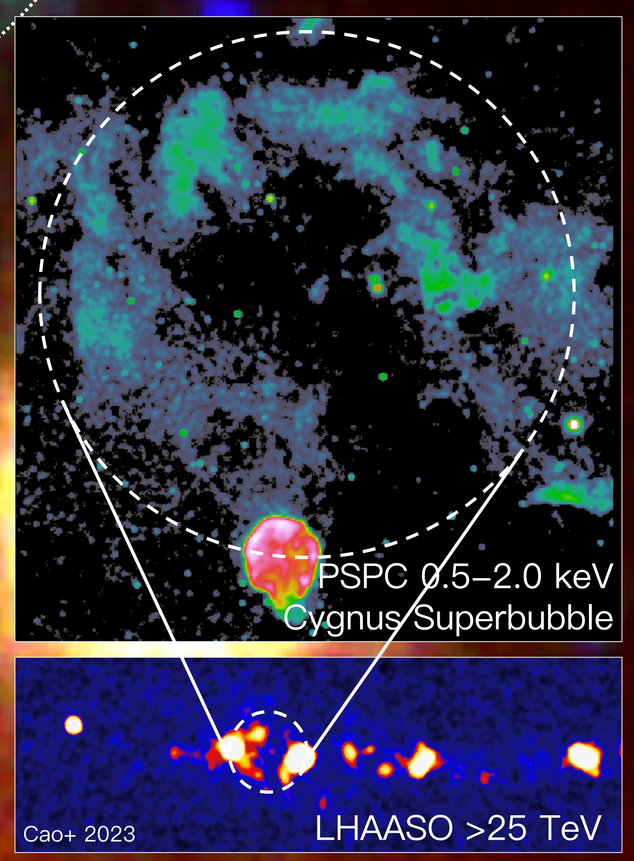
ACIS image resolves massive stars in the superbubble, including 1 BSG and up to 7 WRs. 30 Dor C has 8 WRs in total, *more than any other* LMC superbubbles.

The total power of stellar winds is about 1.6×10^{38} erg s^{-1}, *most from 8 WRs and 3 BSGs.*

30 Dor C: Young and energetic

The temperature radial profile suggests an age of 10^6 yr and ~ 1 SN inside. 30 Dor C is dominated by wind, which has injected ~ 5×10^{51} erg to the bubble.





Cousin of Cygnus Superbubble?

Long-term particle acceleration by stellar winds?

Turbulence in wind-supernova interactions?

ADS link of our article

XMM-Newton
0.4–1.2 keV
1.2–2.0 keV
2.0–5.0 keV