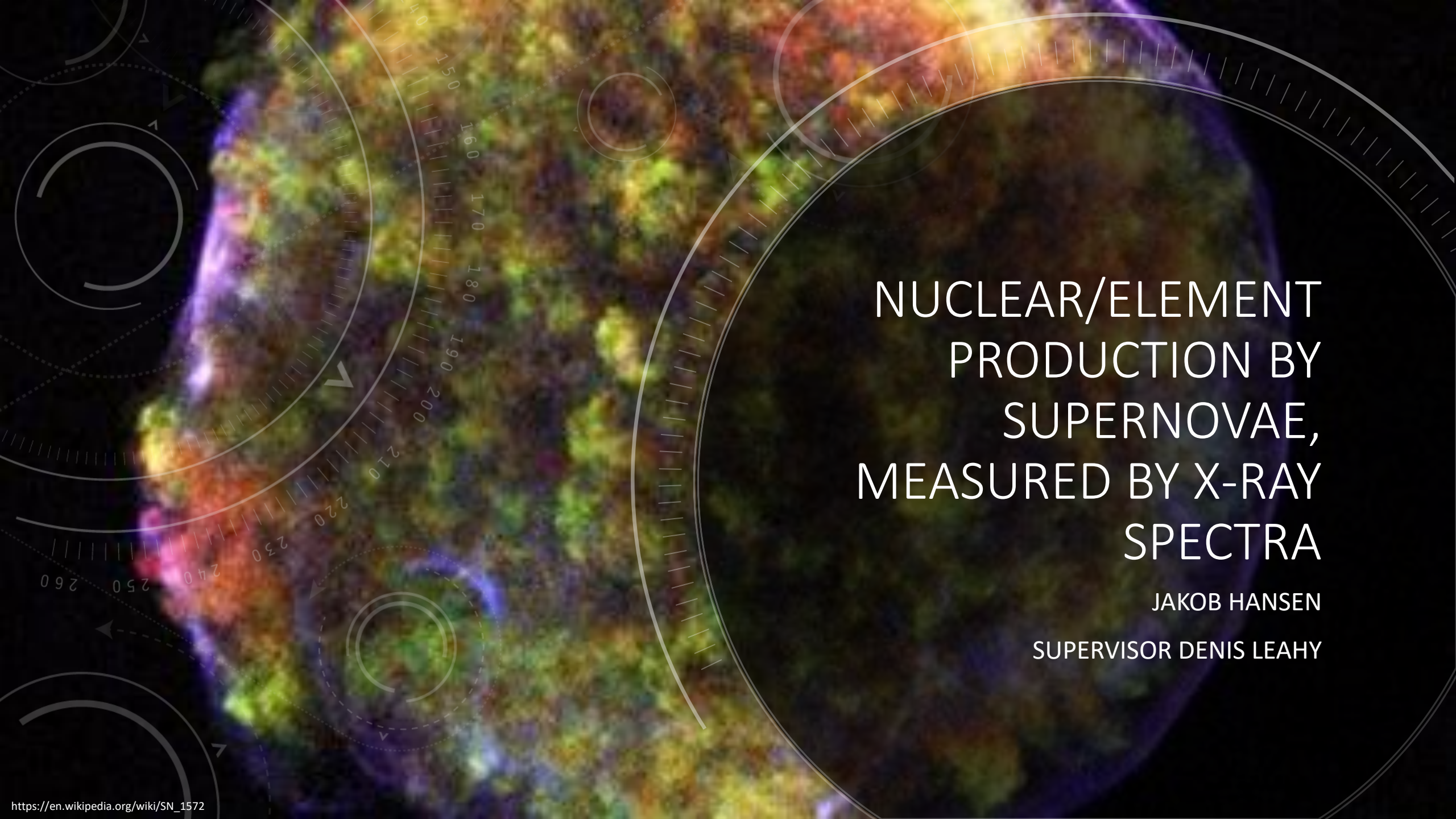


NUCLEAR/ELEMENT PRODUCTION BY SUPERNOVAE, MEASURED BY X-RAY SPECTRA

JAKOB HANSEN

SUPERVISOR DENIS LEAHY

https://en.wikipedia.org/wiki/SN_1572

TALKING POINTS

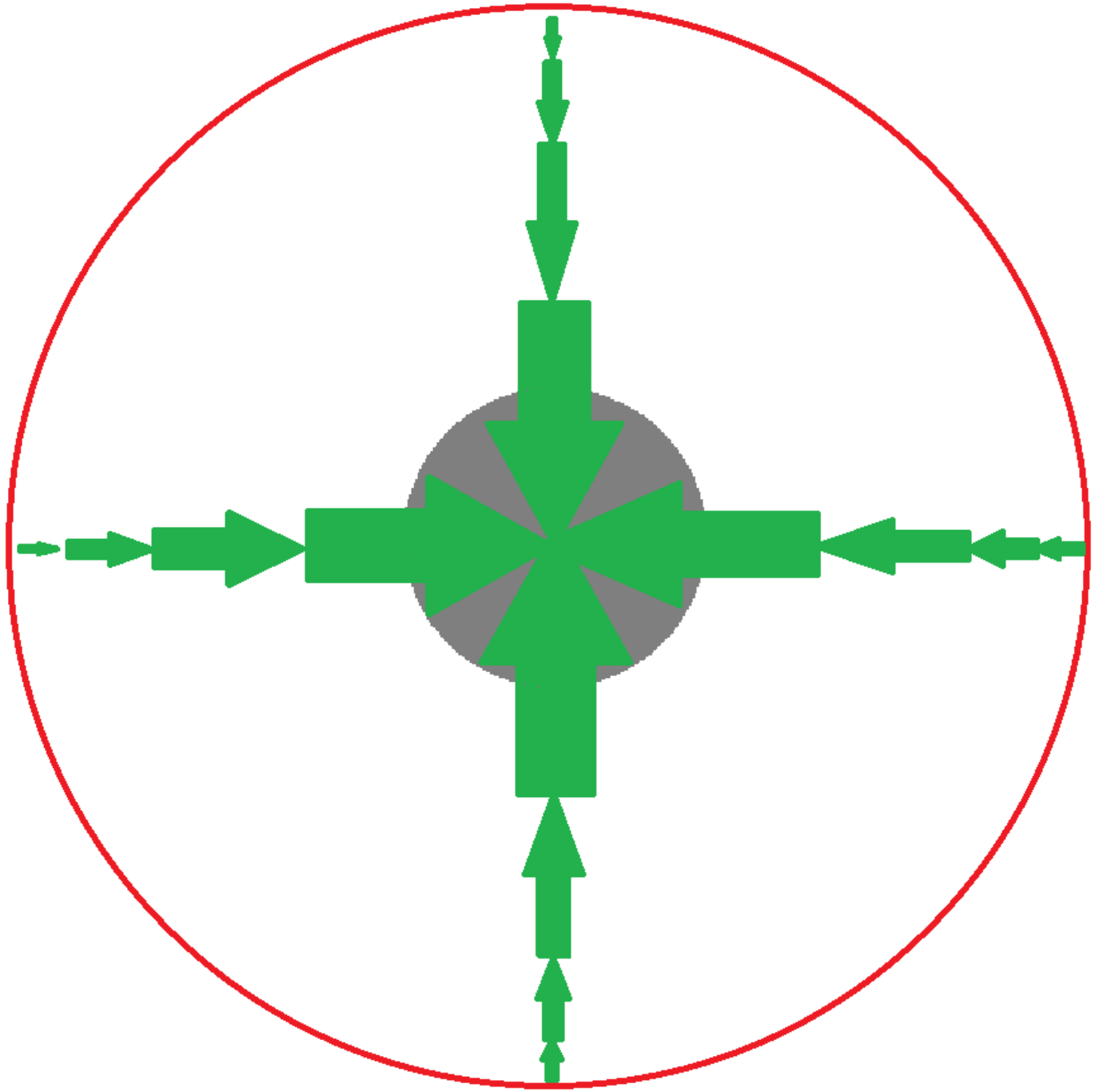
- Supernova remnants: What are they? And why do we care about them
- How we measured elemental abundances
- MY research.

Supernova remnants: What are they? And why do we care about them

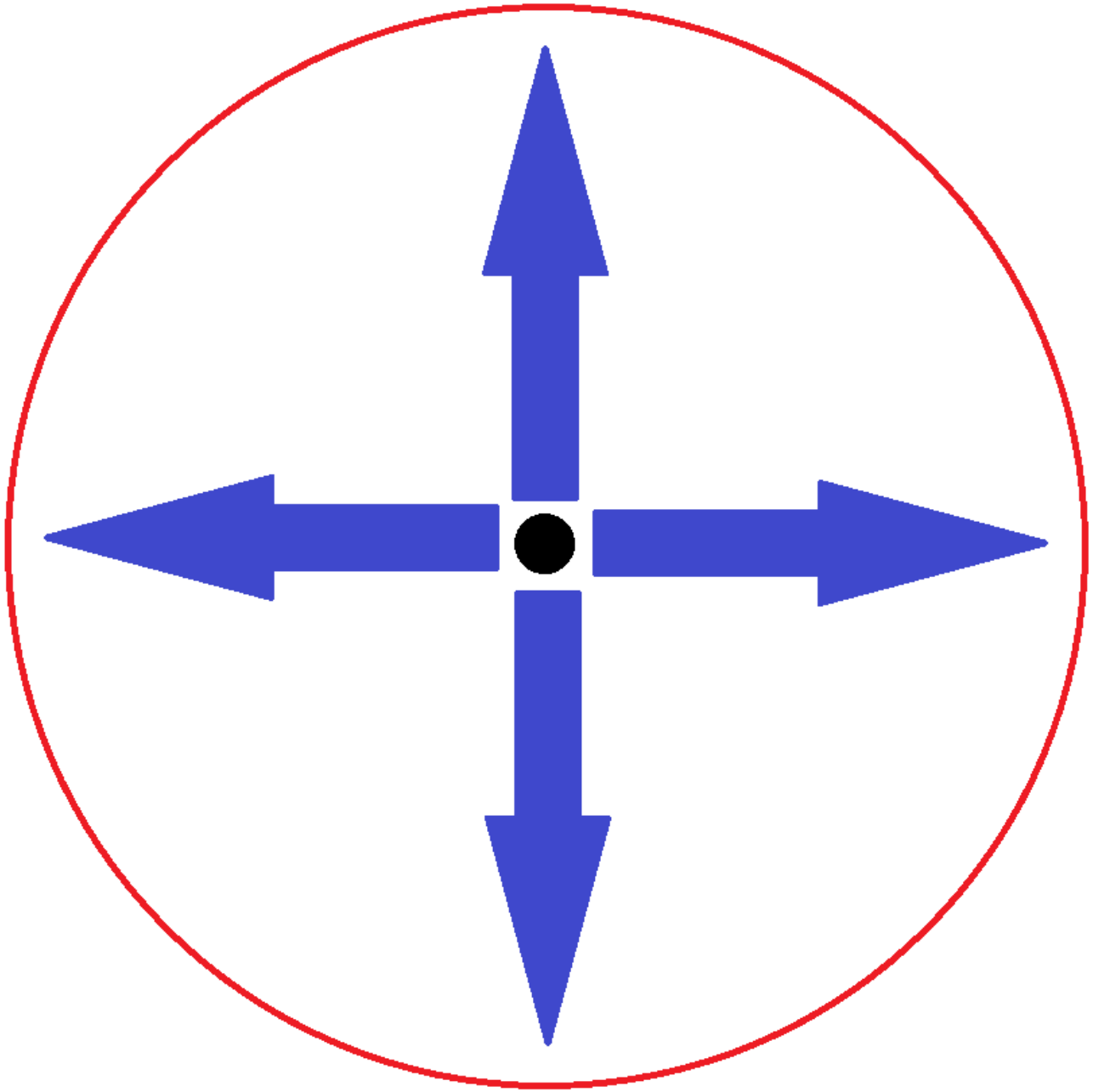
https://www.skyatnightmagazine.com/space-science/when-stars-collapse-what-is-a-supernova

SUPERNOVA

- Death of large stars or white dwarfs
- Massive explosion
- Creation of heavy elements



CONTRACTION



REACTION

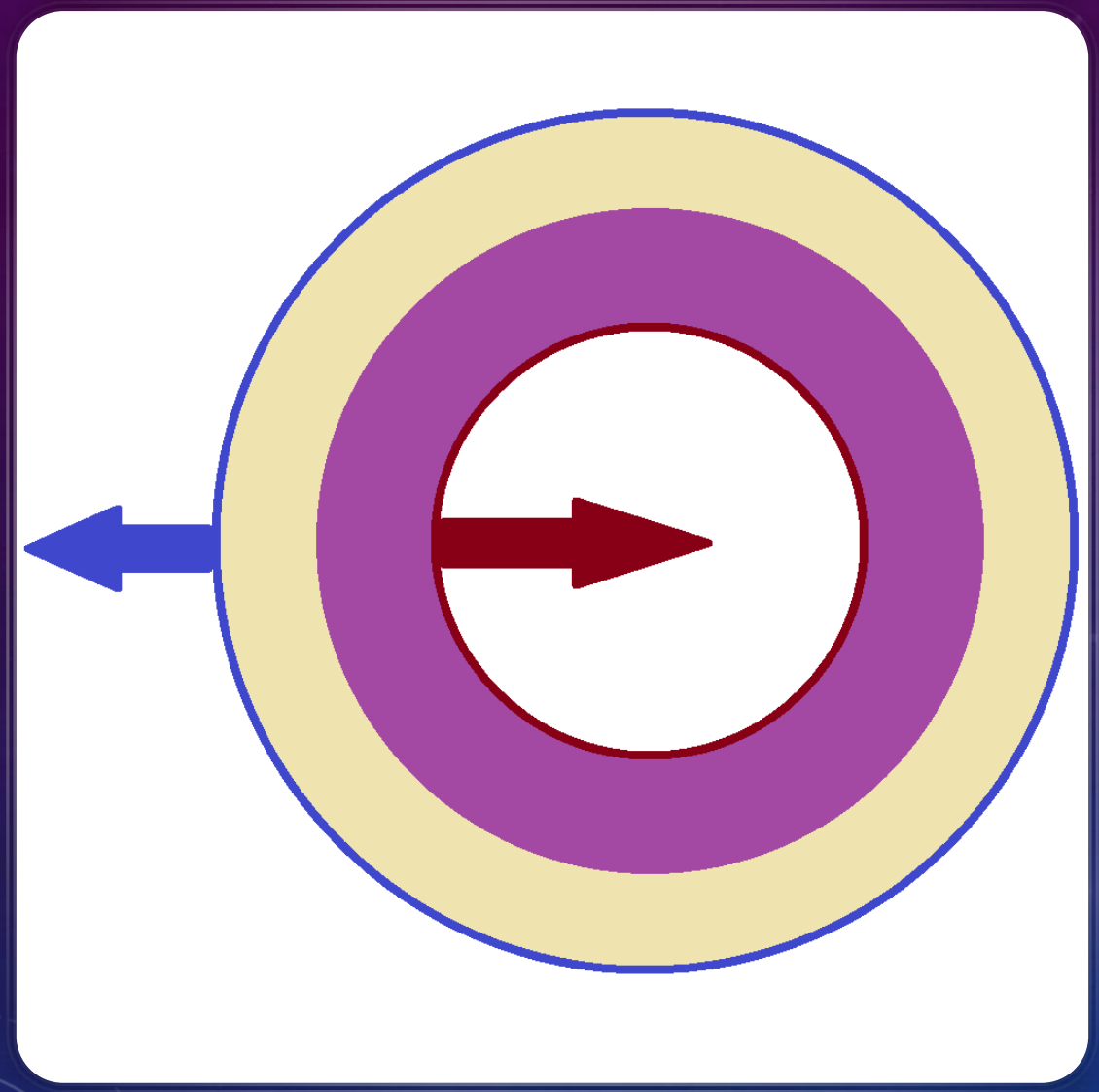
https://www.skyatnightmagazine.com/space-science/when-stars-collapse-what-is-a-supernova

SUPERNOVA

- Death of large stars or white dwarfs
- Massive explosion
- Creation of heavy elements

SUPERNOVA REMNANTS

- Expanding balls of hot gas and plasma
- Interactions with the surrounding dust and gas (Interstellar medium)
- Spreads heavy elements



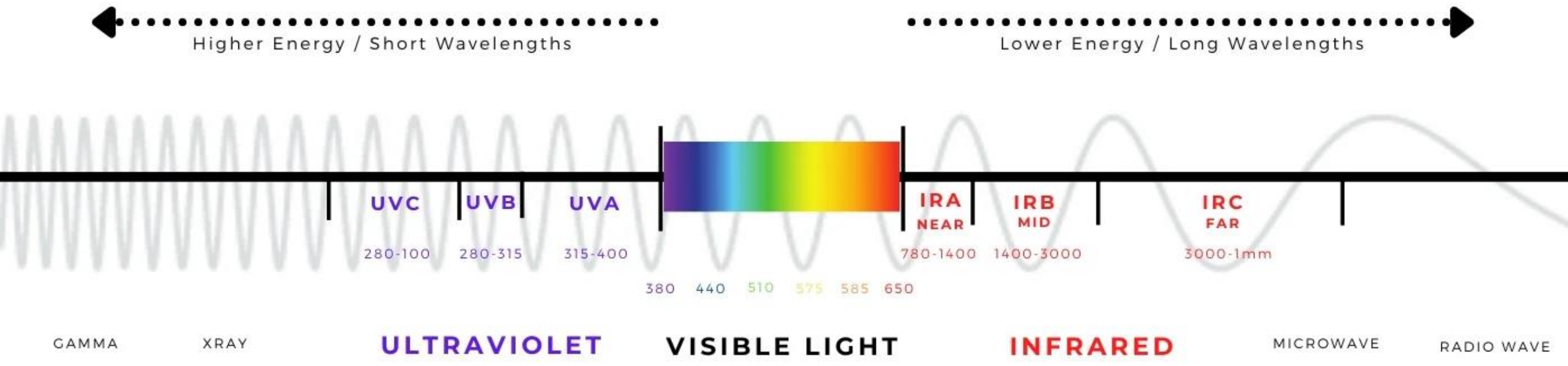
FORWARD AND REVERSE SHOCKS

- Two shocks
- One into ISM, one into material from star
- Emission between shocks
- Little to no hydrogen in purple region


HOW WE MEASURED ELEMENTAL ABUNDANCES
X-ray Spectroscopy
https://s-ink.org/periodic-table-of-elements

X-RAY SPECTRUM

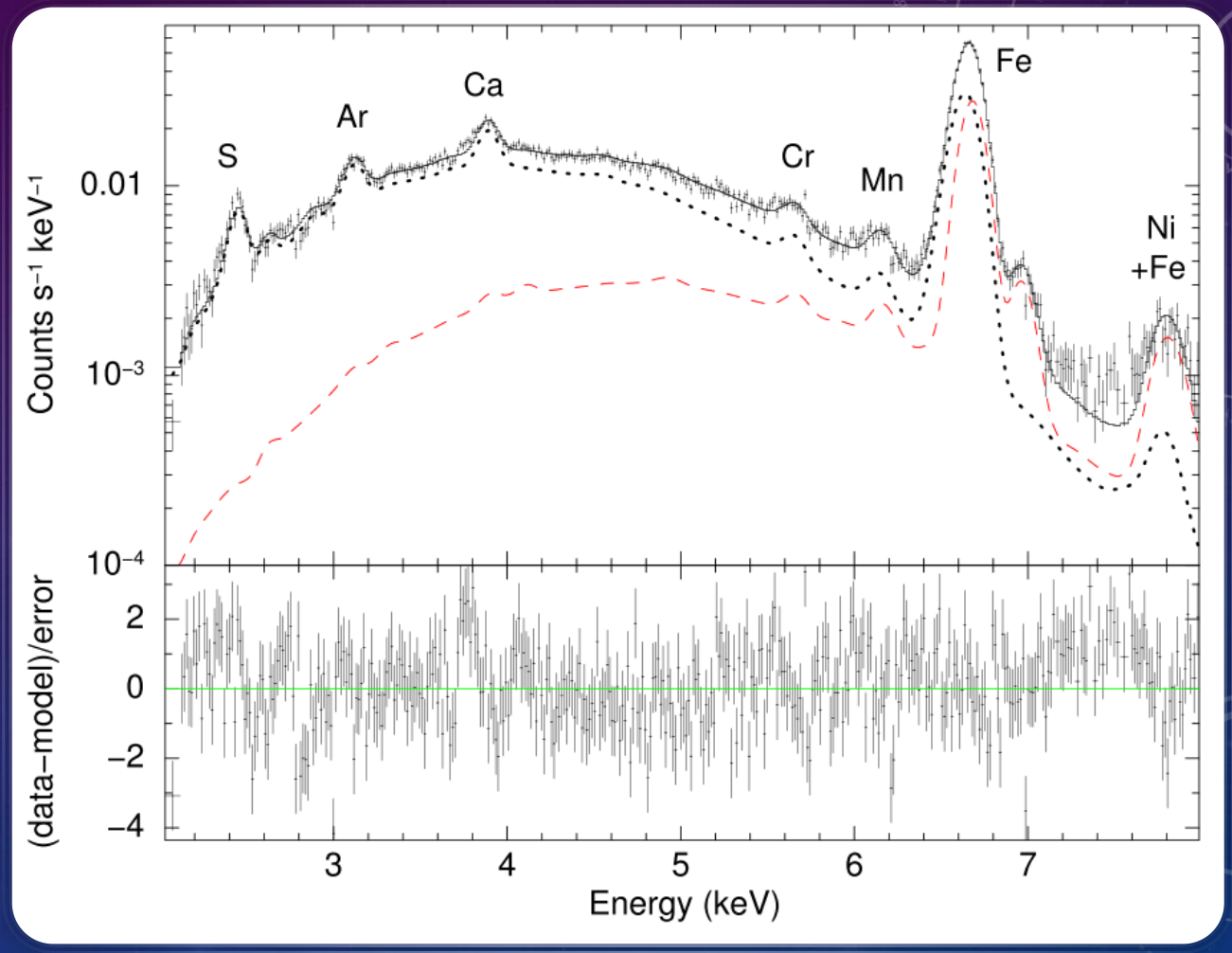
- Photon between 50 to 50,000 time more energetic than visible light
- Typical studies focus of around 1-10keV (1.2-0.12 nm)



https://healthlighting.com/blogs/lighting-guide/guide-to-the-spectrum-of-light

X-SPEC

- Calculates model spectrum and fits to observations
- Uses solar amounts of hydrogen
- Gives abundances from the model spectrum

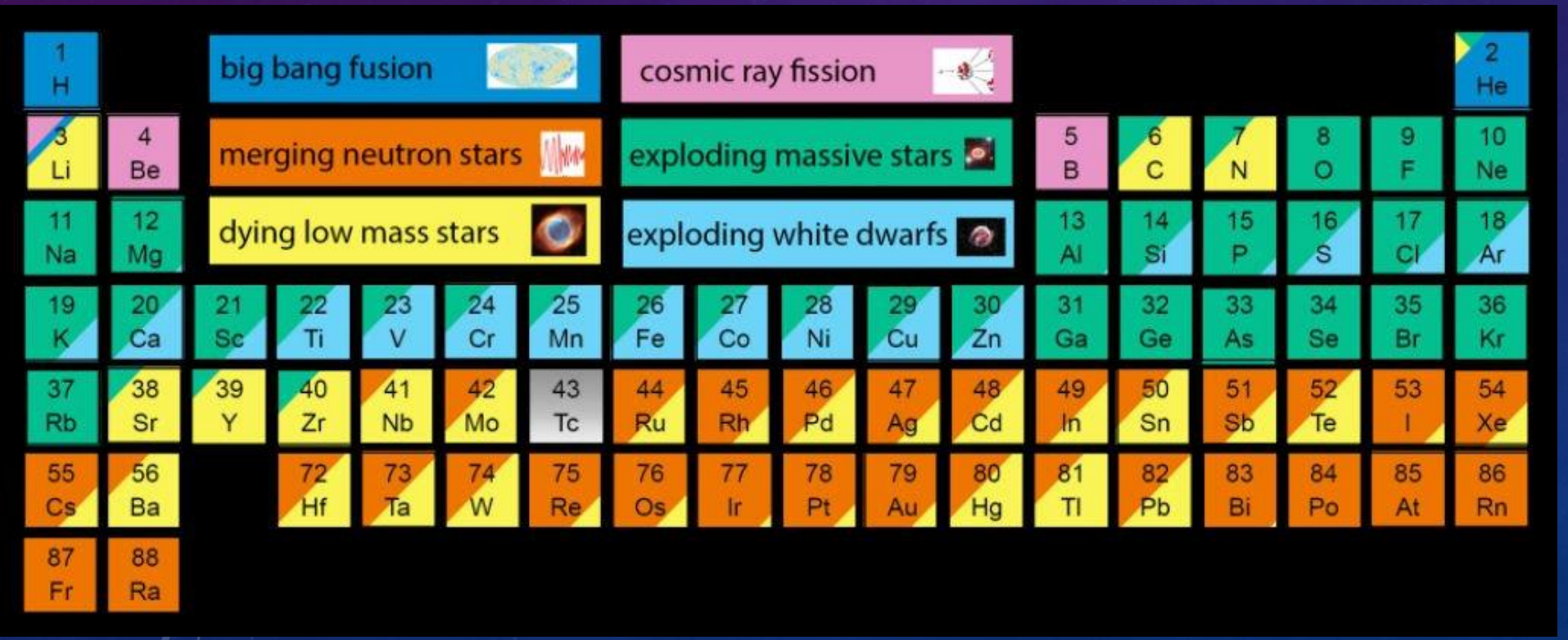


Spectrum from:. Zhou, S.-C. Leung, Z. Li, K. Nomoto, J. Vink, and Y. Chen. Chemicalabundances in sgr a east: Evidence for a type iax supernova remnant. TheAstrophysical Journal, 908(1):31, Feb. 2021.

MY RESEARCH

HYDROGEN ASSUMPTION

- Little to no hydrogen in inner region
- Region between shocks responsible for emission
- X-spec uses approximately solar hydrogen abundances
- X-spec underestimates element abundances



ELECTRON/HYDROGEN DENSITY DENSITY

Element measurements based off electron to hydrogen ratio

Heavy elemental abundances are significantly underestimated

THE PROCESS

01

Find the elemental abundance of supernova remnants previously studied

02

Correct the abundances while assuming little to no hydrogen

03

Calculate the masses of each element (assuming we have distance)

04

End goal of creation catalog of abundances and masses

KEY POINTS

What is a Supernova remnant

- Super nova remnants are spheres of gas and plasma expanding into the surrounded interstellar medium. Supernova create heavy elements.

How are the element abundances messaged

- Elemental abundances are measured using the x-ray spectrum fitting software x-spec. This process assumes solar hydrogen abundances.

My contributions

- I will correct the elemental abundance measurements in regions of supernova remnants that are hydrogen deficient, where the assumption of x-spec are no longer accurate.