# A Glimpse Into The X-ray Realm

## Analysis of G309.92-2.51

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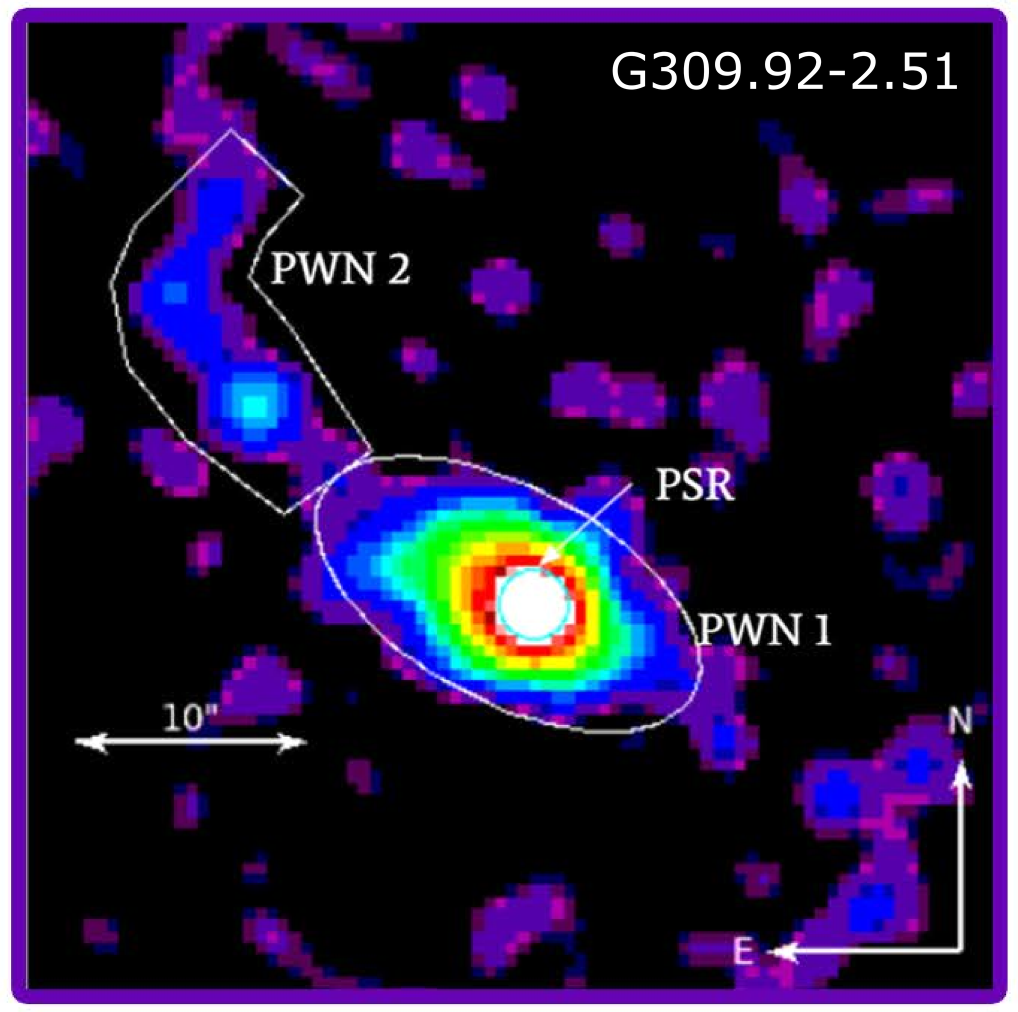
## Background

### Supportive Information

A supernova remnant (SNR) is the remains of a supernova explosion resulting from the death of a star. Sometimes these explosions leave behind an object at its center. For this poster's object of interest, SNR G309.92-2.51, at its center is a Pulsar (PSR), a highly dense Neutron star that spins. Due to this spinning, magnetic fields are induced which accelerate electrons to unfathomable speeds. As a result, additional detectable light is created surrounding the Pulsar called a Pulsar Wind Nebula (PWN).

### About X-rays

The light from the PSR and PWN is not light in the traditional sense we are used to, this light is only highly detectable in the X-ray range. This is why we require tools to make the detection for us (e.g. X-ray telescope). This light is similar to the energetic light that is used to view a broken bone at the doctors, but instead of the x-ray machine producing it, it is the PSR and PWN.

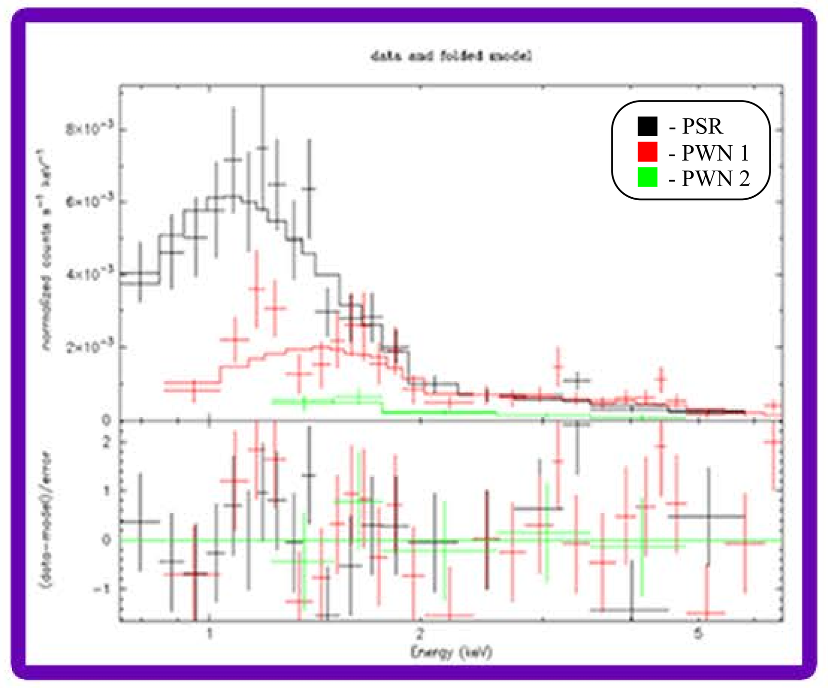



G309 Regions

## Spectral Analysis

### Procedure

To conduct the spectral analysis, G309 was visually sectioned into three distinct regions of interest: PSR, PWN 1, and PWN 2 region (see G309 Regions image). The light data was then extracted for each region. The extracted data is then plotted using software named XSPEC and fit using our best predicted data model (see model fit to the right).




Modeled PSR, PWN 1, and PWN 2 light data

### Results

When modeled, the fit statistic of the model is 1.15 (with a perfect fit being 1). Because 1.15 is close to 1, the model fits well. The properties of the model when compared to a previously published paper agree within their error intervals. Because the new calibrations and software were used for this analysis, and that the results agree with prior understandings, this data is an improvement.

## Main Idea

### Goal

The goal of this research was to use the x-ray telescope Chandra and it's archived data to conduct a spectral and spatial analysis on the PSR and PWN inside the supernova remnant G309.92-2.51 (G309).

For the spectral analysis, the data is fit with a model and various model parameters are calculated. Together these help describe the nature of the PSR and PWN. For the spatial analysis, once complete will provide insight into the structure of the PWN.

### Purpose

The results will then be used in a large research project containing other processed supernova remnant data. The current processed data of G309 is now far outdated due to the new calibrations and analysis software that have been released. Thus, newer more updated data is require.

Chandra X-ray Observatory

Vaughan & NASA/CXC. (n.d.). Chandra X-ray Observatory [Illustration]. https://www.nasa.gov/sites/default/files/thumbnails/image/20years.jpg

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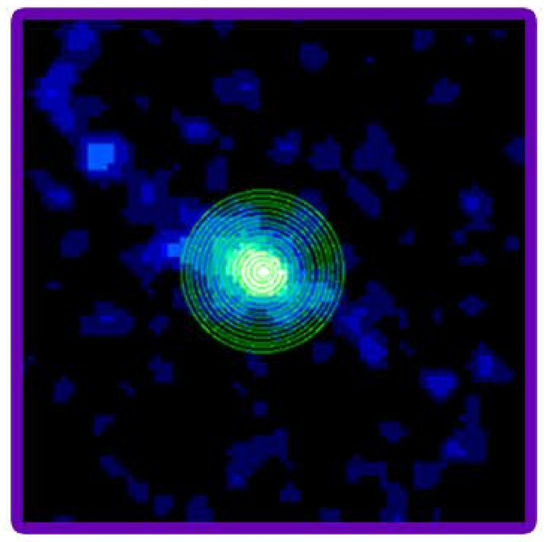
## Spatial Analysis

### Procedure

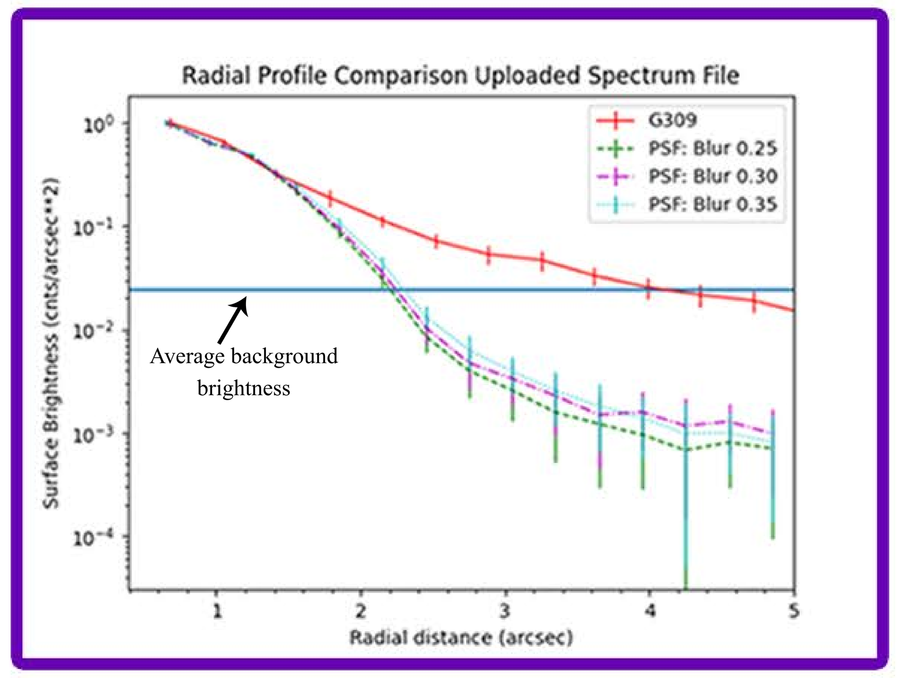
To conduct the spatial analysis, 16 ring regions were selected all centered on the PSR and with increasing radial sizes (see picture right). The surface brightness was then extracted from these regions and plotted using Python. The surface brightness is additionally plotted against the surface brightness of simulated point light sources. This helps to contrast the G309 data with what a point light sources data should be.



G309 Ring Regions

### Results

From the plot, the spatial behavior of G309 can be seen. As the radial distance from the center point increases, the surface brightness of G309 (red) diminishes. It decreases slower than the simulated point sources (other lines). Thus, G309 does not act as a point source but has a more sophisticated behavior.




Radial Profile Comparison

Photo by Felix Mittermeier from Pexels