Visualization of magnetic field structure in shock wave blasts

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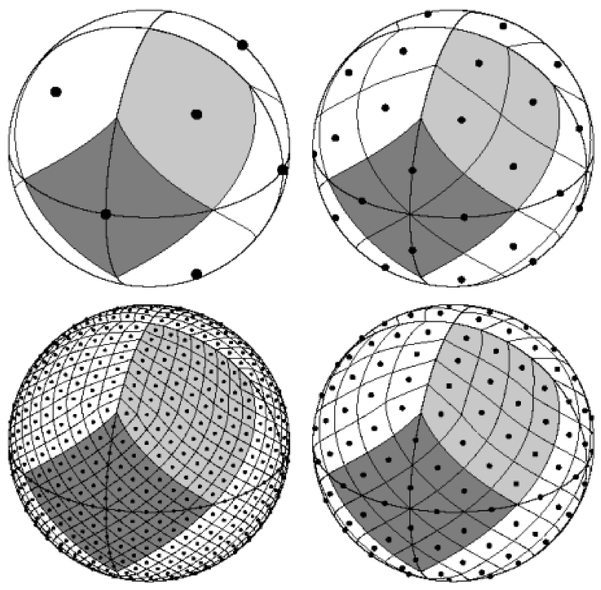
Introduction

- Rapid expansion of gas caused by a stellar explosion forces the formation of a dense shell of gas
- Impacts the environment and magnetic field around it
- Modeled the evolution of the magnetic field due to blast wave in 2 and 3 dimensions
- Plotted simulation data to better understand the impact of supernovae expansions

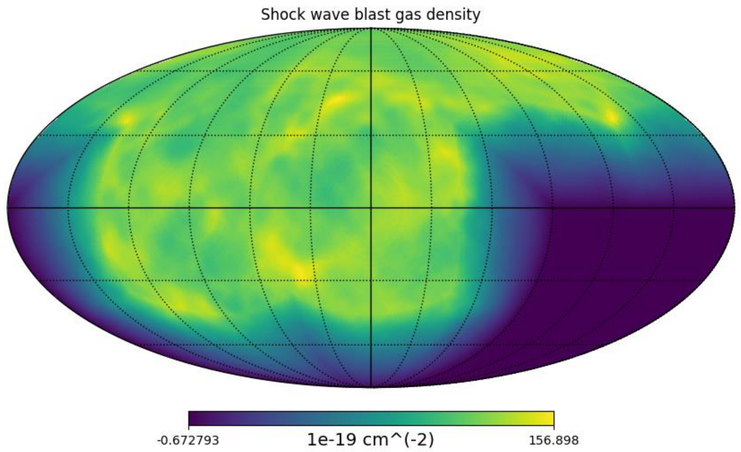
Methods

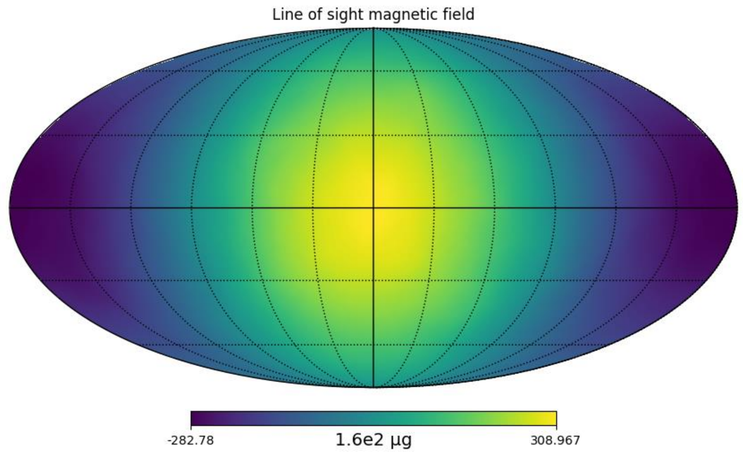
- Used HEALPix library for 2D visualization of the gas density and magnetic field vectors
- Used data from Athena++ magnetohydrodynamics simulations
- Gas density and magnetic field vectors were integrated over radial lines
- Chose equal area distributions across the surface of the shock wave blast sphere
- Compiled column densities and vectors into a HEALPix map for plotting and analysis

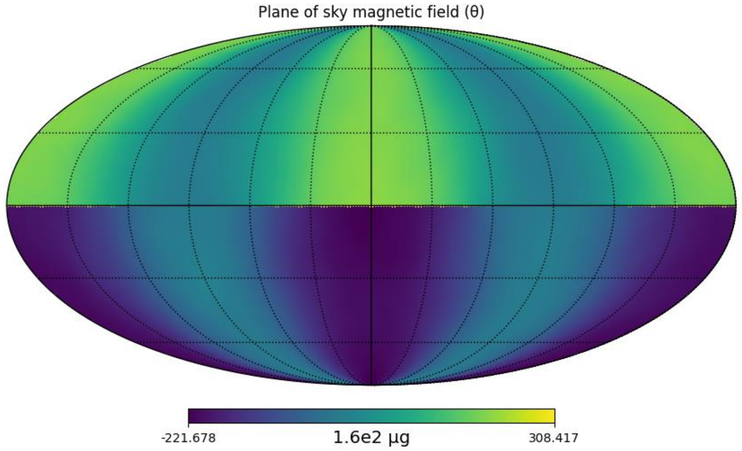


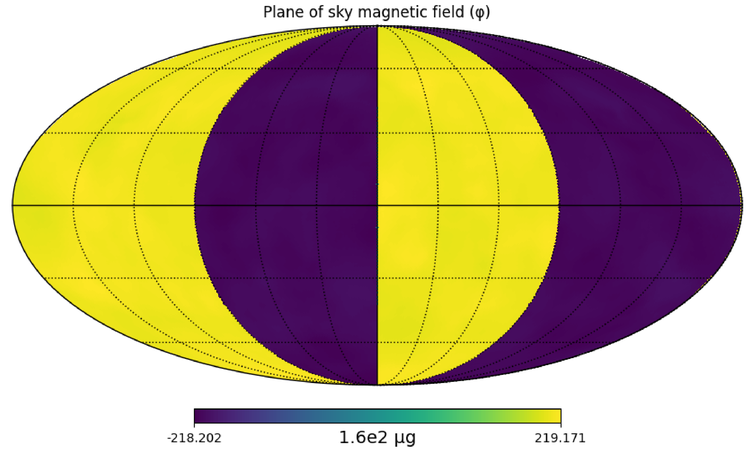
Results

- Plotted Mollweide projection maps for standard perturbed simulation data (t = 30)









Discussion

- We observe the expected effects by the magnetic field on the flow of interstellar material and potential cloud formation
- Proof-of-concept; this method can be used to visualize and analyze simulations of expanding supernova shells
- Line of sight maps allow observation of Zeeman effect
- Plane of sky maps illustrate polarization effects

Acknowledgements

This project was conducted under the guidance of Dr. Fabian Heitsch. Some of the results in this paper have been derived using the healpy and HEALPix package..

References

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