Thesis Project Portfolio

Shock-Ionized Jets from Massive Protostars

(Technical Report)

The Loss of Dark Night Skies: How Cultural and Scientific Advocates are Pushing Back

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Spring, 2022

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Table of Contents

Sociotechnical Synthesis

While my technical project focused on processing and analyzing simulation data, the simulated results would be unenlightening without telescope observations with which to compare them. I post-processed snapshot data from a 3D magnetohydrodynamic simulation of a massive protostellar outflow to predict observables and compare them to observations and theory. In all sciences, theorists can develop and simulate self-consistent models of phenomena, but without experimental results, there is no way to validate these models. Astronomy is no exception. However, in the field of astronomy, instead of running experiments on Earth, we depend on telescope observations of outer space to provide the data to which theory can be compared. My STS project was inspired by recent news regarding the threat new artificial mega-constellations pose to telescope observations and the field of astronomy.

While my STS project was sparked by my own concern as a researcher, it led me to investigate how other social groups value the night sky for different purposes, a primary one being the role dark night skies play in many indigenous cultures. I sought to explore further how astronomers and indigenous people each value and seek to protect dark night skies. Considering how the interplay between Western science and indigenous culture has historically been dominated by conflict, like when Native Hawaiians protested the construction of the Thirty Meter Telescope atop Maunakea, it was particularly interesting to consider these two social groups approaching a common goal.

Through my STS project, I learned about the importance of considering all participants to create transdisciplinary solutions to problems that may affect various social groups differently. I conclude that the best way to protect dark night skies, for all purposes, is by using indigenous worldviews to inform policy and create social solutions to be implemented alongside technical solutions. This approach can be applied anywhere various social groups share a common goal, even when their motives and approaches vary and they have been on opposing sides of other disputes.

In my technical project, I found the ionization fraction, intensity of radio emission, spectra, and flux variability resulting from shocks in our simulated outflow to be consistent with observations. This offers support for the Turbulent Core Model of massive star formation via core accretion, upon which the simulation is based. However, these results are preliminary and will be followed by a more detailed analysis that accounts for cooling effects in the shocked gas.

While these two projects address very different research questions, without the sociotechnical protection of dark night skies studied by my STS project, astronomy research like that of my technical project would not be possible. A similar relationship could be drawn if one were to replace my technical astronomy project with a social project on indigenous cultural practices with dark night skies: Without the sociotechnical protection of dark night skies, these cultural practices would not be possible. In conclusion, a transdisciplinary sociotechnical approach to protecting dark night skies is crucial to all participants, regardless of their specific motives.