Bondi Accretion in the Presence of Heating
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Accretion is an extremely important astrophysical process that contributes greatly to the dynamics and evolution of stars, compact objects and black holes. In fact, recently the Event Horizon Telescope (EHT) produced a picture of the shadow of a supermassive black hole at the center of the giant elliptical galaxy M87.[1] This image shows the existence of a magnetized accretion disk orbiting the rotating supermassive black hole. In order to interpret the results, the data was compared to relativistic magnetohydrodynamic accretion models. These accretion models are very complex and generally very difficult to compute, however, there exist a few analytical models from which we can gain intuition about accretion.

One such model is Bondi Accretion which assumes certain symmetries to obtain an analytical framework. In his derivation, Herman Bondi assumed steady state, radial, spherically symmetric, adiabatic accretion onto a non-rotating black hole. This project seeks to understand how accretion changes when we relax the assumption of adiabaticity. There are many different sources of heating that could exist around a black hole. Heating from an external source could interact with matter around the black hole and influence accretion. In particular, we are motivated by the possible annihilation of dark matter (DM) particles occurring around the SMBH at the site of Sgr A*. We will focus on computing the transonic profiles, for which the gas becomes supersonic, as well as subsonic profiles, for which the gas remains subsonic.

Assuming a power-law heating profiles, as motivated by possible DM distributions around a black hole, we then find the profiles for both transonic and subsonic flow. We found that for certain values of the power law heating profile, we are able to find viable transonic and subsonic profiles. However, for a different set of parameters we were unable to find viable physical solutions.

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[1] Event Horizon Telescope Collaboration, et. al, First M87 Event Horizon Telescope Results. I. The Shadow of the Supermassive Black Hole. *The Astrophysical Journal Letters*, 875(1):L1, April 2019.