W62a Relativistic radiation mediated shocks in photon starved regime

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Radiation-mediated shocks (RMS) play an important role in shaping the early emission in many astrophysical transients. In most cases, e.g. shock breakout in supernovae, GRBs, and neutron star mergers, the upstream plasma is devoid of radiation (photon starved), and the photons that ultimately reach the observer are generated predominantly within the shock. Therefore, in order to explore the emissions from these phenomena, one needs to evaluate the structure of RMSs in the photon starved regime.

While the physics of RMSs is well established in non-relativistic regime, the nature of relativistic RMSs (RRMSs) is still poorly understood. To tackle this issue, we have developed a novel numerical method for solving self-consistent steady-state solutions of RRMSs. In this talk, we present the results of simulations of photon-starved RMS, which yield the shock structure and emission for a broad range of shock velocities, from subrelativistic ($\beta_{sh} = 0.1$) to highly relativistic ($\Gamma_{sh} = 20$). Our simulations confirm that in relativistic RMS the immediate downstream temperature is regulated by exponential pair creation, ranging from 50 keV at $\beta_{sh} = 0.5$ to 200 keV at $\Gamma_{sh} = 20$. At lower velocities, the temperature becomes sensitive to the shock velocity, with kT $\sim$ 0.5 keV at $\beta_{sh} = 0.1$. We also confirm that in relativistic shocks the opacity is completely dominated by newly created pairs, which has important implications for the breakout physics. We find the transition to pair dominance to occur at $\beta_{sh} = 0.5$ roughly. In all cases examined, the spectrum below the νF_ν peak has been found to be substantially softer than the Planck distribution.