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Extreme Astrophysics with Relativistic Transients

Tanmoy Laskar[(1)]
(1) Department of Astrophysics/IMAPP, Radboud University Nijmegen, 6500 GL Netherlands
e-mail: T.Laskar@astro.ru.nl

As the most energetic explosions in the Universe, relativistic astrophysical transients provide a unique opportunity to explore physics at extreme energy scales that are otherwise impossible to investigate in Earth-bound laboratories. I will demonstrate the power of multi-wavelength observations, combined with theoretical modeling, in teasing apart the physics of relativistic extragalactic transients. Shining a special spotlight on radio wavelengths, I will describe how pushing the boundaries of observational efforts is leading to new insights into these extreme events. Using a series of case studies (e.g. Gamma-ray bursts, tidal disruption events), I will describe the multi-messenger revolution currently underway in extragalactic time-domain astrophysics, concluding with highlights of future prospects in this rapidly evolving, data-driven field.

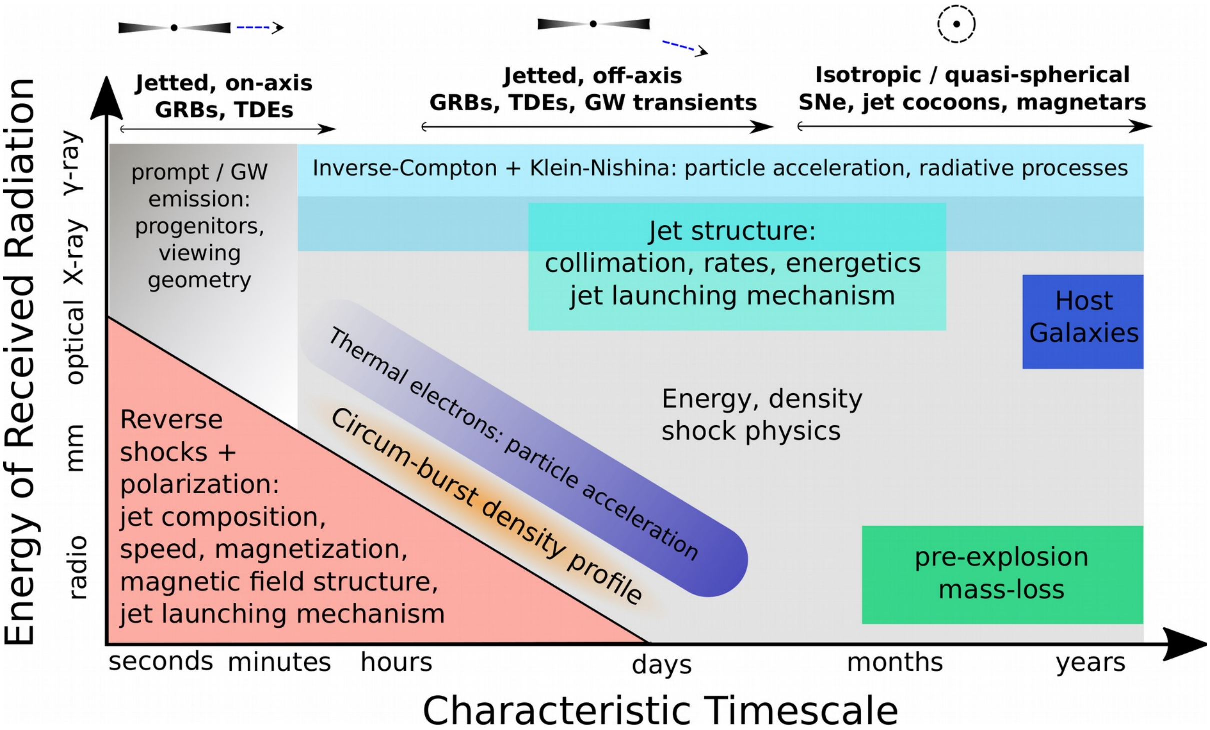

Figure 1. The physics of relativistic transients in observational phase-space of energy of radiation vs characteristic timescale. Jet-driven relativistic transients viewed on-axis are rare, luminous, visible shortly after explosion, and fade rapidly. Off-axis jets enter the line of sight later, while quasi-spherical events are often the least luminous, but may be visible for days to years after explosion. Studies of each class allow us to probe not only the formation of relativistic outflows, but how physics works at extremes of temperature, density, velocity,and magnetic field that cannot be attained even in the largest Earth-bound experiments.