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Fast-follow up Optical Polarimetry of GRBs afterglows

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Gamma-ray Bursts (GRBs) are the most powerful explosions in the Universe. After the collapse of a massive star or the merger of a compact object binary, material is accelerated to relativistic speeds along the narrow beam of a jet. As this jet continues to travel outwards, it collides with the external material surrounding the dying star, producing a long-lasting afterglow that can be seen across the entire electromagnetic spectrum, from the most energetic gamma-rays to radio wavelengths. But how can such material be accelerated and focused into narrow beams? The internal shock model proposes that repeated collisions between material blasted out during the explosion can produce the gamma-ray flash. The competing magnetic model credits primordial large-scale ordered magnetic fields that collimate and accelerate the relativistic outflows.

To distinguish between these models and ultimately determine the power source for these energetic explosions, our team studies the polarization of the light during the first minutes after the explosion. Using novel instruments on fully autonomous telescopes around the globe, we directly probe the magnetic field properties in these extragalactic jets. In this talk, I will review the recent developments that have been made using this technology. Those include some insights on GRB progenitors/remnants, the first detection of highly polarized optical light and confirmation of mildly magnetized jets with large-scale primordial magnetic fields (GRB 120308A), and the early-time polarimetric observations of the first GRB detected at very high TeV energies (GRB 190114C). This suggests some jets can be launched highly magnetized and that the collapse and destruction of ordered magnetic fields at very early times may have powered the explosion itself. Fast-follow up polarimetry opens a new frontier of GRB magnetic field studies in the multimessenger era.

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