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Probing the Magnetic Field Structure in Gamma-Ray Bursts through Polarization Measurements JONATHAN GRANOT, KIPAC, Stanford — Linear polarization at the level of a few percent has been measured in several gamma-ray burst (GRB) optical afterglows, hours to days after the burst. This supports synchrotron emission as the dominant radiation mechanism, while the evolution of the degree of polarization and its position angle probe the magnetic field structure in the shocked external medium as well as the structure and dynamics of GRB jets. The magnetic field structure in the GRB ejecta could potentially be tested by the polarization properties of the prompt gamma-ray emission. However, reliable polarization measurements in gamma-rays are extremely difficult. Therefore, it is much more promising to probe the magnetic field structure in the GRB ejecta through polarization measurements of the optical or radio emission from the reverse shock that propagates into the ejecta as it is decelerated by the external medium. Such optical emission that is attributed to the reverse shock has been observed in a few GRBs from tens of seconds to about ten minutes after the burst, while the radio emission from the reverse shock has been detected in a few cases after about a day. Upper limits of the linear and circular polarization from this radio emission for three GRBs already provide interesting constraints on the magnetic field structure in the GRB ejecta, while polarization measurements of the optical emission from the reverse shock may become available soon by robotic telescopes following rapid localizations by the recently launched Swift satellite.

Jonathan Granot
KIPAC, Stanford

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