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Polarimetry of GRB prompt emission with POLAR and POLAR-2

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Gamma-Ray Burst (GRB) prompt polarization has been measured in more than thirty cases. However, as they suffered from large systematical/statistical uncertainties, they showed a wide range distribution of polarization degrees (PDs). The theoretical community has recently paid more attention to the POLAR mission, which reported PDs of 14 GRBs at mostly a level of $\sim$10% and a hint of polarization angle (PA) evolution over time. If the prompt gamma-rays are produced by photospheric emission, multiple scattering will significantly reduce the PD; synchrotron radiation would also allow a low PD if the magnetic field is dissipated. In another non-uniform jet scenario, if stochastic variations (patchy shells or mini-jets at scales $\ll 1/\Gamma$) indeed endure with intrinsically independent magnetic field orientation and evolution, the integrated PD would be suppressed and PA evolution would occur. More realistic theoretical models of both time-/energy-dependent polarization based on advanced numerical simulations are needed to better interpret the results. Meanwhile, the next-generation polarimeter POLAR-2 is required to improve the measurement accuracy. POLAR-2 will be launched in 2025 to the China Space Station and consists of three detectors: a High-energy polarization Detector, a Low-energy polarization Detector and a Broad-band Spectroscopy Detector, sharing most of their mission time to monitor jointly the sky with overlapped fields of view. The synergies of the three detectors will allow POLAR-2 to significantly improve the accuracy ($\sim$10 times better) of GRB polarimetry, and shed new light on the jet physics of GRBs.

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