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Gamma-Ray Polarimetry of GRBs with the POLAR and POLAR-2 missions

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Despite over 50 years of Gamma-Ray Burst (GRB) observations many open questions remain about their nature and the environments in which the emission takes place. Polarization measurements of the GRB prompt emission have long been theorized to be able to answer most of these questions. The POLAR detector was a dedicated GRB polarimeter developed by a Swiss, Chinese and Polish collaboration. The instrument was launched, together with the second Chinese Space Lab, the Tiangong-2, in September 2016 after which it took 6 months of scientific data. During this period POLAR detected 55 GRBs as well as several pulsars. From the analysis of the GRB polarization catalog we see that the prompt emission is lowly polarized or fully unpolarized. There is, however, the caveat that within single pulses there are strong hints of an evolving polarization angle which washes out the polarization degree in the time integrated analysis. Building on the success of the POLAR mission, the POLAR-2 instrument is currently under development. POLAR-2 is a Swiss, Chinese, Polish and German collaboration and was recently approved for launch in 2024. Thanks to its large sensitivity POLAR-2 will produce polarization measurements of at least 50 GRBs per year with a precision equal or higher than the best results published by POLAR. POLAR-2 thereby aims to make the prompt polarization a standard observable and produce catalogs of the gamma-ray polarization of GRBs. Here we will present an overview of the POLAR mission and all its scientific measurement results. Additionally, we will present an overview of the future POLAR-2 mission, and how it will answer some of the questions raised by the POLAR results.

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