Probing Cosmic Dust of the Early Universe through High-Redshift Gamma-Ray Bursts

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The discovery of high-redshift GRBs opens a new window into the nature of dust in the early universe. We explore the dust properties of the host galaxies of ~40 long-duration GRBs at $2.0\leq z\leq 6.7$, with a mean redshift of z=3.34 (corresponding to a look-back time of 1.94 Gyr), by fitting their ultraviolet-optical-near-IR afterglow spectral energy distributions. We find that the average dust extinction in the visual band is A_V~0.3 mag. The E_{B-V}/N_{HI} and A_V/N_{HI} ratios decrease linearly with the dust-to-gas ratio, suggesting that the dust properties remain unchanged at the epoch of $2.0\leq z\leq 6.7$. The inferred extinction curves are closely reproduced in terms of a mixture of amorphous silicate and graphite. The dust properties do not appear to evolve with z in the interval $2.0\leq z\leq 6.7$.