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Beaming in Fast Radio Bursts

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Among the mysteries of Fast Radio Bursts (FRBs) is how they direct, or 'beam' their energy. Despite observations of over 1000 FRBs from unique sources, the majority of the leading theories for emission mechanisms include some form of beaming, but this is often ignored for simplicity. Interpretations of features in the energy distribution, such as bimodality and broken power-laws implicitly assume an isotropic or unphysical top hat emission cone. In this work, we approach the FRB beaming problem by simulating FRB bursts with a variety of beam shapes and their effects on different underlying intrinsic energy distributions. Under the most realistic beaming models (e.g. a Gaussian, pulsar-like beam), it is challenging to preserve bimodality and even a break in the power-law of the intrinsic energy function. We find that a large beam area with small intensity variation is the only way to reproduce bimodality. With our new approach, we are able to reproduce bimodality in simulated energy distributions, resembling that of FRB 20201124A and FRB 20121102.
We are also able to simulate a broken power-law energy distribution from a combination of one Gaussian and one relativistic beam, affected by the same intrinsic power-law distribution, energy distribution, showing that the effects of beaming play a significant role in interpreting the intrinsic energy distribution.

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