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Learning to Deblend Galaxies from Blended Observations with Diffusion Models

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Galaxy surveys such as LSST require robust deblending methods to separate overlapping sources in crowded fields, a challenging inverse problem due to PSF convolution, noise, and source mixing. In this talk, I present a Bayesian framework that leverages diffusion models to learn a prior on galaxy light profiles directly from blended observations. Building on a recent expectation-maximization approach for training diffusion models with corrupted data, our method enables full posterior sampling as well as MAP estimation for each deblended source. The likelihood is explicitly defined and differentiable, thanks to our *scarlet2* framework, which models PSF effects, source mixing, and resampling, making it suitable for multi-resolution imaging.

Looking ahead, the next decade of galaxy surveys will deliver unprecedented overlapping data across multiple wavelengths, epochs, and resolutions. Our framework enables joint analysis of these multi-survey datasets, improving the quality of galaxy catalogs and opening the door to a wide range of astrophysical and cosmological applications, including time-domain discoveries and better constraints on fundamental parameters.

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