

**Title:** Bayesian Light Source Separator (BLISS): Probabilistic detection, deblending and measurement of astronomical light sources

**Abstract:** We introduce a new scalable probabilistic algorithm for detecting, deblending, and measurement of light sources (e.g. stars and galaxies): the Bayesian Light Source Separator (BLISS). BLISS is designed to target state-of-the-art photometric galaxy surveys. BLISS builds upon recent ideas in deep generative modeling, variational inference, and variational autoencoders. Our algorithm is designed to address the systematic bias that blending contributes to weak lensing studies as blending affects source detection, photometric measurement, and shape measurement. Given an astronomical survey image, BLISS approximates the posterior of light sources' counts, locations, fluxes, and shapes with a variational distribution. In other words, BLISS can output a probabilistic catalog of astronomical images. The BLISS variational distribution factorizes over small subimages of a large image, and exploits the fact that the latent properties of faraway light sources are not highly dependent. The variational distribution is parametrized by neural networks, which allows for efficiency and flexibility. By using an appropriate prior, inferred probabilities are calibrated to capture uncertainty in detections, photometry, and shapes in the presence of blends. This uncertainty can then be efficiently propagated to downstream cosmological analysis. We show how BLISS accurately deblends and captures the measurement uncertainty on simulated and realistic galaxy blends using a flexible galaxy model based on a variational autoencoder (VAE).