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Type : **Poster**

From Starlight to Synapses: How Cosmological Bayesian Inference Reveals the Brain's Molecular Structure

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Super-resolution microscopy is a rapidly evolving field, and analytical tools are struggling to keep up with novel imaging techniques. 'MINFLUX' (minimal fluorescence photon fluxes) is one such technique; it uses targeted emission to track molecules down to the nanometer scale. However, 'MINFLUX' outputs localizations of these molecules rather than viewing the protein superstructure directly, leaving a gap for a tool that can make that leap. 'AstroPhot' is a Bayesian framework traditionally used to analyze and deblend crowded/transient cosmological data by separating objects and fitting parameters individually. With some unifying adjustments, 'AstroPhot' can be calibrated to ingest MINFLUX data and fit shared parameters across objects to fit greater protein superstructure based on molecular localizations. This approach is tested against 'MINFLUX' data from neural inhibitory synapses, where the hexagonal lattice structure of the gephyrin protein is analyzed. Gephyrin is crucial in the regular function of the brain; mutations and abnormalities in gephyrin are linked to epilepsy, Alzheimer's, and schizophrenia. The natural superstructure formed by gephyrin in the brain is debated throughout the literature. Thus, understanding gephyrin structure and applying the approach used to other proteins is key to tackling some of the longstanding neurological disorders plaguing humanity.

Did you give a contributed talk at CASCA 2026?

No

If you are selected for a poster, would you be interested in giving a short flash talk on your work?

Yes

What is your career level?

Undergraduate

Which keyword describes the area of focus of this talk?

Astrostatistics

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