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Simulated analogues: a new methodology for non-parametric matching of models to observations

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Star formation is a multi-scale problem. Theoretically, only global simulations that account for the connection from the large-scale gas flow to the accreting protostar reflect the observed complexity of protostellar systems. In such global models, star are born in a stochastic process as a statistical ensemble and it is not possible to create constrained models that match specific observations ab initio. Observationally, a combination of single dish and interferometers are able to resolve the nearest protostellar objects on all scales from the protostellar core to the inner few AU, for the nearest protostars. It is challenging to create models that objectively and non-parametrically match the observed properties, and henceforth can be used to better interpret the data and understand the underlying physical mechanisms.

We have developed a new methodology for using high-resolution models and post-processing methods to match simulations and observations non-parametrically using deep learning in a semi-automatic fashion and extract robust physical indicators which can radically speed up the interpretation of high-resolution interferometric high-resolution observations. With machine-learning, we can down-select from large datasets of synthetic images to a handful of matching candidates. This is particularly useful for binary and multiple stellar systems and has the end goal to infer the underlying physics that drives the creation and evolution of protostellar systems.

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