Predicting Star Formation: Past and Future

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Abstract: This proposal explores one of the most fundamental questions in astrophysics: what sets the masses of stars? The story of a star's life is written at birth: its initial mass determines how long it will shine, whether it is likely to host a habitable planet and how it will eventually die. Telescope observations show the distribution of initial stellar masses is surprisingly similar across our Milky Way galaxy and others like it. However, why stars have the masses they do remains unsolved despite decades of research. Advances in both computational and statistical methods have enabled fresh approaches to this problem. This project combines state-of-the-art simulations of forming stars with recently developed neural network architectures to predict pre-stellar gas evolution. We will train and test Fourier and Markov neural operators using simulations and then apply them to recent radio observations of star-forming regions to predict the prior and future evolution. This study will produce a novel, general method that will allow us to identify the subset of gas that goes on to form stars and thereby reconstruct the earliest phases of stars like our own Sun.