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Modelling galaxy emission-line kinematics using self-supervised, physics-aware, Bayesian neural networks

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In the upcoming decades large facilities, such as the SKA, will provide resolved observations of the kinematics of millions of galaxies. In order to assist in the timely exploitation of these vast datasets we have explored the use of self-supervised, physics aware neural networks capable of Bayesian kinematic modelling of galaxies. I will present the network's ability to model the kinematics of cold gas in galaxies with an emphasis on recovering physical parameterisations and accompanying modelling errors. The models discussed are able to recover rotation curves, inclinations and disc scale lengths for both CO and HI data which match well with those estimated in the literature. The models are also able to provide modelling errors over learned parameters thanks to the application of quasi-Bayesian Monte-Carlo dropout. This work shows the promising use of machine learning and, in particular, self-supervised neural networks in the context of kinematically modelling galaxies observed using interferomers such as ALMA and VLA as well as IFU instruments like SDSS (MaNGA).

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