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Information Field Theory: Concepts & Astrophysical Applications

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Fields play a central role in all areas of astrophysics, like the density, velocity, magnetic, or gravitational field. Inferring an astrophysical field from data is an ill posed problem, as the finite, noisy, and incomplete data can not alone constrain the infinite number of degrees of freedom of a function over continuous space. Domain knowledge has to regularize the set of possible solutions, however, usually significant uncertainties remain and need to be quantified. This can be done via information field theory (IFT), which is a mathematical formulation of probabilistic field inference. Here, the basic concepts of IFT and its numerical implementation are introduced. Its application to astrophysical datasets is shown for the ongoing project to build an atlas of the Milky Way.

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