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Chaos in the Gravitational Three-Body Problem

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The gravitational three-body problem has a long history, extending all the way back to Sir Isaac Newton. In spite of hundreds of years of research, we still do not have a complete solution to the general case, where no restrictions are placed on the nature of the interaction. Historically, this has been attributed to the appearance of chaos in large regions of parameter space, implying that a probabilistic theory is the only way to go. In this talk, I will briefly review the general three-body problem and its present-day astrophysical significance. I will then go on to introduce a probabilistic solution for the outcomes of chaotic three-body interactions mediated by gravity, and describe how my collaborators and I are using this new tool to build a model that evolves entire populations of binary stars in dense star clusters due to three-body interactions with single stars. The model is entirely analytic, and covers regions of parameter space that are only accessible to modern simulations with great computational cost.

Primary authors: LEIGH, Nathan (Universidad de Concepcion); Prof. STONE, Nicolas (Hebrew University); Prof. WEBB, Jeremy (University of Toronto)

Presenter: LEIGH, Nathan (Universidad de Concepcion)

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