Chaos in the Universe

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Video: https://www.youtube.com/watch?v=J-6835pJIxE&feature=youtu.be

Stars move with respect to each other due to the Newtonian forces between them.

These equations of motion are intrinsically chaotic. As a consequence, computers have great difficulty solving them, except if we design special algorithms to address this particular issue. Once we have those algorithms, we can study fundamental physical processes that play a role in stellar clusters.

One fundamental problem we intend to address is the association between phase-space statistical behavior and chaos. But these problems are also associated with the transport of energy and angular momentum withing the system, and with the growth of entropy. The latter aspect relates the evolution of the distribution function to the direction of time.

These are fundamental concepts that link mathematics, theoretical physics and computer science directly to astronomy.

Inderstanding the evolution of the distribution function for stellar systems will lead to new insight in the formation of binary stars in dense star clusters, the production of black holes and the appearence of tidal streams in the Galaxy.

From an observational point of view these topics are relevant for astronomical radio and X-ray observations, black hole merger detections with LIGO/VIRGO and with the exquisite astrometric observations by the gaia satalite.

We propose to constrain this stellar distribution function and relate it to astronomical phenomena. Current and future observations will then allow us to further understand fundamental aspects of chaos in the Universe and of the dynamical evolution of dense stellar systems.