l'Observatoire de Paris — SYRTE — Systèmes de Référence Temps-Espace

l'Observatoire de Paris — IMCCE — Institut de Mécanique Céleste et de Calcul des Éphémérides

Isochrony and self-gravitating dynamical systems.

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Salle Jean-François Denisse, Paris

In classical mechanics, isochrony often characterizes equal-period oscillation dynamics. In 1959, the mathematician and astronomer Michel Hénon introduced an extended definition of isochrony to characterize astrophysical observations of certain globular clusters. In those spherically symmetric systems, radially periodic trajectories show energy-dependent periods. Today, Michel Hénon's isochrone potential is mainly used for his integrable property in numerical simulations, but is generally not really known. The talk aims at presenting new results on isochrony that have particular importance in self-gravitating systems dynamics.

After introducing Michel Hénon's isochrone definition, based on a brilliant remark on the gravitational dynamics, we will complete the set of isochrone potentials. This completeness will allow us to exhibit a particular relation between the isochrones by generalizing the Bohlin transformation. In fact, we will determine the Keplerian nature of isochrones, that is at the heart of the new isochrone relativity. Eventually, the consequences of this relativity in celestial mechanics (generalization of Kepler's Third law, Bertrand's theorem) will be applied to analyze the result of a gravitational collapse.

References :

- Hénon M., L'amas isochrone, Annales d'Astrophysique, Vol. 22, p.126, 1959
- Simon-Petit A., Perez J., Duval G., Isochrony in 3D radial potentials, Comm. in Math. Phys., 363(2), pp. 605-653, July 2018. DOI : 10.1007/s00220-018-3212-y. Preprint : https ://arxiv.org/abs/1804.11282.