

1086-65-1626

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Rigorous Numerical Methods for Gravitational Orbits.

There is a configuration of three masses which, under Newtonian gravity, chase each other around a figure-eight orbit. This striking result, first numerically discovered by Cris Moore, is an example of an “ n -body choreography”. While some choreographies have rigorous existence proofs — for instance, Chenciner and Montgomery proved existence of the figure-eight orbit — proof techniques have lagged behind numerical evidence. In this talk, we will first explain the numerical action-minimization methods and show, by live demonstration, that it is surprisingly easy to find interesting choreographies. We will then present a method, based on an effective form of Newton’s method, for converting these numerical results into fully rigorous computer-assisted proofs. Put together, this procedure lets one automatically convert a picture into a theorem! We will conclude with some other applications of this computer proof technique. (Received September 23, 2012)