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News

Heavenly choreography

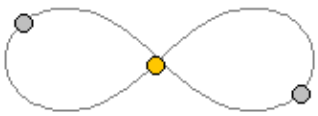
When heavenly bodies such as stars and planets attract each other by means of gravity, what are the possible effects on their motion? In general this is an insoluble problem, even though the equations of gravity were described by Sir Isaac Newton three centuries ago. But one new possibility has recently been discovered by mathematicians Richard Montgomery and Alain Chenciner.

The problem is that although we have Newton's equations, solving them is a very different matter. If there are only two bodies in the universe, then the problem becomes easier and we can describe all the possibilities. If the two bodies have the same mass, they will normally orbit round one another, which means they follow each other round a circular path.

However, even for three bodies of equal mass, we do not know what all the solutions of Newton's equations look like. We do know about some solutions, such as the Lagrangian systems, where, as in the 2−body case, the three bodies orbit each other in a fairly simple circular path, but we do not know what others are possible.

Montgomery and Chenciner have recently confirmed suspicions of another type of solution, where the bodies trace out a figure−of−eight. This new solution of the three−body problem is shown below (if your browser is Java−enabled it will be animated):

You can view the interactive version of this if you enable Java in your browser and reload this page.



Three bodies following a figure−of−eight solution to Newton's equations. Animation by Bill Casselman.

The new class of solutions which includes this elegant motion have been called "choreographies".

A more detailed and slightly more technical discussion of the new result is given in an excellent article by Bill Casselman on the AMS website, from which the animation above is taken.

Mark Wainwright

Plus is part of the family of activities in the Millennium Mathematics Project, which also includes the NRICH and MOTIVATE sites.