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Generalized Albouy-Chenciner equations for central configurations: a test case for methods from tropical geometry and fewnomial theory.

In 1998 Alain Albouy and Alain Chenciner provided an elegant new formulation of polynomial equations for central configurations of the N-body problem. Central configurations, which include relative equilibria configurations, provide major landmarks in the study of the N-body problem. With a change of an exponent in the potential function, the Albouy-Chenciner equations can also be applied to the study of N point vortices. A famous problem in celestial mechanics is to determine the finiteness of the relative equilibria for a fixed set of positive masses; the Albouy-Chenciner equations provide a polynomial system that have been used to partially answer that problem. We will review some of these developments and then consider the additional issue of how many of the solutions are real for a family of potential functions that includes the Newtonian and point vortex cases. It is perhaps surprising that the number of positive real solutions to this family may not depend on the potential's exponent at all, although results from BKK theory (Bernstein, Kushnirenko, and Khovanskii) provide some explanation. (Received September 23, 2012)