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Singularities and collisions of generalized solutions to the N -body problem

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Abstract

The validity of Sundman-type asymptotic estimates for collision solutions is established for a wide class of dynamical systems with singular forces, including the classical N -body problems with Newtonian, quasi-homogeneous and logarithmic potentials. The solutions are meant in the generalized sense of Morse (locally—in space and time—minimal trajectories with respect to compactly supported variations) and their uniform limits. The analysis includes the extension of the Von Zeipel's Theorem and the proof of isolatedness of collisions. Estimates on the contribution of collisions to the Morse index will be discussed. Furthermore, such asymptotic analysis is applied to prove the absence of collisions for locally minimal trajectories and, therefore, existence of new periodic and almost-periodic solutions for the N -body problem which are equivariant under the action of an appropriate symmetry group.