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Non-collision singularities in n-body problems

Abstract: The existence of non-collision singularities in the n-body problem was already conjectured by Painlevé in 1895. Even before the existence was proven in the 1990s, the question came up, whether the set of all initial conditions leading to non-collision singularities is a set of measure 0. A first result of this kind was proven for $n = 4$ particles in $d \geq 2$ dimensions by Saari (1977). Using the so called Poincaré surface method, Fleischer (2018) could improve this for $n = 4$ particles in $d \geq 2$ dimensions by extending the result to a wider class of potentials. But the problem is still open for more than four particles.

After an overview of these works, we consider trajectories that are close to the case of four particles but with some small perturbing forces given by additional particles. In order to apply the Poincaré surface method, we need to prove that these forces cannot break the bounds derived for the four-particle case. If time allows, we will sketch in the end how one could use these results to prove the improbability of larger systems that can be suitably decomposed into diverging systems of up to four particles each.