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**Nathan Duignan\*** ([nathan.duignan@sydney.edu.au](mailto:nathan.duignan@sydney.edu.au)). *On the Simultaneous Binary Collision and the Curious  $8/3$ .*

Of central importance in the  $n$ -body problem is the fact that isolated binary collisions can be regularised; a singular change of space and time variables allows trajectories to pass analytically through binary collisions unscathed. This so called Levi-Civita regularisation provides a flow smooth with respect to initial conditions. Curiously, when two binary collisions occur simultaneously, we are not so fortunate. In 1999, Martinez and Simó gave strong evidence to conjecture the regularised flow, in a neighbourhood of the simultaneous binary collision, is at best  $C^{8/3}$ . Remarkably, the conjecture has been shown for some sub-problems of the 4-body problem, including the collinear and trapezoidal problems.

In this talk we provide a proof for conjecture in the planar 4-body problem. Some notable components of the proof are the use of an uncommon normal form procedure, a type of projective blow-up which produces a collision manifold foliated by invariant  $\mathbb{R}P^3$ , and the study of transitions near manifolds of normally hyperbolic fixed points. Notably, through the proof, a link is established between the inability to construct a set of integrals local to simultaneous binary collisions and the curious loss of differentiability. (Received September 17, 2019)