Reduction of Order, Radiation Reaction and Resummation

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Recent and future experiments with extremely intense laser systems have spurred renewed interest in the dynamics of particles in strong fields, including radiation reaction. The Landau-Lifshitz equation of motion is the first in an infinite series of approximations to the Lorentz-Abraham-Dirac equation obtained from 'reduction of order'. We show that this series is divergent, predicting wildly different dynamics at successive perturbative orders. Iterating reduction of order *ad infinitum* in a constant crossed field, we obtain an equation of motion that is free of runaways and pre-acceleration. We show that Borel-Padé resummation of the divergent series accurately reproduces the dynamics of this equation, using as little as two perturbative coefficients. Comparing with the Lorentz-Abraham-Dirac equation, our results show that for large times the optimal order of truncation typically amounts to using the Landau-Lifshitz equation, but that this fails to capture the resummed dynamics over short times.