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Strength and Breakup Factors in Impact Scenario Risk Assessment

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ABSTRACT

There are many sources of uncertainty in evaluating the damage and risk for a potential impact scenario, both in characterizing the properties of the incoming object and in the approaches used to model the impact and resulting damage from potentially diverse objects. Probabilistic impact risk assessments use statistical distributions of uncertain impactor properties, along with simplified models of asteroid entry, breakup, and resulting hazards, to evaluate the ranges and likelihoods of potential damage levels. While the potential damage range is predominantly driven by the object size and impact location, these primary properties

can be constrained by additional observations or rendezvous missions as a threatening object approaches. In contrast, even when basic properties are known, many aspects of how various types of objects breakup, airburst, or impact remain largely uncertain due to lack of direct observational data. In particular, parameters representing an object's aerodynamic strength and resulting breakup behavior have proven difficult to characterize or validate and are still poorly constrained.

Although risk uncertainties due to strength and related modeling factors are minor compared to those due to the primary asteroid and impact variables, understanding them becomes more pertinent when assessing the potential damage areas for a specific object with determinable properties and trajectory. In this presentation, we will consider the degree to which such strength and breakup modeling factors may affect blast footprint prediction or damage probabilities for a potential impact scenario. Areas of potential exploration include sensitivities to assumed strength ranges and distributions, effects of correlating strength with other observable properties, and how different breakup strengths and subsequent energy deposition rates may affect the shape or extent of blast overpressure footprints. Findings will help to better characterize current breakup and blast modeling uncertainties, and to guide future refinement of probabilistic asteroid impact risk and damage models.

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