Computer simulation models potential asteroid collisions

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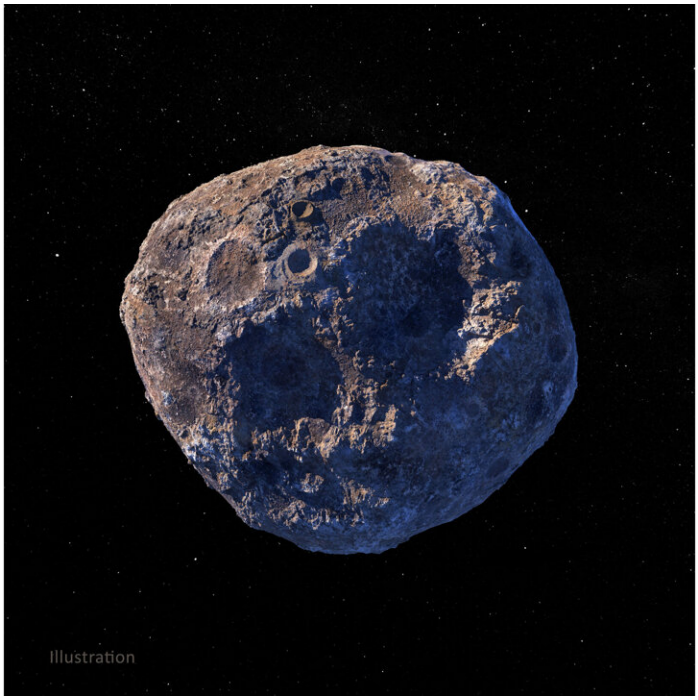

NASA's Psyche mission aims to be the first spacecraft to explore an asteroid made entirely of metal. CREDIT: NASA/JPL-Caltech/ASU. Credit: NASA/JPL-Caltech/ASU

An asteroid impact can be enough to ruin anyone's day, but several small factors can make the difference between an out-of-this-world story and total annihilation. In *AIP Advances*, a researcher from the National Institute of Natural Hazards in China developed a computer simulation

of asteroid collisions to better understand these factors.

The computer simulation initially sought to replicate model asteroid strikes performed in a laboratory. After verifying the accuracy of the simulation, Duoxing Yang believes it could be used to predict the result of future asteroid impacts or to learn more about past impacts by studying their craters.

"From these models, we learn generally a destructive impact process, and its crater formation," said Yang. "And from crater morphologies, we could learn impact environment temperatures and its velocity."

Yang's simulation was built using the space-time conservation element and solution element method, designed by NASA and used by many universities and government agencies, to model shock waves and other acoustic problems.

The goal was to simulate a small rocky asteroid striking a larger metal asteroid at several thousand meters per second. Using his simulation, Yang was able to calculate the effects this would have on the metal asteroid, such as the size and shape of the crater.

The simulation results were compared against mock asteroid impacts created experimentally in a laboratory. The simulation held up against these experimental tests, which means the next step in the research is to use the simulation to generate more data that can't be produced in the laboratory.

This data is being created in preparation for NASA's Psyche mission, which aims to be the first spacecraft to explore an asteroid made entirely of metal. Unlike more familiar rocky asteroids, which are made of roughly the same materials as the Earth's crust, metal asteroids are made of materials found in the Earth's inner core. NASA believes studying

such an asteroid can reveal more about the conditions found in the center of our own planet.

Yang believes computer simulation models can generalize his results to all metal asteroid impacts and, in the process, answer several existing questions about asteroid interactions.

"What kind of geochemistry components will be generated after impacts?" said Yang. "What kinds of impacts result in good or bad consequences to local climate? Can we change trajectory of asteroids heading to us?"

More information: "Numerical modeling of laboratory-scale asteroid impact based on elastoplastic flow model and CESE method" *AIP Advances*, DOI: 10.1063/5.0064441

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