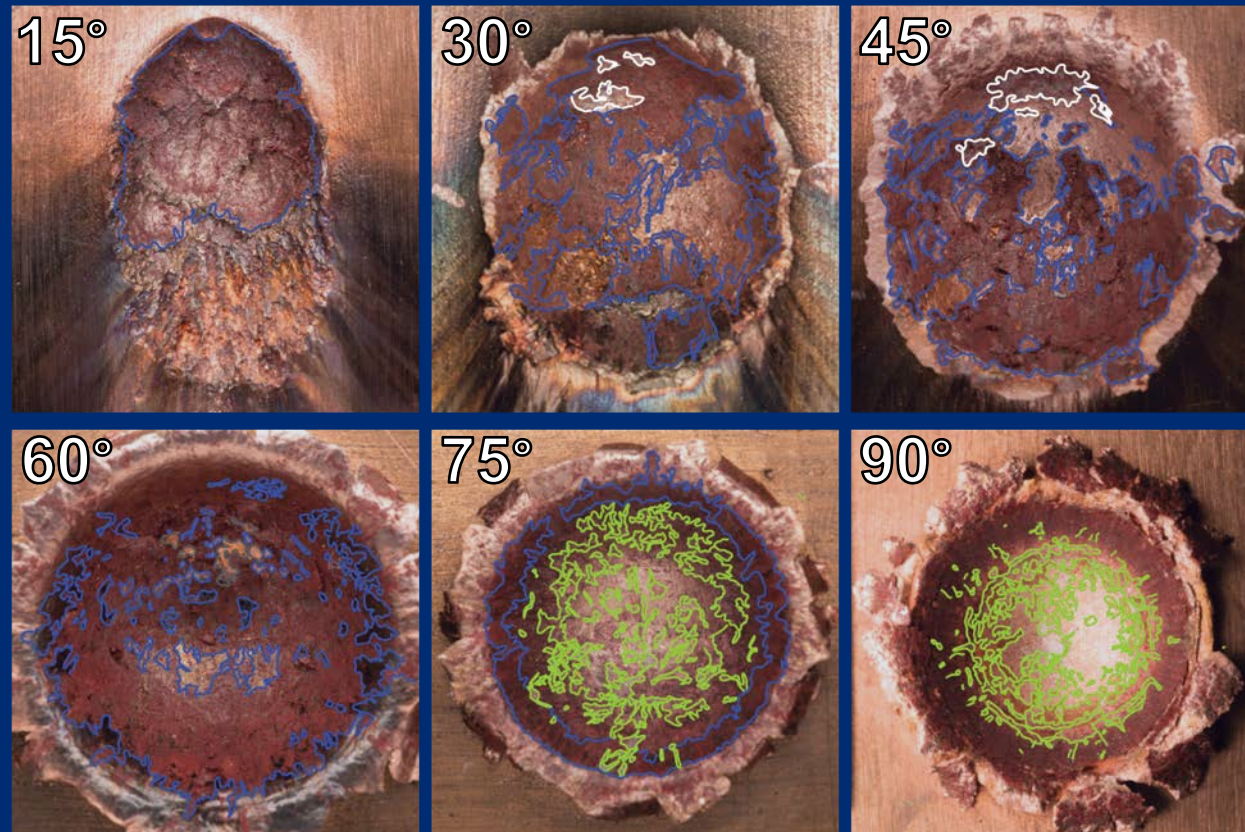
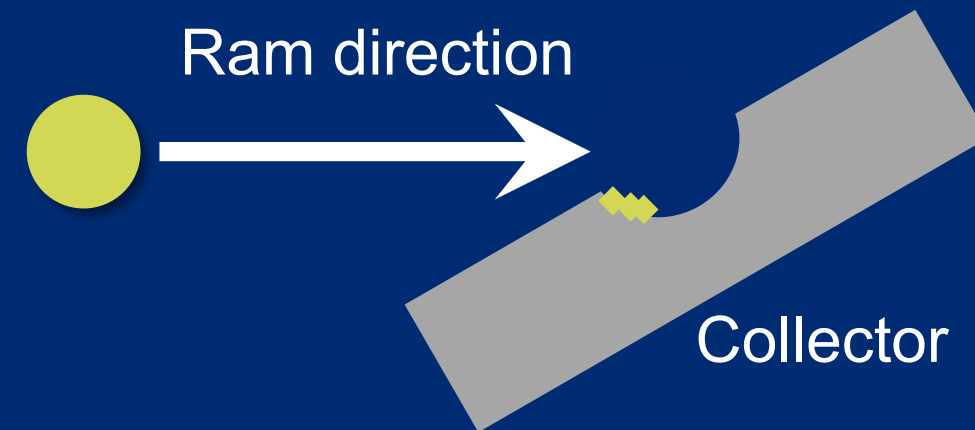


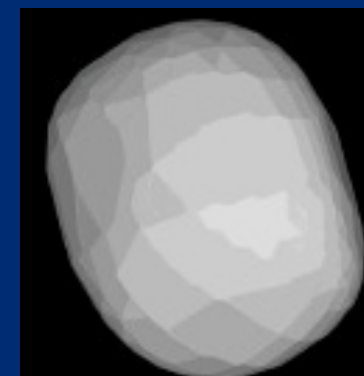
Projectile preservation during oblique impacts



Projectile residues line craters created during ~5 km/s impacts. The residues include glasses rich in both projectile- and target-derived material (outlined in purple), surviving impactor fragments (outlined in white), and nearly pure projectile glasses (outlined in green).



For sample return missions that rely on capturing particles in flight (e.g., the proposed LIFE mission), an incidence angle of 30°, rather than head-on capture, would increase the odds of returning intact, lightly shocked material.



M-type asteroids such as Psyche (depicted here using a radar-based shape model from Shepard et al., 2017) should be plastered with foreign, asteroidal material. Exogenic material could obscure Psyche's original surface. The Psyche mission will be able to test this prediction when it visits the asteroid in 2026.

Oblique impacts significantly enhance projectile preservation. The results suggest a new strategy for sample return missions that rely on impact capture. Moreover, our findings imply that M-type asteroids should bear considerable amounts of exogenic material.