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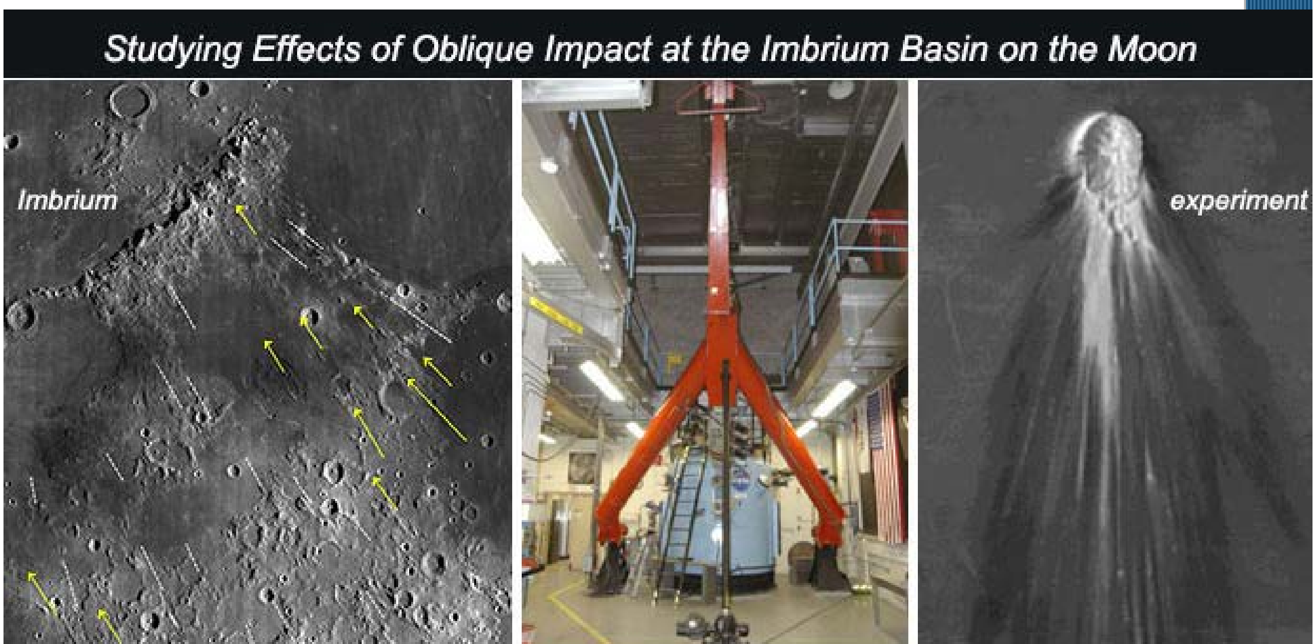
Quick Views of Big Advances

Groovy Imbrium

Patterns of grooves at Imbrium basin may mark the effects of it's excavation during an oblique collision by a large impacting body on the Moon. Two sets of grooves are identified in images, one radial from the basin center and the other not. While radial grooves and secondary craters are associated with ballistic ejecta and debris from the basin-forming process, Peter Schultz (Brown University) and David Crawford (Sandia National Laboratories) use the non-radial trends to interpret scouring from the earliest stages of collision—at the impactor's first contact point—before the basin's big dig and emplacement of ejecta.



(Schultz, P.H. and Crawford, D.A., 2016, *Nature*, v. 535, p. 391,doi: 10.1038/nature18278. NASA / Brown University.)

[LEFT] Orbital view of the Imbrium basin. White dashed lines indicate grooves and gashes formed by impact ejecta that gouged the surface when the basin formed. Yellow arrows point toward the northwest corner of the basin and indicate grooves identified by Schultz and Crawford as signs that pieces of the impactor broke off at the first contact point (up range from the basin's center) then re-impacted and marred the surface down-range. Image from NASA/Northeast Planetary Data Center/Brown University. [CENTER] Photo of the NASA Ames Vertical Gun Range used by the authors for hypervelocity impact experiments. [RIGHT] Photo of the result of an oblique impact experiment into an aluminum plate by a 0.635-cm aluminum sphere at an impact angle of 15^{o} from the horizontal. The bright area shows the damaged surface originating from the first contact made by the impacting sphere and the streaks show the pattern of re-impacting projectile debris, rather than ejecta from the crater.

The grooves radial to Imbrium overlap (came after) the non-radial grooves. Schultz and Crawford used impact experiments at the NASA Ames Vertical Gun Range to better understand their observations. Multiple cameras captured the direction and velocities of ejecta throughout the crater-forming process: from an impactor's first contact point and the resulting down-range trajectories of the early debris to the final crater excavation and later emplacement of radially-distributed ejecta. The team also used shock physics codes in order to demonstrate that the experiments actually apply to large scales as well. They estimate the diameter of the Imbrium impactor as a whopping proto-plant size of ~250km ± 25km, its impact point on the Moon, and the survival of impactor fragments. If pieces of the Imbrium impactor survived, Schultz and Crawford suggest these could have been distributed down range and could account for meteoritic compositions identified in Apollo 16 regolith breccias (For example, see **PSRD** article: ***Leftovers from Ancient Lunar Impactors***.)

See Reference:

· Schultz, P. H. and Crawford, D. A. (2016) Origin and Implications of Non-Radial Imbrium Sculpture on the Moon, *Nature,* v. 535, p. 391-394, doi: 10.1038/nature18278. [***abstract***]

See also:

· Joy, K. H., Zolensky, M. E., Nagashima, K., Huss, G. R., Ross, D. K., McKay, D. S., and Kring, D. A. (2012) Direct Detection of Projectile Relics from the End of the Lunar Basin-Forming Epoch, *Science,* v. 336, p. 1426-1429, doi: 10.1126/science.1219633. [***abstract***]

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