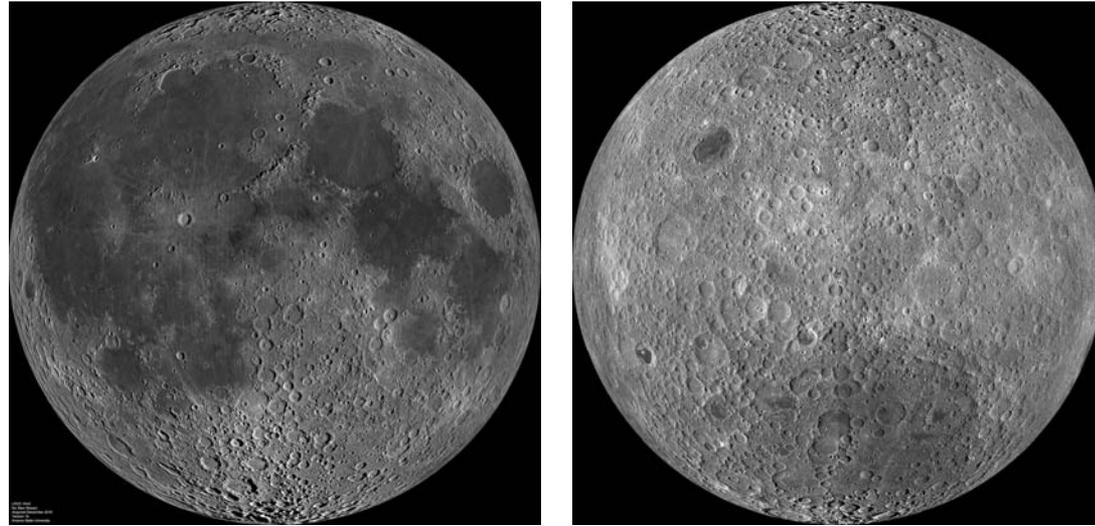


The Man in the Moon: Fate or Coincidence?



The near side (left) and far side (right) of the Moon look very different. Is it a coincidence that the side with many dark smooth plains faces us?

- The Moon's orbital and rotational periods are identical, so that it always keeps the same 'face' toward Earth
- The near and far sides of the Moon are very different. The near side has many maria (dark lava plains) while the far side is mostly cratered and mountainous.
- Recent calculations suggest that it may not be a coincidence that we see the side with the maria

Why Do We See Only One Side?

*Earth and Moon viewed from above.
Sizes and distances are not to scale!*

- Scientists believe the Moon rotated faster when it formed than it does today
- Earth's gravity raises tidal bulges on the Moon and pulls on them, slowing the Moon's rotation (see figure) until it keeps the same side facing Earth.
- The final orientation of the Moon is influenced by properties such as its mass distribution, its rigidity, and its rate of rotational slowing
- The lunar maria are relatively high density rock. Tides require the 'Man in the Moon' to face away from or towards Earth.



Earth's gravity stretches the rotating Moon, raising tidal bulges on the near and far sides.



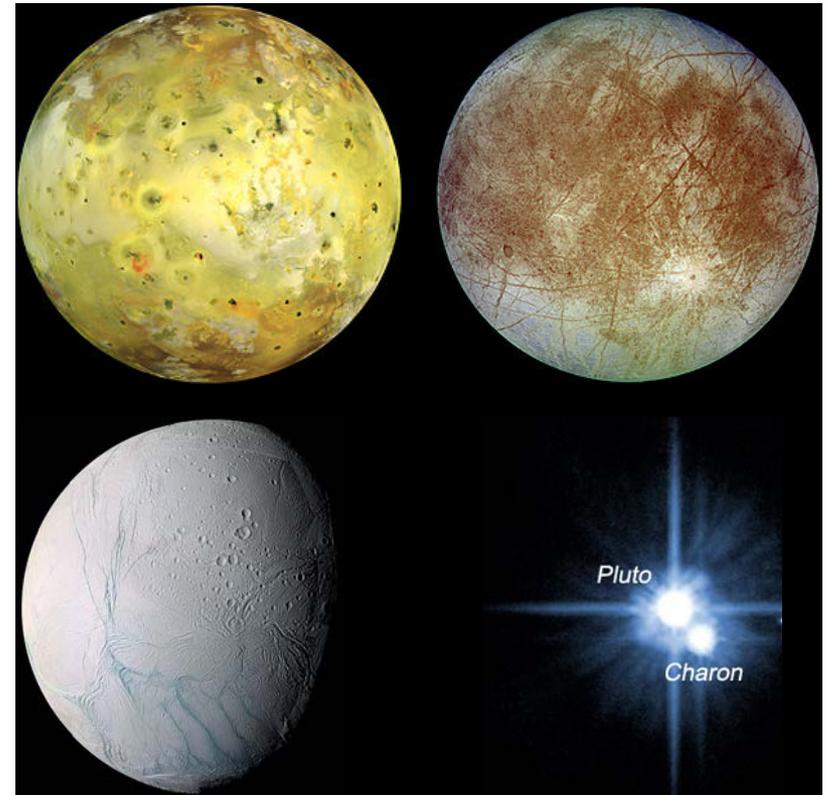
The solid Moon takes time to flex, so the bulges lie slightly 'ahead' of the Earth-Moon line.



The Earth exerts a torque on the bulges, and the Moon slows down until the same side always faces Earth (rotation rate equals orbit period)

The Big Picture

- If the Moon's mass distribution formed long ago, the current face is predicted by the calculations. Alternately, a large impact could have knocked it out of equilibrium, allowing it to be captured in its present state
- Virtually all moons (and even some planets) have such *synchronous rotation*, created through tidal interactions with a planet
- Tides not only distort an object by stretching it, they also influence its orientation



Clockwise from top left: Io, Europa, Pluto and Charon, and Enceladus. Tidal forces exerted on all of these objects have slowed their rotation rate over billions of years, so that they always keep the same face toward the object they circle.

For more information...

Press

- Space.com – 03/07/12 - “How the ‘Man in the Moon’ Turned to Face Earth”
<http://www.space.com/14808-moon-man-illusion-explained.html>

Images

- Slide 1 images courtesy NASA / LRO / Wikimedia Commons
http://en.wikipedia.org/wiki/File:Moon_Farside_LRO.jpg
http://en.wikipedia.org/wiki/File:Moon_nearside_LRO.jpg
- Slide 2 Earth and Moon images by Lars Rohwedder and NASA / JPL / USGS
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http://www.nasa.gov/mission_pages/hubble/plutos_moons.html

Source Articles (on-campus login may be required to access journals)

- Aharonson et al., ‘Why do we see the Man in the Moon?’, *Icarus*, 219, doi:10.1016/j.icarus.2012.02.019, 2012.
<http://www.sciencedirect.com/science/article/pii/S001910351200067X>

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