

Hypotheses of the Origin of the Moon

Hypothesis

Problems

1) *condensation
or co-accretion*

1) Moon's orbital plane is near the ecliptic rather than the predicted equatorial plane.

2) density and chemical composition too different – Moon has more refractories, less volatiles, e.g. no water.

a) This implies a hotter history for the moon.

2) *fission*

1) again, wrong orbital plane

2) angular momentum

a) Requires an unusually high amount.

b) The Earth-Moon system angular momentum is high, but not high enough for this idea.

3) *capture*

1) This possibility is highly improbable for two reasons.

a) For Earth to be able to capture such a sizable object would require very specific approach parameters. Further, it would help were capture to occur only during Earth's early formation, when some energy loss needed for capture might occur from friction with Earth's accretion disk.

b) The Moon's hotter history would imply it was formed close in to the Sun. It would be an unlikely development for the Moon to find its way to Earth, compounding the unlikelihood of its capture once in Earth's vicinity.

4) *collision*

The Evidence in support of the Collision (large impact) theory.

- 1) An off-centered collision could easily explain the high angular momentum of the Earth-Moon system.**
- 2) With any differentiation within the Earth having already occurred, the resulting debris would be metal-poor, being rock and minerals from upper mantle and crust of both bodies, but mostly from Earth.**
 - a) Volatiles were lost in space, driven out by the high temperatures caused by the collision.**
 - b) The iron core of Earth would remain in the Earth; the iron core of the impactor merged with Earth; indeed, from the perspective of Earth, this violent event may be viewed as just a singular event in the accretion process that formed it.**
 - c) This explains the compositional differences discovered in the Apollo rock samples, the Moon's smaller iron core, and more generally, the mystery of its hotter history.**
- 3) This theory is consistent with the observational fact of the Moon's orbital plane lying near the Earth's ecliptic plane.**
 - a) An impactor from elsewhere in the solar system would come from some direction in or near the ecliptic plane, blasting material also near the ecliptic plane.**