

# Chapter C4: Systems and Frames



# Clicker Question

Consider the Solar System as a “system” of particles. Which of the following qualify as external interactions?



- A. The contact interactions between the Earth and a car moving on the Earth's surface.
- B. The gravitational interaction between the Earth and the International Space Station.
- C. The magnetic interaction between the Sun and the Earth.
- D. The gravitational interaction between the Sun and the Andromeda galaxy.
- E. I'm not sure.

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Two space walkers of unequal mass each hold on to the ends of a lightweight cable. The astronauts are originally at rest in deep space, but then start pulling themselves toward each other along the cable until they meet. How will this system's CM move?

- A. It will remain at rest.
- B. It will move at a constant velocity toward either the larger or the smaller astronaut (specify which).
- C. It will accelerate toward either the larger or the smaller astronaut (specify which).
- D. It depends on which astronaut is doing more of the pulling.
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# Key Points to the Center of Mass (CM)

- For an isolated system (*i.e.*, one with no external interactions):



- If the CM is at rest, it will *always* be at rest; it will never, ever, ever move.
- If the CM is moving at a constant velocity or acceleration, it will continue to move at that same constant velocity or acceleration.
- A system's total momentum is simply its total mass times the velocity of the CM and therefore won't change
- We can therefore treat a complex system as if it were a single particle located at the CM!

# Stability

