Logical Analysis of the Shuttle and Missile Objection

Guiding idea — The text presents the objection as a reductio ad absurdum directed at the physical invariance of the speed of light on a one-way journey.

1. Preliminary distinction

- **Sense 1 — one-way:** light physically has the same speed c between two distinct points for all inertial observers.
- **Sense 2 — round-trip:** the average speed of light is c over a closed path.

The objection concerns only physical invariance in Sense 1. It does not directly challenge round-trip measurements.

2. Logical chain of the objection

1. Physically measuring a one-way speed requires determining the departure time and the arrival time at two distinct locations.
2. This requires distant clocks to be synchronized.
3. Synchronization defines lines—or hyperplanes—of simultaneity.
4. If the one-way invariance of c is a physical property rather than a mere convention, the lines of simultaneity must themselves be given physical significance.
5. They must then indicate which bodies or events exist "now" for the reference frame under consideration.
6. In the thought experiment, the shuttle initially has a certain state of motion. According to its first plane of simultaneity, the event associated with the missile—for example, its launch—has already occurred.
7. The shuttle then changes velocity. According to the relativity of simultaneity, its new plane of simultaneity tilts.
8. The same event involving the missile may then lie in the future relative to the shuttle's new simultaneity: it "has not yet occurred."
9. If these planes genuinely represent the present existence of bodies, the same event must be regarded first as having already existed and then as not yet existing.
10. The shuttle's change in motion would thereby make the present existence of a distant event depend on the shuttle's own state of motion.
11. The text regards this as a violation of the principle of non-contradiction or, more precisely, of the irreversible continuity of becoming: what has occurred cannot revert to what has not yet occurred.

3. Condensed logical form

P: the speed of light is physically invariant one-way for all inertial reference frames.

P → S: this invariance requires relative simultaneity endowed with physical significance.

S → B: when the shuttle changes its state of motion, its physical plane of simultaneity tilts.

B → C: the same distant event must be regarded first as having already occurred and then as not yet having occurred.

¬C: such a contradiction is rejected.

Therefore ¬P: the universal one-way invariance of c cannot be a physical property.

$$(P \rightarrow S) \wedge (S \rightarrow B) \wedge (B \rightarrow C) \wedge \neg C \implies \neg P$$

4. Conclusion drawn in the text

The immediate conclusion is not that relativistic measurements are false, but that the hypothesis of a universal physical invariance of the one-way speed of light, valid for all inertial observers, cannot be maintained.

The text therefore leaves open the possibility of:

- invariance measured on a round trip;
- universal simultaneity;
- local variations in clock rates;
- a relational explanation of light propagation.

5. Decisive premise

The entire demonstration depends on this pivotal premise: if the one-way invariance of c is physically real, relativistic planes of simultaneity must physically determine what presently exists.

This implication is the true focus of the debate. A standard relativist may accept transformations of simultaneity while denying that each hyperplane represents a present that is ontologically created or erased by the observer's motion. In that case, the contradiction does not follow.

The objection replies that this solution would make one-way invariance conventional or formal rather than fully physical. The reasoning therefore presents a dilemma:

- either the planes of simultaneity have physical significance, in which case their tilting produces the alleged contradiction;
- or they have only a conventional function, in which case one-way invariance should not be presented as a physical property independent of synchronization.

This dilemma—more than the simple scene involving the shuttle and the missile—constitutes the logical core of the objection.