

The Galilean View: A “Democratic” Framework

☞ The Aristotelian view mixes elements of universal structure to be attributed to *space-time itself* with elements particular to *individual observers*:

(1) Elements of universal structure:

- Events
- World-lines of particles; world-surfaces of sticks, ropes, etc.; world-regions of 2D and 3D objects
- Facts about intersections of world-lines, etc.
- Facts about “straightness” of world-lines (i.e., about the *constancy* of velocity with which things are moving)
- Time 3-planes

(2) Elements of the Aristotelian structure particular to individual observers (or set-ups):

- Spatial positions of events
- Facts about angles at which world-lines are “inclined” (i.e., about *particular* velocities with which things are moving, including zero velocity or the state of rest)

We now want:

- to “separate out” (1) and “clearly post it within space-time” itself, i.e. make it part of the intrinsic structure of space-time “out there,” make it “public,” independent of any observers;
- to banish (2) from space-time, relegate it to individual observers, make it “private.”

Individual observers retain their importance: space-time structure deprived of (2) is a very *abstract* construct and defies clear visualization: it is hard to represent physical phenomena and processes without imposing any particular “Aristotelian” coordinatization (i.e., labeling of positions) on events. But we now consider such coordinatization, not as part of the *intrinsic* structure of space-time but as something *additional* to it, having to do with a particular point of view.

The Galilean view is “a mechanism for ending [a] bickering between the various Aristotelian groups. By fiat, we simply democratize the situation: all the Aristotelian groups are admitted on an equal footing” (Geroch. p. 46).

☞ What universal structural features result?

Those that are common to all Aristotelian observers:

- Common time 3-planes
- Common system of straight world-lines of all conceivable inertial objects (those moving with various constant velocities (but not with any *particular* velocity!)) *taken together*.

These common features are preserved in any “beveling-of-the-deck” transformation.

“An event is naturally characterized by giving its position in space together with the time of its occurrence”—WRONG, from now on!

☞ A *single* space-time picture (always made from the point of view of one particular observer) cannot represent the structure of the Galilean space-time adequately.

Recipe: When looking at a space-time picture, make an intellectual effort and “ignore the verticality” of certain lines.

☞ What relationships among events (and what statements about objects) make sense in the Galilean framework?

A lot fewer than in the Aristotelian framework?

Why?

“The relationships between events which make sense in the Galilean view will be precisely those which can be determined from the structure on space-time (one family of horizontal 3-planes; an infinite variety of lines) available in this view. [T]he relationships which make sense in the Galilean view are just those on which all Aristotelian groups will agree” (Geroch, p. 48).

[T]he relationships which make sense in the Galilean view are just those on which all Aristotelian groups will agree = those that are preserved under all “beveling-the-deck” transformations.

- “These two events occurred at the same time”
 - “The time elapsed between these two events is five seconds”
 - “These two events occurred at the same position in space”
 - “The spatial distance between these two events is five meters”
 - “The spatial distance between these two simultaneous events is five meters”
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- “This particle is moving at constant velocity”
 - “This particle has a speed of 5 m/sec”
 - “This particle is at rest”
 - “This particle collided with that one”
 - “This rope is straight”
 - “This stick is bent”
 - “Particle A is moving at 15 m/sec relative to particle B”
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- Newton’s law of gravitation: $F = G \frac{m_1 m_2}{r^2}$
 - “Light travels with the speed of 3×10^{10} cm/sec”