

Lecture: Fisher, Thirring & SM - Arrow of Time 24 Jan 2014

①

[based in part on Wallace's "Arrow of Time in Phys"]

"Metaphysics of Time"

most contemporary work begins w/ or deals w/ metaphysics.

① B-series: \exists fundamental order on events ("moments of time")
"earlier than"

② A-series: add privileged moment, the 'now', to B-series

for our purposes - B-series has built-in directionality:
"later" distinguished from "earlier" \Rightarrow "arrow of time", "flow of time"

But: how or why? just brute fact about world?
or should we try to find answer from analysis of
or construction from our best physical theories?

in this lecture, we focus on latter

2 distinctions (so 4 ways to go in total)

A: quantitative-constructive vs qualitative-heuristic

B: based on role time plays in defining/regulating
form of dynamics vs correlation of temporal relations
with facts about actual dynamical processes

Wallace, e.g., demands quantitative-constructive; I'm more
lax - I'd be happy w/ a good arg of any reasonable form!

Lecture: Fresh Themes of SM - Arrows of Time 24 Jun 2018

(2)

"Diff't" Arrows of Time (not all of them generally recognized in the literature)

- 1) thermodynamic: approach to equilibrium; increase entropy
- 2) SM: approach to equilibrium; increase entropy
- 3) electromagnetic: consistent on evolution of radiation (spontaneously expanding not contracting spheres)
- 4) gravitational: sense of attraction; singularities and BHs!
- 5) cosmological: expanding not contracting universe; structure formation
- 6) quantum-mechanical: measurements?
- 7) radioactive (radioactive decay): elements spontaneously decay into products; products don't spontaneously recombine
- 8) weak-force: K₀ decay
- 9) strong force: CP viol (no neutron EDM observed)
- 10) biological: divided processes (respiration, e.g.)
- 11) organic and inorganic chemical (molecular processes: the Krebs cycle, e.g.)
- 12) computational: "creation vs erasure of records/memory"

Not all really are prime face puzzling - cosmological, e.g., just follows more or less directly from reasonable models in GR, though one may ask why we're in expanding, not contracting phase

"Phil" arrows?

- 1) causality: "causes precede effects" - though close attention to physical theory shows this to be highly problematic (in Newt Mechs, 2nd Law is only good for attribution of causality, but forces are simultaneous w/ accelerations)
- 2) control: we know how to perform an experiment and then see its outcome; not how to "will-have-already-performed-one, then will-have-already-seen-its-outcome"

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(3)

Fundamental claims.

all arrows "point in same direction"

Fundamental problem (to me - not discussed in literature to my serious extent)

what does it mean for 2 arrows to "point in the same direction"?

- must give criteria independent of temporal concepts

- ^{some} possibilities

1) "approach to equil"

⇒ not clear it works for all (biology, control, radioactive decay, quantum-mechanical, weak-force non-TRE, strong force non-TRE, computational, chemical, cosmol)

2) "increasing entropy"

⇒ again, works for all? maybe not biological (where entropy decreases), cosmol, control, gen, weak force, strong force, cosmological (must include controversial "gravitational entropy")

any others? not off the top of my head -