Title: Confusing Ontic and Epistemic Causes Trouble in Classical Physics Too

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Abstract: The subject of this conference is the Quantum State --- what the hell it is. A central issue is whether quantum states describe reality (the ontic view) or an agent's knowledge of reality (the epistemic view). Advocates of the epistemic view maintain that many quantum puzzles and conundra are artifacts of an inappropriate reification of strictly epistemic concepts. To provide a broader context for such considerations, I argue that even in classical physics we have got into major trouble by inappropriately conferring physical reality on the abstractions we have used to organize what we know.

Confusing ontic and epistemic gets us into trouble in classical physics too

Waterloo, September 2009

Confusing ontic and epistemic
gets us into trouble
in classical physics too

or

Do the measurement problem
and the problem of transience
both arise from the same bad habit?

Physics Today, May 2009 (free! at physicstoday.org)

WHAT'S BAD ABOUT THIS HABIT

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Our bad habit: *Reification*

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Our bad habit: *Reification*

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Polemic and not very insightful dismissal of quantum foundations and philosophy of science.

Example:

Are quantum states real?

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A view many physicists have on the reality of the quantum state:

> In two-slit electron diffraction there is something real
> going through both slits — wave-function stuff.
> The stuff propagate out from the source,
> spreads enough to cover both slits,
> interfers with itself on the far side like an ordinary wave,
> and then condenses into a single spot on the screen.

A view few physicists have on the reality of the quantum state:

> During alpha decay wave-function stuff
> slowly oozes out of the nucleus
> until the growing cloud of stuff
> abruptly gives birth to a helium nucleus,
> whereupon the cloud vanishes, the leakage stops,
> and the nucleus loses four mass units.

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Vertically polarized photon enters birefringent crystal
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Counters are in each beam. *One or the other counter clicks.*

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Yet full quantum description is

$$(1/\sqrt{2})\Big(|\text{ordinary photon}\rangle \otimes |\text{ordinary counter clicks}\rangle + |\text{extraord photon}\rangle \otimes |\text{extraord counter clicks}\rangle\Big)$$

Coherent superposition; *not an either-or affair.*

Ontic view

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Virtue: Can (in principle) be excluded by experiment.

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giving the likelihood of which photomultiplier clicks,
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Source of measurement problem: Reification of quantum state

An analogous issue in classical physics

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Problem of *the Now*

("Transience")

Einstein said that the problem
of the Now worried him seriously.
He explained that the experience of the Now
means something special for man,
something essentially different
from the past and the future,
but that this important difference
does not and cannot occur within physics.
That this experience cannot be grasped
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Now he has departed from this strange world
a little ahead of me. That means nothing.
People like us, who believe in physics,
know that the distinction between
past, present, and future is only
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Letter of condolence to
the family of Michele Besso

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[Einstein] taught us that in physics
the division of space-time into past, present, and future
is an illusion. He also understood that this division
is as illusory in human affairs as it is in physics.

— F. Dyson

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If Now is an illusion then everything is an illusion.

DG: Ultimately string theory will explain everything.

DM: String theory will not explain consciousness.
Consciousness will remain a mystery.

DG: Consciousness is an illusion.

DM: The illusion of consciousness will remain a mystery.

Problem of the Now:

Physics has no place for the Now.
Physics cannot define Now,
and deals only with relations
between one time and another.

The present moment, obvious as it is to me,
cannot be identified in any terms
known to today's physics.

Descartes:

Cogito. Ergo sum.

Corollary:

Sum. Ergo Nunc est.

Uninteresting sense in which there is no Now in physics:

Relativity of simultaneity:

There is no *global* Now.

Whether or not events in different places
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Events outside the light cone of an event are irrelevant.

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Special because it is the *real* state of affairs.

Real unlike earlier events, which are merely remembered.

Real unlike later events, which can only be imagined.

Real in the sense that a dream or hallucination is not real.

The objective world simply is,
it does not happen.
Only to the gaze of my consciousness,
crawling upward along the lifeline of my body,
does a section of the world come to life
as a fleeting image in space
which continuosly changes in time.

— H. Weyl

My Now is a special event — a limit point of the remembered past.
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an answer requires a second "time", outside ordinary time,
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Question: What is the mistake that leads us to believe
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That arena lays out all the events from my birth to my death.
There is no Now in that arena.

Question: What is spacetime?

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One should not confuse the continuum we have invented to represent events, with the events themselves.

Space and time are modes by which we think,
not conditions under which we live.

— A. Einstein

If, for instance I say "That train arrives here at 7 o'clock" I mean something like this: "The pointing of the small hand of my watch to 7 and the arrival of the train are simultaneous events"

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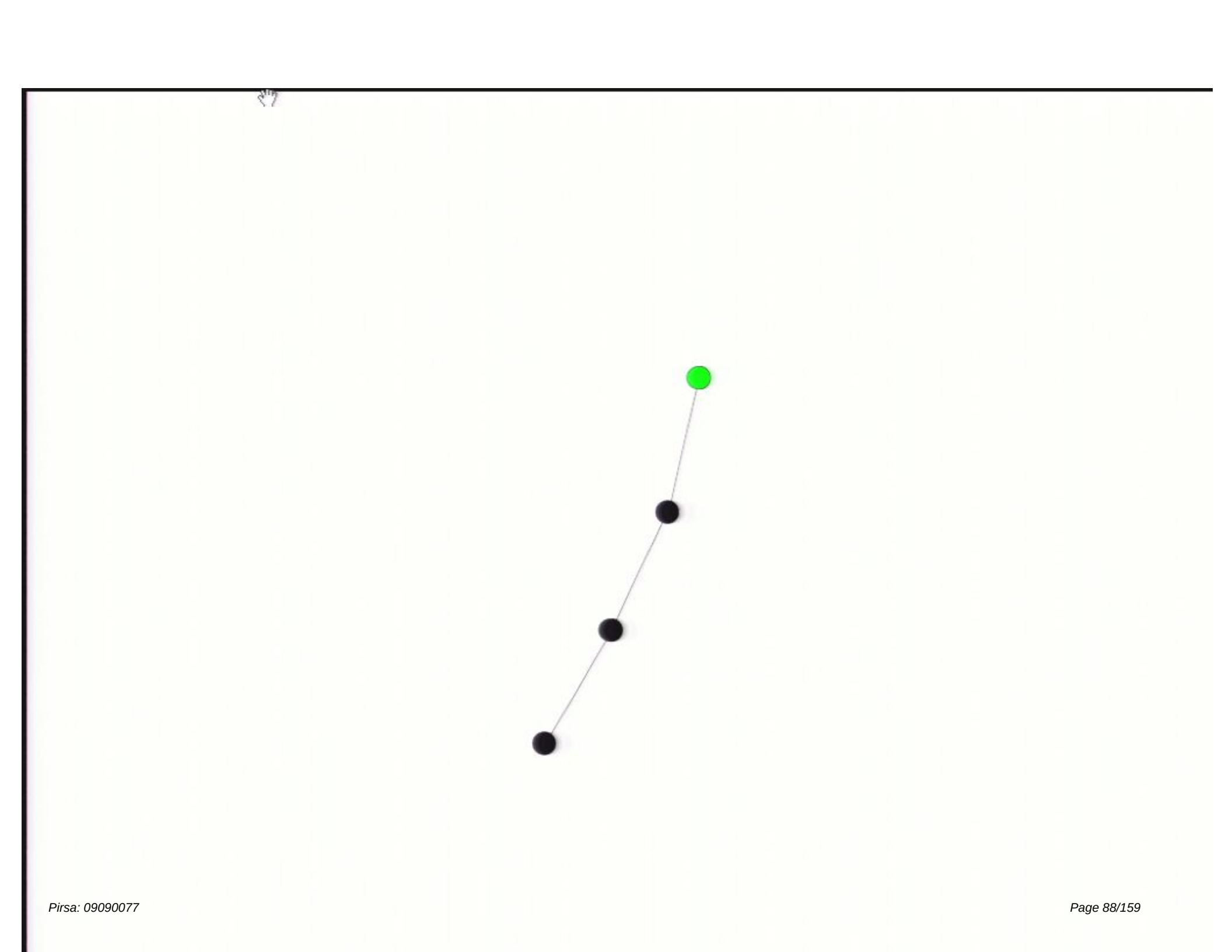

Source of paradox:

Confusing time in my diagrammatic representation of events, with real time — the reading of my watch.

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How fast my Now moves in spacetime:

> *My trajectory grows one second of proper time —*
> *i.e. its length in the diagram increases by a distance*
> *representing a second of time as indicated by the ticks*
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This is the representation in the diagram of the fact
that if you ask me the question "What time is it Now?"
I look at my watch and report the reading that I see on it.

There is no problem of the Now,
for the Now of a single sentient being.

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The solution recognizes that spacetime is a bookkeeping device — a 4-dimensional diagram useful for representing events — and not an objective arena in which events happen.

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Otherwise there could be no communication.

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Event happens Now, if and only if it is Now for any (and hence every) sentient being present at that event.

Digression:

Commonality of your Now and my Now when we are together
requires both our Nows to advance along the trajectory
each of us is plotting at one second of experience
per proper second of clock time along our trajectory.
Otherwise our Nows would not coincide at successive meetings,
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The twin "paradox" — far from being paradoxical —
makes it possible for the Nows of the travelling and
stay-at-home twin to coincide both at separation and reunion.

Does extending Now to events make trouble?

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That two observers who move apart and come back together,
continue to share their Nows at their reunion,
is preserved whatever conventions they use
to construct their global Nows.

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It means that we must not identify that formalism with the world the formalism was constructed to represent.

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Nature of problem	*Experiments have have outcomes*	*Time passes*
Evidence for problem	*Our direct experience*	*Our direct experience*
Why this is a problem	*Quantum states superpose outcomes: nothing happens*	*No motion in space-time: no transient Now*
Source of problem	*Reification of quantum state*	*Reification of spacetime*

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Source of problem	*Reification of quantum state*	*Reification of spacetime*

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