WAVES AND FIELDS IN BIO-ONTOLOGIES

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OVERVIEW

• Waves in a medium
• Waves without a medium
• Photons
• Fields
WAVES IN A MEDIUM

What is a wave?

• A process?
• A material portion of the waving medium?
• A disposition?
Waves are superposable.

A trough of one wave may physically coincide with a peak of another.

Throw two pebbles into any pond if you need to be convinced of this.
AGAINST PORTIONHOOD

Standing waves have portions of the medium that don’t move.
AGAINST DISPOSITIONHOOD

Medium-borne waves need a medium and this medium needs the appropriate **dispositions**.

A **Mexican Wave** is borne by a **discontinuous medium**.

You **collectively** have the disposition to manifest a Mexican Wave.

If you are not waving Mexican right now then the wave is not identical with the disposition.
WHAT ABOUT WAVES WITHOUT A MEDIUM?
ARE PHOTONS ENERGY?
NO.
Energy is not the kind of thing that can bear angular momentum.
Photons have angular momentum.
Spectroscopy only works because photons have angular momentum.
When a sodium atom undergoes a $3p \rightarrow 3s$ transition, it loses angular momentum.

The angular momentum is carried away by an orange photon.

This is how sodium streetlights work.
Consider a massless, yet charged, cricket ball.

It is repelled by the surface charges on ordinary objects. It is spatially extended, so can have angular momentum. Its passage through the air is slowed by induced charges on nitrogen and oxygen molecules. It will be visible because it is coated in dust and bits of grass. It has a history.

But if you hit it for six you will never see it again.
WHAT IS A FIELD?

A field, in the sense we are interested in, is something that has different values at different points in space.

We can describe many things in terms of a field.

It does not follow that a field is a kind, that the gravitational field of Uranus is of a kind with the electrical field of a van der Graaff generator is of a kind with the population density in Graz is of a kind with the direction of the hairs on my head at each point of my scalp.
ELECTROMAGNETIC FIELDS

GRAVITATIONAL FIELDS

describe the **manifestation** of a mutual **disposition** at a given point in space
ELECTROMAGNETIC FIELDS

GRAVITATIONAL FIELDS

describe the curvature of space–time at a given point in space and time
ELECTROMAGNETIC FIELDS

GRAVITATIONAL FIELDS

have a gauge boson we have actually detected
IN BRIEF

Waves cannot be identified with the portions of their bearers, but wavefronts can.

Waves cannot be identified with a disposition of their bearers.

Photons are not energy.

Fields are not a natural kind.
QUESTIONS?

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