Alexandre Guay

The exceptionality of space-time symmetries

Research Focus

This research concentrates on the analysis of a classification of symmetry and its criterion, namely the external/internal symmetry distinction. This classification is believed to capture the distinction between those symmetries that refer to properties of space and time from symmetries which make no such reference. These former are considered the framework of physics theories. It is thought that the criterion for identifying these symmetries is straightforward. My preliminary result, however, is that this criterion is more problematic than is recognized.

Definition

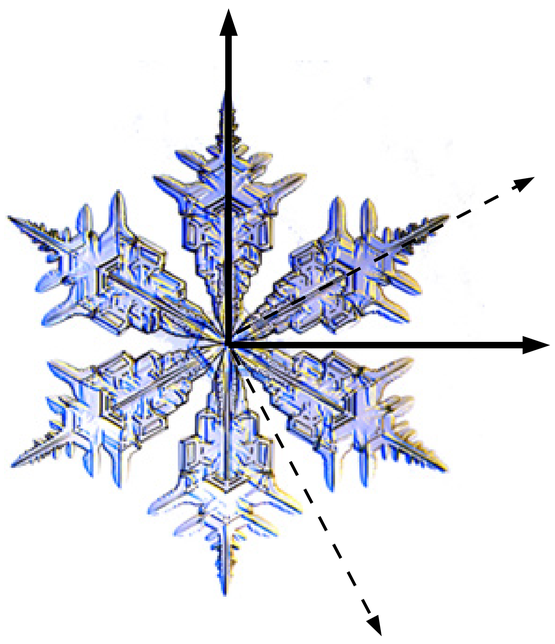
<u>External symmetry:</u>
Symmetry caracterized by transformations of spatial and/or temporal variables.

<u>Internal symmetry:</u>
Symmetry caracterized by transformations of non spatial or temporal variables.

How to distinguish transformations

Space-time transformations admit *active* and *passive* interpretation.

Non space-time transformations admit only *active* interpretation.



<u>Active interpretation:</u>
Rotation of the snowflake (real change)

<u>Passive interpretation:</u>
Opposite rotation of the coordinates system (representation change)

Ontological Unification

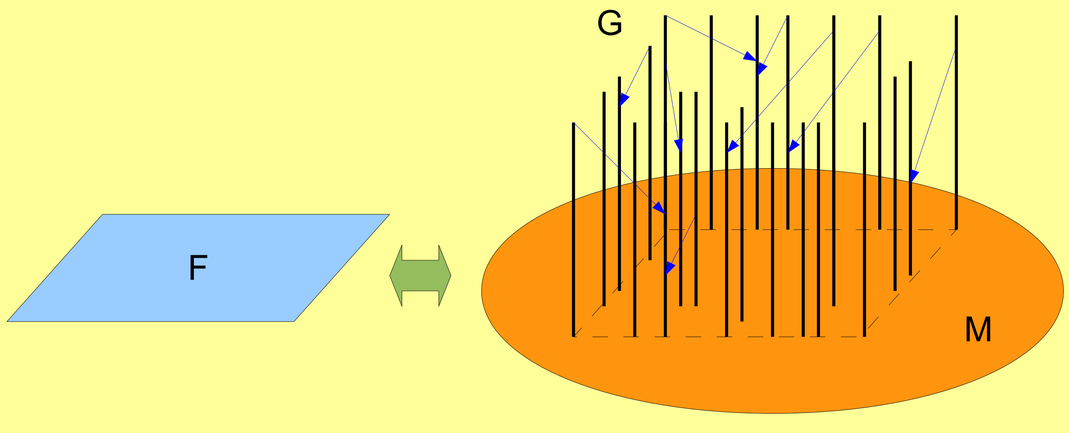
It can be argued that internal symmetry transformations can only be given a meaninful *active* interpretation, and if we regard as a sufficient and perhaps necessary condition for ontological unification the possibility of a *passive* interpretation, then (on the assumption of necessity) we can argue that internal symmetries do not signal ontological unification […]. Michael Redhead

A possible clarification

A geometrical figure *F* in space-time *M* has a symmetry caracterized by a group of transformations *S* of *M* (external symmetry).

Space-time manifold *M* + a groupoid *G*.
In other words, M + types of points (orbits) + fibres (isotropy groups).

The external symmetry seems to have been internalized.



An unfortunate consequence

Most gauge symmetries are apparently internal symmetries. Therefore they should not signal an ontological unification.

If a gauge transformation relates different physical states, then the theory is indeterministic. This seems an unacceptable consequence. A Gauge transformation must relate equivalent states.

<u>Possible conclusions:</u>
1) Gauge theories are indeterministic or
2) Internal transformations can be given a passive interpretation and therefore allow ontological unification. Consequently the distinction between internal and external symmety is blured or
3) Ontological unification is not connected to the active/passive distinction, which is puzzling.