Canadian Association of Physicists
Association canadienne des physiciens et physiciennes

Contribution ID: **427** Type: **Oral (Non-Student) / Orale (non-étudiant(e))**

The Collapse of the Manifold

Wednesday 9 June 2021 16:02 (3 minutes)

THESIS: The ontology of spacetime should not be modelled as a single universally-shared 4D spacetime manifold.

THE CONSENSUS SPACETIME ONTOLOGY: The accepted ontology of classical spacetime is of a 4D differentiable manifold of events. Although different observers may assign different coordinate labels to events, it is conventionally asserted that the underlying reality is that of a single spacetime manifold.
This single classical manifold ontology prohibits nonlocality, because there is no possibility for any form of physical interaction, except those occurring along paths in the manifold. Consequently, Bell nonlocality (EPR) remains mysterious [1].

DIAGNOSIS: The existence of an invariant distance measure (the spacetime interval), and smooth coordinate manifolds has been taken to imply the existence of a universally-shared smooth spacetime manifold. However, this move involves an improper conflation of two different modes of description.
The causal structure possesses invariant properties, but lacks the smooth neighborhood properties required for a manifold, whereas exactly the converse is true of the coordinate manifolds. Manifolds are smooth, but not invariant. We cannot borrow invariance from the causal structure and glue it to coordinate manifolds to create an invariant manifold.

GR: The tensor calculus of GR is "coordinate-free" in the sense that it gives consistent results, irrespective of coordinate system. However, the existence of coordinate mappings between spacetime manifolds does not imply the physical existence of a universal shared manifold. By analogy, the existence of an atlas of the human brain (allowing anatomical mapping between individual brains) does not imply the physical existence of a shared 'universal brain'. A mathematical mapping does not imply a physical process.

CONCLUSION: To move beyond classical GR, it is necessary to abandon the image of spacetime as a single deformable 4D entity, and to replace it with a structure acknowledging the reality of the multiple coordinate manifolds. See [2] for such a 'many-spaces'proposal, including an account of quantum nonlocality.

REFERENCES

[1] Nicolas Brunner et al. "Bell nonlocality". In: Rev. Mod. Phys. 86 (2 Apr. 2014), p. 419.

[2] J. C. Sharp. One Universe, Many Spaces: A Non-Local, Relativistic Quantum Spacetime https://doi.org/10.20944/preprints201805.0003.v1

Author: SHARP, Jonathan (University of Alberta)

Presenter: SHARP, Jonathan (University of Alberta)

Session Classification: W3-2 Mathematical and Theoretical Physics (DTP) / Physique mathématique et physique théorique (DPT)

Track Classification: Theoretical Physics / Physique théorique (DTP-DPT)