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Synthetic approach to the singularity problem

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We try to convince the reader that the categorical version of differential geometry, called Synthetic Differential Geometry (SDG), offers valuable tools which can be applied to work with some unsolved problems of general relativity. We do this with respect to the space-time singularity problem. The essential difference between the usual differential geometry and SDG is that the latter enriches the real line by introducing infinitesimal of various kinds. Owing to this geometry acquires a tool to penetrate "infinitesimally small"parts of a given manifold. However, to make use of this tool we must switch from the category of sets to some other suitable category. We try two topoi: the topos
$calG$ of germ determined ideals and the so-called Basel topos
$calB$. The category of manifolds is a subcategory of both of them. In
$calG$, we construct a simple model of a contracting sphere. As the sphere shrinks, its curvature increases, but when the radius of the sphere reaches infinitesimal values, the curvature becomes infinitesimal and the singularity is avoided. The topos
$calB$, unlike the topos
$calG$, has invertible infinitesimal and infinitely large nonstandard natural numbers. This allows us to see what happens when a function "goes through a singularity". When changing from the category of sets to another topos, one must be ready to switch from classical logic to intuitionistic logic. This is a radical step, but the logic of the universe is not obliged to conform to the logic of our brains.

Summary

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