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Using Isabelle/HOL to Verify First-Order Relativity Theory

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Abstract Logicians at the Rényi Mathematical Institute in Budapest have spent several years developing versions of relativity theory (special, general, and other variants) based wholly on first-order logic, and have argued in favour of the physical decidability, via exploitation of cosmological phenomena, of formally unsolvable questions such as the Halting Problem and the consistency of set theory. As part of a joint project, researchers at Sheffield have recently started generating rigorous machine-verified versions of the Hungarian proofs, so as to demonstrate the soundness of their work. In this paper, we explain the background to the project and demonstrate a first-order proof in Isabelle/HOL of the theorem "no inertial observer can travel faster than light". This approach to physical theories and physical computability has several pay-offs, because the precision with which physical theories need to be formalised within automated proof systems forces us to recognise subtly hidden assumptions.

Keywords Isabelle/HOL · First-order relativity theory · Hypercomputation · Physics and computation

CR Subject Classification F.4.1 · J.2

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