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An Observer-Based Foundation of Geometry NEWSHAW BAHREYNI, Department of Physics, University at Albany, Albany NY 12222, KEVIN H. KNUTH, Department of Physics, University at Albany, Albany NY 12222, Department of Informatics, University at Albany, Albany NY 12222 — The fact that some events influence other events enables one to define a partially ordered set (poset) of events, often referred to as a causal set. A chain of events, called observer chain, can be quantified by labeling its events numerically. Other events in a poset may be quantified with respect to an observer chain/chains by projecting them onto the chain, resulting in a pair of numbers. Similarly, pairs of events, called intervals, can be quantified with four numbers. Under certain conditions, this leads to the Minkowski metric, Lorentz transformations and the mathematics of special relativity (Bahreyni & Knuth, APS March Meeting 2011). We exploit the same techniques to demonstrate that geometric concepts can be *derived* from order-theoretic concepts. We show how chains in a poset can be used to define points and line segments. Subsequent quantification results in the Pythagorean Theorem and the inner product as well as other geometric concepts and measures. Thus the geometry of space, which is assumed to be fundamental, emerges as a result of quantifying a partially ordered set. More importantly, this proposed foundation of geometry is entirely observer-based, which may provide a natural way toward integration with quantum mechanics.

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