Spacetime Trigonometry: A Cayley-Klein Geometry Approach to Special and General Relativity

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Arthur Cayley and Felix Klein showed that Euclidean, Elliptic, and Hyperbolic geometries are special cases of Projective geometry. By exploiting the duality between points and lines in projective geometry, it turns out that there are actually nine Cayley-Klein geometries [in two dimensions] the other six are spacetime geometries studied in Relativity: Minkowski, deSitter (and anti-deSitter) and their Galilean limits. In this talk, we present a unified formalism for these nine geometries.

Inspired by I.M. Yagloms “A Simple Non-Euclidean Geometry and its Physical Basis” and Edwin Taylor and John Wheelers “Spacetime Physics,” we use familiar techniques from the analytic geometry and trigonometry of Euclidean space to develop the corresponding analogues for Galilean and Minkowski spacetimes and immediately provide them with physical interpretations. We lay out an idealized curriculum from high-school geometry to introductory General Relativity.

Along the way, we will mention some interesting connections with Euclid’s Postulates and with generalizations of the complex numbers. We will also mention numerous related problems in physics and in math that we have been working on [and that could use your help!].

Friday, October 31st
3:30pm, Room 1401

All Welcome to Attend
Centennial Hall