THE CHINESE UNIVERSITY OF HONG KONG
Department of Physics

SEMINAR

Henri Poincaré's Special Theory of Relativity

by

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ALL INTERESTED ARE WELCOME
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Abstract

In this talk, I will systematically introduce the mental journey of Henri Poincaré in establishing the special theory of relativity. It includes the following:

- The mathematical structure of 2+1 dimensional pseudo-Euclidean geometry in 1881;
- The viewpoint on the existence of ether in 1888;
- Issues regarding time measurement, the postulate of the constancy of the speed of light, and the problem of simultaneity at different locations in 1898;
- The principle of total momentum conservation for matters and electromagnetic field in 1900, a beam of electromagnetic radiation equivalent to a hypothetical fluid with inertia $m=E/c^2$, and a method proposed for synchronizing clocks at different locations using light signals, resulting in the time transformation formula under first-order approximation: $t'=t-vx/c^2$;
- The principle of relativity in classical mechanics and the unobservability of Earth's motion relative to the ether in 1902; the relativity of simultaneity;
- The complete statement of the principle of relativity in 1904;
- The pseudo-Euclidean geometry structure and the Lorentz transformation as a four-dimensional spacetime rotation around the origin, which together with spatial rotation forms the Lorentz group, published in two articles on June 5 and July 23 in 1905. The relativistic velocity addition rule; mathematical formulas for length contraction, time dilation, and the relativity of simultaneity at different locations; the complete covariance of electrodynamics; the relativistic principle of least action; the Lorentz group symmetry of physical laws; and the relativistic equations of motion for electrons.