Abstract Submitted
for the DAMOP13 Meeting of
The American Physical Society

Lorentz symmetric n-particle systems without "multiple times"

FELIX T. SMITH, Retired — The need for multiple times in relativistic n-particle dynamics is a consequence of Minkowski's postulated symmetry between space and time coordinates in a space-time $s = [x_1, .., x_4] = [x, y, z, ict]$, Eq. (1). Poincaré doubted the need for this space-time symmetry, believing Lorentz covariance could also prevail in some geometries with a three-dimensional position space and a quite different time coordinate. The Hubble expansion observed later justifies a specific geometry of this kind, a negatively curved position 3-space expanding with time at the Hubble rate $l_H(t) = l_{H,0}+c\Delta t$ (F. T. Smith, Ann. Fond. L. de Broglie, 30, 179 (2005) and 35, 395 (2010)). Its position 4-vector is not s but $q = [x_1, .., x_4] = [x, y, z, il_H(t)]$, and shows no 4-space symmetry. What is observed is always a difference 4-vector $\Delta q = [\Delta x, \Delta y, \Delta z, ic\Delta t]$, and this displays the structure of Eq. (1) perfectly. Thus we find the standard 4-vector of special relativity in a geometry that does not require a Minkowski space-time at all, but a quite different geometry with a expanding 3-space symmetry and an independent time. The same Lorentz symmetry with but a single time extends to 2 and n-body systems.

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Date submitted: 30 Jan 2013 Electronic form version 1.4