B2
Symmetry and Relativity
Lecture 11

Morning reading

https://arxiv.org/abs/2311.00608

Spacetime is Right-handed

Peter Woit

*Department of Mathematics, Columbia University**

(Dated: November 2, 2023)

Abstract

We describe the relation between vectors and spinors in complex spacetime in an unconventional chirally asymmetric manner, using purely right-handed spinors, with Minkowski spacetime getting Wick rotated to a four-dimensional Euclidean spacetime with a distinguished direction. In this right-handed spinor geometry self-dual two-forms can be used to get chiral formulations of the Yang-Mills and general relativity actions. Euclidean spacetime left-handed spinors then transform under an internal $SU(2)$ symmetry, rather than the usual $SU(2)_L$ spacetime symmetry related by analytic continuation to the Lorentz group $SL(2,\mathbf{C})$.

WICK ROTATION OF FOUR-DIMENSIONAL VECT

A simple way to understand Minkowski spacetime and i tifying spacetime vectors (x_0, x_1, x_3, x_3) with Hermitian tw

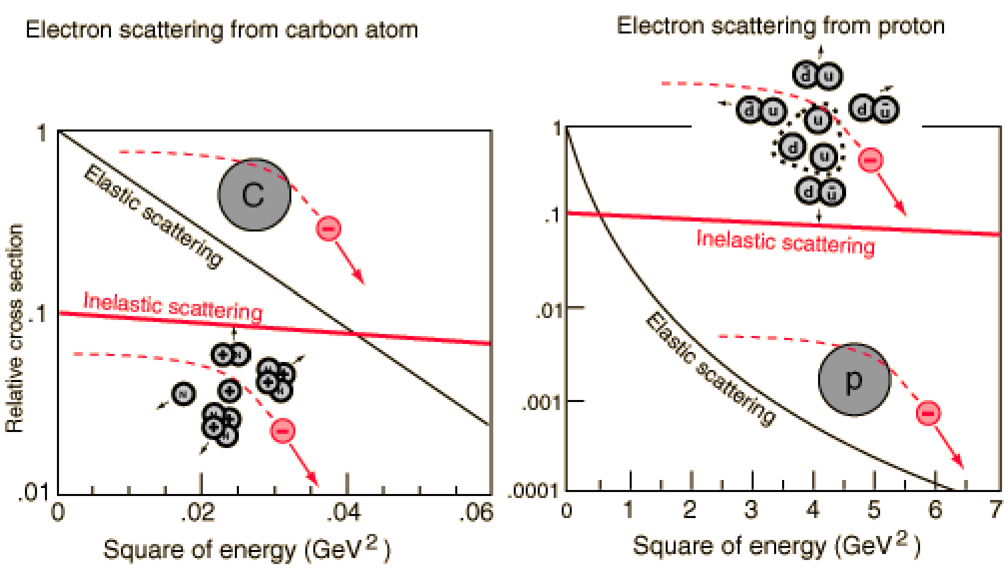
$$\begin{pmatrix} x_0 + x_3 & x_1 - ix_2 \\ x_1 + ix_2 & x_0 - x_3 \end{pmatrix} \quad (1)$$

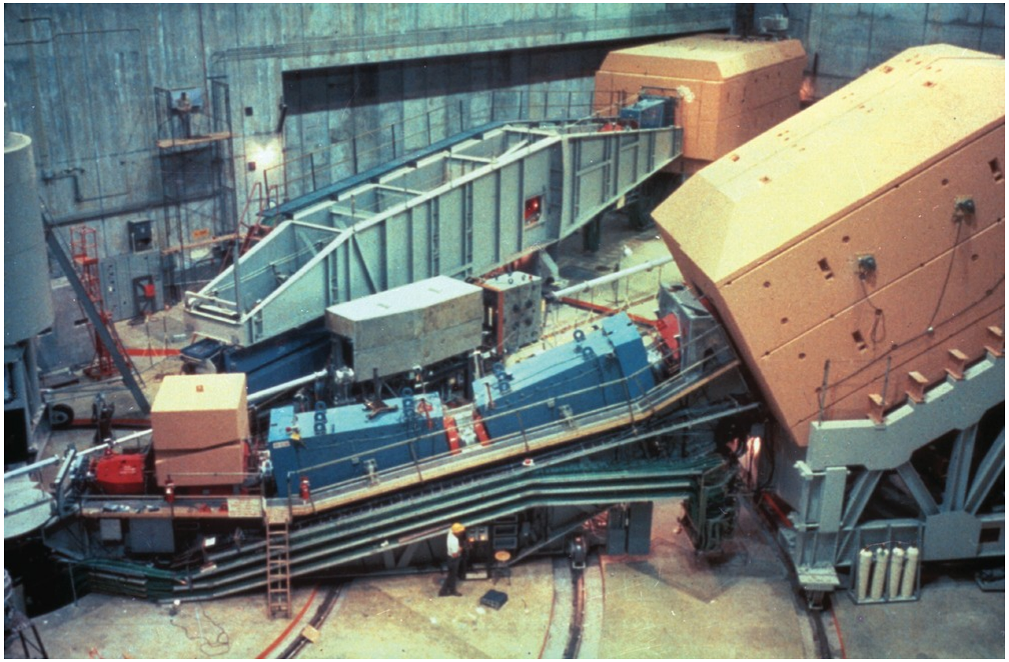
which have determinant minus the Minkowski length-squared: $-x_0^2 + x_1^2 + x_2^2 + x_3^2$. Elements Ω_L and Ω_R of the Lorentz group $SL(2,\mathbf{C})$ of matrices of determinant one act by taking this matrix to

$$\Omega_L \begin{pmatrix} x_0 + x_3 & x_1 - ix_2 \\ x_1 + ix_2 & x_0 - x_3 \end{pmatrix} \Omega_R^{-1}$$

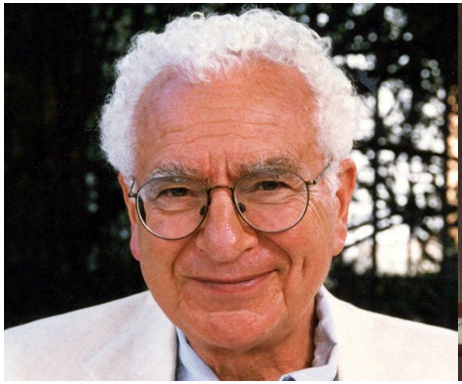
preserving the Minkowski norm. When $\Omega_R^{-1} = \Omega_L^\dagger$ the Hermiticity condition is preserved and one has an action on Minkowski spacetime.

Deep Inelastic Scattering and Quarks

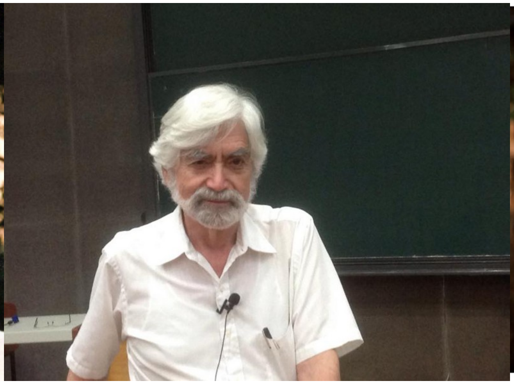




Gell-Mann



Zweig



Bjorken

Taylor, Kendall, Friedman