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# Towards generalized group structures for changes of quantum reference frames: the twisted Poincaré case

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An ordinary change between two classical reference frames (RF) A, B can be seen as a point $g$ in a Lie group manifold $G$; $g$ sharply specifies the orientation and motion (of the origin) of B relative to A, while the group product encodes the composition of two changes into a third one. So far, physical theories are characterized by their covariance under a suitable $G$. If A, B are classical RFs but the state of B relative to A is mixed (i.e., a classical statistical distribution), or more generally if A and/or B are quantum RFs (i.e., use "clocks"and "rulers"that are themselves quantum systems), then in general one cannot describe the associated "unsharp" changes of RF without some generalized group (GG) structure.
In the talk I will discuss some general requirements for GGs and how Hopf algebras (or "quantum groups ") $H$ may fulfill the latter. Remarkably, covariance under $H$ allows for noncommutative (NC) spacetime coordinates. As a non-trivial example of $H$ I will consider the "quantum Poincaré group"$H$ of covariance of the NC Minkowski spaces with coordinates fulfilling commutation relations of the type $[x^\mu, x^\nu] \equiv i\theta^{\mu\nu}$ =const.
Work in collaboration with F. Lizzi.

## Working Group

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**Author:** FIORE, Gaetano (Università di Napoli Federico II, and INFN, Napoli)

**Presenter:** FIORE, Gaetano (Università di Napoli Federico II, and INFN, Napoli)

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