

## Drinfel'd doubles and coisotropic spacetimes

**Ivan Gutierrez-Sagredo**

Universidad de Burgos

igsagredo@ubu.es

Angel Ballesteros

Universidad de Burgos

angelb@ubu.es

Francisco J. Herranz

Universidad de Burgos

fjherranz@ubu.es

In this talk we will present and explicitly construct all Drinfeld double (DD) decompositions of the Poincaré Lie group  $G$ . We show that there exist eight such non-isomorphic DD structures [1]. Each of these structures define a Poisson-Lie group  $(G, \Pi)$  with associated Lie bialgebra  $(\mathfrak{g}, \delta)$ .

The coisotropy condition for the cocommutator  $\delta$ , i.e.  $\delta(\mathfrak{h}) \subset \mathfrak{h} \wedge \mathfrak{g}$ , where  $\mathfrak{h} = \text{Lie}(H)$  is the Lorentz algebra, is a necessary and sufficient condition for  $(\mathcal{M}, \pi)$  to be a Poisson homogeneous space (PHS), where  $\mathcal{M} = G/H$  is Minkowski spacetime and  $\pi$  is the canonical projection of  $\Pi$ . Some of these PHS verify the stronger condition  $\delta(\mathfrak{h}) \subset \mathfrak{h} \wedge \mathfrak{h}$ , which are less numerous but can be more easily promoted to quantum homogeneous spaces (see [2, 3, 4] and references therein).

We will explicitly construct these coisotropic PHS arising as the semiclassical limit of non-commutative spacetimes, which are expected to be one of the footprints of quantum gravity effects at the Planck scale. In fact, we will see that our procedure gives the full non-commutative spacetimes in all but one case [1]. In the last part of the talk we will also present the full classification of Poisson-Lie structures for the Poincaré Lie group  $G$ , based on the classification of r-matrices given in [5] and we will identify which of them come from a DD structure.

## References

- [1] A. Ballesteros, I. Gutierrez-Sagredo, F.J. Herranz, The Poincaré Lie algebra as a Drinfeld double, (arXiv:1809.09207) (2018).
- [2] V. G. Drinfeld, On Poisson homogeneous spaces of Poisson-Lie groups, *Theoret. Math. Phys.* 95 (1993), 524.
- [3] A.G. Reyman, Poisson structures related to quantum groups, in *Quantum Groups and its applications in Physics, Intern. School Enrico Fermi (Varenna 1994)*, L. Castellani and J. Wess, eds., IOS, Amsterdam, p. 407 (1996).
- [4] A. Ballesteros, C. Meusburger, P. Naranjo, (A)dS Poisson homogeneous spaces and Drinfeld doubles, *J. Phys. A: Math. Theor.* 50 (2017) 395202.

- [5] P. Stachura. Poisson-Lie structures on Poincaré and Euclidean groups in three dimensions. *J. Phys. A. Math. Gen.* 31 (1998).