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Non-perturbative QFT in de Sitter: representation theory and Källén–Lehmann spectral representation

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There has been an extensive series of works aimed at understanding the non-perturbative QFT in AdS and Minkowski spacetime using bootstrap techniques. Implementing these techniques to QFT in dS requires a concrete understanding of Hilbert space decomposition into Unitary Irreducible Representation (UIR) of the dS symmetry group. In this spirit, we study the decomposition of the tensor product of free theory single-particle states as well as conformal multiplets of a bulk CFT into UIR of dS. Our main tools are the Harish-Chandra characters and the numerical diagonalization of the truncated quadratic Casimir of $SO(1,d+1)$. As the first step in a non-perturbative approach to QFT in dS, we derive the Kallen-Lehmann representation of spinning two-point functions. We find an inversion formula for the spectral density and discuss its analyticity properties. We conclude by reporting explicit expressions of the spectral density for several examples including CFT and free theory composite operator two-point functions.

Author: SALEHI VAZIRI, Kamran (University of Amsterdam)

Presenter: SALEHI VAZIRI, Kamran (University of Amsterdam)