



Contribution ID: 604

Type: **Invited Speaker / Conférencier invité**

Wigner function negativity and contextuality in quantum computation on rebits

Wednesday 17 June 2015 13:45 (30 minutes)

We describe a universal scheme of quantum computation by state injection on rebits (states with real density matrices). For this scheme, we establish contextuality and Wigner function negativity as computational resources, extending results of [M. Howard et al., Nature 510, 351–355 (2014)] to two-level systems. For this purpose, we define a Wigner function suited to systems of n rebits, and prove a corresponding discrete Hudson's theorem. We introduce contextuality witnesses for rebit states, and discuss the compatibility of our result with state-independent contextuality.

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Session Classification: W2-2 Quantum Information and Quantum Computation (DTP-DCMMP) / Information et calcul quantique (DPT-DPMCM)

Track Classification: Condensed Matter and Materials Physics / Physique de la matière condensée et matériaux (DCMMP-DPMCM)