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Uncertainties and correlations in the framework of spatiotemporal quantum reference frames

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The perspective-dependence of position and momentum uncertainties and their correlations are studied in the framework of nonrelativistic spatiotemporal quantum frames of reference [M. Suleymanov, I.L. Paiva, E. Cohen, Nonrelativistic spatiotemporal quantum reference frames, Phys. Rev. A 109, 032205 (2024)]. One of the results [M. Suleymanov, A. Carmi, E. Cohen, Uncertainties and covariances in the framework of spatiotemporal quantum reference frames, forthcoming] is that, even in the non-interacting case, the Heisenberg uncertainty relations of a certain particle described by different observers do not coincide in general. What is invariant and constant for all observers, in the current framework, is the determinant of the frame-dependent total covariance matrix [A. Carmi, E. Cohen, Relativistic independence bounds nonlocality, Sci. Adv. 5, eaav8370 (2019)]. A generalized version of uncertainty relations is obtained for the relational description, affected by the correlations between all subsystems in a chosen frame.

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