

Abstract Submitted  
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**Frame representations of quantum mechanics and the necessity of negativity in quasi-probability representations**<sup>1</sup> CHRISTOPHER FERRIE, JOSEPH EMERSON, University of Waterloo — Several finite dimensional quasi-probability representations of quantum states have been proposed to study various problems in quantum information theory and quantum foundations. These representations are often defined only on restricted dimensions and their physical significance in contexts such as drawing quantum-classical comparisons is limited by the non-uniqueness of the particular representation. Here we show how the mathematical theory of frames provides a unified formalism which accommodates all known quasi-probability representations of finite dimensional quantum systems. Moreover, we show that any quasi-probability representation satisfying two reasonable properties is equivalent to a frame representation and then prove that any such representation of quantum mechanics must exhibit either negativity or a deformed probability calculus.

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