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Correspondence between classical and quantum uncertainty by dimensional analysis VIOLA GATTUS, Univ of Manchester, SOTIRIOS KARAMITSOS, University of Pisa — Heisenberg's uncertainty principle is often presented as a "purely quantum" relation with no analogue in the classical $\hbar \to 0$ limit. However, this formulation of the classical limit is problematic for many reasons, one of which stems from dimensional analysis. Since $\hbar$ is a dimensionful constant, we may always work in natural units in which $\hbar = 1$. Dimensional analysis prescribes that all physical laws can be expressed purely in terms of dimensionless quantities. It follows that the existence of a dimensionally consistent constraint on $\Delta x \Delta p$ requires the existence of a dimensionful parameter with units of action. In this talk, I will argue that any definition of the classical uncertainty, if it is to be meaningful, must be formulated in terms of dimensionless quantities. I will compare the uncertainty of certain coupled classical systems and their quantum counterparts and show that they converge in the classical limit. Most notably, since these systems feature additional dimensionful scales, the uncertainty bounds are dependent on multiple dimensionless parameters, in accordance with dimensional considerations.

Viola Gattus
Univ of Manchester

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