PHYSICS SEMINAR

Estimating Unknown Parameters in Quantum Systems

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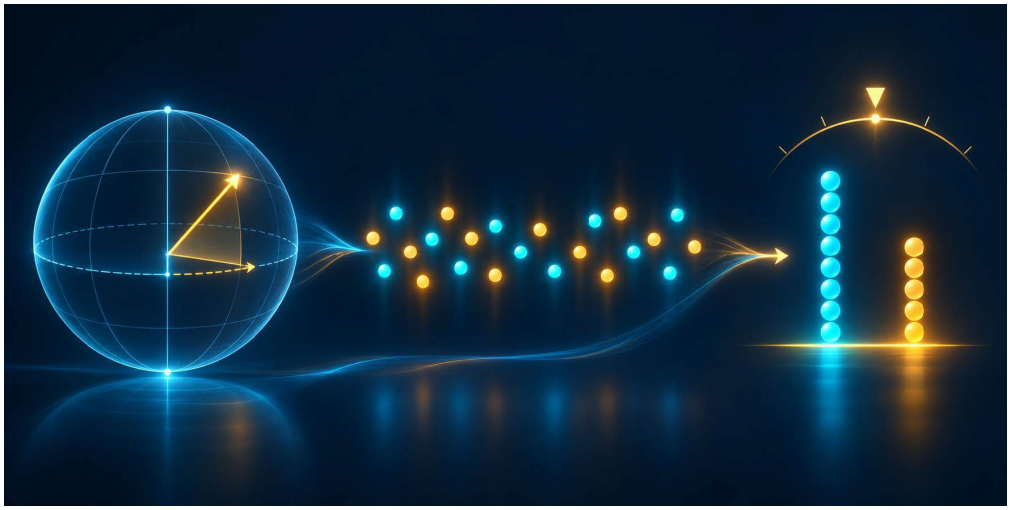
Thursday, November 19, 2026
12:30 – 1:30 p.m.
Wubben 264

How can repeated measurements reveal an unknown quantity when individual outcomes vary? Classical estimation uses the fact that an unknown parameter can shape the distribution of measurement outcomes. In quantum estimation, the parameter is encoded in a quantum state. Even an ideal measurement can yield different outcomes across identically prepared trials, with probabilities that depend on both the state and the choice of measurement.

This seminar begins with classical estimation and introduces Fisher information as a measure of how well the outcomes of a given measurement can distinguish parameter values. We then use a qubit to illustrate how measuring the same state in different bases can reveal different amounts of information about an unknown parameter. Finally, we introduce quantum Fisher information, which gives the maximum Fisher information obtainable by optimizing the measurement, and connect it to the Cramer-Rao bound which is a limit on estimation precision.



Refreshments!