

Seminar

Refuting local hidden variable theories without recourse to non-locality

Keerthan Subramanian

TCIS, Hyderabad

The completeness debate related to quantum mechanics traces its origin to the seminal paper by Einstein, Podolsky and Rosen (EPR) dating back to 1935. The thought experiment suggested by EPR leads to mutually exclusive outcomes either confirming or refuting the completeness of quantum mechanics. These ideas had to await a simpler formulation by Bohm and a theorem by Bell before this debate could be addressed experimentally. Experimental resolution using entangled photons violating Bell's inequality, some as recent as 2015 closing various loopholes, have only confirmed that quantum mechanics is complete and that our ideas of local realism are untenable with physical reality.

While the spin angular momentum (SAM) associated with photons has been known since almost a century, the revelation that photons can also possess an orbital angular momentum (OAM) is a recent one. This opens up the possibility of creating locally correlated SAM/OAM photon states that are mathematically isomorphic with non-locally correlated, entangled states. Measuring the SAM is straightforward as it is related to the polarization, whereas OAM being related to wave front helicity needs a phase sensitive technique for its projection. We propose and demonstrate an interferometric device that acts as an OAM projector and use it to measure correlations between photon SAM and OAM. We create locally correlated SAM/OAM states and show that strong correlations for such states culminate in a violation of Bell's inequality thereby resolving the EPR debate without taking a recourse to non-locality.

Friday, Sep 8th 2017

11:30 AM (Tea/Coffee at 11:15 AM)

Auditorium, TIFR (FReT-B)