

Bunching and Antibunching of Quantum Particles From Astronomy to AMO

Young's double slit setup, introduced about two hundred years ago, is one of the most versatile tool to demonstrate the interference phenomena for both the light and the matter waves in physics. In contrast to this amplitude interferometry, there is also an intensity interferometry, discovered by Hanbury Brown and Twiss (HBT) about half a century ago, where correlations of signal intensities, rather than amplitudes was used to measure the angular sizes of astronomical objects. Instead of the two slits, the intensity interferometry involves two detectors and measures the probability of simultaneous arrival of particles in the detector. In view of the strange unclassical character of the identical particles, this detection probability is enhanced for bosons (bunching) and diminished for fermions (anti-bunching) compared to the corresponding values for the particles whose trajectories obey classical laws of physics. This interferometry, is now an exquisite tool in particle physics on a scale of 10^{-10} , just the opposite of the astronomical scale of 10^{10} in original HBT effect, in addition to its applications in AMO and condensed matter physics.

This talk will covers the historical journey that begins with the work of Dirac, Heisenberg, Pauli and Fermi and others, and encounters the celebrated work of Hanbury Brown Twiss in astronomy and focus on one of the most exciting new frontiers, namely the physics of ultracold atoms that is revolutionizing physics.