Non-Abelian Anyon Collider

June-Young Lee*[1] and H.-S. Sim*[1]

[1]Korea Advanced Institute of Science and Technology – South Korea

Abstract

Anyon is an exotic quasiparticle that is neither fermion nor boson. On top of long time efforts to detect the anyonic statistics in the fractional quantum Hall (FQH) systems, there was a recent experimental breakthrough on the Abelian anyon collider at a Laughlin state (1), in agreement with the non-equilibrium bosonization theory (2). However, it remains elusive which aspect of the anyonic statistics is identified from the experimental results, and there is even no theoretical prediction for the non-Abelian anyons.
Here we develop a theory of anyon colliders on the generic FQH systems, that is applicable for both Abelian and non-Abelian anyons (3). Based on a conformal field theory and non-perturbative resummation over all perturbation orders of anyon injection to the collider, we predict that the collider provides a tool for direct observation of the braiding statistics of various Abelian and non-Abelian anyons. Its dominant process is not direct collision between the injected anyons, contrary to common expectation, but a time-domain interference that an anyon excited at the collider braids with the injected anyons. Our finding implies that the collider experiments including Ref. (1) actually provide a direct signature of the anyon braiding.

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*Speaker