# Quantum Hall Systems on Toroidal Geometries

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We present and discuss results of recent numerical calculations of second Landau level states on toroidal geometries. Calculations on the torus generally allow for smaller particle numbers than those on the sphere, due to less powerful symmetries. However, on the torus, different candidate states for particular quantum Hall plateaus appear at equal flux, in contrast to the situation on the sphere or plane, where the flux can be shifted. This means that working on the torus allows for more direct comparisons of trial states and reduces the problem of aliasing. Moreover, the torus brings interesting geometry described by a modular parameter. This potentially allows for a larger variety of phases as well as some interesting limits which can be treated analytically (notably the thin torus limit). It also allows for the calculation of the Hall viscosity, a quantity which corresponds to the shift on the sphere. Calculating this in principle allows for direct identification of the correct number of flux quanta to consider in calculations on the sphere or plane. We give an explanation of our methods and show results which include calculations of the Coulomb spectra, Hall viscosity as well as excitation gaps and overlaps with various trial wave functions. The fillings considered include $\nu = \frac{12}{5}$ and $\nu = \frac{5}{2}$ where states hosting non-Abelian anyons have been conjectured. We compare the situation to more well-established first Landau level results and note that these second Landau level systems behave quite differently away from the thin torus limit, in particular showing rather large finite size effects.