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Title: The N-vortex problem on a sphere

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Abstract: In this talk, I will describe the formulation and dynamics of the N-vortex problem on the surface of a rotating sphere. The system is a particle discretization of the Euler equations of incompressible fluid dynamics with an interaction energy that is logarithmic. There are three main features of this model that make the problem interesting. First is the compact nature of the sphere which causes local features of the flowfield to have global effects as a result of the Poincaré index theorem. Second is the (generic) misalignment of the center-of-vorticity vector with the axis of rotation, not possible for the more familiar planar problem. Third is the coupling of the particles to the background field which, in certain circumstances, can trigger the generation of Rossby waves which subsequently break the conserved quantities of the underlying Hamiltonian system. I will develop the problem from the ground-up, treating it as a hierarchical model to study vorticity and particle transport in the atmosphere. I will end with a survey of related problems of interest, such as the implementation of models that conserve potential vorticity, stochastic versions driven by random-walks, Thomson's global optimization problem of how to distribute N charged particles on the surface of a sphere (related to the Tammes spherical packing problem), the problem of optimal grid-generation on curved and topologically complex surfaces using particle interaction methods, recent work on the modeling of vortices in thin-film superconductors on curved surfaces, and understanding the arrangement of atoms in spherical molecules, the most familiar of which is the buckminsterfullerine. Collaborators include M. Jamaloodeen, R. Kidambi, S. Ross, T. Sakajo, H. Shokraneh.