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Kinetic energy for the nuclear Yang-Mills collective model GEORGE ROSENSTEEL, NICK SPARKS, Tulane University — The Bohr-Mottelson-Frankfurt model of nuclear rotations and quadrupole vibrations is a foundational model in nuclear structure physics. The model, also called the geometrical collective model or simply GCM, has two hidden mathematical structures, one Lie group theoretic and the other differential geometric. Although the group structure has been understood for some time, the geometric structure is a new unexplored feature that shares the same mathematical origin as Yang-Mills, viz., a vector bundle with a non-abelian structure group and a connection. Using the de Rham Laplacian $\triangle = \star d \star d$ from differential geometry for the kinetic energy extends significantly the physical scope of the GCM model. This Laplacian contains a "magnetic" term due to the coupling between base manifold rotational and fiber vorticity degrees of freedom. When the connection specializes to irrotational flow, the Laplacian reduces to the Bohr-Mottelson kinetic energy operator. More generally, the connection yields a moment of inertia that is intermediate between the extremes of irrotational flow and rigid body motion.

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