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A complete set of data to characterize loop braiding statistics in (3+1)-D topological phases DOMINIC ELSE, Department of Physics, University of California, Santa Barbara, CHETAN NAYAK, Microsoft Research, Station Q, University of California, Santa Barbara — In (2+1)-D, topological phases of matter can be classified by the braiding statistics of their particle-like excitations. Similarly, in (3+1)-D one expects topological phases to be characterized by the braiding statistics of their excitations, which may be particle-like or loop-like. A "braiding" of loop-like excitations is any continuous deformation of some collection of (possibly linked) loops which eventually returns the loops to their original locations. Here, we identify a finite set of basic data which determines the amplitude for *any* loop braiding in an abelian (3+1)-D topological phase. This includes the "three-loop braiding" recently considered by several authors, but also all other possible braidings. Our basic data are the natural generalization of the F and R symbols of (2+1)-D topological phases to (3+1)-D. From a mathematical point of view, we expect them to correspond to a "ribbon 2-category".

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