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Anomalous Symmetry Fractionalization and Surface Topological Order XIE CHEN, California Institute of Technology, FIONA BURNELL, University of Minnesota, ASHVIN VISHWANATH, University of California, Berkeley, LUKASZ FIDKOWSKI, Stony Brook University — In addition to fractional statistics, anyon excitations of a 2D topologically ordered state can realize symmetry in unusual ways such as carrying fractional quantum numbers, leading to a variety of symmetry enriched topological (SET) phases. While the symmetry fractionalization must be consistent with the fusion and braiding rules of the anyons, not all consistent symmetry fractionalizations can be realized in 2D systems. Instead, certain SETs are anomalous in that they can only occur on the surface of a 3D symmetry protected topological (SPT) phase. In this paper we describe a procedure for identifying an anomalous SET which has a discrete unitary symmetry group G. The basic idea is to gauge the symmetry and expose the anomaly as an obstruction to defining a consistent topological theory involving both the original anyons and the gauge fluxes. We point out that a class of obstructions are captured by the fourth cohomology group $H^4(G, U(1))$, which also labels the set of 3D SPT phases, providing an explicit link to surface topological orders. We illustrate this using the simplest possible example - the projective semion model - where a $Z_2 \times Z_2$ symmetry acts on a chiral semion in a way which is only possible on the surface of a 3D SPT phase.

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