This is joint work with Chris Douglas and Chris Schommer-Pries.

A favorite symmetric monoidal 3-category:

- Objects are (finite rigid) $\otimes$-category
- Finite bimodule categories
- 2-morphisms are braided functors
- 3-morphisms are natural transformations.

Why is this a 3-category? Use universal properties.

**Theorem.** (Separable) fusion categories are fully dualizable.

**Theorem.** Finite rigid monoidal categories are 2-dualizable. In fact, most 3-dimensional handles are okay.

**Theorem.** There is an $O(3)$-action on finite rigid $\otimes$-categories.

Suppose the positively-oriented point is sent to $\mathcal{C}$. Then the negatively-oriented point is sent to $\mathcal{C}^{op}$, the category with the opposite monoidal structure.

The 3-framed on $S^1$ coming from a 1-framing is sent to $\mathcal{C} \boxtimes_{\mathcal{C}^{op}} \mathcal{C}$. The circle that bounds $D^2$ is sent to $Z(\mathcal{C})$.

Note, that the set of framings on an interval is $\pi_1(SO(3)) = \mathbb{Z}_2$. The nontrivial framed interval is sent to $c\mathcal{C}_C$, where the right $\mathcal{C}$-action is twisted by the double dual.

We have a 2-bordism between the square of the nontrivial framing and the trivial framing, it is sent to a map $c\mathcal{C}_C \to c\mathcal{C}_C$, where the right $\mathcal{C}$-module structure on the first $\mathcal{C}$ is twisted by the quadruple dual. The map is given by sending 1 to $D$, the canonical invertible bimodule.

Recall that pivotal structure is a natural isomorphism between the double dual and the identity. A pivotal category is spherical if the square of the trivialization of the double dual is the canonical identification.

Warning: this is not Morita invariant. Instead, one can define $h$-pivotal to be an isomorphism $c\mathcal{C}_{C} \overset{\sim}{\to} c\mathcal{C}_{C}$, where the right $\mathcal{C}$-structure on the first $\mathcal{C}$ is twisted by the double dual. $hspherical$ is defined in a similar way to spherical.

$SO(3)$-fixed points are identified with $hspherical$ categories satisfying some anomaly vanishing condition.
$SO(2)$-fixed points are hpivotal satisfying self-braided vanishing condition.