THE BRANES BEHIND GENERALIZED SYMMETRY OPERATORS

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Based on works with:

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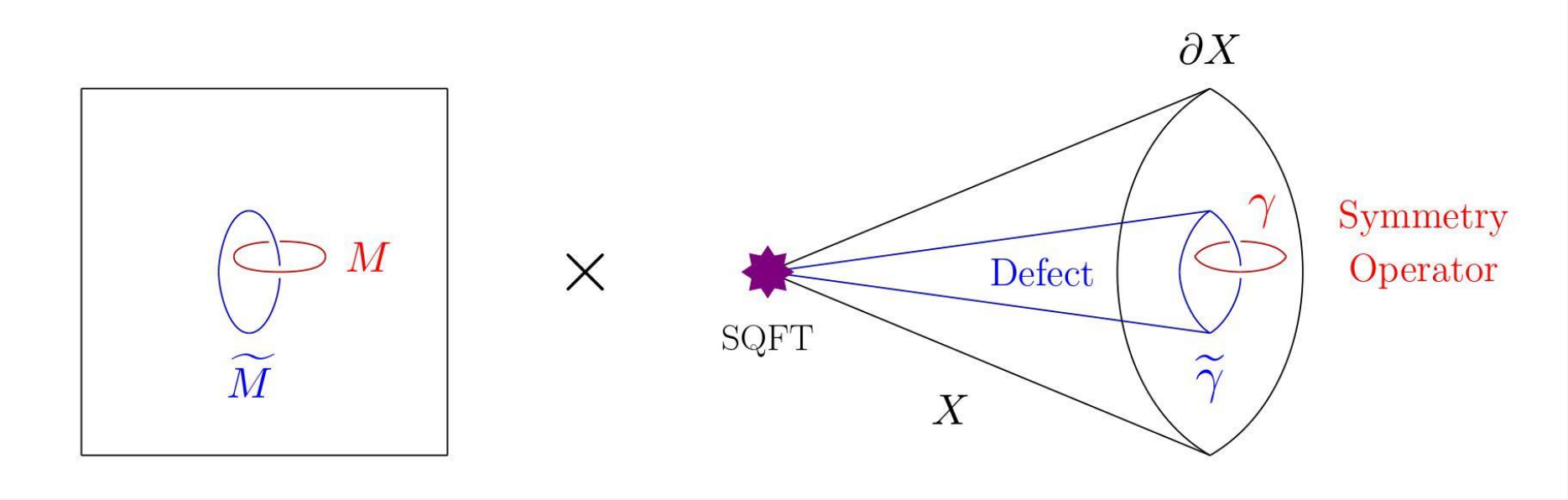
GENERAL MOTIVATION

- Lots of recent interest in the high energy theory community in the subject of generalized/categorical symmetries. Higher-group and non-invertible symmetries are particular instances. [See Seiberg+Cordova talks]
- The perspective of symmetries as topological (extended) operators has been central in elucidating and discovering many of these structures in field theories that are now recognized to be generic
- Given the well-known successes of string theory in understanding strongly coupled dynamics of SCFTs and SQFTs, where do these new field theory tools lie in the stringy domain?

GEOMETRIC ENGINEERING AND TOPOLOGICAL OPERATORS

Key idea:
[2209.03343]
[2305.09665]



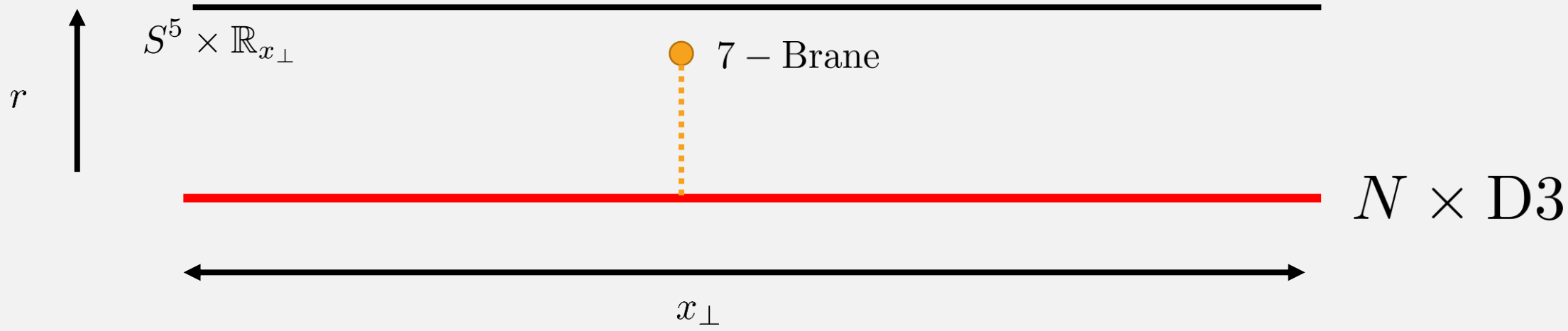
Spacetime of field theory

Internal directions of string/M-theory

- Generically fusion rules are non-invertible due to numerous WZ terms of branes/fluxbranes

(see also [Apruzzi ,Bah ,Bonetti ,Schafer-Nameki,'22] and [Garcia-Extrebarria '22] for earlier work in holographic context, as well as [Thomas' Gong Show])

7-BRANES AS DUALITY DEFECTS



IIB string picture of 4d N=4 duality/triality defects of [Kaidi,Ohmori,Zheng '21]. Can generalize to D3s probing singularities. (See [2212.09743])

Flexible setup depending on 7-brane, direction of cut, value of τ and boundary conditions for B_2 and C_2.

Similarly ([2305.05689]), can realize charge conjugation operators of 6D SCFT/SQFTs via the non-supersymmetric R7 branes of [2212.05077].

X COMPACT

- Now place string/M-theory on compact, closed X with finite volume, then G_N of lower dimensional theory non-zero
- "One-line proof" of no global symmetries in string/M-theory:

$$\partial X = 0$$

(No branes at infinity if there is no infinity!)

- More non-trivially ([2307.13027]), we can still predict emergent generalized symmetries in the IR limit of gravitational theories as

$$X \setminus (\text{singularities and/or brane loci})$$

plays the role of an "effective asymptotic boundary" in the deep IR.

CONCLUSIONS/FUTURE DIRECTIONS

- We saw new methods for determining symmetries of QFTs constructed from string theory. Despite some new (at the time) features, e.g. 6D 2-form symmetry of SCFTs can be non-invertible, duality symmetries for N=1 quiver gauge theories, this program is still in its infancy
- For compact X, connection between emergent generalized global symmetries and exponential hierarchies?
- Application to non-supersymmetric QFTs?
- What notion of generalized homology of ∂X should we be wrapping the branes on?
- Dynamical role of symmetry breaking? (for some examples see [2304.03300])
- Purely QFT advancements: What are constraints on dynamics implied from non-invertible symmetries and their anomalies?

THANK YOU!