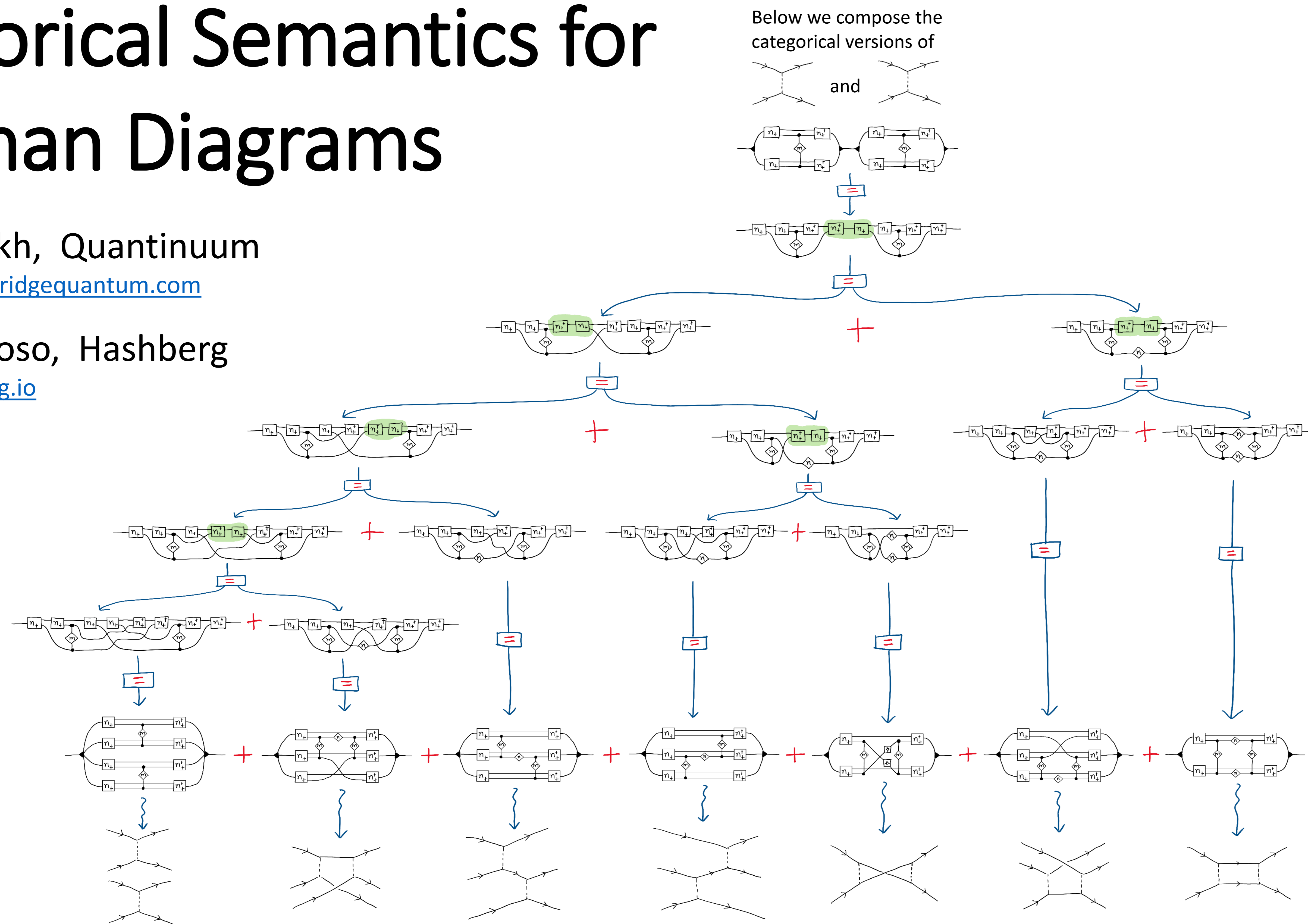


Categorical Semantics for Feynman Diagrams

Razin A. Shaikh, Quantinuum
razin.shaikh@cambridgequantum.com

Stefano Gogioso, Hashberg
quantum@hashberg.io



Sequential composition of two categorical Feynman diagrams results in the superposition of all possible graph-theoretic combinations of the individual diagrams

Examples	
nucleon – nucleon scattering (2 nd order)	
nucleon – nucleon scattering (4 th order)	
nucleon – anti-nucleon scattering	
meson decay	
meson – meson scattering	

Ingredients

- Creation and annihilation operators
- Feynman propagator
- Split and merge maps

Rules

- Isometry
- Sliding rule (split)
- Sliding rule (merge)

Categorical Feynman Diagrams

For a given Feynman diagram, we consider its corresponding term in Wick's expansion. We translate that term into a string diagram, obtaining a linearized version of the Feynman diagram as a process in our \star Hilb category.

We rewrite the string diagram using the given rules to obtain the categorical Feynman diagram.

introduce a split-merge pair sliding rules replace sums with spiders fuse spiders