**Abstract**

Color codes are topological codes that can be defined in any dimension. In 3D or higher dimensions they can have a transversal $T$ gate. We review how to systematically construct color codes in any dimension, then focus on the 3D case and upper bound the distances of the codes generated from different tilings.

**Color codes**

A $D$-dimensional color code is composed of a $D$-dimensional homogeneous simplicial complex whose vertices are $D + 1$ colorable with respect to the edge relation. Qubits are identified with the $D$-cells and $X$ and $Z$ stabilizers are identified with $x$-cells and $z$-cells. To encode one logical qubit one can cut out from the bulk a large simplex with $D + 1$ colored boundaries. A colored boundary does not contain vertices of its own color. Cutting out a larger simplex will result in a code with a larger distance. **Logical $X$** (resp. $Z$) operators have dimensionality $D - z - 2$ (resp. $D - x - 2$). In the case of a one-dimensional operator, it has the structure of a string net.

**Uniform tesselations**

Uniform tilings are space filling arrangements of regular polytopes where all vertices “look” the same. Symmetry groups are so-called Coxeter groups, generated by reflections, with group relations determined by internal angles in the tesselation.

Given a Coxeter group we can construct a uniform tesselation which is $D + 1$ colorable. This construction is an other formalization of the “inflating” method described in [1]. Coxeter groups have been classified and can be used to explicitly construct color codes with closed or open boundaries.

**2D tesselations**

Well-known examples:

- $4 \times 4$
- $4 \times 6$
- $6 \times 6$

**3D tesselations**

Stabilizer weights:

<table>
<thead>
<tr>
<th>$X$</th>
<th>48, 16, 16, 48</th>
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</thead>
<tbody>
<tr>
<td>$Z$</td>
<td>8, 6, 4</td>
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see also [2]

**References**
