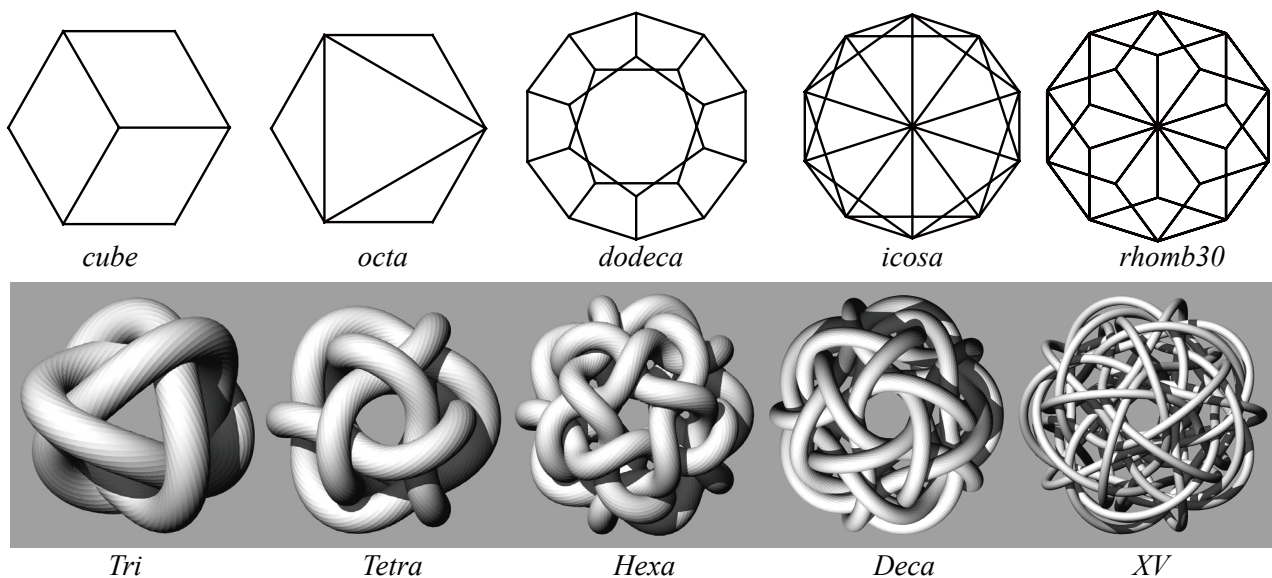


## Poly-Twistor by 3D Printer Classification of 3D Tori

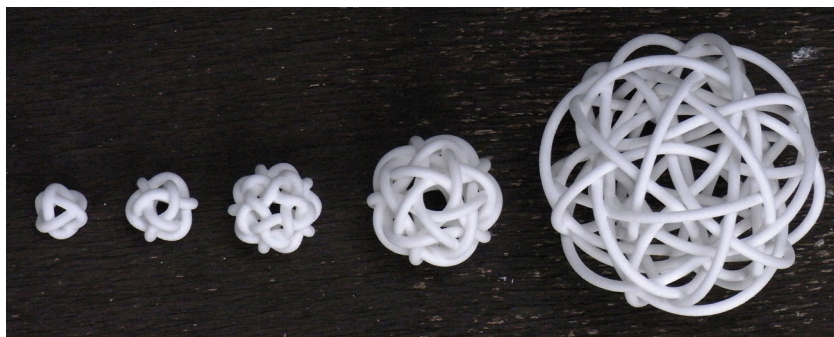
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### Abstract

Using 3D printing, we can manufacture forms called Poly-Twistors. These are knotted closed loops around the surface of either a torus or a polyhedron. Variants have handedness and can be parameterized using different integer winding frequencies.

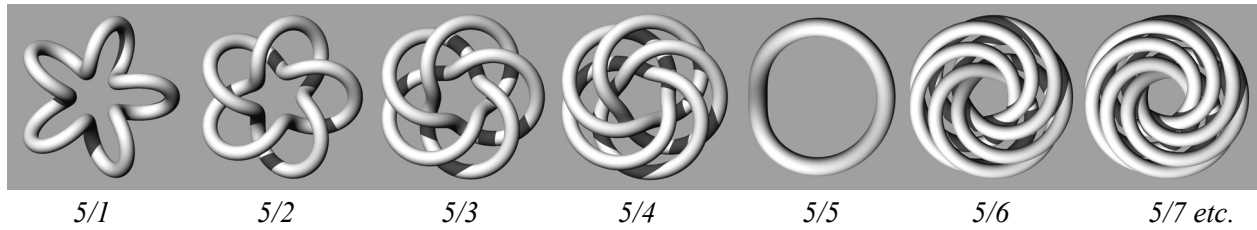


**Figure 1 :** *The Five Simplest Poly-Twistors*

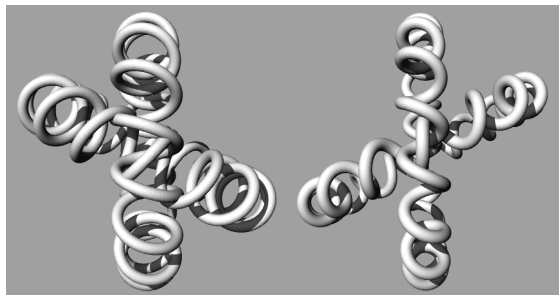


**Figure 2 :** *Real Models of the Simplest Poly-Twistor*  
Size: from 12mm to 60mm diameter , Material: plastic

We can consider the three-dimensional torus by identifying the parallel aspect to face each other of the polyhedron. The Poly-Twistor is one expression of the 3D tori. We show the five simplest Poly-Twistors and their corresponding polyhedron on Fig. 1. We can produce the real models by 3D printer as shown on Fig. 2.



**Figure 3:** An Example of Helical-Torus in case of  $5/k$ .

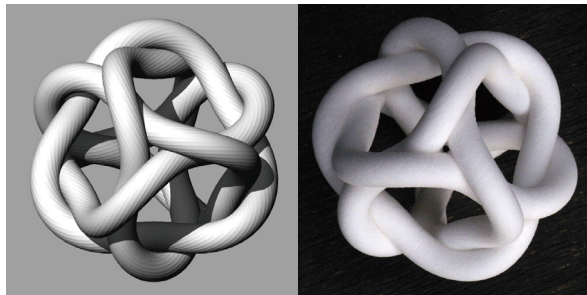


**Figure 4:** *plus-minus chirality*

The Poly-Twistor is an assemblage of identical helical-torus arranged with polyhedral symmetry. We define any helical-torus by a single frequency. We show an example in Fig. 3. When the frequency is a fraction (not integer), the helical-torus makes a torus knot. We can decide any frequency, amplitude of helices, thickness of the tube, and cross-section.

There are two kinds of chirality governing any two helical-tori interlock with each other. We define left type is “+ (plus)”, and right type is “- (minus)” as shown on Fig. 4. Tri-Twistor and XV-Twistor don't have such

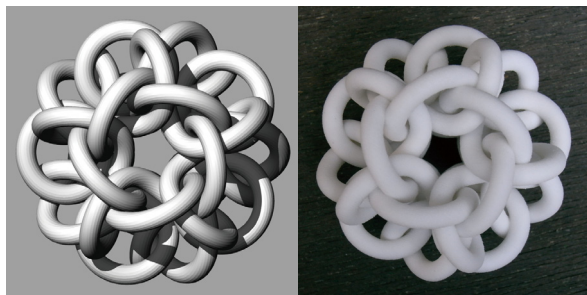
chirality because tori's equatorial planes intersect in a right angle when we view from the 2-fold rotational axis of symmetry. Therefore there are eight kinds of Poly-Twistor. Further technically, there are sixteen kinds of Poly-Twistors because helical-torus itself has also chirality of clockwise and counterclockwise.



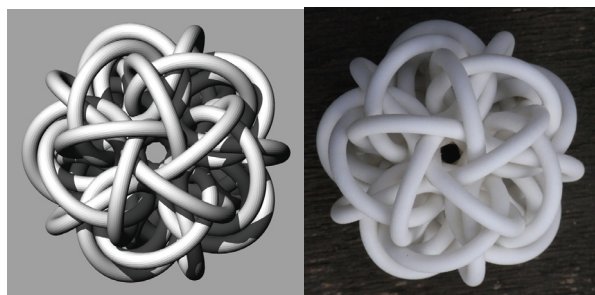
*Tetra-Twistor 3/1 minus*

The simplest Tetra, Hexa, and Deca-Twistor in Fig. 1 are plus chirality. We show minus simplest in Fig. 5.

We wrote the C program to generate STL data of the Poly-Twistors directly. We can produce almost endless kinds of such topological structures. We show some sample CG and photos of real models from next pages.

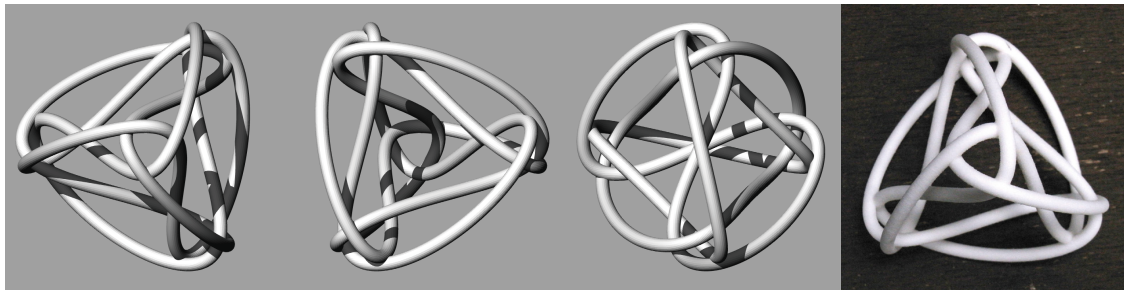


*Hexa-Twistor 5/1 minus*

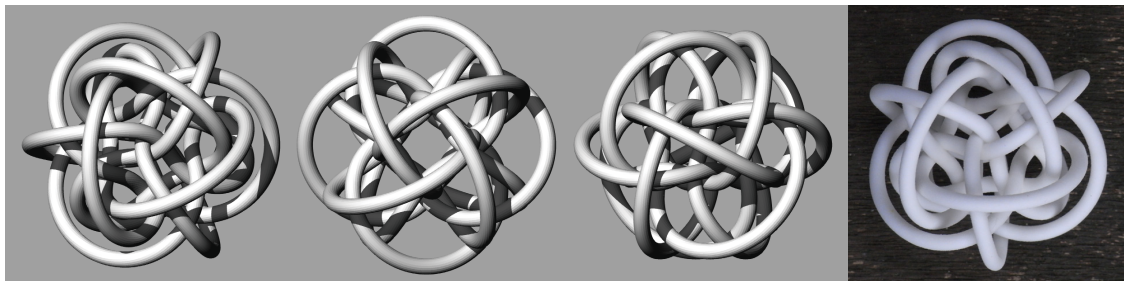


*Deca-Twistor 3/1 minus*

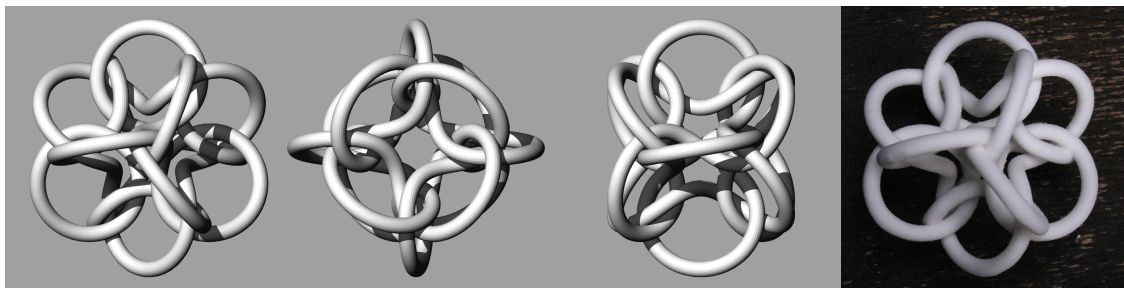
**Figure 5:** Three minus simplest of Poly-Twistores



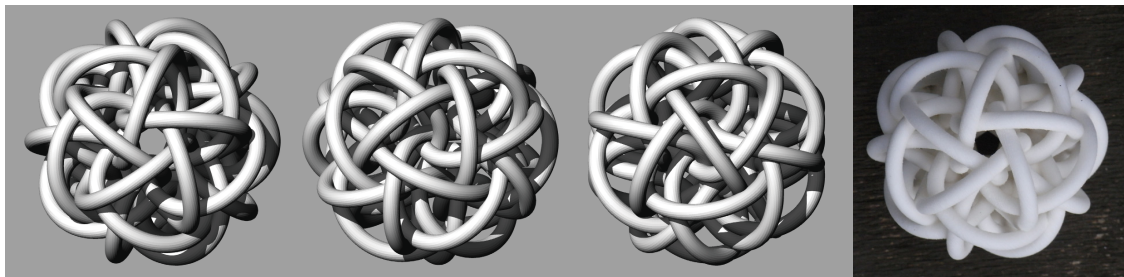
*Tri-Twistor 2/1*



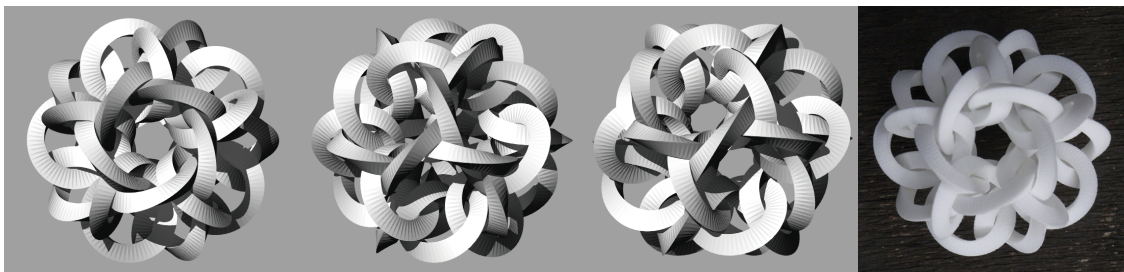
*Tetra-Twistor 3/2 plus*



*Tetra-Twistor 3/1 minus*

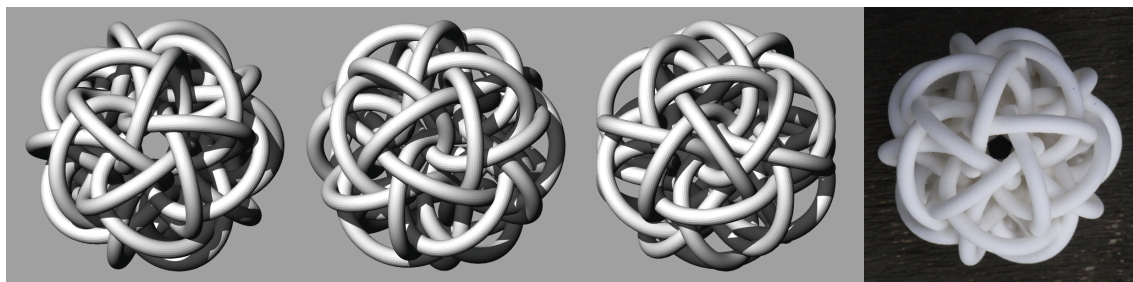


*Hexa-Twistor 5/2 plus*

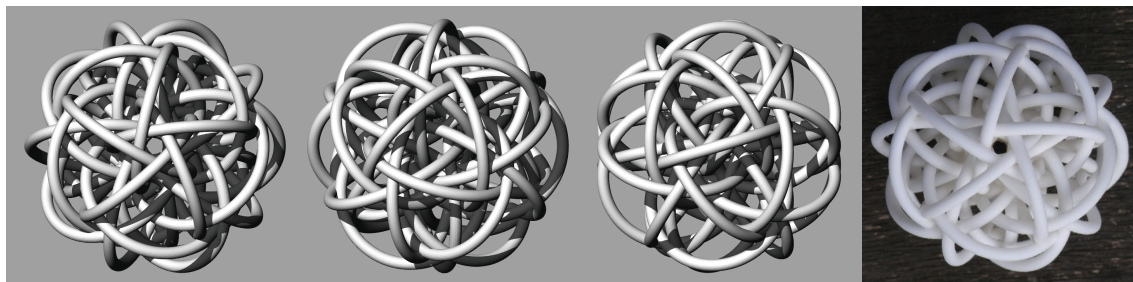


*Hexa-Twistor 5/1 minus (triangular section)*

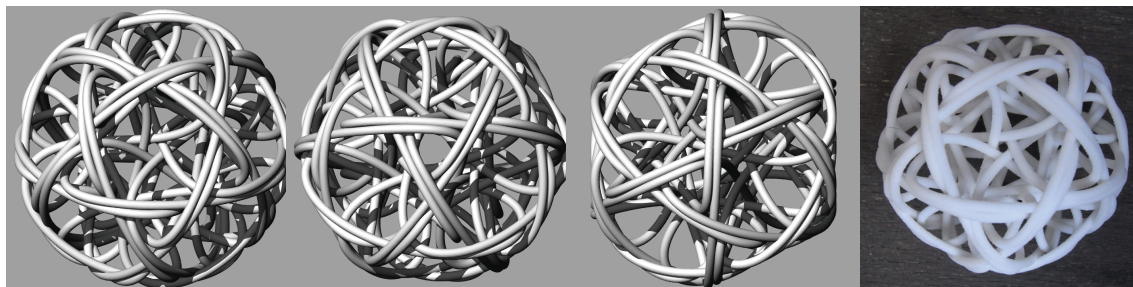
**Figure 6 (1):** *Samples of Poly-Twistors.*



*Hexa-Twistor 5/2 plus*



*Deca-Twistor 3/2 minus*



*XV-Twistor 2/1*

**Figure 6 (2):** *Samples of Poly-Twistors.*

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