Double Triamond, w/ Hexastix!

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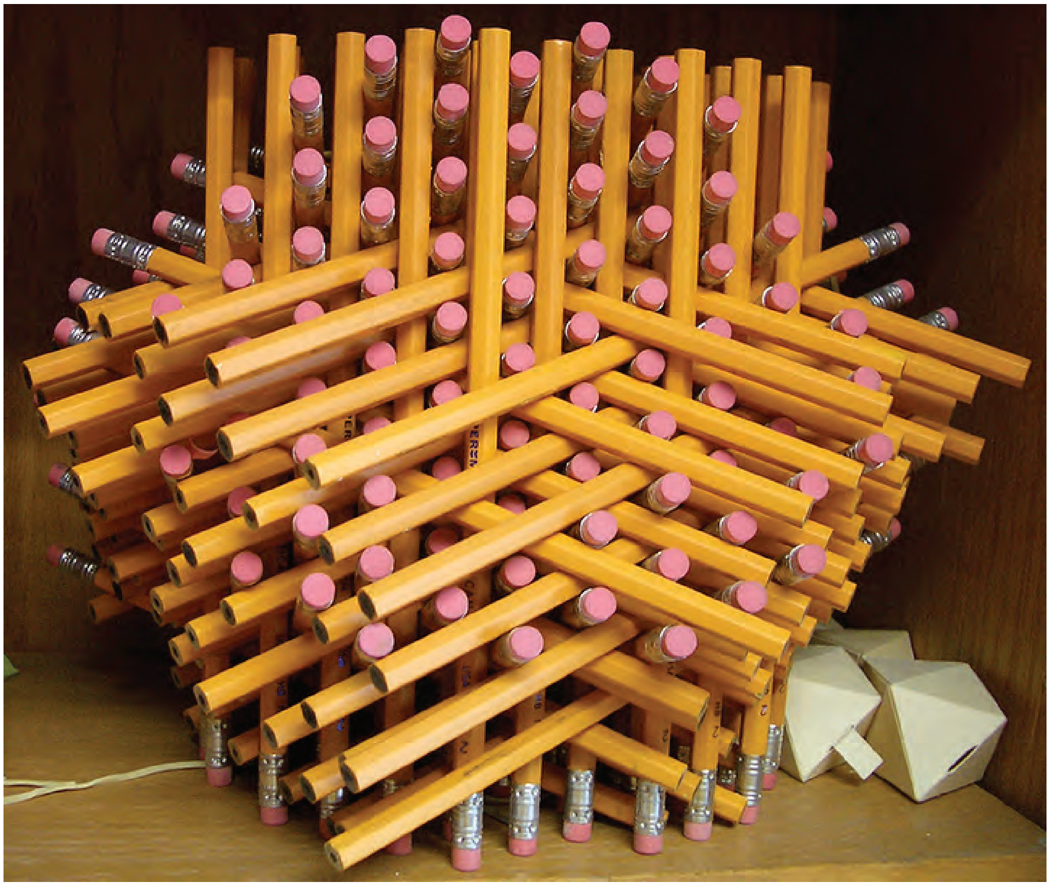
G4G8 2008



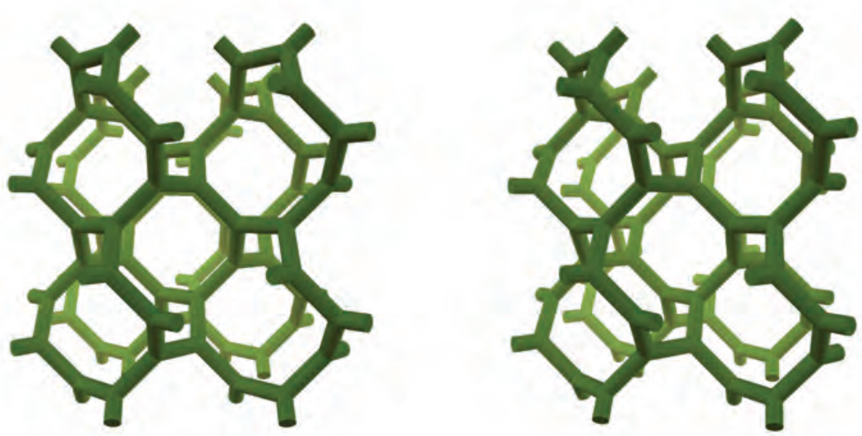
$4^{+}/4$

The quarter symmetries of space are in a sense the sparsest and so the most pleasing aesthetically—To our limited geometric senses, these quarter symmetries appear to lie astride the boundary of order and disorder, our direct comprehension never fully enveloping the mathematical structure before our eyes.

Two interpenetrating, dual cubic lattices are as symmetrical as can be, with the full plenary symmetry type $8^{o}{:}2$. In this symmetry, and in all the plenary symmetry types, there are four directions of three-fold axes of rotation, and such axes intersect at the centers of any cube.

The quarter groups also have such axes, but only one-quarter as many. In particular, only one such axis passes through the center of any cube. These axes are shown at left, as interwoven pencils.

The most symmetrical of quarter groups (with the pencils identical on both ends) is denoted $8^{o}/4$; by breaking symmetries we have subgroups of this, ultimately reaching $1^{o}/4$.

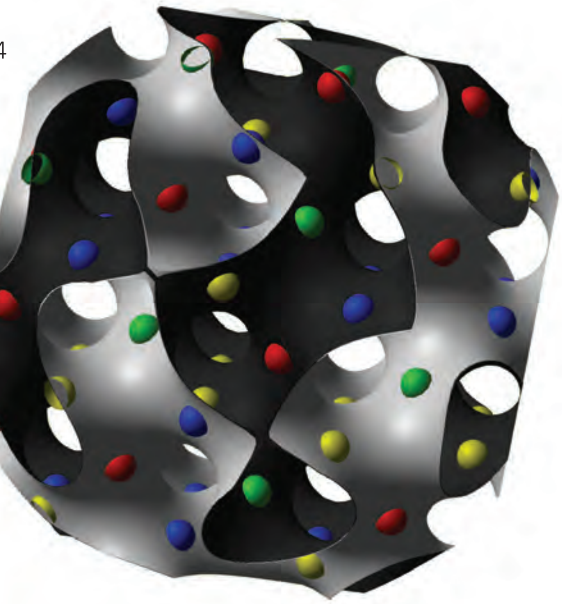


The triamond, in stereo.

One triamond is shown above, twice. Two trianets can be entertwined together, each dual to the other, with opposite orientations. Together, these duals have symmetry $8^{o}/4$.

Breaking this symmetry, distinguishing between these duals (say by ignoring one, as in the images above) we have symmetry $4^{+}/4$.

$4^+/4$



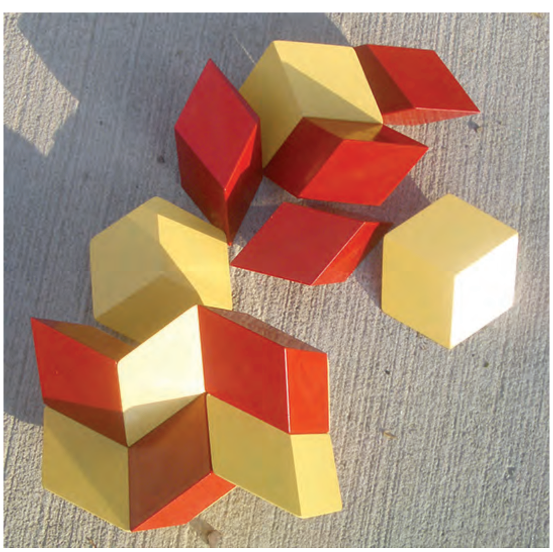
The set of points *xyz* that satisfy
0 = sin *x* cos *y* + sin *y* cos *z* + sin *z* cos *x*
form a surface with symmetry $8^\circ/4$;

That surface very closely approximates the famous minimal surface, the Gyroid, discovered by Alan Schoen, with the same symmetry type.

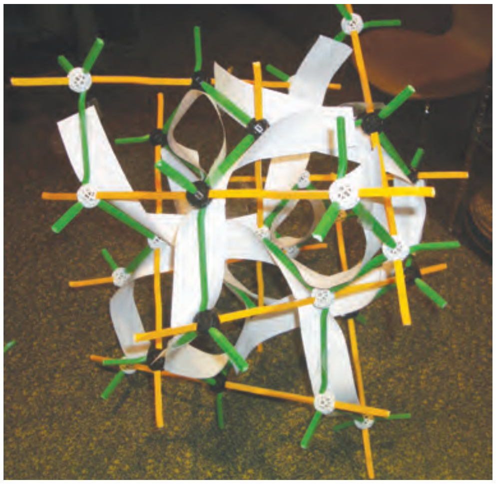
At right this surface is shown, but with its two sides distinguished, resulting in symmetry $4^+/4$ encoded as which colors might be swapped.

At left, a portion of the gyroid is shown in purple, entwined with two dual triamonds—one black, the other reversed, in gray. The yellow lines are the three-fold rotation axes, following the same lines as the pencils on the opposite page

$2^-/4$



The quarter groups are fascinating family of symmetries, exhibited by many interesting objects.



We began with this zome and paper model, working out the structure we'd use.

From this, we intended to cast triamond modules in bronze — an expensive and difficult proposition!

The plaster model we made as a first test was pretty, but we quickly saw we would need to do something else.

The zometool model, with its paper strips, had already pointed the way. Quickly, we made a complete prototype of final sculpture out of wood and rolled aluminum. . .

But how to get coils of steel for the sculpture itself?

Eugene geared up his torch onto a crankshaft, rigged to turn at exactly the correct rate as the torch moved — the coils of ***Double Triamond, w/ Hexastix!*** are cut from steel pipes.

A lot of hard work before getting to see much...

One of the most fascinating parts of any project is working through all the kinks and obstructions that will interfere with the final assembly process.

This sculpture was all kinks and obstructions—hand-made but with little tolerance for error if everything was to align. We carefully worked out a process of flushing out any error, sweeping it across to one side and off the sculpture, and hoped that we had this right!

Painting and packing.

Note the subtle feature that coils twisting one way are painted green on the outside and white on the inside; coils twisting the other are painted white on the outside and green on the inside.

At times this was confusing!

And the pieces arrive and are unwrapped.

Everything went marvelously smoothly.

done in an hour, plus touch up!

One the front cover, the sculpture is shown down a four-fold glide-rotation axis.
The piece also has two-fold rotation and three-fold rotation axes.