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Relations between icosahedral polytopes induced by group ring elements.

The symmetry operations considered in classical crystallography are isometries which preserve lengths and angles. In some situations, however, it is beneficial to consider a larger class of operations. It is well-known that scalings play an important role in the analysis of quasicrystals via inflation rules, but they also occur naturally in the description of biomacromolecules, relating an inner channel to the outer hull of the molecule.

It was observed by A. Janner that the enclosing forms of macromolecules can often be described by star polygons which explain that the scalings found take special values related e.g. to the golden ratio (in case of 5- or 10-fold symmetry) or $\sqrt{2}$ (in case of 8-fold symmetry). A closer analysis of the intersection points of the different star polygons in a regular n-gon shows that the ratios between the radii of these points often correspond to units in the integral group ring of the corresponding cyclic group.

This immediately raises the question whether units in group rings of other groups also give rise to interesting geometric relations. We give an affirmative answer by demonstrating that the group ring of the icosahedral group provides a wealth of relations between various polytopes with icosahedral symmetry. (Received January 27, 2014)