Group actions applied to virus architecture

Philippe Cara

Vrije Universietit Brussel

(Joint work with A. Devillers and R. Twarock)

It has been known for a long time that most viruses exhibit icosahedral symmetry. In 1962 Caspar and Klug[1] developed a theory describing the structure of the protein containers that encapsulate and hence protect the viral genome. The theory's main ingredients are triangulations of the faces of an icosahedron. The location of (centres of mass of) structural proteins is deduced from such triangulations.

More recently Keef and Twarock[2] extended the Caspar–Klug theory using more general tilings of the icosahedron and superpositions of several tilings. Now more structural details can be explained as well as the organisation of the viral genome inside the icosahedral capsid. In this theory many mathematical objects like quasicrystals, groups, lattices, etc. interact to provide more insight.

We clarify these interactions and provide a more uniform mathematical framwork based on group actions.

References

[1] Caspar D.L.D. and Klug A., *Physical principles in the construction of regular viruses*, Cold Spring Harbor Symp. 27:1–24, 1962.

[2] Keef, T. and Twarock, R., *Affine extensions of the icosahedral group with applications to the three-dimensional organisation of simple viruses*, J. Math. Biol. 59: 287-313, 2009.