

Trigonometry of tetrahedra and rational elliptic surfaces

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The trigonometry of tetrahedra is a classical subject with its origins tracing back for thousands of years. In the 20th century, several new ideas arose in the field originating from representation theory. In particular, physicist Tullio Regge discovered a rich group of symmetries acting on trigonometric relations between elements of tetrahedra. In the talk I will describe an algebra-geometric approach to the trigonometry of tetrahedra based on a correspondence between non-Euclidean tetrahedra and rational elliptic surfaces inspired by the theory of motives. This approach clarifies the meaning of Regge symmetries and leads to some unexpected relations between the dihedral angles and the edge lengths of a tetrahedron. For instance, we will see that the cross-ratio of the exponents of the spherical angles of a Euclidean tetrahedron coincides with the cross-ratio of the perimeters of its faces.