

Cubic Surfaces with 27 Lines and 13 Eckardt Points

Fatma Karaoglu^{1,2}, ***Anton Betten***¹

[fkaraoglu@nku.edu.tr]

¹ Department of Mathematics, Colorado State University, Fort Collins, CO 8526, USA

² Department of Mathematics, Tekirdag Namik Kemal University, Tekirdag, Turkey

A cubic surface is an algebraic variety of degree three in projective three space. Important geometric invariants are the number of lines on the cubic surface and the number of Eckardt points, which are points where three lines of the surface are concurrent. In this talk, we focus on cubic surfaces with 27 lines and 13 or 45 Eckardt points. Two cubic surface with same number of lines and the same number of Eckardt points may be projectively distinct.

We classify the cubic surfaces with 27 lines over a field of even characteristic with 13 or 45 Eckardt points. We give a concise description of all cubic surfaces with these properties and compute the automorphism groups of them. This work generalizes earlier work by Hirschfeld [4] which settles the case of 45 Eckardt points.

This work is based on the relation between cubic surfaces with 27 lines and 6-arcs in a plane [2], on the configuration of Eckardt points [3] and the automorphism groups of 6-arcs. Furthermore, the tables of cubic surfaces over small finite fields from [1] are used.

Keywords

Finite Geometry, Grup Theory, Eckardt Points, Configurations

References

- [1] A. BETTEN AND F. KARAOGU, Cubic surfaces over small finite fields. *Des. Codes Cryptogr.* **87**(4), 931–953 (2019).
- [2] F.E. ECKARDT, Ueber diejenigen Fl"achen dritten Grades, auf denen sich drei gerade Linien in einem Punkte schneiden. *Math. Ann.* **10**, 227–272 (1876).
- [3] J. W. P. HIRSCHFELD, Classical configurations over finite fields. I. The double- six and the cubic surface with 27 lines. *Rend. Mat. e Appl.* **26**(5), 115–152 (1967).
- [4] J. W. P. HIRSCHFELD, The double-six of lines over PG(3, 4). *J. Austral. Math. Soc.* **4**, 83–89 (1964).