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A NEW CLASS OF TRANSLATION PLANES OF ORDER q^3

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1. Introduction

Let q be an odd prime power, where 2 is a non-square in $GF(q)$. The aim of this paper is to construct a new class of translation planes of order q^3 and to determine their linear translation complements. Their kernels are isomorphic to $GF(q)$. If $q \neq 3$, then the linear translation complement of any plane of this class has exactly two orbits of length 2 and q^3-1 on the line at infinity and it is of order $3(q-1)(q^3-1)$. If $q=3$, then the plane is the Hering plane of order 27 and the translation complement is isomorphic to SL(2, 13).

The planes also differ from those which are generalized André planes [1] and semifield planes.

2. Preliminaries

We list some results that will be required in the calculations of the linear translation complements.

Let q be a prime power. For $\alpha \in GF(q^3)$ put $\bar{\alpha}=\alpha^q$ and $\bar{\bar{\alpha}}=\alpha^{q^2}$. Set

$$M(3, q^3) = \left\{ \begin{pmatrix} \alpha_{11} & \alpha_{12} & \alpha_{13} \\ \alpha_{21} & \alpha_{22} & \alpha_{23} \\ \alpha_{31} & \alpha_{32} & \alpha_{33} \end{pmatrix} \middle| \alpha_{ij} \in GF(q^3) \right\}$$

and

$$\mathfrak{A} = \left\{ \begin{pmatrix} \alpha & \bar{\alpha} & \bar{\bar{\alpha}} \\ \beta & \bar{\beta} & \bar{\bar{\beta}} \\ \gamma & \bar{\gamma} & \bar{\bar{\gamma}} \end{pmatrix} \in GL(3, q^3) \right\} .$$

Then $\varepsilon \in \mathfrak{U}$ if and only if

$$\varepsilon = \begin{pmatrix} \alpha & \bar{\alpha} & \bar{\bar{\alpha}} \\ \beta & \bar{\beta} & \bar{\bar{\beta}} \\ \gamma & \bar{\gamma} & \bar{\bar{\gamma}} \end{pmatrix}$$