Maximal surfaces with planar lines of curvature

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Abstract

It is known that a connected minimal surface in the Euclidean space $\mathbb{E}^3$ with planar lines of curvature is a piece of either a plane, an Enneper's surface, a catenoid or a surface in a continuous family of Bonnet's surfaces. In the context of maximal surfaces, we intend to present a similar result:

Theorem. *If one family of lines of curvature on a connected maximal surface in Minkowski space $\mathbb{L}^3$ consists of planar curves, then so does the other family. Up to an isometry and a homothety of $\mathbb{L}^3$, such a surface is part of either a plane, a maximal Enneper surface, a maximal catenoid, or one of the maximal Bonnet surfaces, of 1^{st} and 2^{nd} kinds.*

Our proof is based on the ideas used by Nitsche (in his famous book) to prove the analogous theorem for minimal surfaces, besides the classification (not found in the literature) of the orthogonal systems of curves with constant geodesic curvature in the hyperbolic plane.