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Autor: Kauffman, Louis H. / Lambropoulou, Sofia
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ON THE CLASSIFICATION OF RATIONAL KNOTS

by Louis H. KAUFFMAN and Sofia LAMBROPOULOU

ABSTRACT. In this paper we give combinatorial proofs of the classification of unoriented and oriented rational knots based on the now known classification of alternating knots and the calculus of continued fractions. We also characterize the class of strongly invertible rational links. Rational links are of fundamental importance in the study of DNA recombination.

1. INTRODUCTION

Rational knots and links comprise the simplest class of links. The first twenty five knots, except for 8_5 , are rational. Furthermore all knots and links up to ten crossings are either rational or are obtained by inserting rational tangles into a small number of planar graphs, see [6]. Rational links are alternating with one or two unknotted components, and they are also known in the literature as Viergeflechte, four-plats or 2-bridge knots depending on their geometric representation. More precisely, rational knots can be represented as :

- plat closures of four-strand braids (Viergeflechte [1], four-plats). These are knot diagrams with two local maxima and two local minima.
- 2-bridge knots. A 2-bridge knot is a knot that has a diagram in which there are two distinct arcs, each overpassing a consecutive sequence of crossings, and every crossing in the diagram is in one of these sequences. The two arcs are called the bridges of the diagram (compare with [5], p. 23).
- numerator or denominator closures of rational tangles (see Figures 1, 5). A rational tangle is the result of consecutive twists on neighboring endpoints of two trivial arcs. For examples see Figure 1 and Figure 3.