



VI KONGRES MŁODYCH MATEMATYKÓW POLSKICH

15-18 września 2016

Wydział Matematyki i Nauk Informatycznych

Politechnika Warszawska

Non-Euclidean geometry; a world without the fifth postulate

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I have discovered things so wonderful that I was astounded ... out of nothing I have created a strange new world¹

Nowadays we know that Janos Bolyai slightly overestimated his abilities while making this statement, yet little had we known about what geometry truly is before papers on non-Euclidean geometry were published. In my lecture I am going to describe hyperbolic geometry by operating on two-sheeted hyperboloid to create Klein's and Poincare's models. Using them I will show how basic properties of hyperbolic plane should be understood. I will also address the problem of the defect of a triangle and its connection with the Parallel Postulate, proving that in hyperbolic geometry all similarities are necessarily isometries. Should I have enough time, we will move to projective geometry, analysing hemisphere and drawing a connection between it and the Moebius strip. My aim would be to make you realise that although we have built most of our civilization on Euclidean geometry, the world of mathematics is far richer and much more complex than that.

¹J. J. O'Connor and E. F. Robertson "Non-Euclidean Geometry": Janos Bolyai in a letter to his father in 1823.