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Boundary Plateau Laws

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Dipping a wire of metal or plastic in soapy water and taking it out is a favorite classroom experiment: typically the soapy water will form a thin film which is attached to the wire. The classical Plateau laws, stated by the Belgian physicist Joseph Plateau in the nineteenth century, assert that, away from the wire, the local geometry of a soap film is described locally by the following list of shapes: a 2-dimensional plane, three halfplanes meeting at a common line with equal angles, and the cone over the 1-dimensional skeleton of a regular tetrahedron.

Is there a similar list of possible shapes for the points where the film touches its "boundary", namely the wire of the classroom experiment? The classical Plateau laws were translated into a mathematical theorem by Jean Taylor in the seventies: in a nutshell Taylor's theorem rigorously classifies 2-dimensional conical shapes which minimize the area. In this talk I will illustrate a recent joint work with Federico Glaudo, classifying conical shapes which minimize the area and include a boundary line: the corresponding list suggests an analog of Plateau's laws at the boundary of the soap film, which are very much in agreement with both real-life and numerical experiments.

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