Signs, polynomials, and reaction networks

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Abstract: This talk is centered on the development of tools within the framework of applied algebra for the analysis of mathematical models arising in the study of biochemical reaction networks. In this context, the dynamics of the concentrations of the chemical species over time are often modelled by a system of parameter-dependent ordinary differential equations, which are typically polynomial or described by rational functions. Problems such as the determination of the possible number of equilibria for varying parameters, the stability of equilibria, and the existence of bifurcation parameters, can be translated into the study of the solutions to a (huge) system of polynomial equalities and inequalities.

In my talk I will present the challenges within applied algebra of the study of solutions to polynomial systems of equalities and inequalities, and the formalism of the theory of reaction networks. Afterwards I will focus on the problem of counting equilibria by showing recent results that exploit the connection between the Newton polytope of a multivariate polynomial and the signs the polynomial attains over the positive orthant.