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Non-existence of torically maximal hypersurfaces

Simple Harnack curves are extremal objects in real algebraic geometry that were introduced by Mikhalkin. Since then they have appeared in different areas of mathematics and finding their higher dimensional analogues has been an interesting open problem. One proposed generalisation are torically maximal subvarieties. These are real subvarieties of the complex torus whose logarithmic Gauß map is generically totally real. In this talk we will explain why, beyond the case of curves, the only torically maximal projective hypersurfaces are hyperplanes. In higher dimensions we also show that the only real hypersurfaces having a totally real logarithmic Gauß map are hyperplanes of projective spaces. In higher codimension, products of torically maximal hypersurfaces are also torically maximal, but the existence of other examples remains an open problem.

This talk is based on joint work with Erwan Brugallé, Grigory Mikhalkin, and Jean-Jacques Risler.