1135-15-1288 **J. William Helton**, **Igor Klep** and **Jurij Volčič*** (jurij.volcic@auckland.ac.nz), University of Auckland, Department of Mathematics, Auckland, New Zealand. *Free singularity loci of noncommutative polynomials.*

The free singularity locus of a (matrix-valued) noncommutative polynomial f is defined to be the union of hypersurfaces

$$\mathcal{Z}(f)=\bigcup_{n\in\mathbb{N}}\mathcal{Z}_n(f),\qquad \mathcal{Z}_n(f)=\left\{X\in \mathrm{M}_n(k)^g : \det f(X)=0\right\}.$$

Such sets naturally arise in free analysis and free real algebraic geometry, for example as the free algebraic closure of the boundary of a free spectrahedron or the complement of the domain of a noncommutative rational function.

In this talk we will first establish an algebraic certificate for the inclusion of free loci $\mathcal{Z}(f_1)\subseteq\mathcal{Z}(f_2)$ to hold. Then the correspondence between irreducible components of $\mathcal{Z}_n(f)$ for large n and irreducible factors of f in the free algebra will be explained. Lastly, smooth points on $\mathcal{Z}(f)$ will be related to one-dimensional kernels of images of f, which implies the quantum version of Kippenhahn's conjecture and pertains to Positivstellensätze on free semialgebraic sets. (Received September 21, 2017)