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J William Helton*, Math Dept, UCSD, La Jolla, CA 92093. *Noncommutative Inequalities*. Preliminary report.

The talk will cover aspects of inequalities for non-commutative functions in free $*$ -algebras mostly done with Igor Klep, Scott McCullough, Chris Nelson and Jaka Cimpric At this point we have:

- A. Free $*$ -algebra versions of the classical real algebraic geometry description, ie. positivstellensatze (resp. nullstellensatze), which provide an algebraic certificate for a polynomial q to take positive definite (resp. zero) values on the set where another, q , takes positive definite (resp. zero) values;
- B. Classifications of convex rational functions, varieties and open sets. There are shockingly few;
- C. An emerging picture of free convex hulls and projections of free semi-algebraic sets;
- D. Some theory of changes of variables to achieve non-commutative convexity and the relationship to positivstellensatze;
- E. Other.

The work originates in trying to develop some theory for studying the matrix inequalities which are ubiquitous in linear engineering systems and control. The talk will select a topic from the list above and will be co-ordinated with Scott McCullough's talk. (Received September 16, 2013)