General talk (Kuweit lectures):

“The shape of an algebraic variety”

Abstract: An algebraic variety $X$ over the complex numbers has, as one of its main facets, a topological space $X^{\text{top}}$. The study of $X^{\text{top}}$ has played an important role in the history of algebraic geometry. We will present a way of measuring the “shape” of $X^{\text{top}}$ by considering maps from it into different targets. The targets $T$, which are like spaces, are also profitably viewed as $n$-stacks, a notion from higher category theory. The complex algebraic structure of $X$ leads to a number of different structures on $\text{Hom}(X^{\text{top}}, T)$. For example when $T = BG$, the mapping stack $\text{Hom}(X^{\text{top}}, BG)$ may be viewed as the moduli space of $G$-bundles with integrable connection, or principal $G$-Higgs bundles. These fit together into Hitchin’s twistor space. Consideration of these structures is a good way of organizing the investigation of the topology of complex algebraic varieties.

Seminar talk (Algebraic geometry seminar):

“Regulators of canonical extensions”

Abstract: Suppose $X$ is a smooth projective variety with normal crossings divisor $D$. A flat connection on $U := X - D$ with unipotent monodromy around components of $D$ leads to the Deligne canonical extension, a bundle $E$ over $X$ such that the connection $\nabla$ has logarithmic poles and nilpotent residues. We would like to define Chern-Simons regulators for $(E, \nabla)$ in $H^{2g-1}(X, \mathbb{C}/\mathbb{Z})$, and prove the Reznikov theorem that they are torsion in the algebraic case. The latter should be a consequence of T. Mochizuki’s theorem about deforming a representation to a variation of Hodge structure. In joint work with J. Iyer, we have been able to do this in the first case when $D$ is smooth. Deligne and Esnault have sent ideas for the general normal crossings case.