LTCC Proposed Course

Title: Algebraic de Rham cohomology and flat connections

Basic Details:

- PhD students in pure mathematics.
- Course Format (**Extended**: 5 x 2hr lectures)

Course Description:

- **Keywords:** Algebraic de Rham cohomology, Flat Connection, Gauss—Manin Connection
- **Syllabus:** Things which will definitely be covered: definition of algebraic de Rham cohomology, examples. comparison with analytic de Rham cohomology, Hodge decomposition, Gauss—Manin connection, de Rham cohomology in characteristic p.
  Things (some of) which might be covered: extensions of mixed Hodge structure, intermediate Jacobians, Kodaira—Spencer morphism, flat connections on principal G-bundles, iterated integrals and the de Rham fundamental group, Buium—Manin theory of differential characters, functional transcendence, rigid cohomology, point counting algorithms, p-adic integration.
- **Recommended reading:**
  These notes give a good account of how to compute some examples of things we will talk about in the course:
  "p-adic cohomology: from theory to practice", Kedlaya
  Chapter 2 of the book "Galois groups and fundamental groups" by Szamuely gives a friendly account of glat connections and the Riemann—Hilbert correspondence.
- **Additional Optional reading**: Everything starts with the following papers
  "On the de Rham cohomology of algebraic varieties", Grothendieck
  "On the differentiation of De Rham cohomology classes with respect to parameters", Katz—Oda
  There are a number of beautiful papers of Katz on algebraic de Rham cohomology which are relevant to the course. For the material on flat connections on principal G-bundles, possible references are
  "Complex analytic connections in fibre bundles", Atiyah
  Appendix of "Algebraic leaves of algebraic foliations over number fields", Bost
  The first two sections of "A differential approach to Ax—Schanuel I", Blazquez-Sanz, Casale, Freitag, Nagloo.
- **Prerequisites:** We will use the language of schemes, we may occasionally refer to the p-adic numbers, and we will assume familiarity with a first course in algebraic topology and Galois theory.

Format:

- No of discussion/problem sheets: 2
- Electronic lecture notes: These will be provided as we go along.
- Necessary support facilities: None.

Lecturer Details:

- Lecturer: Netan Dogra
- Lecturer home institution: King’s College London
- Lecturer e-mail: netan.dogra@kcl.ac.uk