LTCC Proposed Course

Title: Riemannian Holonomy Groups

Basic Details:

- Core Audience (1st yr or 2nd/3rd yr: pure, app. or stats): pure
- Course Format (**Extended**: 5 x 2hr lectures or **Intensive**: 2 x 4hr lectures over 2 consecutive days): extended

Course Description:

- Keywords: Riemannian manifolds, Einstein manifolds, special holonomy, Calabi-Yau, hyperkähler, G2 and Spin(7) manifolds
- Syllabus:

The course will be an introduction to the theory of Riemannian holonomy groups and the geometry of manifolds with special holonomy. After an introduction to holonomy and Berger's classification of holonomy groups of irreducible non-symmetric Riemannian manifolds, we will concentrate on the Ricci-flat holonomy groups SU(n), Sp(n), G2 and Spin(7). The second part of the course will focus on constructions of complete non-compact and compact Ricci-flat manifolds with special and exceptional holonomy.

Rough outline of the lecture contents:

1. Berger's classification of the Riemannian holonomy groups.
   (Principal bundles and connections, the Levi-Civita connection, parallel transport, Berger's classification.)
2. The Ricci-flat holonomy groups.
   (Calabi-Yau, hyperkähler, G2 and Spin(7) metrics, Ricci-curvature and topology, structure results for Ricci-flat manifolds.)
3. Kähler Ricci-flat metrics.
   (Kähler and complex geometry, the Calabi Conjecture, compact Calabi-Yau and hyperkähler manifolds.)
4. Bundle constructions of complete non-compact manifolds with special holonomy.
   (Calabi Ansatz, Bryant-Salamon's asymptotically conical manifolds with exceptional holonomy.)
5. Kummer-type constructions of compact manifolds with special holonomy.
   (The Kummer construction of hyperkähler metrics on the K3 surface, Joyce's construction of compact manifolds with exceptional holonomy.)

- Recommended reading: a good reference for the course is D. Joyce, *Compact manifolds with special holonomy*. Oxford Mathematical Monographs. Oxford University Press, Oxford, 2000.
- Prerequisites: basic knowledge in differential and Riemannian geometry

Format:

- Brief electronic lecture notes outlining the content of lectures and providing a guide to the literature will be made available during the course.

- An extensive list of problems and exercises will be made available during the course.
- The course will be organised into 5 2h lectures.

Lecturer Details:

- Lecturer: Lorenzo Foscolo
- Lecturer home institution: UCL
- Lecturer e-mail:
- Lecturer telephone number: