

Mathematical Research Center (CRM) "Ennio De Giorgi"
May 2-13, 2011

Pedagogical School on "Knots and Links: from Theory to Applications"

Programme outline

Professor Mitchell Berger (Exeter U., UK)

- 1) Elements of braid theory;
- 2) Applications to magnetic fields;
- 3) Energy-complexity relations.

Professor Denis Ilyutko (Moscow State U., Russian Federation)

- 1) Combinatorics of knots: virtual knots and Gauss diagrams; geometry of knots and quadrisecants;
- 2) Parity in knot theory and low-dimensional topology: localizing global information coming from combinatorial structure;
- 3) Graph-links.

Professor Slavik Jablan (U. Belgrade, Republic of Serbia)

- 1) Conway notation of knots and links;
- 2) Families of knots and links;
- 3) Unknotting (unlinking) number.

Professor Louis H. Kauffman (U. Illinois at Chicago, USA)

- 1) Knots, colorings, fundamental group, linking number;
- 2) Alexander-Conway polynomial, Jones polynomial, virtual knot theory;
- 3) quantum link invariants, Khovanov homology, topological quantum computing.

Professor Sergei Matveev (Chelyabinsk State U., Russian Federation)

- 1) Basic definitions: knot, knot diagram, Reidemeister moves, connected sum, knot semigroup. Diamond Lemma, prime decomposition theorem for knots in the 3-sphere.
- 2) Quandles and knot invariants. Alexander polynomial.
- 3) Knots in thick surfaces and global knots.

Professor Kenneth C. Millett (U. California at Santa Barbara, USA)

- 1) Polygonal and lattice knots and links, stick number, curvature, torsion, linking, crossing number, average crossing number, knot and link presentations;
- 2) prime knots, composite knots, ephemeral knots, slipknots, local knots, global knots, polygonal knot space, knot probability, random knots;
- 3) Tight knots, thickness/ropelength, ideal knots, asymptotic knot probability Theorems of Sumners, Whittington, Pippenger, Millett).

Professor Carlo Petronio (U. Pisa, Italy)

- 1) Hyperbolic structures; link and graph complements and general 3-manifolds;
- 2) Computer detection of hyperbolicity and calculation of hyperbolic invariants;
- 3) Hyperbolic Dehn filling and exceptional slopes, Graph complements.

Professor Renzo L. Ricca (U. Milano-Bicocca, Italy)

- 1) topological equivalence of frozen fields, Calugareanu-White invariant, helicity; writhe, twist and Reidemeister type I move;
- 2) topological dynamics of vortex knots, links, energy-complexity relations for vortex tangles;
- 3) magnetic braids, topology bounds energy theorem, groundstate energy spectrum of knots

Professor Mauro Spera (U. Verona, Italy)

- 1) Gauss linking number, Thom classes, link homology and hydrodynamical interpretation; helicity and Hopf invariant;
- 2) Parallel transport, flatness, nilpotent connections, Chen calculus, aspects of combinatorial group theory;
- 3) Higher order linking numbers (Milnor, Massey), pure braids. hyperlogarithms, brunnian braids.

Professor De Witt Sumners (Florida State U., USA)

- 1) DNA topology;
- 2) tangles, writhe, 4-plats, rational tangles;
- 3) site-specific recombination, random knots, viral capsids.