

READING COURSE ON DIFFERENTIAL EQUATIONS
MTH G734–READINGS IN ALGEBRA
NORTHEASTERN UNIVERSITY, FALL 2009

VALERIO TOLEDANO LAREDO

This reading course is related to, but not a necessary prerequisite for, the graduate course on Differential Equations and Quantum Groups I will be giving in the Spring term.

The aim of that course will be to understand how the quantum groups associated to simple Lie algebras such as the algebra of $n \times n$ matrices can be used to effectively compute the monodromy representation (that is the analytic continuation of solutions of) certain differential equations in the complex domain.

These differential equations go under various esoteric names: KZ (for Knizhnik–Zamolodchikov), Dunkl–Cherednik and Casimir and appear in a large number of contexts: low-dimensional topology (knot invariants for example), physics (string theory and statistical mechanics) representation theory (of Hecke algebras) and, more recently in algebraic geometry (stability conditions and quantum cohomology). Their knowledge will not be assumed, in fact we shall spend some time studying them per se, nor will the above contexts, which are mentioned merely give a sense of perspective.

The course will be a blend of representation theory (quantum groups), some basic complex algebraic geometry (blowups), some category theory (tensor categories) and some deformation theory (Hochschild cohomology).

In preparation for it, we will be running a reading course this term to cover some related background material. The organisational meeting will take place on Friday Sept. 11 in my office (528 NI) at 2PM.

The course will be run as a seminar given by graduate students. We will meet on Wednesdays, starting on Sept. 16, from 10:30 to 1 in room 544 NI.

REFERENCES

- [BTL] T. Bridgeland, V. Toledano Laredo, *Stability conditions and Stokes factors*, arXiv:0801.3974.
- [DCP] C. De Concini, C. Procesi, *Wonderful models of subspace arrangements*, Selecta Math. (N.S.) **1** (1995), 459–494. *Hyperplane arrangements and holonomy equations*, Selecta Math. (N.S.) **1** (1995), 495–535.
- [Ha] M. Haiman, *Cherednik algebras, Macdonald polynomials and combinatorics*, International Congress of Mathematicians, Vol. III, 843–872, 2006.
- [Io] B. Ion, *Involutions of double affine Hecke algebras* Compositio Math. **139** (2003), no. 1, 67–84.
- [L] H. van der Lek, *Extended Artin groups*, In: Singularities, Part 2 (Arcata, Calif., 1981), Proc. Sympos. Pure Math. **40**, Amer. Math. Soc., 1983, pp. 117121. *The homotopy type of complex hyperplane complements*, Ph.D. Thesis, Katholieke Universiteit Nijmegen, 1983.
- [Ma] I. G. Macdonald, *Affine Hecke algebras and orthogonal polynomials*. Cambridge Tracts in Mathematics, **157**. Cambridge University Press, Cambridge, 2003.
- [NVD] Nguyễn Việt Dũng, *The fundamental groups of the spaces of regular orbits of the affine Weyl groups*, Topology **22** (1983), 425–435.
- [TL] V. Toledano Laredo, *Quasi-Coxeter Algebras, Dynkin Diagram Cohomology and Quantum Weyl Groups*, International Mathematics Research Papers 2008.

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ORGANISATION OF THE COURSE

Week	Dates	Topic	Speaker
1 Sept. 7–13	<i>Sept. 3: Labour day</i> Sept. 11	Organisational meeting	
2 Sept. 14–20	Sept. 16	Fuchsian ODEs in the complex plane	V. Toledano
3 Sept. 21–27	Sept. 23	Connections and curvature	A. Foksha
4 Sept. 28–Oct. 4	Sept. 30	Braid groups (I) [Io,Ha,L,Ma,NVD]	M. Balagovic
5 Oct. 5–11	Oct. 7	Braid groups (II)	M. Balagovic
6 Oct. 12–18	<i>Oct. 12: Columbus day</i> Oct. 14	No meeting	
7 Oct. 19–25	Oct. 21	Hyperplanes and holonomy equations (I) [DCP]	S. Stella
8 Oct. 26–Nov. 1	Oct. 28	Hyperplanes and holonomy equations (II) [DCP]	S. Stella
9 Nov. 2–Nov. 8	Nov. 4	Hyperplanes and holonomy equations (III) [DCP]	S. Stella
10 Nov. 9–15	<i>Nov. 11: Veterans' day</i>		
11 Nov. 16–22	Nov. 18	Stability conditions and Stokes factors (I) [BTL]	A. Appel
12 Nov. 23–29	<i>Nov. 25–29: Thanksgiving</i>		
13 Nov. 30–Dec. 6	Dec. 2	Stability conditions and Stokes factors (II) [BTL]	A. Appel
14 Dec. 7–13	Dec. 9	Stability conditions and Stokes factors (III) [BTL]	A. Appel

Further lectures to be arranged: Quantum groups (Nivedita Bhaskhar, J. Russel), Trigonometric differential equations (Sachin Gautam).