

REPORT ON THE WORKSHOP ON CHEREDNIK ALGEBRAS

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1. SIGNIFICANT DEVIATIONS

There were no significant deviations from the original proposal.

2. OVERVIEW

The workshop was attended by around seventy mathematicians, a mixture of PhD students and postdocs, UK based researchers working in related topics and international leaders in the field of Cherednik Algebras. There were twenty six talks during the week, the majority of which reported on research in Cherednik algebras that had been carried out in the last six months. These talks represented many different points of view on the subject - algebraic, geometric, combinatorial and analytic - and featured several significant breakthroughs from the last couple of months. The week included a special lecture on Open Problems designed for non-experts. There was a great deal of interaction throughout the workshop, and one of the great bonuses was the chance for on-the-spot discussion with people with intellectually and geographically diverse backgrounds. An immediate outcome of the workshop will be a special issue of *Selecta Math.* devoted to Cherednik Algebras: this will feature mostly the ICMS participants, writing either research or survey articles.

3. EXTENDED REPORT

The background. The Cherednik Algebras meeting had 72 participants based in 8 countries (UK 37, US 15, France 9, Russia 5, Japan 2, Netherlands 2, Poland 1, Germany 1). Of these, 13 were PhD students and 11 were post-docs based in the UK. There was a wide range of interests amongst the participants, cutting across mathematical physics, integrable systems, noncommutative algebra, (group and Lie) representation theory and combinatorics. Almost all of the international experts in Cherednik algebras attended the conference, but there was one unfortunate exception: Cherednik himself was unable to attend to due to visa problems (in Japan!). Cherednik did, however, send a talk to the conference and this was presented by Pavel Etingof.

The talks. There were 26 talks, each one hour long. They included a basic introductory lecture by Gordon (“What is a Cherednik algebra?”), an introductory series by Rouquier on the representation theory of rational Cherednik algebras (“Introduction to Cherednik algebras I,II”), and short series by Etingof on Cherednik algebras associated to orbifolds (“Geometry of rational Cherednik algebras I, II”) and Ginzburg on quantum hamiltonian reduction and character sheaves (“Character sheaves and Cherednik algebras I, II”). The introductory talks of Gordon and Rouquier took place on the first day.

There were several themes represented in the remaining talks. Crudely, these can be listed as geometric representation theory (Varagnolo, Vasserot), algebraic combinatorics (Berenstein, Cherednik, Martino, Suzuki, Vazirani), algebraic Lie theory (Guay, Hernandez, Nazarov, Premet), deformation theory (Montarani, Rains), differential operators (Berest, Etingof, Rouquier), Hopf algebras (Bazlov), derived categories (Turner). There was also an Open Problems talk by Etingof and Ginzburg (which is available on the webpage of the meeting). Nearly all the work presented included new results which were either unpublished, or had appeared on the arXiv only in the last few months. Notably there were beautiful presentations of big new theorems by Etingof, Finkelberg-Ginzburg, Kashiwara-Rouquier, Varagnolo-Vasserot; some of these theorems are going to help to define the subject over the next couple of years.

Outcomes. The workshop had three goals: to bring together international figures working on Cherednik algebras; to widen interest in the subject amongst the UK representation theory community; to give young mathematicians access to established international leaders in the field.

The first goal was achieved. As mentioned above, researchers came from all over the world to present their work and to collaborate. One reason for the success is that this was a timely meeting. The subject of Cherednik algebras is still quite new, but it is blossoming with connections to new topics being found quite regularly. It now impacts on Macdonald (q, t) -combinatorics, geometric representation theory, Kazhdan-Lusztig combinatorics, deformation quantisation, microlocal analysis, resolutions of singularities, noncommutative algebraic geometry, orthogonal polynomials, differential operators, (finite, affine and double affine) Lie theory, integrable systems (a longer list than when the application for the meeting was made). At this meeting there were participants and talks on all of these subjects, given from the Cherednik algebra point of view. In the very near future it may become impossible to run a coherent meeting with so many perspectives; it is likely the subject will become too broad for an accessible, focused, all-encompassing workshop. It is a

particular strength of the ICMS to respond quickly to mathematical developments and put on such meetings.

In the workshop many new ideas were presented and in the questionnaires several people mentioned that they believed they had learned new techniques which they would harness to their current problems, and that they now had a clearer vision for the development of the subject. It is very interesting to read the wide variety of answers to the question: “What in your view are the key future research areas in the field?”. These range across algebraic geometry, quantum field theory, homological representation theory, Poisson geometry, noncommutative algebra, finite dimensional representations, noncommutative algebraic geometry, Yangians, Hopf algebras, braided categories, deformation theory, vertex operator algebras!

It will take longer to see if the second goal was realised. There were certainly many UK based mathematicians attending, working in many distinct topics: Lie algebras, derived categories, finite groups, quantum groups, noncommutative algebra, integrable systems, Hecke algebras, Hopf algebras. The feeling from the meeting and the questionnaires seems to be that these participants now have a good idea for the relevance of the subject, the techniques it involves and the areas in which it exerts influence. Being very optimistic we might hope that several have been inspired to work with or use Cherednik algebras.

We hope the third goal was achieved. As the numbers show, there were many young participants and at all times they were encouraged to interact and participate in the conference. We facilitated this by running the Open Problems lecture, and by having five lectures from postdocs (Turner, Bazlov, Martino, Guay, Montarani).

Publication. The organisers and the editors of *Selecta Math* have arranged to use the conference as an inspiration to have an issue of the international journal *Selecta Math* dedicated to Cherednik Algebras. All the speakers at the meeting, together with some people who were invited but unable to attend, have been encouraged to send in articles (research or expository) which will then go through the usual refereeing procedure. The articles will be tied together by an introductory commentary by the organisers of the meeting. Of course, the ICMS meeting will be thoroughly acknowledged as the inspiration for this issue.