Final report- Poisson 2012 (Poisson Geometry in Mathematics and Physics)

by Marius Crainic (chair of the organizing committee)

1. Poisson 2012: short introduction

"Poisson 2012: Poisson Geometry in Mathematics and Physics" was held at the Utrecht University in Utrecht from July 23 to August 3, 2010. It consisted of two parts:
- Summer School (the week of July 23-27).
- Conference (the week of July 30-August 3).

Poisson 2012 belongs to a well-known series of biannual international meetings on Poisson geometry. Previous meetings were held in Warsaw (1998), Luminy (2000), Lisbon (2002), Luxembourg (2004), Tokyo (2006), Lausanne (2008), and Rio de Janeiro (2010). The conference has consistently grown in scope and size. Poisson 2012 attracted about 230 participants, from which about 180 participated also in the School.

The Summer School offered four mini-courses consisting of four lectures per course with additional time for problem sessions. The second week was an international conference, featuring twenty-three plenary speakers working on Poisson geometry and related areas. The list of confirmed speakers includes many high-profile senior names, but also a substantial number of stellar junior researchers.

The total expenses for Poisson 2012 were 143,501 Euro, from which about 3/7 was spent on the School and 4/7 on the conference. The sponsoring organization provided us with a budget of 135,500 Euro.

A clear picture on Poisson 2012 can be obtained by inspecting the website of the meeting:

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http://www.uu.nl/poisson2012
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2. Summer school: lecturers, minicourses, program

The lecturers in the Summer School were:

Anton Alekseev (U. Genève)	Henrique Bursztyn (IMPA, Rio)
Rui Loja Fernandes (IST, Lisbon)	Michael Gekhtman (Notre Dame)

Here are the **school courses** and short abstracts:

- *Poisson and Symplectic Geometry of Moduli Spaces of Flat Connections* (A. Alekseev, Genève)

  Abstract: Moduli spaces of flat connections on surfaces are among the most interesting examples of Poisson and symplectic spaces. The course reviewed finite and infinite-dimensional constructions of symplectic forms and Poisson bivectors, and gave a brief introduction into the following topics:
    1. Symplectic volumes and Duistermaat-Heckman localization;
    2. Moduli of flat connections and integrable systems;
    3. Quantization of moduli spaces and Verlinde formula.

- *Lie Groupoids and Multiplicative Structures* (H. Bursztyn, IMPA, Rio de Janeiro)

  Abstract: The global objects underlying Poisson structures, encoding relevant symmetries, are symplectic groupoids, i.e., Lie groupoids equipped with multiplicative symplectic structures; they play a key role, for instance, in the Poisson-geometric approach to the theory of moment maps. This course provided a short introduction to Lie groupoids and symplectic groupoids, followed by a more general discussion of multiplicative structures that are relevant in Poisson geometry.

- *Poisson Geometry- Global Aspects* (R.L. Fernandes, IST, Lisbon)

  Abstract: The course started with a quick introduction to some basis concepts in Poisson geometry, such as complete Poisson maps, symplectic realizations, coisotropic submanifolds, etc. Then it addressed more recent topics such as coisotropic deformations, leaf stability, normal forms around leaves, rigidity.

- *Cluster Algebras and Compatible Poisson Structures* (M. Gekhtman, Notre Dame)

  Abstract: After reviewing basic definitions in the theory of cluster algebras and discussing several examples, the course concentrated on the notion of the Poisson brackets compatible with the cluster structure and it was explained how it can be used to recognize cluster structures in coordinate rings of Poisson varieties. Some of the examples presented were: Grassmannians, Teichmueller spaces and Poisson-Lie groups. Also a connection with integrable systems and Poisson geometry of networks on surfaces was discussed.

Each course consisted of 4 lectures plus several problem sessions and with two tutors per course (in total 8 sessions of Exercise classes of 1 hour each). The precise schedule, including the social events, can be consulted at

> `http://www.projects.science.uu.nl/poisson2012/School_Schedule.php`

3. Conference: speakers and the titles of the talks, poster session

Here is the list of invited speakers and the titles of their talks:

- Anton Alekseev (Genève):
  Poisson-Lie groups and tropical correspondence principle

- Philip Boalch (Paris):
  Poisson geometry of moduli spaces of meromorphic connections on curves and their Stokes data

- Damien Calaque (Lyon):
  Classical TFTs and symplectic structures on mapping spaces with boundary conditions

- Gil Cavalcanti (Utrecht):
  SKT geometry

- Giovani Felder (ETH-Zurich):
  : The classical master equation

- Marco Gualtieri (Toronto):
  Symplectic groupoids of log symplectic manifolds

- Victor Guillemin (MIT):
  Assignment cohomology

- Sergei Gukov (Caltech):
  The Verlinde formula via mirror symmetry

- Nigel Higson (Penn State):
  K-homology and the quantization commutes with reduction problem

- Nigel Hitchin (Oxford):
  Generalized geometry of type B_n

- Madeleine Jotz (EPFL):
  (Almost) Dorfman connections and the infinitesimal data of Dirac groupoids

- Camille Laurent-Gengoux (Metz):
  L-infinity structures in Poisson geometry : an application

- David Li-Bland (Toronto):
  Moduli spaces of flat connections on coloured surfaces

- Jiang-Hua Lu (Hong Kong):
  On a Poisson structure on Bott-Samelson varieties

- David Martinez-Torres (IST Lissbon):
  Poisson manifolds of compact type

- Rajan Mehta (Penn State):
  Symplectic 2-groupoids and Courant algebroids

- Yoshihiko Mitsumatsu (Tokyo):
  Lawson's foliation and a regular Poisson structure on the 5-sphere

- Hessel Posthuma (UvA):
  Longitudinal index theory on Lie groupoids and the Lie-Poisson structure on the dual of a Lie algebroid

- Ajay Ramadoss (ETH Zurich):
  Noncommutative Poisson structures, derived representation schemes and Calabi-Yau algebras

- Florian Schaetz (Utrecht):
  Deformations of Lie algebroid morphisms

- Mathieu Stienon:
  Atiyah classes and homotopy algebras

- Alan Weinstein (Berkeley):
  Functorial integration of Poisson manifolds and Lie algebroid comorphisms

- Thomas Willwacher (Harvard):
  Drinfeld associators, Kontsevich formality morphisms and P. Etingof's conjecture

The 23 talks mentioned above were distributed over the entire week -for the precise schedule, please see

`http://www.projects.science.uu.nl/poisson2012/Conference_Schedule.php`

During the conference there was also a display of 26 posters on various research topics related to Poisson Geometry. The list of posters can be consulted at:

`http://www.projects.science.uu.nl/poisson2012/Conference_Poster_Session.php`

4. Lecture notes, videos, publications, etc

Each course in the School consisted of 4 lectures plus problem sessions with two tutors per course (in total 8 sessions of Exercise classes of 1 hour each). The courses were videotaped and are freely available at:

`http://www.projects.science.uu.nl/poisson2012/School_Courses.php`

The preliminary versions of the lectures notes were made available during the school. Due to the very positive reaction of the various participants to the high quality of the lectures (the chosen topics as well as the quality of the speakers), we plan to put together these lecture notes into a volume which will serve as an introduction to Poisson Geometry (see also below).

At the conference, all the 23 talks mentioned above were videotaped- and can be downloaded from:
`http://www.projects.science.uu.nl/poisson2012/Conference_Speakers_&_Talks.php`

The proceedings of the conference will be published in a special volume of Indagationes (the Journal of the Royal Netherlands Academy of Arts and Sciences).

5. The Lichnerowicz prize (press release)

The André Lichnerowicz prize in Poisson geometry was established in 2008. It is awarded for notable contributions to Poisson geometry, every two years at the International Conference on Poisson Geometry in Mathematics and Physics, to researchers who completed their doctorates at most eight years before the year of the Conference. The prize is named in memory of André Lichnerowicz (1915-1998) whose work was fundamental in establishing Poisson geometry as a branch of mathematics. It is awarded by a jury composed of the members of the scientic and advisory committees of the conference. The 2012 Lichnerowicz prize is sponsored by the Koninklijk Wiskundig Genootschap (the Royal (Dutch) Mathematical Society), through the mathematics journal of the Koninklijke Nederlandse Akademie van Wetenschappen (Royal Netherlands Academy of Arts and Sciences), Indagationes Mathematicae.

The recipient of the 2012 Andr Lichnerowicz prize in Poisson geometry is Thomas Willwacher (Harvard University). Thomas Willwacher completed his Ph.D. in 2009 at the ETH Zürich, under the supervision of Giovanni Felder. His thesis, titled 'Cyclic formality', earned him the 2010 ETH medal for outstanding dissertation. He subsequently took on a position at Harvard University, as a Junior Fellow of the Society of Fellows.

Willwacher has made deep and fundamental contributions to Poisson geometry, combining techniques from quantum field theory, homological algebra, and graph complexes. His results include proofs of Kontsevich's cyclic formality conjecture for cochains and Tsygan's cyclic formality conjecture for chains. Together with Severa, he established the homotopy equivalence between Kontsevich's and Tamarkin's formalities of the little disk operad. More recently, he proved that the cohomology of the Kontsevich graph complex is isomorphic to the Grothendieck-Teichmueller Lie algebra.

6. Participants

The total number of participants was about 230, from which about 180 participated in the school. The list of registered participants can be seen at:

`http://www.projects.science.uu.nl/poisson2012/Conference_Participants.php`

A more complete list (including last minute registrations and cancellations, more details on the participants and their signature at their arrival) will be made available upon request.

The career distribution of the participants was the following (approximately)

- Speakers: 23.

- Permanent Staff: 60.

- PostDocs: 40.

- PhD students: 70.

- Master Students: 25.

- Bachelor Students: 15.

The geographical distribution of the participants (depending on their residence) was the following:

- Africa: 10.

- Asia: 25.

- Europe: 115 (but please note that many of these are of nationality from Sputh America, Russia or Asia).

- Middle East: 10.

- North America: 35.

- Russia: 10.

- South America: 25.

7. About the organization

For a global view on the organization of Poisson 2012, we refer to the web page:

> `http://www.projects.science.uu.nl/poisson2012/Home.php`

The lecturers were chosen by a Scientific Committee consisting of

Eckhard Meinrenken (U. Toronto, chair)	Tudor Ratiu (EPFL, Lausanne)
Rui Loja Fernandes (IST, Lisbon)	Ping Xu (Penn State)
Jiang-Hua Lu (Hong Kong)	

with the assistance of an Advisory Committee whose members are

Anton Alekseev (U. Genève)	Alberto S. Cattaneo (Zürich)
Henrique Bursztyn (IMPA, Rio)	Giuseppe Dito (Dijon)
Giovanni Felder (ETH-Zürich)	Marco Gualtieri (Toronto)
Xiang Tang (St. Louis)	

The local organization was handled by the "Utrecht Poisson Geometry Group", with Marius Crainic as the main organizer; see also:

> `http://www.projects.science.uu.nl/poisson2012/Home_Committees.php`

8. Financial aspects

Here are the main parts of the financial aspects of the organization. The main expenses can be divided into:

- Hotel speakers and lecturers: 27, 230
- Travel speakers and lecturers: 10,910 Euro.
- Accommodation young participants: 27,824 Euro.
- Travel young participants: 23,600 Euro.
- Meals expenses (per diem, offical dinner, excursion, etc): 25,866 Euro.
- Coffe, tea, etc + reception: 11, 529 Euro.
- Local organization (various material such as block notes, small gifts, publicity through posters and announcemnets, etc): 10,624 Euro.
- Rent room: 4,918 Euro.
- Lichnerwowicz prize: 1,000 Euro.

Total expenses: 143,501 Euro.

And here are the funding sources:

- The Compostio Fundation: 20,000 Euro.
- The ESF (European Science Fundation), through the networks CAST and IGTP: 14,000 Euro.
- The NSF (USA): 15,000 Euro.
- The KNAW (Royal Netherlands Academy of Arts and Sciences): 12,000 Euro.
- The NWO (the Dutch Science Fundation): 8,000 Euro.
- The NWO clutser GQT: 15,000 Euro.
- The Wonder research school (NL): 5,000 Euro.
- The ERC research grant of M. Crainic: 20,000 Euro.
- The "personal research budget" of M. Crainic: 20,000 Euro.
- , Mathematics Department of Utrecht University: 4.500 Euro.
- The "personal research budget" of A. Henriques: 1,000 Euro.
- Indagationes: 1,000 Euro.

Total budget: 135,500 Euro.
(the overspanding will be covered by the "personal research budget" of M. Crainic).

9. Conclusions (highlights)

The School: The Summer School was a great success from all points of view.

The primary aim of the School was to provide the young researchers with an introduction to Poisson Geometry. At the same time, it also aimed at attracting more experienced "crossing fields" researchers- with backgrounds in other fields (in various areas of geometry or of mathematical physics). These aims were brilliantly achieved by all four lecturers, who delivered a large part (more than half) of their courses at a rather introductory level, but included some enlightening examples and more recent results, revealing various connections with other fields.

There are two points that I would like to clearly emphasize here, since they apply particularly to this school:

- the very high quality of the lectures: well delivered, clear but often also intruiging, exciting.

- the excellent choice of the topics, which covered various parts of Poisson geometry and neghbooring fields.

All these, together with the choice of the lecturers (well known experts), made the program very attractive, with a record number of participants. Also, the very positive reaction we have received from the participants (often enthousiastic) made us decide to put together all the lectures notes into a volume that will serve as an introduction to Poisson Geometry.

Another point that I would like to mention here is the "Exercises sessions" which were introduced here for the first time in the Poisson summer schools. Although the format was not very clear and the students were a bit nervous at the beginning, I believe that, overall, this was a good innitiative as it provided the stdents with the framework and the times spot, as well as help from tutors and lecturers, for solving some of the exercises from the lectures. In some cases this worked extremely well- e.g. in the case of students with rather low background (such as a group of 6 students from Sudan which, although capable, lacked some background) which received special tutoring. Moreover, these sessions stimulated interactions, and students often continued working together on the exercises after the organized exercise session ended.

The Conference: As in the case of the School, also the Conference was a success.

The principal objective that was achieved was that of bringing together mathematicians and mathematical physicists from diverse backgrounds, having common interests in Poisson geometry, giving them the opportunity to present and discuss their most recent research.

One of the main characteristics of the Conference was the diversity from all points of view: topics, the geographic representability, the age representability (both for speakers as well as for participants). I would like to mention here:

- The talks covered diverse topics such as symplectic topology (Guillemin), differential geometry (Hitchin, Gualtieri), differential topology (Martinez-Torres, Cavalcanti), mathematical physics and QFT (Gukov, Felder, Alekseev), non-commutative geometry (Higson, Posthuma), deformation quantization (Willwacher, Calaque), higher-order algebraic structures (Laurent-Gengoux, Mehta), etc.

- The list of speakers includes not only many high-profile senior names, but also a substantial number of stellar junior researchers, such as Madeleine Jotz (EPFL), David Li-Bland (Toronto), Hessel Posthuma (Amsterdam), Rajan Mehta (Penn State), T. Willwacher (Harvard).

These attracted researchers from a various other areas in mathematics and mathematical physics, most notably from Symplectic Geometry, Foliation Theory, Noncommutative Geometry and Mathematical Physics. Note that, usually, such researchers are not brought together by meetings in their specialized areas and they met in the conference for the first time. Many of them also attended the summer school.

I would also like to mention that the quality of the talks, both in content as well as in the way they were delivered, was very high.

The conference came together with various social events that stimulated interactions, such as a reception in the first day, an excursion and an official dinner.

Participation

Please note the very high number of participants. Another noticable point, both for the school as well as for the conference, is the diversity in the participation (career-wise as well as geographical)- see above. All these were possible because of two reasons: one is more scientifical and refers to the array of lecturers/speakers and their topics, while the other one is more material and refers to the possibility of offering various financial support to the participants with no financial means (mainly the young participants).

Local organization

Regarding the local organization, we believe that the the entire event run rather smoothly. This was possible due to a large and etnhousiastic local organizing committee: 15 researchers (ranging from PhD students to permanent staff), 3 secretaries, as well as the valuable assistance of the Summer School organization of Utrecht University which provided us with affordable access to student style accommodation.

Publications

As we mentioned above, all the lectures and talks are available online, the proceedings of the conference will be published in a special volume of Indagationes (the journal of the Royal Netherlands Academy of Arts and Sciences) while the lectures from the school will be organized in an introductory volume to Poisson Geometry.