Department of Mathematics

An online publication for Mathematics Students & Alumni

Keeping in touch with *YOU*

Issue 2/July 2012

News & Events

Singapore Youth Award 2012

A familiar face to many of us - our alumnus Dr Yeo Sze Ling has been awarded the Singapore Youth Award 2012, the highest national accolade for youth.

The department is extremely proud of her achievements and hopes that she continues to inspire others.

Read more about it at http://ww1.math.nus.edu.sg/News%20Archive/ST210612-Dr%20YeoSzeLing-SYA.pdf

2012 QS World University Rankings

Published annually since 2004, QS World University Rankings® is one of the world's major university ranking in the world. In the 2012 world university ranking by subject, our department was ranked 11th worldwide (from a ranking of 23rd in 2011) and 1st in Asia. The list of universities can be viewed at http://www.topuniversities.com/university-rankings/world-university-rankings/2012/subject-rankings/natural-sciences/mathematics

Mathematics Enrichment Camp, Saturday 25 August 2012

Organised annually by the department, this event provides interesting insights to various applications of Mathematics.

Suitable for pre-university students and undergraduates. Details at http://ww1.math.nus.edu.sg/misc/Mathematics%20Enrichment%20Camp%202012-Brochure.pdf

NUS and Faculty Open House, 17 & 18 March 2012

The university held its annual open house over the weekend of 17 & 18 March, at the Multi Purpose Sports Hall. Each faculty showcased her programs to interested students applying for admission to the University for the August 2012 intake.

The faculty held her open house on 19 May, to provide an opportunity for interested students to learn more about the faculty's programs and to interact with her lecturers and students.

Honours Class Graduation Lunch, 18 April 2012

As part of the department's tradition, a graduation lunch was held on 18 April for the honours class of 2012.

More pictures at http://ww1.math.nus.edu.sg/alumni/photo/Honours%20Lunch%202012/index.htm

Congratulations to Graduating Class of 2012

The commencement ceremony for Mathematics graduates was held on Tuesday 10 July, 8pm, at the University Cultural Centre.

More pictures at http://ww1.math.nus.edu.sg/alumni/default.aspx?file=photogallery

Symposium on "A Practitioner's Insight of Gaming Mathematics"

With the opening of two casinos in Singapore, gambling has become a hot topic, both for gamblers and onlookers alike.

Have you ever wondered how the casinos keep their systems in check, and what the odds of winning a game of Blackjack or Poker are?

The Department successfully organized a half-day symposium "A Practitioner's Insight of Gaming Mathematics" on 23 February 2012 to share with the public and relevant industry partners on the applications of mathematics in casino gaming.

Talks were given by Mr Todd Haushalter, Vice President, Business Strategy, Shuffle Master, Inc. *("Mathematical Designs & Modelling of Successful Casino Table Games"*), and Mr David Scambler, Vice President, Mathematics, BMM Compliance ("*The Mathematical Approach to Fair Casino Gaming")*

The symposium ended with a lively and informative panel discussion.

Programmes and Workshops jointly organized with the Institute for Mathematical Sciences (IMS), NUS

Faculty members from the department actively organize joint workshops and programmes with IMS.

Details of upcoming and past programmes in 2012 as follows. Click on each programme link for details

- **Joint Workshop of IMS and IMI on Mathematics for Industry: Biological and Climatic Prospects** *(3 - 7 Sep 2012)*
- **Asian Initiative for Infinity (AII) Graduate Summer School** *(20 Jun - 17 Jul 2012)*
- **School and Workshop on Random Polymers and Related Topics** *(14 - 25 May 2012)*
- **Workshop on Non-uniformly Hyperbolic and Neutral One-dimensional Dynamics** *(23 - 27 Apr 2012)*
- **Branching Laws** *(11 - 31 Mar 2012)*
- **Workshop on Nonlinear Partial Differential Equations: Analysis, Computation and Applications**
  (7 - 10 Mar 2012)
- **Multiscale Modeling, Simulation, Analysis and Applications***(1 Nov 2011 - 20 Jan 2012)* and **Winter School** *(12 Dec 2011 - 13 Jan 2012) --- Continued from 2011*

Welcome on Board!

We look forward to these new staff joining us in July/August 2012.

Dr Dilip Raghavan, Assistant Professor

Dr Raghavan received his PhD in 2008 from the University of Wisconsin--Madison under Ken Kunen and Bart Kastermans. His interests include set theory, mathematical logic, and general topology.

Prior to joining us, Dr Dilip Raghavan was a JSPS postdoctoral fellow at Kobe University from July 2011 to present, and a postdoctoral Assistant Professor at University of Toronto from July 2008 to June 2011.

Dr Jeffrey Pang, Assistant Professor

Dr Pang obtained his BSc (Hons) in Mathematics from NUS in 2003, his SM in High Performance Computation of Engineered Systems from the Singapore-MIT Alliance in 2004, and his PhD in Applied Mathematics from Cornell University in 2009.

He did a post-doctorate in Canada (at the Fields Institute and at the University of Waterloo) in 2009-2010, and was an Instructor in Applied Mathematics in MIT from 2010 to 2012.

Dr Wang Dong, Assistant Professor

Dr Wang received his Ph.D in Mathematics in 2008, from Brandeis University, USA. Prior to joining us, he was a postdoc assistant professor at the department of mathematics at the University of Michigan, working with Jinho Baik. Before he joined the University of Michigan, he was a postdoctoral fellow at the Center of Mathematics Research (CRM) at the University of Montreal, from 2008 to 2009. His research interest is probability and analysis. His research now focuses on random matrix theory.

Awards & Accolades

Annual Teaching Excellence Awards 2010/2011

Dr Ng Wee Seng received the University Annual Teaching Excellence Award 2010/2011.

The Annual Teaching Excellence Award identifies teachers who qualify as educators who facilitate learning that is of value even outside the boundaries of their specific disciplines and professions. Such teachers help learners to acquire not only discipline-/profession-specific knowledge and abilities, but also the ideas, mental capacities, mindsets and habits we expect every university graduate to have, regardless of their areas of specialisation.

Student Honours

Congratulations to our students for their outstanding performance at the Mathematics Contest in Modeling (MCM) 2012, an international contest opened to all tertiary students. One team from the Continuous MCM (A) Problem was designated as one of the Outstanding Winners and won the Ben Fusaro Award.

Research Profiles

Multiplicity one in symmetry breaking

Professor Zhu Chengbo

Prof Zhu Chengbo, along with Prof Sun Binyong of the Chinese Academy of Sciences, have established the validity of a longstanding conjecture called `multiplicity one'. Their paper, entitled 'Multiplicity one theorems: the Archimedean case', was published in the January 2012 issue of the *Annals of Mathematics*, one of the most prestigious journals in the mathematical community.

This phenomenon of multiplicity one was first predicted in an influential lecture of J. Bernstein in the Piateski-Shapiro symposium in May 1989. Sun and Zhu proved his conjecture in 2008 for real or Archimedean cases, and the p-adic analog was shown by Aizenbud, Gourevitch, Rallis and Schiffmann the year before. (The latter paper appeared in the Annals of Mathematics in 2010.)

Contextually, the theorems established by the duo teams stemmed from representation theory, which is a field in mathematics that studies symmetry patterns. Symmetry breaking, also known as branching, is a process of comparison for two symmetry patterns, one larger than the other. In analyzing any symmetry pattern, it is important to understand how it branches. The situation is particularly favorable if one can show the property of multiplicity one, namely the larger symmetry pattern breaks into sub-symmetry patterns, each of which appears at most once.

The theorems of Aizenbud-Gourevitch-Rallis-Schiffmann-Sun-Zhu thus say that classical pairs indeed have this remarkable property, over any local fields. Collectively their results are expected to have important implications to the study of L-functions, especially the special values at the center of symmetry.

Scalar curvature flow method and prescribed scalar curvature problem

Professor Xu Xingwang

Prof Xu Xingwang Xu, jointly with Dr. Chen Xuezhang from Nanjing University of China, has established a new method (namely the scalar curvature flow method) to handle the long-standing problem : is it possible to continuously deform the rough sphere to the prefect sphere? Mathematically there are several ways to measure the roughness. The scalar curvature measurement is the weakest one. With the scalar curvature measurement, the problem is commonly called the prescribing scalar curvature problem.

Their paper "The Scalar curvature flow on S^n - perturbation theorem revisited" has been published by *Inventiones (187, No 2, pp395-506 with an erratum pp 506-509)*, one of the most prestigious journals in the mathematical community.

The prescribing scalar curvature problem has existed for more than a half century. Many great mathematicians have made important contributions. Such problem can be converted to finding some positive solutions of elliptic type partial differential equations. Such equation is always invariant under a non-compact group. The bubbling phenomena (very sharp needle) can happen. It is known among mathematicians that above two difficulties can only occur in the particular manifolds, namely the prefect sphere case.

In the seventies, French mathematician, T. Aubin, proved some interesting result, saying that if the rough sphere is relatively flat, up to some second lowest tone, it can be deformed to the prefect sphere without changing its angle measure.

In the early nineties, A. Chang and P. Yang, now both Professors of Princeton University, had rechecked this problem and found that if the rough sphere is sufficiently close to the prefect sphere and has no degenerate sharp needle with extra technical assumptions, the deformation is possible. Their argument is based on the perturbation method and the calculus of variation.

In the past ten years, the most significant mathematical achievement is the reconfirmation of the famous Poincare conjecture. We all know that the proof is through the powerful Hamilton's Ricci flow which was introduced near thirty years ago. Its success in Poincare conjecture stimulates many people to re-examine the Ricci flow and apply it to other important problems.

In the last several years, we adopted this flow method to the prescribing scalar curvature problem. We obtained in certain sense the best possible conclusion under the same assumption as ones by Aubin and Chang-Yang. Basically we show that, with Aubin's relative flatness assumption plus Chang-Yang's topological assumptions, the problem is solvable. The important observation in this work is that the relative flatness given by Aubin is in fact to ensure the flow can have only one sharp needle which makes the blow-up analysis much easier.

The other tool Prof Xu and Dr Chen used in this work is the infinitely dimensional Morse theory. As it is well known, the difficult part in this theory is to control the energy level since the global existence depends on the initial energy level. This mainly is due to the fact that the global existence of the flow
depending on the level of initial energy level. When we deform the open set in the infinite dimensional space, we need to make sure that along the deformation curves, the solution to the flow equation exists. Thus we have to control the deformation curves' energy level. Once it is done, the rest is the simple topological argument.

$$u_t = \frac{n-2}{4}(\alpha(t) f - R)u$$