Mini-school on the mathematics of string theory

April 11 - April 16 2016, CIRM

1 Organizing committee

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2 Scientific context

The school at CIRM school which took place from April 11th to April 15th, 2016 was the first event held within the program on the mathematics of string theory held at the Institut Henri Poincaré April 17 - July 15.

Progress in string theory is inexorably tied to its continued interaction with a wide range of areas in mathematics. In turn, string theory has proven a reliable generator of innovative mathematical ideas, and continually inspires new avenues of mathematical research. Increasingly often, new mathematical ideas and results find their first application in string theory.

Conformal field theory, vertex algebras, mirror symmetry, generalized complex geometry, topological field theory, noncommutative geometry are just some of the areas of such fruitful interaction. Recent exciting developments include open string mirror symmetry, wall crossing formulae, topological classification of D-branes and the derived category approach to D-branes on Calabi-Yau manifolds, geometric transitions, the relation of N=2 instanton partition functions to conformal field theory, the matrix model approach to gauge theory, the relation between Langlands program and supersymmetric gauge theories, BPS counts and mock modular forms.

The idea behind the programme was to bring together experts from around the world, mathematicians and physicists alike, to study some of these new developments, to deepen our understanding of the physical and mathematical structures at play, and to explore the interconnections between these ideas. The main focus of the program was on recent developments in string theory which are of strong mathematical interest. These included foundations of string/M-theory, the physics and mathematics of D-branes, BPS states, and various dualities on the physics side and such areas of mathematics as derived categories, enumerative geometry, number theory, elliptic cohomology, geometric Langlands correspondence, quantum cohomology.

The mini-school helped to familiarise younger researchers, notably graduate students, with this circle of ideas and to prepare interested graduate students for the IHP quarter. By providing both foundational background and reviews of recent developments, facilitated their active and successful participation in the the IHP thematic trimester and the StringMath conference.

3 List of topics and lecturers

The choice of lectures reflected the bi-disciplinary nature of the program: three mathematicians and three physicists working on the frontier between the two fields gave courses ranging from curve counting and automorphic forms to 6d superconformal field theories and AdS/CFT applications. The courses in detail were

Lothar Gttsche (ICTP): *Refined Curve Counting*

Valéry Gritsenko (Université Lille): *Automorphic forms and Kac-Moody Lie algebras*

Sergei Gukov (California Institute of Technology): *Homological Algebra of BPS States*

Jonathan Heckman (University of North Carolina, Chapel Hill): *6D SCFTs from String Compactification*

Shamit Kachru (Stanford University): *Moonshine and Gravity*

David Morrison (University of California, Santa Barbara): *Calabi-Yau manifolds, Mirror Symmetry, and F-theory*

The school website is: *http://scientific-events.weebly.com/1413.html*

4 Participants & Funding

We had 74 students. Their participation was covered by various sources, most notably CIRM covered local expenses of the lecturers and 32 participants.

FMJH helped to finance participation of the following 7 students:

1. Coimbra, André (postdoc, IHES)
2. Prins, Daniel (postdoc, IPhT)
3. Sasmal, Soumya (PhD student, IPhT)
4. Strickland-Constable, Charles (postdoc, IHES)
5. Chen, Yifan (M2, Ecole Polytechnique)
6. Malinovskaya, Olesya (M2, Paris Sud)
7. Francis Bischoff (PhD student of Marco Gualitier, FMJH visitor)