

# The Alfred Brauer Lectures, March 15-17, 2010

Alex Eskin, University of Chicago

## **Lecture 1: Billiards In Rational Polygons And Dynamics On Teichmuller Space. Phillips 215, Monday, March 15, 3:30-4:30 Pm**

This will be a slow introduction to the subject. A polygon is rational if all of its angles are rational multiples of  $\pi$ . A well known "unfolding" construction creates a flat surface with conical singularities (called a "translation surface") out of the polygon. It turns out that the dynamics of the billiard flow on the polygon is closely connected to the dynamics of the  $SL(2, \mathbb{R})$  action on the moduli space of surfaces. I will describe the moduli space, the  $SL(2, \mathbb{R})$  action, and some of the connections.

## **Lecture 2: Volumes Of Fundamental Domains And The Siegel-Veech Constants Phillips 332, Tuesday, March 16, 4:00-5:00 Pm**

In this lecture I will describe an analogy between the moduli space of translation surfaces and the moduli space of lattices (i.e.  $SL(n, \mathbb{R})/SL(n, \mathbb{Z})$ ). For example, the problem of counting periodic trajectories in a rational billiard becomes analogous to (a quantitative version of) the Oppenheim conjecture of number theory. I will discuss the current status and some open questions in this direction.

## **Lecture 3: The Teichmuller Geodesic Flow: Lyapunov Exponents And Periodic Trajectories. Phillips 332, Wednesday, March 17, 4:00-5:00 Pm**

The Teichmuller geodesic flow is the action of the diagonal subgroup of  $SL(2, \mathbb{R})$ . I will describe a formula for the sum of the first  $g$  Lyapunov exponents of the flow (joint work with M. Kontsevich and A. Zorich) and some asymptotic formulas for the number of periodic orbits of the flow (joint with M. Mirzakhani and K. Rafi).

**There will be a reception in the Mathematics Faculty/Student Lounge on the third floor of Phillips Hall, Room 330, starting at 4:45 P.M. on Monday, March 15. Refreshments will be available at 3:30 before the second and third lectures.**

<b>Brauer Lecture 1</b>	Phillips 215	March 15, 3:30–4:30 PM
<b>Brauer Lecture 2</b>	Phillips 332	March 16, 4:00–5:00 PM
<b>Brauer Lecture 3</b>	Phillips 332	March 17, 4:00–5:00 PM

*There will be a reception in the Mathematics Faculty/Student Lounge on the third floor of Phillips Hall, Room 330 immediately following the first lecture. Refreshments will be available at 3:30 before the second and third lectures.*

### **About The 2010 Brauer Lecturer**

Professor Eskin received his Ph.D. in 1993 from Princeton University under the direction of Peter Sarnak. He has been a Professor at the University of Chicago since 1999. Eskin works in a number of important related areas of mathematics including the dynamics and geometry of Teichmüller space, billiards in rational polygons, geometric group theory, ergodic theory, and Lie groups with applications to number theory. Professor Eskin has received numerous awards including a Sloan Fellowship, a Packard Fellowship and a Clay Research Award in 2007 for his work on rational billiards and geometric group theory. He will present an invited 45 minute lecture at the International Congress of Mathematicians at Hyderabad, India in August 2010.

The Alfred Brauer Fund was established by the Department of Mathematics in 1984 on the occasion of his ninetieth birthday, and the Alfred Brauer Lectures began in 1985. The most recent Brauer Lecturers have been Yakov Eliashberg, Peter Sarnak, János Kollár, Andrew Majda, Jeff Cheeger, Shing-Tung Yau, Percy Deift, Charles Fefferman and Claire Voisin.