FALL 2013 COLLOQUIUM SCHEDULE AND ABSTRACTS

Oct. 1. Semyon Dyatlov [MSRI and Clay Fellow]

Title: Black hole ringdown and resonances in general relativity

Abstract: This talk describes a mathematical model of the ringdown phenomenon of black holes, occurring when a black hole spacetime settles down after a large scale event such as merging with another black hole. During the ringdown phase, black holes emit gravitational waves at fixed complex frequencies; these frequencies are known as quasi-normal modes or resonances. Gravitational waves are expected to be observable by the existing detectors, once they are running at full capacity, and to provide information about the parameters of astrophysical black holes. We discuss a simplified (linear scalar) model of gravitational waves and explain how the geometry of the Kerr(–de Sitter) black hole spacetimes influences the distribution of quasi-normal modes and the analytic properties of the ringdown.

Oct 8. Tepper Gill [Howard University.]

title: Analysis on Infinite-dimensional Spaces.

abstract: We discuss the development of a regular sigma-finite version of Lebesgue measure on $\mathbb{R}^\infty$ which generates a regular sigma-finite restriction on every separable Banach space with a Schauder basis. After a brief discussion of measurable functions, integrable functions and the standard limit theorems, we transfer the classical inequalities and Fubini's Theorem to this setting. After showing that the maximal translation invariant subspace of $\mathbb{R}^\infty$ is ℓ_1, we define a universal representation for Gaussian measure on a separable Banach space, which is absolutely continuous with respect to our measure. We then extend the Fourier transform to Schwartz functions on reflexive Banach space, which extends the Pontryagin duality theory. As a application, we discuss existence and uniqueness of solutions to the heat equation on Hilbert space.

Oct 15. Lars Andersson (U. of Stockholm and MSRI)

Title: Building mountains on neutron stars

Abstract:Neutron stars are highly compact objects, thought to have an elastic crust surrounding a superfluid interior. In this talk I will give discuss recent work in the context of Newtonian self-gravitating elastic bodies, which yields an existence result for non-symmetric, compact, self-gravitating steady states. In particular this gives a construction of "mountains" on neutron stars, which are expected to provide a source for gravitational radiation. An important step in the proof is an improved stability analysis for steady self-gravitating fluid bodies (eg. stars).

Oct 22. James Isenberg [U. of Oregon and MSRI]

Title On the Nature of Singularities in Cosmological Solutions of Einstein's Equations

The Hawking-Penrose theorems tell us that cosmological solutions of Einstein's equations are generally singular, in the sense of the incompleteness of causal geodesics (the paths of physical observers). These singularities might be marked by the blowup of curvature and therefore crushing tidal forces, or by the breakdown of physical determinism. Penrose has conjectured (in his "Strong Cosmic Censorship Conjecture") that it is generically unbounded curvature that causes singularities, rather than causal breakdown. One approach to studying this question relies on the Belinskii, Khalatnikov and Lifshitz [BKL] scenario, which starts by conjecturing that time derivatives of the fields dominate space derivatives of the fields near the singularity. The verification that BKL behavior is generically present in certain families of solutions has proven to be a very useful tool for studying Strong Cosmic Censorship. We discuss what is known about BKL behavior and Strong Cosmic Censorship in families of solutions defined by varying degrees of isometry, and discuss new results which we believe will extend this knowledge and provide new support for Strong Cosmic Censorship.

Oct 29 Alessio Figalli [U. Texas and MSRI] something in optimal transport

title: Stability results for the semisum of sets in $\mathbb{R}^n$

abstract. Given a Borel A in $\mathbb{R}^n$ of positive measure, one can consider its semisum $S = (A + A)/2$. It is clear that S contains A, and it is not difficult to prove that they have the same measure if and only if A is equal to his convex hull minus a set of measure zero. We now wonder whether this statement is stable: if the measure of S is close to the one of A, is A close to his convex hull? More generally, one may consider the semisum of two different sets A and B, in which case our question corresponds to proving a stability result for the Brunn-Minkowski inequality. When $n = 1$, one can approximate a set with finite unions of intervals to translate the problem to the integers $\mathbb{Z}$. In this discrete setting the question becomes a well-studied problem in additive combinatorics, usually known as Freiman's Theorem. In this talk, which is intended for a general audience, I will review some results in the one-dimensional discrete setting and show how to answer to the problem in arbitrary dimension.

Nov 5 Greg Galloway [U. of Miami and MSRI]

Title: On the topology of black holes and beyond.

Abstract: In recent years there has been an explosion of interest in black holes in higher dimensional gravity. This, in particular, has led to questions about the topology of black holes in higher dimensions. In this talk we review Hawking's classical theorem on the topology of black holes in $3+1$ dimensions (and its connection to black hole uniqueness) and present a generalization of it to higher dimensions. The latter is a geometric result which places restrictions on the topology of black holes in higher dimensions. We shall also discuss recent work on the topology of space exterior to a black hole. This is closely connected to the Principle of Topological Censorship, which roughly asserts that the topology of the region outside of all black holes (and white holes) should be simple. All of the results to be discussed rely on the recently developed theory of marginally outer trapped surfaces, which are natural spacetime analogues of minimal surfaces in Riemannian geometry. This talk is based primarily on joint work with Rick Schoen and with Michael Eichmair and Dan Pollack.

Nov. 12, Allen Knutson [Cornell].

title: Bruhat atlases and the wonderful compactification of a group

Abstract: A manifold is covered by an atlas of charts, all isomorphic to affine space. Given a manifold with a stratification, we can look into covering it with affine spaces with stratifications. Some of the nicest such stratified affine spaces are the Bruhat cells inside flag manifolds, and I'll explain many of the reasons why. Then I'll define a Bruhat atlas on a general stratified manifold, and focus on two examples: the Grassmannian with the "positroid strata" indexed by juggling patterns, and the "wonderful compactification" of a group. This work is joint with Xuhua He and Jiang-Hua Lu.

Nov 19. Viktor Ginzburg [UCSC]

title: TBA

Abstract: TBA

Nov 26 NO COLLOQUIUM

Dec 3. Hans Lindblad [John Hopkins]

title: Asymptotic Stability of Minkowski space time

Abstract: TBA