Ancient solutions to the Yamabe flow
Panagiota Daskalopoulos, Columbia University

We will discuss new ancient solutions of the Yamabe flow on $S^n$. We will also discuss Yamabe solitons.

On negative eigenvalues of two-dimensional Schrödinger equations
Alexander Grigor’yan, University of Bielefeld

We prove an upper bound for the number $\text{Neg}(H)$ of negative eigenvalues of the Schrödinger operator $H = -\Delta - V$ in $\mathbb{R}^2$, in terms of a weighted $L^p$-norm of the potential $V$, for any $p > 1$. This estimate scales correctly (linearly) in $\alpha$ under the transformation $V \mapsto \alpha V$ of the potential. In $\mathbb{R}^n$, $n \geq 3$, an upper estimate of $\text{Neg}(H)$ with a correct scaling in $\alpha$ has been known since 1970s and is due to Cwikel-Lieb-Rosenblum.

Inverse mean curvature flow
Gerhard Huisken, MPI, Gravitational Physics

The lecture gives an overview of techniques and results for inverse mean curvature flow, with a special view to applications in geometry.

Geometric topology of moduli spaces of Riemann surfaces
Lizhen Ji, University of Michigan

The mapping class group $\text{Mod}_g$ of a compact surface of genus $g$ acts properly on the Teichmüller space $T_g$ of genus $g$, and the quotient is the moduli space $M_g$ of compact Riemann surfaces of genus $g$. It is known that $T_g$ is a model of universal space of proper actions of $\text{Mod}_g$.

In this talk, we will discuss vanishing of the simplicial volume of the moduli space $M_g$ and construction of spines, i.e., equivariant deformation retracts, of the Teichmüller space $T_g$, which provide cofinite (or cocompact) models of universal space of proper actions of $\text{Mod}_g$. 

The existence of infinitely many holomorphic $P^1$ in a K3 surface

Jun Li, Stanford University

The function field version of Lang’s conjecture states that every smooth algebraic K3 surface contains infinitely many holomorphic $P^1$. We report the recent progress on this conjecture, using Tate conjecture, reduction to finite field method, and the moduli of stable maps. The talk will be expository.

A global Torelli theorem for Calabi-Yau manifolds

Kefeng Liu, UC Los Angeles

We prove that the period map from the Teichmüller space of polarized and marked Calabi-Yau manifolds to the classifying space of polarized Hodge structures is an embedding. The proof is based on the constructions of holomorphic affine structure and global holomorphic affine flat coordinates on the Teichmüller space.

Eigenvalues of Collapsing Domains and Drift Laplacian

Zhiqin Lu, UC Irvine

By introducing a weight function to the Laplace operator, Bakry and Émery defined the “drift Laplacian” to study diffusion processes. Our first main result is that, given a Bakry-Émery manifold, there is a naturally associated family of graphs whose eigenvalues converge to the eigenvalues of the drift Laplacian as the graphs collapse to the manifold. Applications of this result include a new relationship between Dirichlet eigenvalues of domains in $\mathbb{R}^n$ and Neumann eigenvalues of domains in $\mathbb{R}^{n+1}$, variational principles, and a maximum principle. Using our main result and the maximum principle, we are able to generalize all the results in Riemannian geometry based on gradient estimates to Bakry-Émery manifolds.

Gradient Ricci solitons

Ovidiu Munteanu, Columbia University

Gradient Ricci solitons arise in the study of singularities of the Ricci flow. They are also interesting as a geometric partial differential equation, being a natural generalization of Einstein manifolds. In this talk we survey recent development in the theory of complete noncompact Ricci solitons and we will cover topics such as the rate of volume growth, curvature estimates and topology at infinity.
Gap theorems on Kaehler manifolds
Lei Ni, UC San Diego

A gap theorem concerns, when the curvature of a complete noncompact Riemannian manifold has a sign, what amount of curvature is needed to ensure that the metric is non-trivial (namely non flat at in this case).

In this talk I shall survey on different versions of gap theorems with one started in 1977. The focus shall be placed on various new techniques developed, most often motivated by the study of other subjects in geometric analysis such as the functions of several complex variables, the vanishing theorems in complex geometry, the nonlinear evolution equation, including the Ricci flow on complete manifolds, etc, with the goal of proving the sharp results.

The constant rank Hessian problem for some degenerate fully non-linear equations
Duong H. Phong, Columbia University

The property of Hessians having constant rank has received a lot of attention in the case of elliptic equations. Much less studied is the degenerate case. We discuss some initial results in this case, for the Monge-Ampère and the Donaldson equations.

An extremal eigenvalue problem for surfaces with boundary
Richard Schoen, Stanford University

Beginning with the work of J. Hersch for the two sphere and that of P. Li and S. T. Yau for more general surfaces, the question of determining surfaces of fixed area which maximize the first eigenvalue has been actively studied. In this talk we will describe recent work with A. Fraser concerning extremal eigenvalue questions for surfaces with boundary. In both cases the eigenvalue problems are related to minimal surface questions. For closed surfaces these are minimal surfaces in spheres while for surfaces with boundary they are related to minimal surfaces in the ball satisfying a natural boundary condition. We will describe the extremal surfaces in the genus zero case.

Asymptotics in the Study of Minimal Submanifolds
Leon Simon, Stanford University

This will be a survey lecture, focusing on results about asymptotic behavior of minimal submanifolds, either on approach to singular points or, in the case of complete unbounded minimal submanifolds, on approach to infinity.
Gradient estimates and Sobolev inequality  
Jiapeng Wang, University of Minnesota
We will explain a gradient estimate for the eigenforms of Hodge Laplacian. The estimate is in turn used to obtain a Sobolev inequality for differential forms.

Gluing determinants of Laplacians  
Richard Wentworth, University of Maryland
I’ll talk about new elliptic boundary conditions for Laplace operators of framed holomorphic hermitian line bundles on Riemann surfaces with boundary. The framing is a choice of trivialization near the boundary. These boundary conditions give rise to gluing formulas for determinants on closed surfaces which may be used to study asymptotics. I’ll also discuss an application to the behavior of the determinant of the Dirichlet to Neumann operator.

Quasi-local Mass and Momentum in General Relativity  
Shing-Tung Yau, Harvard University
In this talk, we shall talk about joint work with Mutao Wang and Poning Chen on the definition and properties of quasilocal mass in general relativity.