TITLES and ABSTRACTS

♠ **강현석** (고등과학원)
Title: Isospectral Riemann surfaces of genus 2 and 3
Abstract: We discuss some problems arisen from the famous question 'Can one hear the shape of a drum?' by Mark Kac in 1960's. Although the original question remains open, the general statement on Riemannian manifolds turns out to be false. Instead, this initiated the study of finding pairs of non-isometric manifolds with the same eigenvalue spectrum of the Laplacian. Many of such construction follow from Sunada technique, the covering technique using so called almost conjugate subgroups. However, checking non-isometry between isospectral manifolds is via ad hoc method and in our case, we compare the lengths the closed geodesics.

♠ **강효상** (고등과학원)
Title: Arithmeticity of complex hyperbolic lattices
Abstract: In this talk, I will give a historical background on finding non-arithmetic lattices, and deliever ideas of constructing complex hyperbolic lattices.

♠ **김종수** (서강대)
Title: Gradient Ricci solitons
Abstract: This lecture is basically to introduce some researches on gradient Ricci solitons, aimed mainly for graduate students and possibly for some relevant researchers. Although Ricci solitons arise as a branch of Ricci flow theory, there are already large (and still expanding) literatures on them. So I narrow down on a few aspects. In particular, I will talk mostly on 4-dimensional gradient shrinking Ricci solitons and related works.

After basic definitions, I am going to explain on 2 or 3-dimensional Ricci solitons, which are understood relatively better than higher dimensions. About the 4-dimension, I will touch the subjects of Cao-Zhou [**?**], positive isotropic curvature (on self-dual) [**?**, **?**] and Cao-Chen [**?**]. Cao's article [**?**] should be helpful for an overview and the book [**?**] is good for some details.

I may briefly mention about the role of Ricci solitons in the theory of Ricci flows on compact manifolds. Though this lecture is mostly of survey, I will take one application of argument for solitons to other geometric study.

References

[1] Chow et al: *Ricci flow: Techniques and Applications, Part I: Geometric Aspects*. Mathematical Surveys and Monographs Volume 135 (2007).

[2] Bing-Long Chen, Siu-Hung Tang, Xi-Ping Zhu: *Complete classification of compact four-manifolds with positive isotropic curvature.*, J. Diff. Geometry 85 (2010), 175-185.

[3] H.D. Cao: *Recent progress on ricci solitons.*, Adv. Lect. Math. (ALM), 11 (2009), 1-38. http://arxiv.org/abs/0908.2006v1.

[4] H.D. Cao and Q. Chen: *On Bach flat gradient shrinking ricci solitons.*, http://arxiv.org/abs/1105.3163v1.

[5] H.D. Cao, D. Zhou: *On complete gradient shrinking ricci solitons.*, J. Diff. Geometry 85 (2010), 175-185.

[6] Thomas Richard and Harish Seshadri: *Positive isotropic curvature and self-duality in dimension 4*, http://arxiv.org/abs/1311.5256v1

♠ **어윤희** (국가수리과학연구소)
Title: Generalization of 4-dimensional Einstein manifolds
Abstract: In this talk, we introduce the concept of a weakly Einstein manifold regard as a natural generalization of a 4-dimensional Einstein manifold and give a characterization of a weakly Einstein manifold in terms of so-called generalized Singer-Thorpe bases. We shall give some examples and applications of this manifold.

♠ **윤갑진** (명지대)
Title: On the structure of complete hypersurfaces in a Riemannian manifold of nonnegative curvature and L^2 harmonic forms
Abstract:

♠ **이윤원** (인하대)
Title: Witten deformation - Witten's proof of Morse inequality
Abstract: On a closed manifold, the Morse inequality shows the relation between the Betti numbers and the number of critical points of a Morse function. Classically it is shown by using the relation between the critical points of a Morse function and the cell structures of a manifold. In 1980's Witten introduced a deformation of the de Rham operator with the help of a Morse function in his seminal paper "Supersymmetry and Morse theory, Jour. of Diff. Geom. 17, (1982), p.661-692". Using this deformation, he defined a one parameter family of Laplacians called Witten Laplacians, which are zero order perturbations of the usual Hodge Laplacians. This family of operators has a nice spectral property. The spectra of these operators divide into two parts, which are small eigenvalues and large eigenvalues. The number of small eigenvalues of Witten Lalacians acting on q-forms is exactly same as the number of critical points of index q and the eigenspace corresponding to the small eigenvalues forms a de Rham subcomplex which computes the same de Rham cohomologies. This construction naturally leads to the new and pure analytic proof of the Morse inequality. In this lecture, I'm going to review some basic facts about the Morse inequality and explain briefly the Witten's proof of the Morse inequality.

♠ **이재혁** (이화여대)
Title: The Construction of Compact G_2 manifolds
Abstract: The construction of compact manifolds with G_2 holonomy is one of the challenging research topics in differential geometry. Recently, the geometry group of Imperial College introduce new approach to the twisted sum method to produce huge class of manifolds with G_2 holonomy. And this new construction is expected to lead us to a better understanding on the geometry of G_2-manifolds. But the new construction is very complicated to understand since it is based on deep theories from differential geometry, symplectic geometry, algebraic geometry and geometric analysis. In this talk, we recall basic facts on the geometry of G_2-manifolds and have an introduction to the new construction of G_2-manifolds.

♠ **정승달** (제주대)
Title: Geometry of a foliation
Abstract: Foliation theory has its origin in the global analysis of solutions of ordinary differential equations. On an n-dimensional manifold M, an differential equation is defined by a vector field. That is, if the vector field has no singularities, then its trajectories form a partition of M into curves, i.e., a foliation of codimension $n-1$. More generally, a foliation of codimension q on M corresponds to a partition of M intoimmersed submanifolds of dimension $p = n - q$. In 1959, B. Reinhart introduced a Riemannian foliation, i.e., the existence of a bundle-like metric on M for which the leaves of the foliation remain locally at constant distance from each other. Actually, the condition for a foliation to be Riemannian is a "transverse property", being given by the existence on the local quotient manifolds of a supplementary geometric structure. In this talk, we give a definition and examples of foliations. Also, we study the several basic properties about a Riemannian foliation.

♠ **조종택** (전남대)
Title: Reeb flows on contact manifolds
Abstract: A $(2n+1)$-dimensional differential manifold (M, η) is said to be a *contact manifold* if there is a 1-form η which satisfies $\eta \wedge (d\eta)^n \neq 0$ everywhere on M. In this talk, I describe a *contact transformation*, which preserves a contact form η, by means of the so-called Huygen's Principle. The Reeb vector field ξ of a given contact manifold generates a contact transformation, i.e., $\pounds_\xi \eta = 0$. Then we may consider several interesting applications. One of them, we shall prove the following theorem.
Theorem. *The Ricci operator S of a contact metric three-manifold M is invariant along the Reeb flow ξ, that is, M satisfies $\pounds_\xi S = 0$ if and only if M is Sasakian or locally isometric to a Lie group* $\mathrm{SU}(2)$, $\mathrm{SL}(2,\mathbb{R})$, $E(2)$ (*the group of rigid motions of Euclid 2-plane*) *with a left invariant contact Riemannian metric respectively.*

♠ **최광호** (서울대)
Title: On bubbling for sequences of harmonic maps and their heat flows from surfaces
Abstract: We review Sacks and Uhlenbeck's bubbling phenomena for sequences of harmonic maps from a compact surfaces and then present Parker and Wolfson's renormalization of the sequences resulting in bubble-tree convergence.

♠ **표준철** (부산대)
Title: Surfaces in a smooth metric measure space
Abstract: We first introduce smooth metric measure spaces. Then we give some rigidity results of weighted constatnt mean curvature surfaces in a metric measure space with some geometric conditions. In particular, with special boundary condition of translating surfaces, we give a rigidity result of rotational symmetric translating surfaces.

♠ **한강진** (고등과학원)
Title: Some problems on low-codimensional projective varieties
Abstract:

♠ **허석문** (성균관대)
Title: A Torelli type problems for logarithmic bundles over projective varieties
Abstract: For an arrangement D of smooth hypersurfaces on a nonsingular variety X, we can define a logarithmic sheaf as a sheaf of differential 1 forms with logarithmic poles along D. This sheaf is locally free when D has simple normal crossings. When the logarithmic bundle is free, we call the divisor to be free. In particular,we lose many information about the free divisors when we consider their corresponding logarithmic bundles. As an opposite extremal case, we can ask Torreli question, i.e. can we rediscover the divisor from the logarithmic bundles? This question was answered in the case of projective spaces by Dolgachev-Kapranov and Valles. In this talk, we introduce the recent result on the same question over quadric hypersurfaces and multiprojective spaces.

♠ **현동훈** (POSTECH)
Title: Differential forms on toric manifolds
Abstract: I will discuss basic toric geometry of differential forms, especially the canonical bundle formula obtained by generalizing the well known Euler sequence for projective spaces.