華東師範大學 | 数学科学学院
School of Mathematical Sciences,East China Normal University

2019 ECNU Summer School and Summer Workshop on Geometry and Analysis on Manifolds

Program

East China Normal University, Shanghai

2019.7.1—2019.7.7

2019 ECNU Summer School and Summer Workshop on Geometry and Analysis on Manifolds

There will be a summer school and workshop on geometry and analysis on manifolds held in the Department of Mathematics at East China Normal University from July 1 to July 7, 2019.

The purpose is to disseminate current research development in differential geometry, geometric analysis and related fields to graduate students, postdoctoral fellows, and mathematicians who are interested in these topics. We hope to bring students and experts together in an inspiring environment, which facilitates the beginning and the continuing of research collaborations and dissemination.

Participants are encouraged to engage in informal discussions between and after the lectures. According to the participants' interests, some informal talks may be arranged on demand.

Organizing Committee

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2019 ECNU Summer School on Geometry and Analysis on Manifolds

Math Building, Lecture Hall 102, ECNU, Shanghai, China

July 1-5, 2019

Timetable

Session	Time	July 1	July 2	July 3	July 4	July 5
Moring Session	9:00-10:15	Goette, Sebastian	Goette, Sebastian	Goette, Sebastian	Jiang, Wenshuai	Shi, Yuguang
	10:30-11:45	Jiang, Wenshuai	Rong, Xiaochun	Rong, Xiaochun	Rong, Xiaochun	Rong, Xiaochun
Afternoon Session	14:30-15:45	Shi, Yuguang	Shi, Yuguang	Jiang, Wenshuai	Shi, Yuguang	Jiang, Wenshuai
	16:00-17:15	Goette, Sebastian	Wang, Zuoqin	Wang, Zuoqin	Wang, Zuoqin	Wang, Zuoqin

Registration：June 30，14:00-18:00 at Loby of Baolong Yiyue Hotel and Huangcheng Holiday Hotel.
(6 月 30 日下午 14：00-18：00 在宝龙艺悦酒店和皇程假日酒店大厅注册)

Shuttle：There will be a shuttle(短驳车) to pick you up from Baolong Yiyue hotel to math building at 8:40 a.m. and 14:10 p.m. from July 1 to July 7.

2019 ECNU Summer School on Geometry and Analysis on Manifolds

Math Building, Lecture Hall 102, Minhang Campus of ECNU, 500 Dongchuan Road, Shanghai, China

July 1-5, 2019

Course Introduction

Lecture 1

Title: eta-Invariants in Differential Topology

Speaker：Goette, Sebastian (University of Freibrug)

Introduction：To study the topology of closed manifolds, one can use tools from classical algebraic topology like fundamental group, (co-) homology, K-theory etc. For even dimensional manifolds, one can sometimes describe their cobordism classes by characteristic numbers. For odd-dimensional manifolds M, one may consider so-called boundary defect invariants instead. These are typically defined using relative characteristic numbers on a compact manifold W with boundary $\partial W = M$. While abstract bordism theory tells us that such W exist, it is not always easy to find a concrete W on which to evaluate the relevant invariants.

In the lecture series, we will study an intrinsic approach to certain boundary defect invariants. I will begin by explaining the index theorems by Atiyah-Singer for closed even-dimensional manifolds, and by Atiyah-Patodi-Singer for even dimensional compact manifolds with boundary. The relevant boundary contribution is the so-called η-invariant. Then I will sketch intrinsic descriptions of certain boundary defect invariants in terms of η-invariants. Under additional geometric assumptions like positive scalar curvature or special holonomy, some of these invariants possess natural refinements.

In the last part of the series we will consider several examples. For each example, we first describe some particular construction of manifolds, then define appropriate boundary defect invariants, represent them in terms of η-invariants, and finally sketch the computational tools necessary to evaluate them. If time permits, we will see metrics of non-negative sectional curvature on all exotic 7-spheres, and closed 7-manifolds admitting several deformation families of metrics with holonomy G2.

Lecture 2

Title: Quantitative estimates for singular set of Ricci limit space

Speaker: Jiang, Wenshuai (Zhejiang University)

Introduction: In these four lectures, we will discuss some recent results about manifold with lower Ricci curvature bound. In the first two lectures, we will briefly recall some results of Cheeger, Colding, Tian and Naber, such as almost metric cone theorem, almost splitting theorem and Cheeger-Naber's quantitative estimate of singular set and applications. In the last two lectures, we will discuss quantitative estimates in Jiang-Naber and Cheeger-Jiang-Naber. We will introduce the neck regions and neck region decomposition theorem for manifold with lower Ricci curvature.

Lecture 3

Title：The Gromov's theorem on almost flat manifolds

Speaker: Rong, Xiaochun (Capital Normal University)

Introduction： In the collapsing theory of Cheeger-Fukaya-Gromov on collapsed manifolds with bounded sectional curvature, the Gromov's theorem on almost flat manifold has been a corner stone. We will present a detailed proof for the Gromov's theorem, and we will discuss its a generalization and applications.

Lecture 1. Nilpotent manifolds, equivariant Gromov-Hausdorff convergence.
Lecture 2. Successive blow-ups, Fibration theorems.
Lecture 3. A new proof of Gromov's theorem on almost flat manifolds.
Lecture 4. Manifolds of almost non-negative Ricci curvature whose Riemannian universal cover is not collapsed

Lecture 4

Title: Semiclassical methods in spectral Geometry

Speaker：Wang, Zuoqin (University of Science and Technology of China)

Introduction：In this series of lectures I will give an introduction to semiclassical analysis which plays a role as a bridge between classical mechanics (i.e. symplectic geometry) and quantum mechanics (i.e. spectral theory). I will start with a quick introduction to the necessary symplectic geometry background. Then I will explain Weyl quantization that connect the classical and quantum theory. Finally I will focus on some classical theorems in spectral geometry that are proven using this classical-quantum correspondence point of view.

Lecture 5

Title: 数量曲率相关的几何问题

Speaker：Shi, Yuguang (Peking University)

Introduction：对于三维以上的流形，数量曲率是最弱的一种曲率不变量， 但一个微分流形上具有非负数量曲率度量，却会对流形的拓扑有较大的限制。另一方面，数量曲率在广义相对论中被解释为能量密度， 因此数量曲率几何问题和广义相对论中的能量问题有着紧密的联系。在四次讲座中，我们将报告与之相关的几何问题，包括 Schoen-Yau 三维流形上正质量定理的证明。

2019 ECNU Summer Workshop on Geometry and Analysis on Manifolds

Math Building, Lecture Hall 102, Minhang Campus of ECNU, 500 Dongchuan Road, Shanghai, China

Schedule

July 6

Morning Session **Chair: Dai, Xianzhe**

9:00-9:50 **Wang, Jiaping** (University of Minnesota, Twins Cities)
Topology of gradient Ricci solitons

9:50-10:10 Group Photo and Tea Break

10:10-11:00 **Zhu, Xiaohua** (Peking University)
Unstability of Kaehler-Ricci flow

11:00-11:10 Tea Break

11:10-12:00 **Guan, Bo** (Ohio State University)
TBA

12:00-14:30 Lunch and Snap

Afternoon Session **Chair: Zheng, Yu**

14:30-15:20 **Sung, Chiung-Jue Anna** (National Tsing Hua University)
Green's function estimates and applications

15:20-15:30 Tea Break

15:30-16:20 **Xia, Chao** (Xiamen University)
Escobar’s conjecture on lower bound for first Steklov eigenvalue

16:20-16:30 Tea Break

16:30-17:20 **Xu, Lu** (Hunan University)
Solutions to the equations from the conformal geometry

17:30 Dinner

July 7

Morning Session	**Chair: Wei, Guofang**
9:00-9:50	**Zhang, Qi** (University of California, Riverside) A few properties of global solutions of the heat equation on Euclidean space and some manifolds.
9:50-10:00	Tea Break
10:00-10:50	**Qiu, Ruifeng** (East China Normal University) Heegaard splittings on 3-manifolds: a survey
10:50-11:00	Tea Break
11:00-11:50	**Liu, Gang** (Northwest University) Gromov-Hausdorff limits of Kaehler manifolds with Ricci curvature lower bound
11:50-14:30	Lunch and Snap
	Chair: Liu, Pan
14:30-15:20	**Li, Qiongling** (Chern Institute of Mathematics) Domination results for harmonic maps in higher Teichmüller theory
15:20-15:30	Tea Break
15:30-16:20	**Pan, Jiayin** (University of California, Santa Barbara) Semi-local simple connectedness of non-collapsing Ricci limit spaces
16:20-17:00	Free discussion

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Math Building, Lecture Hall 102, Minhang Campus of ECNU, 500 Dongchuan Road, Shanghai, China

July 6-7, 2019

Abstracts

Topology of gradient Ricci solitons

Wang, Jiaping
E-mail: wangx208@umn.edu
University of Minnesota, Twins Cities

Abstract: The talk mainly concerns the issue of connectedness at infinity for gradient Ricci solitons. Ricci solitons are precisely the self-similar solutions to the Ricci flows. They play an important role in the singularity analysis of Ricci flows and are of interest of themselves.

Unstability of Kaehler-Ricci flow class

Zhu, Xiaohua
E-mail: xhzhu@math.pku.edu.cn
Peking University

Abstract: In this talk, we will show that there exists a Fano manifold with admitting a Kaehler-Ricci soliton on which the Kaehler-Ricci flow is unstable for Kaehler metrics (the complex structure may vary) in the first Chern class. As a consequence, the second variation of Perelman's entropy on this manifold is not stable for Kaehler metrics in the first Chern class . The situation is totally different on Kaehler-Einstein manifolds on which the second variation of Perelman's entropy is always stable.

TBA

Guan, Bo
E-mail: guan@math.ohio-state.edu
Ohio State University

Abstract: TBA

Green's function estimates and applications

Sung, Chiung-Jue Anna
E-mail: cjsung@math.nthu.edu.tw
National Tsing Hua University

Abstract: In this talk, we intend to explain some estimates for the Green's function on complete manifolds admitting a weighted Poincaré inequality. Applications will also be mentioned. This is a joint work with Ovidiu Munteanu and Jiaping Wang.

Escobar's conjecture on lower bound for first Steklov eigenvalue

Xia, Chao
E-mail: chaoxia@xmu.edu.cn
Xiamen University

Abstract: It was conjectured by Escobar in 1999 that for a smooth compact Riemannian manifold with boundary, which has nonnegative Ricci curvature and boundary principal curvatures bounded below by some c>0, the first Steklov eigenvalue is greater than or equal to c with equality holding only on isometrically Euclidean balls with radius 1/c. In this talk, we present a resolution to this conjecture in the case of nonnegative sectional curvature. This is a joint work with Changwei Xiong at ANU.

Solutions to the equations from the conformal geometry

Xu, Lu
E-mail: xulu@hnu.edu.cn
Hunan University

Abstract: We solve the Gursky-Streets equations with uniform $C^{1, 1}$ estimates for $2k\leq n$. An important new ingredient is to show the concavity of the operator which holds for all $k\leq n$. Our proof of the concavity heavily relies on Garding's theory of hyperbolic polynomials and results from the theory of real roots for (interlacing) polynomials. Together with this concavity, we are able to solve the equation with the uniform $C^{1, 1}$ \emph{a priori estimates} for all the cases $n\geq 2k$. Moreover, we establish the uniqueness of the solution to the degenerate equations for the first time.

A few properties of global solutions of the heat equation on Euclidean space and some manifolds

Zhang, Qi
E-mail: qizhang@math.ucr.edu
University of California, Riverside

Abstract: We report some recent results on Martin type representation formulas for ancient solutions of the heat equation and dimension estimates of the space of these solutions under some growth assumptions. We will also present a new observation on the time analyticity of solutions of the heat equation under natural growth conditions. One application is a solvability condition of the backward heat equation, i.e. under what condition can one turn back the clock in a diffusion process. Part of the results are joint work with Fanghua Lin and Hongjie Dong.

Heegaard splittings on 3-manifolds: a survey

Qiu, Ruifeng
E-mail: rfqiu@math.ecnu.edu.cn
East China Normal Univesity

Abstract: Let M be a closed, orientable 3-manifold, then there exists a closed surface which cuts M into two handlebodies. This structure on 3-manifold is called Heegaard splitting. In this talk, I will introduce some classical results on Heegaard splitting and its applications.

Gromov-Hausdorff limits of Kaehler manifolds with Ricci curvature lower bound

Liu, Gang
E-mail: gang.liu@northwestern.edu
Northwestern University

Abstract: A fundamental result of Donaldson-Sun states that non-collapsed Gromov-Hausdorff limits of polarized Kaehler manifolds, with 2-sided Ricci curvature bounds, are normal projective varieties. We extend their approach to the setting where only a lower bound for the Ricci curvature is assumed. More precisely, we show that non-collapsed Gromov-Hausdorff limits of polarized Kaehler manifolds, with Ricci curvature bounded below, are normal projective varieties. In addition the metric singularities are precisely given by a countable union of analytic subvarieties. This is a joint work with Gabor Szekelyhidi.

Semi-local simple connectedness of non-collapsing Ricci limit spaces

Pan, Jiayin
E-mail: j_pan@math.ucsb.edu
University of California, Santa Barbara

Abstract: We prove that any non-collapsing Ricci limit space is semi-locally simply connected. This is joint work with Guofang Wei.

Domination results for harmonic maps in higher Teichmüller theory

Li, Qiongling
E-mail: qiongling.li@gmail.com
Chern Institute of Mathematics

Abstract: In this talk, we study the harmonic maps in higher Teichmüller theory from the viewpoint of the Higgs bundles. Let X=(S,J) be a closed Riemann surface with genus at least 2. The non-abelian Hodge theory gives a correspondence between the moduli space of representations of the fundamental group of a surface S into a Lie group G with the moduli space of G-Higgs bundles over the Riemann surface X. The correspondence is through looking for an equivariant harmonic map from X to the symmetric space associated to G. Hitchin representations are an important class of representations of fundamental groups of closed hyperbolic surfaces into PSL(n,R), at the heart of higher Teichmüller theory. We discover some geometric properties of such harmonic maps for Hitchin representations or more general representations by using Higgs bundles techniques.

Campus Map


皇程假日酒店
上海皇程假日酒店
如家商旅酒
上海市
永德生活广场
99旅馆连锁
宝龙艺悦酒店
虹梅南路隧道
紫晶南园
学生共享空间
X210
体育与健康学院
华东师范大学(闵行校区)-校医院
实验A楼
15号线(在建)
华东师大教师之家宾馆
生命科学学院
第二教学楼
友爱小区
莲花南路
东海职业技术学院
华东师大闵行校
数学楼
X212
秋实阁
华东师范大学(闵行校区)
信息科学技术学院
办公楼
东川路

Hotels in Minhang Campus:

(1) 宝龙艺悦酒店
地址: 上海闵行区吴泾尚义路 39 弄 1 号
电话：021-38959188

(2) 皇程假日酒店
地址：上海市闵行区吴泾镇永德路 710 号
电话：021-31106688

Lunch and dinner of the Summer School and Workshop: 秋实阁

Location of the Summer School: Lecture Hall 102, Math Building (数学楼 102 报告厅)

Location of the Workshop: Lecture Hall 102, Math Building (数学楼 102 报告厅)

Contact: Zhang, Hongyan (张红艳) Tel: 13651698338
Zhou, Linfeng（周林峰）Tel: 13818111461

交通出行

到达 出发	闵行校区
浦东机场	**路线1:机场七线**->(上海南站)->见上海南站 **路线2:磁悬浮**->(龙阳路站)->**轨道交通7号线**->(耀华路站)->**轨道交通8号线**->(沈杜公路 站)->乘坐出租车到达东川路校门大约需要30元 **路线3:磁悬浮/轨道交通2号线**->(龙阳路站)->**轨道交通7号线**->(耀华路站)->**轨道交通8 号线**->(江月路站)->**闵行11路**->东川路校门 **路线4:轨道交通2号线**->(人民广场站)->见人民广场站 **路线5:**直接乘坐出租车大约需要220元（S32申嘉湖高速[收费]剑川路出口下）
虹桥机场/ 虹桥火车站	**路线 1:公交 938 路**->(漕溪北路站)->**轨道交通 1 号线**->(莘庄站)->见莘庄站 **路线2:虹桥枢纽4路**->(东川路莲花南路)->沿东川路步行700米->东川路校门 **路线3:**直接乘坐出租车大约需要120元（S20外环->S4沪金高速[收费]剑川路出口下)
上海火车站	**路线1:轨道交通1号线**->(莘庄站)->见莘庄站 **路线 2:轨道交通 3 号线**->(上海南站)->见上海南站 **路线3:轨道交通1号线**->(人民广场站)->见人民广场站 **路线4:**直接乘坐出租车大约需要120元(南北高架->内环高架->沪闵高架->S4沪金高速[收费]剑川路出口下)

上海南站	**路线1:轨道交通1号线**->(莘庄站)->见莘庄站 **路线 2:公交 180 路**->(莲花南路东川路)->莲花南路校门 **路线3:公交729路**->(虹梅南路华东师大)->研究生公寓 **路线4:**直接乘坐出租车大约需要80元(沪闵高架路->S4沪金高速[收费]剑川路出口下)
人民广场站(市中心)	**路线1:轨道交通1号线**->(莘庄站)->见莘庄站 **路线2:轨道交通8号线**->(江月路站)->**闵行11路**->东川路校门 **路线3:轨道交通8号线**->(沈杜公路站)->乘坐出租车到达东川路校门大约需要30元 **路线4:**直接乘坐出租车大约需要120元(南北高架->内环高架->沪闵高架->S4沪金高速[收 费]剑川路出口下)
莘庄站	**路线1:轨道交通5号线**->(东川路站)->**闵行26路**->(东川路莲花南路)->沿东川路步行700 米->东川路校门 **路线2:轨道交通5号线**->(东川路站)->乘坐出租车到达东川路校门大约需要14元 **路线3:公交816路**->(沪闵路江川路)->**公交958路**->(东川路莲花南路)->莲花南路校门 **路线4:公交725路**->(莲花南路春申路)->**公交180路**->(莲花南路东川路)->莲花南路校门 **路线5:**直接乘坐出租车大约需要60元
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