

# 2023 Simons Summer Math Workshop - Week 1

**Events for:  
Monday, August 7th - Friday, August 11th**

## Monday, August 7th

9:00am **Workshop: Breakfast - SCGP Cafe**

**Title:** Breakfast

9:30am **Workshop: Song Sun - SCGP 102**

**Speaker:** Song Sun

**Title:** Collapsing of Calabi-Yau metrics

**Abstract:** We will discuss recent work involved by the speaker on the collapsing structure of Calabi-Yau metrics. We will give an overview of the subject and then explain two main results: (1) Collapsing of Calabi-Yau metrics for small complex structure degenerations (in general dimensions). This result gives a relatively complete description of the geometry. (2) General structural theory for collapsing in complex dimension 2. This is related to the study of moduli space of K3 surfaces and classification of gravitational instantons. These results are based on joint work Ruobing Zhang, and we will also mention related results which were joint with H. Hein, J. Viaclovsky and R. Zhang.

11:30am **Workshop: Yang Li - SCGP 102**

**Speaker:** Yang Li

**Title:** Metric SYZ conjecture

**Abstract:** The metric aspect of the Strominger-Yau-Zaslow conjecture asks for the existence of special Lagrangian torus fibrations on the generic region of the Calabi-Yau manifolds near the large complex structure limit. It was shown recently that the conjecture holds for a handful of examples, including the Fermat family, and there is a more general sufficient criterion reducing the metric SYZ conjecture to non-archimedean geometry. There will be four lectures, concerning the introductory background on SYZ, the analytic techniques, and the non-archimedean geometry background, which will be finally combined into a proof outline.

1:00pm **Workshop: Lunch - SCGP 102**

**Title:** Lunch

2:00pm **Workshop: Ruobing Zhang - SCGP 102**

**Speaker:** Ruobing Zhang

**Title:** Collapsing geometry of Riemannian manifolds

**Abstract:** This is an expository talk focusing on the geometry of collapsing manifolds with sectional and Ricci curvature bounds. We will exhibit basic notions, motivating examples, fundamental results, and their applications.

3:30pm **Tea time - SCGP Cafe**

**Title:** Tea Time

**Tuesday, August 8th**

9:00am **Workshop: Breakfast - SCGP Cafe**

**Title:** Breakfast

9:30am **Workshop: Song Sun - SCGP 102**

**Speaker:** Song Sun

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1:00pm **Workshop: Lunch - SCGP 102**

**Title:** Lunch

5:00pm **- SCGP 103**

**Title:** Summer Concert Series: Jazz Loft

<b>Wednesday, August 9th</b>
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9:00am **Workshop: Breakfast - SCGP Cafe**

**Title:** Breakfast

9:30am **Workshop: Song Sun - SCGP 102**

**Speaker:** Song Sun

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12:00pm **Workshop: Lunch - SCGP Cafe**

**Title:** Lunch

1:00pm - **Smith Point County Park, 1 William Floyd Pkwy, Shirley, NY 11967, USA**

**Title:** Beach Outing - Smithpoint Beach - 1-5PM

<b>Thursday, August 10th</b>
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9:00am **Workshop: Breakfast - SCGP Cafe**

**Title:** Breakfast

9:30am **Workshop: Yang Li - SCGP 102**

**Speaker:** Yang Li

**Title:** Metric SYZ conjecture

**Abstract:** The metric aspect of the Strominger-Yau-Zaslow conjecture asks for the existence of special Lagrangian torus fibrations on the generic region of the Calabi-Yau manifolds near the large complex structure limit. It was shown recently that the conjecture holds for a handful of examples, including the Fermat family, and there is a more general sufficient criterion reducing the metric SYZ conjecture to non-archimedean geometry. There will be four lectures, concerning the introductory background on SYZ, the analytic techniques, and the non-archimedean geometry background, which will be finally combined into a proof outline.

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**Speaker:** Song Sun

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1:00pm **Workshop: Lunch - SCGP 102**

**Title:** Lunch

2:00pm **Workshop: Ruobin Zhang - SCGP 102**

**Speaker:** Ruobin Zhang

**Title:** Collapsing geometry and special holonomy

**Abstract:** This technical talk centers around the structure of collapsing manifolds with Ricci curvature bounds, especially collapsing Einstein manifolds with special holonomy. We will introduce new tools developed in recent years. The main part involves the epsilon-regularity, the structure of singularity, and characterization of bubbles.

3:30pm **Tea time - SCGP Cafe**

**Title:** Tea Time

6:00pm **Workshop Banquet - Simons Center Cafe**

**Title:** Banquet Dinner

<b>Friday, August 11th</b>
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9:00am **Workshop: Breakfast - SCGP Cafe**

**Title:** Breakfast

9:30am **Workshop: Yang Li - SCGP 102**

**Speaker:** Yang Li

**Title:** Metric SYZ conjecture

**Abstract:** The metric aspect of the Strominger-Yau-Zaslow conjecture asks for the existence of special Lagrangian torus fibrations on the generic region of the Calabi-Yau manifolds near the large complex structure limit. It was shown recently that the conjecture holds for a handful of examples, including the Fermat family, and there is a more general sufficient criterion reducing the metric SYZ conjecture to non-archimedean geometry. There will be four lectures, concerning the introductory background on SYZ, the analytic techniques, and the non-archimedean geometry background, which will be finally combined into a proof outline.

11:30am **Workshop: Simon Donaldson - SCGP 102/ZOOM**

**Speaker:** Simon Donaldson

**Title:** Collapsing co-associative fibrations on  $G_2$ -manifolds.

**Abstract:** Seven dimensional manifolds with torsion-free  $G_2$ -structures share many features with Calabi-Yau manifolds, especially Calabi-Yau threefolds. This talk will give an overview, with few details, of a programme to study  $G_2$ -manifolds fibred over a 3-dimensional base with generic fibres diffeomorphic to the K3 4-manifold, and of very small volume. We will discuss (conjectural) descriptions of calibrated submanifolds in this regime and analogies and similarities with developments in Calabi-Yau theory presented in other lectures in this workshop.

<https://stonybrook.zoom.us/j/92462202749>

1:00pm **Workshop: Lunch - SCGP 102**

**Title:** Lunch

3:30pm **Tea time - SCGP Cafe**

**Title:** Tea Time