

## 1. DAY 1: HISTORY; HIGHER HOMOTOPIES THE SIMPLE OLD-FASHIONED WAY

- (1) (Peter May) Talk 1-1: Overview
- (2) (Meng Guo) Talk 1-2:  $A_\infty$ -spaces, classifying spaces, structures on classifying spaces [Stasheff, Homotopy associative  $H$ -spaces; Sugawara,  $H$ -spaces and spaces of loops]
- (3) (Yunze Lu) Talk 1-3: Adjunctions,  $(\Sigma^n, \Omega^n)$ , monads, and Beck's monadicity theorem [ Struck 2022 REU paper]
- (4) (Shangjie Zhang) Talk 1-4: Operads, monads, and their algebras; little  $n$ -cubes [May: Operads, algebras and modules; Geometry of iterated loop spaces]
- (5) (Weinan Lin, Evening) Talk 1-5: James construction and the Hilton–Milnor theorem

## 2. DAY 2: THE RECOGNITION PRINCIPLE; MULTIPLICATIVE STRUCTURES

- (1) (Shangjie Zhang) Talk 2-1:  $E_n$ -spaces,  $E_\infty$ -spaces and the recognition principle [May, the geometry of iterated loop spaces,  $E_\infty$  ring spaces and  $E_\infty$  ring spectra Chapter 1]
- (2) (Foling Zou) Talk 2-2: The approximation theorem - history and outline of the proof
- (3) (Yu Zhang) Talk 2-3: Operad pairs; examples; the Steiner and linear isometries operads [May, what precisely are  $E_\infty$ -ring spaces and  $E_\infty$ -ring spectra]
- (4) (Meng Guo) Talk 2-4: Monad pairs,  $E_\infty$ -ring spaces and  $E_\infty$  ring spectra [May, what precisely are  $E_\infty$ -ring spaces and  $E_\infty$ -ring spectra]
- (5) (Weinan Li, Evening) Talk 2-5:  $H_*(CX)$  and  $H_*(\Omega^n \Sigma^n X)$  as functors of  $H_*(X)$

## 3. DAY 3: CATEGORICAL MULTIPLICATIVE STRUCTURE

- (1) (Hana Jia Kong) Talk 3-1: Symmetric monoidal and bimonoidal categories, permutative and bipermutative categories, endomorphism operad pairs, and strictification
- (2) (Yu Zhang) Talk 3-2: From symmetric bimonoidal categories to  $E_\infty$ -ring spectra [May, The construction of  $E_\infty$  ring spaces from bipermutative categories]
- (3) (Ningchuan Zhang) Talk 3-3: The Barratt–Priddy–Quillen theorem and algebraic  $K$ -theory [May, what are  $E_\infty$  ring spaces good for]
- (4) (Peter May) Talk 3-4: Overview of equivariant generalizations
- (5) (Guchuan Li, Evening) Talk 3-5: The Goerss–Hopkins recognition of  $E_\infty$  ring spectra

## 4. DAY 4: EQUIVARIANT SPACES AND SPECTRA

- (1) (Zhipeng Duan) Talk 4-1:  $G$ -spaces,  $G$ -CW complexes,  $G$ -Postnikov towers, fixed point and orbit adjunctions, homotopy groups and the Whitehead theorem [May, equivariant homotopy and cohomology theory, chapters I, II]
- (2) (Zhipeng Duan) Talk 4-2: Equivariant stable homotopy theory,  $G$ -prespectra,  $G$ -spectra, the  $(\Sigma^\infty, \Omega^\infty)$  adjunction, and Lewis's theorem [May, equivariant homotopy and cohomology theory, chapters XII; May, what precisely are  $E_\infty$ -ring spaces and  $E_\infty$ -ring spectra, chapter 11]

## 5. DAY 5: EQUIVARIANT RECOGNITION

- (1) (Guchuan Li) Talk 5-1: The additive equivariant recognition principle for  $G$ -categories [Guillou–May, equivariant iterated loop space theory and permutative  $G$ -categories; May, Merling, Osorno. Equivariant infinite loop space theory. The space level story]
- (2) (Peter May) Talk 5-2: The multiplicative recognition principle for  $G$ -categories; the equivariant Barratt–Priddy–Quillen theorem and algebraic  $K$ -theory [Guillou, May, Merling, Osorno multiplicative equivariant  $K$ -theory and the Barratt–Priddy–Quillen theorem]
- (3) (Ningchuan Zhang) Talk 5-3: Orbit categories and the equivalence of homotopy categories, coefficient systems, Bredon cohomology of  $G$ -spaces and axioms, see also talk 18) [May, equivariant homotopy and cohomology theory, chapters VI, IX, XIII]
- (4) (Yunze Lu) Talk 5-4: Mackey functors and  $RO(G)$ -graded cohomology theory [May, equivariant homotopy and cohomology theory, chapters IX, XIII]
- (5) (Guchuan Li, Evening) Talk 5-5: The Atiyah–Segal completion theorem, the Segal conjecture, and equivariant cobordism; the evenness conjecture. [Adams–Haeberly–Jackowski–May, a generalization of the Segal conjecture]

## 6. DAY 6: ORBITAL PRESHEAVES AND QUESTIONS

- (1) (Hana Jia Kong) Talk 6-1: The homotopical Beck monadicity theorem
- (2) (Hana Jia Kong) Talk 6-2: The general theory of composite adjunctions
- (3) (Peter May) Talk 6-3: The recognition principle for orbital presheaves; examples: Eilenberg–MacLane  $G$ -spectra, unit  $G$ -spectra, and Picard spectra
- (4) (Peter May) Talk 6-4: Questions and speculations - homological and motivic applications of the general theory? equivariant and motivic chromatic theory?