The international summer-school For 21 cm Cosmology

Tian Hai-Jun
on behalf of the LOC

2025-01-21

BASIC INFORMATION

- **Time: July 6 ~July 20, 2025 (move forward one or two weeks?)**

(July 6th for arrival, July 7th-19th for lecture, July 20th for departure)

- **Place: Xi'an diazi University**

- **Number of participants: 80-100**

- **International Organizing Committee (SOC):**

Réza Ansari (Co-Chair, Université Paris-Saclay and CEA-Irfu/DAp, France)
Eloy de Lera Acedo (Cambridge University, US)
Ronggen Cai (Ningbo University, China)
Renyue Cen (Zhejiang University, China)
Xuelei Chen (Chair, National Astronomical Observatories CAS, China)
Danny Jacobs (Arizona State University, US)
Yi Mao (Tsinghua University, China)
Mario Santos (University of the Western Cape, South Africa)
Albert Stebbins (Fermi National Accelerator Laboratory, US)
Peter Timbie (Co-Chair, University of Wisconsin-Madison, US)
Xin Zhang (Northeastern University, China)

- **Local Organizing Committee (LOC):**

Haijun Tian (Chair, Hangzhou Dianzi University, China)
Feng shi (Co-Chair, xi'an Dianzi University, China)
Juyong Zhang (Co-Chair, Hangzhou Dianzi University, China)
Bing Yue (National Astronomical Observatories CAS, China)
Yidong Xi (National Astronomical Observatories CAS, China)
Yichao Li (Northeastern University, China)
Fengquan Wu (National Astronomical Observatories CAS, China)
Yougang Wang (National Astronomical Observatories CAS, China)
Jixia Li (National Astronomical Observatories CAS, China)
Jingyu Zhang (National Astronomical Observatories CAS, China)

- **FEE:**

- All participants are exempted from tuition and meals fees (except the accommodation), which will be provided by the summer-school. Due to limited funds, only a small number of graduate students, postdoctoral researchers, and young faculty members will receive financial support for this summer-school.
- Paying the lecture fee for each teacher. Financially support the travel/accommodation/meal expenses for part of senior teachers.

Any suggestion?

TOPICS(PRELIMINARY CONSIDERATION)

Fundamentals of Modern Cosmology (16 hours)

(1)Einstein's Field Equations of Gravitation and Their Cosmological Solutions;
(2) Inflation Theory;
(3) Nucleosynthesis and Particle Cosmology;
(4) Cosmic Microwave Background Radiation;
(5) Primordial Gravitational Waves;
(6) Growth of Density Perturbations;
(7) Formation of Large-Scale Cosmic Structures.

Cosmological Probes and Fundamentals of 21cm Physics (20 hours)

(1) Cosmic Microwave Background Radiation (CMB);
(2) Standard Candles and Rulers (Type Ia Supernovae, Gamma-Ray Bursts, Radio Galaxies, etc.);
(3) Statistics of Large-Scale Structures and Baryon Acoustic Oscillations (BAO);
(4) Gravitational Lensing and Galaxy Clusters;
(5) Physical Basis of the 21-cm Line and Intensity Mapping Methods;
(6) Intensity Mapping of Other Atomic and Molecular Lines such as CII and CO Lines, and Cross-Correlation Between Different Lines.

Low-Redshift 21 cm Cosmology (20 hours)

(1) Observations of the low-redshift 21-cm line constrain primordial non-Gaussianity and inflation theory;
(2) Measurements of large-scale structures and BAO signals limit the equation of state of dark energy;
(3) Redshift distortion effects restrict the growth of cosmic structures and the nature of gravity;
(4) The fundamental principles and the study progress using 21-cm galaxy surveys to investigate dark matter and galaxy formation theories;
(5) The theoretical and physical constraints through the combination of 21-cm detection with other cosmological probes.

High-Redshift 21 cm Cosmology (20 hours)

(1) The evolutionary history of the cosmic dark ages, dawn, and reionization periods;
(2) The physical mechanisms underlying the formation of the first luminous objects and their corresponding 21-cm cosmological signals;
(3) Numerical simulations as a primary tool for studying high-redshift 21-cm signals;
(4) The statistics of 21-cm signals along with other high-redshift cosmological probes.

Frontiers in 21-cm Cosmological Observations (16 hours)

The current major progress in 21-cm experiments includes
(1) surveys of neutral hydrogen intensity mapping in the late universe;
(2) cosmic reionization neutral hydrogen surveys;
(3) cosmic dawn and global average spectrum experiments;
(4) the prospects for 21-cm cosmology research in the era of Square Kilometre Array (SKA).

Any suggestion?