

Probing the Large Scale Structure of the Universe with Weak Lensing

Overview

One of the outstanding problems in cosmology today is to explain the observed late time acceleration of the universe. This can be explained either by incorporating some mysterious component called “dark energy” with negative pressure in the energy budget of the universe or by modifying the Einstein’s General Theory of Relativity on large cosmological scales. In either of these cases, we still do not know what constitutes the dark energy or how to modify the theory of gravity that explains the late time accelerated expansion of the universe.

The formation of large scale structures in the universe is an excellent probe to answer these questions as both dark energy and modified gravity can have unique imprints on the large scale structure of the universe. Already, observational data from galaxy surveys like SDSS, Wiggle-z, BOSS have provided strong constraints on dark energy as well as modified gravity models. Ongoing and future survey experiments like DES, DESI, LSST, SKA, TMT, Euclid, WFIRST and others aim to provide decisive answer. Several of them are designed to provide high precision measurements of weak gravitational lensing, a unique probe of the evolution of cosmic structures based on the deflection of photons by LSS. Therefore, it is essential to know the detailed physics of the large scale structure formation in the universe, of weak gravitational lensing and of the other probes for LSS that are being used by different experiments.

The proposed lecture series is aimed at training researchers in the field of LSS, weak gravitational lensing, and in their application to solve the mystery of the accelerating universe.

The primary objectives of the course are as follows:

- Exposing participants to the physics of LSS formation in the universe with special emphasis on weak lensing and other cosmological probes.
- Exposing the researchers to different statistical tools related to LSS in the universe.
- Enhancing the capabilities of the participants to work in the field of LSS formation in the universe play active roles in future cosmological experiments.

Lecture-wise course plan (March 7-12, 2016)

- **Monday, March 7, 2016**
Lecture 1: 9:15am to 10:30am: **Introductory Cosmology-I**
Lecture 2: 10:45am to 12:00pm: **Introductory Cosmology-II**
Lecture 3: 12:00pm to 1:15pm: **Theory of density perturbation –I (Newtonian Theory)**
- **Tuesday, March 8, 2016**
Lecture 1: 9:15am to 10:30am: **Theory of density perturbation –II (Newtonian Theory)**
Lecture 2: 10:45am to 12:00pm: **Theory of density perturbation –III (Newtonian Theory)**
Lecture 3: 12:00pm to 1:15pm: **Physics of Weak Lensing-I**
- **Wednesday, March 9, 2016**
Lecture 1: 9:15am to 10:30am: **Physics of Weak Lensing-II**
Lecture 2: 10:45am to 12:00pm: **Theory of density perturbation –IV (Relativistic Theory)**
Lecture 3: 12:00pm to 1:15pm: **Tutorial**
- **Thursday, March 10, 2016**
Lecture 1: 9:15am to 10:30am: **Physics of Weak Lensing-III**
Lecture 2: 10:45am to 12:00pm: **Theory of density perturbation –V (Relativistic Theory)**

Lecture 3:12:00pm to 1:15pm: **Physics of Weak Lensing-IV**

- **Friday, March 11, 2016**

Lecture 1: 9:15am to 10:30am: **Physics of Weak Lensing-V**

Lecture 2: 10:45am to 12:00pm: **Statistical tools to probe large scale structure formation**

Lecture 3:12:00pm to 1:15pm: **Tutorial**

- **Saturday, March 12, 2016**

10am:12:00pm: **Examination**

Modules	<p>A: Duration: March 7 – 12, 2016</p> <p>B: Venue Center For Theoretical Physics, Jamia Millia Islamia (A Central University), New Delhi – 25, India</p> <p><i>Number of participants for the course will be limited to fifty.</i></p>
You Should Attend If...	<p><i>Phd students, Post-Doctoral Fellows, Faculties working in the field of Cosmology can participate. Advanced MSc students with basic knowledge of General Theory of Relativity can also attend.</i></p>
Fees	<p>The participation fees for taking the course is as follows:</p> <p>Participants from abroad: US \$200</p> <p>Academic Institutions:</p> <ul style="list-style-type: none">• Faculty members: Rs. 2000/-• Students: Rs. 1000/- <p>The above fee includes all instructional materials, tutorials and assignments, 24 hour free internet facility. The participants will be provided accommodation on payment basis, subject to the availability.</p>

The Faculty



Prof. Alexandre Refregier's research interest is in Cosmology, Dark Energy, Dark Matter, and the formation of structures in the Universe. He received his PhD in Physics in 1997 from Columbia University. In 1998-2002, he pursued his interest in cosmology as a postdoctoral fellow at the Univ. of Princeton and Cambridge. In 2002, he became a faculty member at CEA Saclay near Paris. He has then joined ETH Zurich as a Professor in 2011, and is currently the Head of the Institute for Astronomy at ETH. His work uses a combination of observational, theoretical, and data analysis techniques. He has played a pioneering role in cosmological weak lensing, developed several novel data analysis methods, and performed seminal work on the optimisation of cosmological surveys. He has had a leadership role (Principal Investigator level) in several cosmological space missions under study. At ETH, his group focuses on high-precision measurements to challenge the current cosmological model, as well as on the development of high-performance scientific software.

Webpage: <http://www.cosmology.ethz.ch/>



Prof. Anjan Ananda Sen is currently Professor at the Center For Theoretical Physics, Jamia Millia Islamia, New Delhi, India. He is also an Associate at the Abdus Salam International Center For Theoretical Physics and at the Inter University Center for Astronomy and Astrophysics, Pune, India. He is a member of the International Science Development team for the Thirty Meter Telescope Project (TMT) and also a member of the SKA-India Science Consortium.

Anjan's research interests include topics related to inflation and late time acceleration of the Universe, model building for dark energy and their observational signatures as well as large scale structure formation in the universe. He has published more than seventy research articles on these topics.

Webpage: <http://www.ctp-jamia.res.in/people/aasen.html>

Course Co-ordinator

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Course Registration Link:

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