

Student Seminar Quantum Universe

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4th block, semester 2, 2014/2015

Tuesday 15:00-17:00 (Kapteynborg 161),

Friday 13:00-15:00 (Kapteynborg 161);

Monday 11:00-13:00 (Kapteynborg 245, week 22-25)

This course is given in the style of a seminar with presentations given by the participants.

An introduction to several advanced topics of large interest in present-day cosmology and astroparticle physics is given. Of particular interest will be the connection between the physics at the smallest scales and that of the very largest scales in the Cosmos. The input of the van Swinderen, KVI-CART, and Kapteyn institutes will guarantee the unique multi-disciplinary character for the seminar lectures. Participants will be supervised by the instructors in individually arranged coaching sessions in preparing their specific contribution for the presentation.

Texts & structure:

Week 18-21: ***“An introduction to modern cosmology”*** *A. Liddle*

Week 22-28: ***Recent QU3-QU4-QU5 conferences*** *Various authors*

Physics interest:
Best of two worlds,
be on the interface between
Standard model of Particle Physics
and
Standard model of Cosmology

Student Seminar, Grading Criteria

Preparation:

- Making use of proposed literature
- Incorporating additional literature
- Understanding of the subject matter
- Depth of the presentation
- Structure of the presentation

Presentation:

- Formulation of stimulating questions
- Answering questions from audience
- Presentation technique
- Quality of slides
- Time management

Participation:

- Presence during seminar hours
- Active participation during seminar hours

Contributing questions before the seminar sessions (hand-in)

Posing questions during the presentations

Weighting;

2/3: Preparation & Presentation

1/3: Participation

~ 2 presentations per person

Short evaluating discussion after presentation

No final exam, personal evaluation discussion at end of course

Death by powerpoint: [youtube](#) & [7-things not to do](#)

Seminar Preparation Timeline

Speaker:

week	
N-3	Prepare for yourself the outline of the material to be discussed & determine focus
N-2	present overview presentation to tutor give the group a tutorial reference (~5 pages) which they can use to prepare questions
N-1	1 st trial presentation to tutor
(N -2 d	2 nd trial presentation)
N	Presentation

Audience:

N –few days: Read material & prepare at least 1 written question

2 Observational Overview	3-13
Homogeneity and isotropy ; Thermal distributions and the black-body spectrum	
3 Newtonian Gravity	17-24
The Friedmann equation; The fluid equation; The acceleration equation	
4 The Geometry of the Universe	25-30
Various geometries; Infinite and observable Universes	
5 Simple Cosmological Models	33-40
Hubble'slaw; Particle number densities; Evolution including curvature	
6 Observational Parameters	45-48
The expansion rate; The density parameter; Deceleration parameter	
7 The Cosmological Constant	51-53
Cosmological models with Λ ...	
8 The Age of the Universe	57-62
9 The Density of the Universe and Dark Matter	63-72
Weighing the Universe; What might the dark matter be?; Dark matter searches	
10 The Cosmic Microwave Background	75-81
The photon to baryon ratio	
11 The Early Universe	85
12 Nucleosynthesis: The Origin of the Light Elements	91-96
Hydrogen and Helium; Contrasting decoupling and nucleosynthesis	
13 The Inflationary Universe	99-107
Problems with the Hot Big Bang; Inflation and particle physics	

14 The initial singularity	111
15 The standard cosmological model	115
AT1 General Relativistic Cosmology	119
AT2 Classical cosmology: Distances and Luminosities	125
AT3 Neutrino Cosmology	137
AT4 Baryogenesis	143
AT5 Structures in the Universe	147