

Joost van Valkenhoef (?)

Date: November 12, 2008

Classes: BBL 415 13:15-17:00 (13:15-15:00)

Dates: Sep 10 (17) 24; Oct: (1) 8 (15) 22 (29); Nov 5 (12) 19 (26); Dec 3 (10) 17 [24,31];
Jan 7 (14) 21 (28)

Student seminars: Nov 5 & 19; Dec 3 & 17; Jan 7 & 21 (attendance is obligatory).

Assistants:

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2. Maarten van de Meent Rm. MG309, tel. 253 5905, email: m.vandemeent@uu.nl

For each topic there is a central question to be answered.

Topics for Student Seminar Theoretical Physics (ns-tp501m)

1. Nov 5 2008: Sander A. M. Wolters

Cosmic inflation (Jurjen)

- lecture notes on cosmology (part 3): <http://www.phys.uu.nl/~prokopec/>
- books: Lyddle+Lyth; (Liddle;) Bergström+Goobar; Linde; Guth
- articles: [1–6]

Central question: *Should cosmic inflation be considered as an extension of gravity, or should it be embedded in a particle physics model?*

2. Nov 5 2008: Jeroen G. Burgers

Gravitational waves in astrophysics (Jurjen)

- books: Weinberg (1972); Carroll; Maggiore
- articles: [7–12]

Central question: *How solid is the evidence supporting the existence of gravitational waves?*

3. Nov 5 2008: Jan Weenink

Baryonic matter (baryogenesis and leptogenesis) (Jurjen)

- books: Kolb & Turner; Bergström+Ariel Goobar

- articles: [13–18]

Central question: *At what energy scale was baryonic asymmetry created?*

4. Nov 19 2008: Michiel Bouwhuis; Stijn J. van Tongeren

Black holes in general relativity and astrophysics (Maarten)

- books: Carroll; Straumann; Hartle; Krolik

- articles: [19–24]

Central question: *What would be a definite evidence in support of the existence of black holes? What is the most efficient way of extracting energy out of black holes?*

5. Nov 19 2008: Marcin Dukalski (string cosmology)

Alternative theories of gravity and cosmology (Maarten)

- articles: [4, 25–35]

Central question: *Is there a way of testing string theory based on cosmological observations?*

6. Dec 3 2008: Jildou Baarsma

Cosmic microwave background radiation (Jurjen)

- lecture notes on cosmology (part 2): <http://www.phys.uu.nl/~prokopec/>

- books: Dodelson; Weinberg (2008)

- articles: [36–39] [40–44]

- Particle Data Group: <http://pdg.lbl.gov/>

<http://pdg.lbl.gov/2008/reviews/microwaverpp.pdf>

Central question: *What is maximum amount of information that we can get out of the CMB?*

7. Dec 3 2008: Erik van der Bijl

Dark matter: astrophysical aspects and searches (Jurjen)

- books: Dodelson

- articles: [45–49]

Central question: *Is it possible to get a three dimensional map of dark matter from astronomical observations? Can we get any information about the (kinetic) energy of dark matter (particles)?*

8. Dec 3 2008: Ori Yudilevich

Dark energy (Jurjen)

- lecture notes on cosmology (part 2): <http://www.phys.uu.nl/~prokopec/>

- articles: [50–58]

Central question: *How convincing is the evidence supporting a cosmological constant as the explanation for dark energy?*

9. Dec 3 2008: Floris van Lier

Extra Solar Planets (Maarten)

- books: Klahr+Brandner

- articles: [59–66]

Central question: *How typical is our solar system? What can we conclude about the properties of a mature planetary system from the properties of a protoplanetary cloud?*

10. Dec 17 2008: Michael Agathos

Gravitational waves in cosmology (Jurjen)

- books: Weinberg (1972); Carroll; Maggiore

- articles: [9, 11, 12, 67]

Central question: *What is the expected amplitude of primordial gravitational waves? Are they potentially observable and by what kind of observatory?*

11. Dec 17 2008: Rob Kneijens

Dark matter: (particle) candidates (Jurjen)

- articles: [68–73]

- Particle data group (<http://pdg.lbl.gov/>)

Dark Matter: <http://pdg.lbl.gov/2008/reviews/darkmatrpp.pdf>

Central question: *How likely it is that dark matter is an LSP?*

12. Dec 17 2008: Yasha Oloumi; Mischa Spelt

Neutrinos in cosmology (Maarten)

- articles: [16–18, 74–77]

Central question: *Are neutrinos Majorana or Dirac particles? What is their role in the dynamics of the Universe?*

13. Jan 7 2009: Doru Sticlet

Phase transitions in the early Universe (Maarten)

- lecture notes on cosmology (part 2): <http://www.phys.uu.nl/~prokopec/>

- books: Linde, Bergström+Goobar; Kapusta; Le Bellac; Mukhanov

- articles: [78–83], [84–90]

Central question: *What are the observable consequences of phase transitions in the early Universe? Have we seen any? Shall we?*

14. Jan 7 2009: Misha Veldhoen; Mathijs Wintraecken

Formation of structure and cosmological perturbations (Jurjen)

- books: Weinberg (2008); Dodelson; Peebles (1995)

- articles: [1, 91–94]

Central question: *How can we explain the fact that gravitational potentials are a ‘gauge artifact’ in general relativity, and yet we can observe their various properties? What are the observable properties of primordial potentials, and is any of them quantum?*

15. Jan 7 2009: Maciej Koch-Janusi

LHC physics (Maarten)

- articles: [95]

Central question: *What if there is no higgs particle? Do we really expect to ‘see’ supersymmetry at the LHC?*

- 5b. Jan 21 2009: Thomas Rot

Alternative theories of gravity and cosmology (Maarten)

- articles: [25–33]

Central question: *Can Einstein's theory explain all of the facts in experimental (and theoretical) gravitation and cosmology? Is there a superior theory that explains troublesome observations/features of general relativity?*

16. Jan 21 2009: Arjen Baarsma; Maarten Verdult

Topological defects in cosmology (Maarten)

- lecture notes on cosmology (part 3): <http://www.phys.uu.nl/~prokopec/>

- books: Manton+Sutcliffe; Rajaraman; Coleman;

- articles: [90, 96, 97]

Central question: *How the fact that we have not seen topological defects constrains particle physics models of the Early Universe? How sound are theoretical arguments that support their existence in the Universe?*

Topics that were not selected

17. **Nucleosynthesis**

- Weinberg (2008) or Kolb+Turner; Dodelson

- lecture notes (part 2): <http://www.phys.uu.nl/~prokopec/>

- articles: [98–100]

18. **Thermal and out of equilibrium field theory**

- books: Le Bellac, Kapusta

- articles:

19. **CMB polarisation**

- books: Dodelson; Weinberg (2008)

- articles: [36, 40–44]

Literature

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2. Edward W. Kolb and Michael S. Turner, *The Early Universe*, Addison-Wesley, 1990.
3. Scott Dodelson, *Modern cosmology*, Academic Press, 2003.

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6. Andrew R. Liddle, *An Introduction to Modern Cosmology*, John Wiley and Sons, 2003.
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12. James B. Hartle, *Gravity: an Introduction to Einstein's General Relativity*, Addison-Wesley, New York, 2002.
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15. Julian H. Krolik, *Active Galactic Nuclei: From the Central Black Hole to the Galactic Environment*, Princeton University Press 1998.
16. Nicholas Manton and Paul Sutcliffe, *Topological solitons*, Cambridge University Press 2004, ISBN-13: 9780511207839 — ISBN-10: 0511207832.
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21. Hubert Klahr and Wolfgang Brandner: *Planet Formation: Theory, Observations, and Experiments*, Cambridge University Press, Cambridge 2006, conference proceedings, ISBN 0521860156.

Lecture notes

1. Lecture notes on cosmology (3 parts). Available at the website: <http://www.phys.uu.nl/~prokopec/>

Articles

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- [3] Alan H. Guth, “The Inflationary Universe: A Possible Solution To The Horizon And Flatness Problems,” *Phys. Rev. D* **23** (1981) 347, journal website: http://prola.aps.org/abstract/PRD/v23/i2/p347_1, KEK e-Print: http://ccdb4fs.kek.jp/cgi-bin/img_index?8010295.
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