

# Cosmology:

Lecture course  
University Groningen  
Sept.-Nov. 2007

# *Literature*

## **Course Book**

- **Introduction to Cosmology**

B. Ryden; Addison-Wesley, 2003

... very good, highly accessible and clear text.

# *Literature*

## Course Favorites:

- **Cosmological Physics**

J. Peacock; Cambridge Univ. Press, 1999

Solid and thorough text on physical cosmology, nearly all to be found in here, sometimes very much Peacock's view of things ... Highly recommended !

- **Cosmology, the Science of the Universe**

E. Harrison; Cambridge Univ. Press, 1981 (2<sup>nd</sup> ed. 2000)

beautiful textbook on background and foundations of modern cosmology; providing both historical insight as well as genuine essence of physics. Great Read !!!

- **Cosmology,  
the Origin and Evolution of Cosmic Structure**

P. Coles, F. Lucchin; Wiley, 1995 (2<sup>nd</sup> ed. 2002)

in particular 2<sup>nd</sup> ed. is a very much improved text, providing a good feeling of the involved physics.

# Literature

## Additional Key References

- **Gravitation and Cosmology**  
S. Weinberg; Wiley, 1972  
A Classic !!!  
Focus on general relativistic background
- **Principles of Physical Cosmology**  
P.J.E. Peebles; Princeton Univ. Press, 1993
- **The Early Universe**  
E. Kolb; M. Turner; Addison-Wesley, 1990  
wonderful textbook focussing on the physics of the Early Universe, demanding yet highly gratifying.
- **Physics of the Early Universe**  
eds. J. Peacock, A. Heavens, A. Davies, 1990  
(Proc. 36<sup>th</sup> Scottish Univ. Summer School in Physics. NATO Adv. Study Inst.)
- **Modern Cosmological Observations and Problems**  
G. Bothun; Taylor & Francis, 1998

## Additional Key References

- **Cosmology and Astrophysics through Problems**  
T. Padmanabhan; Wiley, 1972  
book with large number of insightful problem sets,  
including large number of cosmology ones
- **The Cosmological Distance Ladder**  
M. Rowan-Robinson; Freeman, 1985  
by now largely outdated, yet very good and balanced overview of (most) relevant issues
- **Critical Dialogues in Cosmology**  
ed. N. Turok; World Scientific, 1997  
reports on a meeting commemorating the “Great Debate” (Shapley-Curtis)  
in a cosmological context: set of confrontations on major cosmological topics

## Best Popular Cosmology Books

- **The First Three Minutes**  
S. Weinberg; New York: Basic Books, 1997
- **The Big Bang**  
J. Silk; Freeman, 1989
- **A Brief History of Time**  
S. Hawking, Bt Bound, 1999

## Best Popular Cosmology Books

- **The Elegant Universe:  
Superstrings, Hidden Dimensions, and the Quest for the Ultimate Theory**  
B. Greene; Vintage 2000  
A very interesting and well-written account of the new, and exciting, developments in quantum cosmology, string and brane cosmology

## General Relativity

- **Gravitation**  
C.W. Misner, J.A. Wheeler, K.S. Thorne; Freeman, 1973  
Biblical (also in proportion)
- **Problem Book in Relativity and Gravitation**  
A. Lightman, R. Price; Princeton Univ. Press, 1975
- **General Relativity from A to B**  
R. Geroch; Univ. Chicago Press, 1981  
excellent qualitative introduction of basics GR

Week	Dates Hoorcollege	Subject Hoorcollege	Dates Werkcollege	Subject Werkcollege
1	Sep. 3 (c) Sep. 4 (c)	<p><u>The Hot Big Bang:</u> a Review and Introduction</p> <p><u>The metric Universe:</u> General Relativity, basics and essentials</p>	Sep. 6 (w)	werkcollege I
2	Sep. 10 (c) Sep. 11 (c)	<p>The Cosmological Principle Cosmic Time and Weyl's Postulate Observational Evidence Isotropic Universe Observational Evidence Homogeneous Universe</p>	Sep. 13 (w)	werkcollege II
3	Sep. 17 (c) Sep. 18 (c)	<p>Robertson-Walker metric</p> <p>Cosmological Redshift Hubble Expansion Cosmological Observables in a Geometric Universe</p> <p>Observational Cosmology</p>	Sep. 20 (w)	Presentations: Cosmology in History
4	Sep. 24 (c) Sep. 25 (c)	<p>Friedman Equations Cosmological Parameters: Hubble parameter, Omega, q and curvature</p> <p>Cosmic Components: Radiation, (Dark) Matter and Dark Energy</p>	Sep. 28 (w)	Computer Task I

4	Sep. 24 (c) Sep. 25 (c)	<b>Friedman Equations</b> <b>Cosmological Parameters:</b> <b>Hubble parameter, Omega, q and curvature</b>  <b>Cosmic Components:</b> <b>Radiation, (Dark) Matter and Dark Energy</b>	Sep. 28 (w)	Computer Task I
5	Oct. 1 (c) Oct. 2 (c)	<b>Cosmological FRW Solutions:</b> <b>Radiation- and Matter-dominated Universes, Radiation-Matter Equivalence</b> <b>Dark Energy and Cosmic Acceleration</b> <b>General FRW solutions, Matter-Dominated Universes, Flat Universes, ...</b>  <b>Cosmic Horizons</b>	Oct. 4(w)	werkcollege III
6	Oct. 8 (c) Oct. 9 (c)	<b>Measuring Cosmological Parameters</b> <b>The Age of the Universe</b> <b>Concordance Cosmology</b>  <b>Thermal History of the Universe</b> <b>Primordial Nucleosynthesis</b>	Oct. 11 (w)	Computer Task II
7	Oct. 15 (c) Oct. 16 (c)	<b>The Cosmic Microwave Background:</b>  <b>Recombination, Decoupling and Freeze-out</b> <b>Thermalization and Blackbody Spectrum of the CMB</b> <b>Anisotropies of the CMB</b>	Oct. 18 (w)	Werkcollege IV
8	Oct. 22 (c) Oct. 23 (c)	<b>The problems of standard cosmology:</b> <b>Flatness Problem, Horizon Problem,</b> <b>Structure Problem, Monopole Problem</b>  <b>Inflation &amp; the Inflationary Universe</b>	Oct. 26 (c)	Chronicle of the Universe from Neutrino Decoupling back to the Planck Time



# Student Presentations: Early Cosmology



# Student Presentations: Early Cosmology

Inform yourself about the cosmological worldviews and “scientific” endeavours and progress of one of the following individuals or civilizations.

Find out how they thought about questions such as:

- How large is the Universe
- What is it made of ?
- What is its origin ? Its fate ?
- What is the human place in it ?

Presentation: week Sep. 20



# Student Presentations: Early Cosmology Topics

- Aboriginals
- Neolithic Near-East (Catal Huyuk)
- Neolithic Europe (Stonehenge)
- Celtic Cosmology
- Ancient Egyptians
- Ancient Sumerians
- Ancient Babylonians
- Zarathustra & ancient Persia
- Mani & Manicheism
- Ancient Chinese Cosmology
- Hindu Cosmology
- Buddha & Buddhist Cosmology
- Thales
- Anaximander
- Pythagoras
- Democritus
- Epicurus
- Plato
- Aristoteles
- Aristarchus
- Lucretius
- Ptolemaeus
- Jewish Cosmology
- (Medieval) Islamic Cosmology
- Nasir al-Din al-Tusi
- Norse (Germanic, Icelandic) Cosmology
- Byzantine Cosmology
- Medieval (Western-European) Cosmology
- Maya Cosmology
- Aztec Cosmology
- Inca Cosmology
- Navajo cosmology
- Cree cosmology  
(& North-American Indians of the plain)
- Northwest Coast Indian cosmology
- Inuit Cosmology
- Polynesian Cosmology
- Copernicus
- Giordano Bruno
- Johannes Kepler
- Rene Descartes
- Baruch Spinoza
- Isaac Newton
- Gottfried Leibniz
- Immanuel Kant
- Flying Spaghetti Monster