## 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  - M. Rowan-Robinson; Freeman, 1985 by now largely outdated, yet very good and balanced overview of (most) relevant issues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)	The Hot Big Bang: a Review and Introduction  The metric Universe: General Relativity, basics and essentials	Sep. 6 (w)	werkcollege I
2	Sep. 10 (c) Sep. 11 (c)	The Cosmological Principle Cosmic Time and Weyl's Postulate Observational Evidence Isotropic Universe Observational Evidence Homogeneous Universe	Sep. 13 (w)	werkcollege II
		Robertson-Walker metric		

Cosmological Redshift Sep. 17 (c) Sep. 18 (c) Presentations: Hubble Expansion Sep. 20 (w) 3 Cosmology in History Cosmological Observables in a Geometric Universe Observational Cosmology Friedman Equations Cosmological Parameters: Sep. 24 (c) Hubble parameter, Omega, q and curvature Sep. 28 (w) Computer Task I Sep. 25 (c)

Cosmic Components: Radiation, (Dark) Matter and Dark Energy

4	Sep. 24 (c) Sep. 25 (c)	Cosmological Parameters: Hubble parameter, Omega, q and curvature  Cosmic Components: Radiation, (Dark) Matter and Dark Energy	Sep. 28 (w)	Computer Task I
5	Oct. 1 (c) Oct. 2 (c)	Cosmological FRW Solutions: Radiation- and Matter-dominated Universes, Radiation-Matter Equivalence Dark Energy and Cosmic Acceleration General FRW solutions, Matter-Dominated Universes, Flat Universes, Cosmic Horizons	Oct. 4(w)	werkcollege III
6	Oct. 8 (c) Oct. 9 (c)	Measuring Cosmological Parameters The Age of the Universe Concordance Cosmology Thermal History of the Universe Primordial Nucleosynthesis	Oct. 11 (w)	Computer Task II
7	Oct. 15 (c) Oct. 16 (c)	The Cosmic Microwave Background:  Recombination, Decoupling and Freeze-out Thermalization and Blackbody Spectrum of the CMB	Oct. 18 (w)	Werkcollege IV

Chronicle of the Universe

Time

from Neutrino Decoupling back to the Planck

Oct. 26 (c)

Friedman Equations

Thermalization and Blackbody Spectrum of the CMB

Anisotropries of the CMB

Oct. 22 (c)

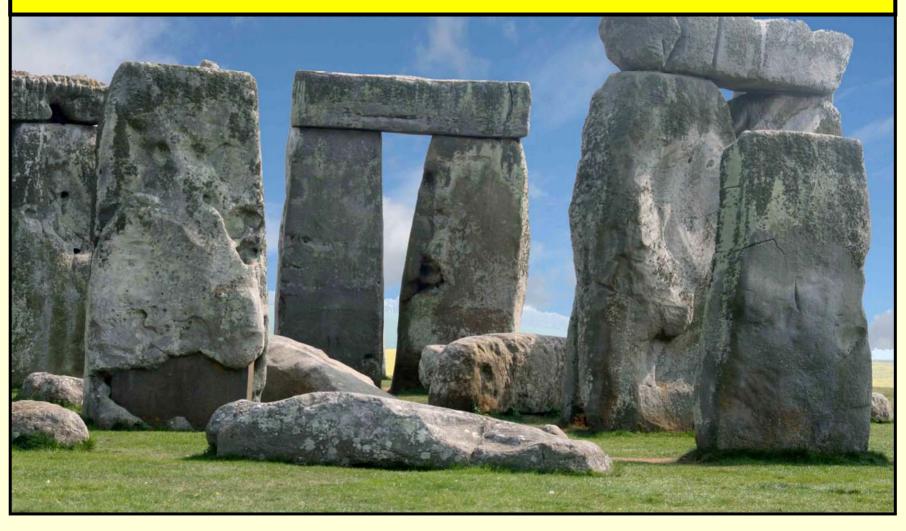
Oct. 23 (c)

The problems of standard cosmology: Flatness Problem, Horizon Problem,

Inflation & the Inflationary Universe

Structure Problem, Monopole Problem

## Student Presentations: Early Cosmology



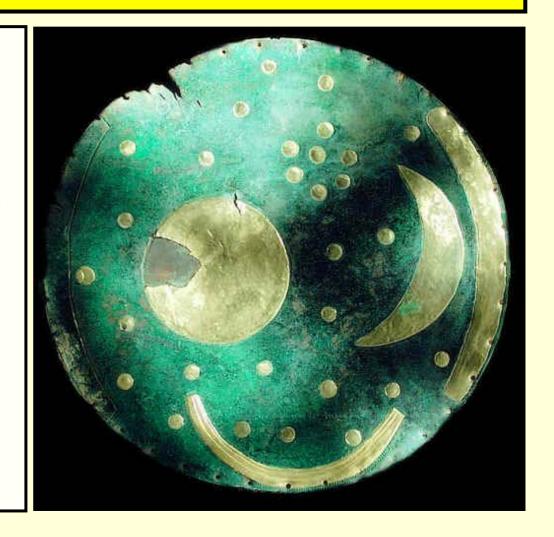
## Student Presentations: Early Cosmology

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