Readers guide for Cosmology and Astroparticle Physics FK7050
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Bergström & Goobar, "Cosmology and Particle Astrophysics"

Chapter 1: The Observable Universe

This is a good general introduction and summary of the observational state of Cosmology and Particle Astrophysics. Probably useful also to recapitulate the material at the end of the course. Note however that the observational status of cosmological parameters and dark matter detection is (already) severely outdated.

Chapter 2: Special Relativity

Important for understanding the central concepts of space-times, four-vectors, metric tensors, scalars, transformation and invariance. Relativistic kinematics is also important, but we will put less focus on details of the kinematics of $2 \to 2$ processes and the derivation of the Doppler effect. Section 2.6 is not part of the major leraning goals of the course.

Chapter 3: General Relativity

Everything important although there is no need to memorize the details of how the FRWL-metric (equation 3.26) is motivated. Appendix A gives a few more details. Appendix A.2 is nice for seeing the connection to Newtonian gravity.

Chapter 4: Cosmological Models

Arguably the most important chapter for the course; make sure you understand it thoroughly.

Chapter 5: Gravitational Lensing

Wait with section 5.3 until the study of gravitational waves. Make sure you understand (but no need to memorize) derivations of the lensing deflection angle. The gravitational lensing equation on the other hand is central.

Note that the section on observations of gravitational lensing (section 5.2) is slightly obsolete. Nevertheless, the concepts (optical depth, magnification etc) are still important.

Chapter 6: Particles and Fields

In this course, the standard model of particle physics is important mostly to understand and know the constituents of the Universe. Chapter 6 should therefore be studied with emphasis on general knowledge rather than details. Therefore, the equations in chapter 6 are not important in this course. The exceptions are the cross-section estimates in section 6.10. Sections 6.11-12 can be skipped. Section 6.13 is conceptually important.

For students interested in the field theory aspects of the particle standard model, chapter 6 should be read together with appendices B-D, for theoretical background.

Chapter 7: Phase Transitions

Not included.

Chapter 8: Thermodynamics in the Early Universe

Important chapter; all sections included.

Chapter 9: Thermal Relics from the Big Bang

Again, an important chapter. Section 9.1 can be read in less detail.

Chapter 10: The Accelerating Universe

All sections included. Note that sections 10.1-2 concerns inflation, or early time acceleration, and 10.3 the late time acceleration. Whether they are connected is currently not known.

Chapter 11: The Cosmic Microwave Background Radiation and Growth of Structure

All sections included. Note that Eq. 11.26 is not correct. Section 11.9 is outdated.

Chapter 12: Cosmic Rays

Not included.

Chapter 13: Cosmic Gamma-Rays

Not included.

Chapter 14: The Role of Neutrinos

Not included.

Chapter 15: Gravitational Waves

All sections included. We will update on the current observational situation in terms of LIGO/VIRGO detections.

Appendix A: Some More General Relativity

See the guide to chapter 3.

Appendix B: Relativistic Dynamics

Although not required in this course, this appendix (especially sections B.1 and 2) is good for general physics knowledge.

Appendix C: The Dirac Equation

Not included.

Appendix D: Cross-Section Calculations

Not included.

Appendix E: Quantum Fluctuations of the Inflaton

Only section E.4 included.

Appendix F: Suggestions for Further Reading

Useful list of material connected to the course content. See also "Suggestions for further reading" for a few comments and updates.

Extra material

Mörtsell, "Cosmological histories from the Friedmann equation"

All material included, with emphasis on understanding the graphical approach to analyzing the Friedmann equation. Note that the notation differs slightly from that in Bergström & Goobar, "Cosmology and Particle Astrophysics".

Suggestions for further reading

As evident from Appendix F in Bergström & Goobar, "Cosmology and Particle Astrophysics", there is a large number of textbooks on the subjects of cosmology and astrophysics.

Liddle, "An Introduction to Modern Cosmology" is nice as a very compact summary of cosmology.

Ryden, "Introduction to Cosmology" is similar in that it offers a very accessible presentation of the most important aspects of cosmology.

Peacock, "Cosmological Physics" offers a much more extensive and detailed presentation.

Peebles, "Principles of Physical Cosmology" does likewise, also in a very good way, although I personally find it more difficult to navigate through the material.

Weinberg, "Cosmology". To me the best book around if you want to gain a deep understanding of cosmology. Every equation is derived from start to end, with all assumptions stated clearly. Especially useful as a reference book.

Literature

1. "Cosmology and Particle Astrophysics",
Bergström, L. & Goobar, A., 2:nd edition,
Springer-Verlag Berlin Heidelberg (2004))
2. "Cosmological histories from the Friedmann equation: The universe as a particle",
Mörtsell, E.,
Eur. J. Phys. 37 (2016), https://arxiv.org/abs/1606.09556