Relação de Disciplinas

41010020 **Programa de Pós-Graduação em Física ME**

Disciplina	Nome da Disciplina	Créditos T	TP	P	Situação
FSC410120	**TÓPICOS ESPECIAIS EM FÍSICA B: Astroparticle Physics and Cosmology** "The course aims to give students the basic knowledge on theoretical concepts of Particle Astrophysics and the Universe evolution with a focus on a deep interconnection between cosmology and particle physics, The course intends to cover the major aspects of the Hot Big Bang theory and the Standard Cosmological Model at the forefront of theoretical and experimental high energy astroparticle physics. Course contents 1. Elements of General Relativity and Particle Physics (1 lecture) 1.1. Geometry, Particles and Symmetries 1.2. Einstein equations and ?-term 1.3. Standard Model of Particle Physics and Beyond 2. Homogeneous Isotropic Universe (1 lecture) 2.1. Friedmann-Lemaitre-Robertson-Walker Metric 2.2. Redshift. Hubble Law 2.3. Gas of free particles in expanding Universe 3. Dynamics of Cosmological Expansion (2 lectures) 3.1. Friedmann equation 3.2. Sample cosmological solutions " Non-relativistic matter " Relativistic matter " Vacuum " General barotropic equation of state 3.3. Solutions with Recollapse 4. The Standard Cosmological Model: ?CDM (3 lectures) 4.1. Composition of the present Universe. Dark Matter and Dark Energy 4.2. General properties of Cosmological evolution 4.3. Radiation Domination and Matter Domination Epochs 4.4. Present Age of the Universe and Horizon Size 4.5. Brightness-Redshift relation for distant standard candles 4.6. Theory versus cosmological observations 5. Thermodynamics of Expanding Universe (1 lecture) 5.1. Densities of bosons and fermions in cosmological plasma 5.2. Entropy generation. Baryon-to-Photon ratio 6. Recombination (2 lectures) 6.1. Recombination temperature. 6.2. Photon last scattering 6.3. Horizon at recombination. 7. Relic Neutrinos (1 lecture) 7.1. Neutrino Freeze-Out in the Early Universe 7.2. Cosmological bound on neutrino mass 7.3. Sterile neutrino 8. Big Bang Nucleosynthesis (1 lecture) 8.1. Neutron Freeze-Out. Neutron-to-proton ratio 8.2. Kinetics of Nucleosythesis 8.3. Theory versus observations 9. Dark Matter: formation, evolution and consequences (2 lectures) 9.1. Cold, Hot and Warm Dark Matter 9.2. Freeze-Out of heavy relic 9.3. Weakly Interacting Massive Particles (WIMPs) 9.4. Dark Matter candidates in Particle Physics: " Neutralino " Sneutrino	4	0	0	Ativo

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	" Gravitino " Axions " Other superheavy relic particles 9.5. Theory versus observations: direct and indirect detection measurements 10. Phase transitions in the Early Universe (1 lecture) 10.1. Order of phase transitions 10.2. Effective potential in one-loop approximation 10.3. Infrared problem 11. Generation of the Baryon and Lepton Asymmetries (1 lecture) 11.1. Necessary conditions for Baryogenesis 11.2. Baryon and Lepton number violation in particle interactions 11.3. Leptogenesis 12. Inflationary Epoch (1 lecture) 12.1. Chaotic Inflation 12.2. Large-Scale Structure of expanding Universe 12.3. Temperature and density fluctuations in the Cosmic Microwave Background 13. Particle Physics of Cosmic Rays and their sources (3 lectures) 13.1. The spectrum and composition of the cosmic rays 13.2. Ultra-High Energy Cosmic Rays and neutrino astrophysics 13.3. Point sources of gamma-rays. Gamma-ray bursts. 13.4. Atmospheric neutrinos: neutrino oscillations 13.5. Neutron stars and pulsars 13.6. Black Holes and Hawking radiation 13.7. Observational implications 14. *Topological defects and Solitons in the Universe 14.1. Production of topological defects in the Early Universe 14.2. The monopole problem 14.3. Variety of topological defects: Cosmic Strings, Domain Walls, Textures and Q-balls				