Cosmology in the XXIst Century

- 1983 - 2003
- 2004 $\rightarrow$

Orfeu Bertolami
(Instituto Superior Técnico, Departamento de Física)
(http://alfa.ist.utl.pt/∼orfeu/homeorfeu.html)

Universidade Católica Portuguesa, Faculdade de Engenharia
6 January 2004

1983 - 2003

- Inflation (1981 - 1982)

SUGRA Inflation (1983)

- Grand Unified Theories:

Baryon Asymmetry (BAU) + Cosmological Phase Transitions

- Quantum Cosmology (Wave Function of the Universe (1983)):

Initial Conditions for Inflation + Singularity Problem

- Nucleosynthesis: $Y_P = 0.23 \Leftarrow N_\nu \leq 4$

- Cosmic Microwave Background (CMB) (1964):

Dipole (1979), Quadrupole (COBE) (1992)

- Cold Dark Matter Model (1983)

- Large Scale Structure (1986): Voids + Walls (~ 1200 galaxies)

- Accelerated Expansion (SNe Ia) (1998)

- WMAP (2003) (BOOMERANG, MAXIMA, ARCHEOPS, ...)

- Gravitational Lensing, S-Z Effect, Lyman α-Forest, ...

Golden Decade of Astronomy (1963 - 1971):

Quasars, Pulsars, CMB, Gamma-Ray Bursts, X-Ray Sources (BHs)

2004 $\rightarrow$

- Dark Matter: Self-interacting ?, Detection ?

- Dark Energy: Nature ?

- Dark Energy - Dark Matter:
Interaction ? Unification ? (Generalized Chaplygin Gas ?)

- Inflation: Theory ?

- BAU: Mechanism ?

$\Downarrow$

Cosmological Constant Problem

$\Uparrow$

- String/M-Theory: Quantum Mechanics + Theory of Spacetime

- Braneworld Scenarios:
Soft Corrections to Gravity - Sub-millimeter level, Pioneer Anomaly, Accelerated Expansion

- Violation of Fundamental Symmetries: Equivalence Principle ? Lorentz ? CPT ?

- Variation of Fundamental Couplings ?

Golden Decade of Observational Cosmology (2001 - ?):

Sloan Digital Sky Survey, WMAP, PLANCK, SNAP, Sputnik 5