Launch of the School of Physics and Astronomy
Astronomy Unit – Cosmology

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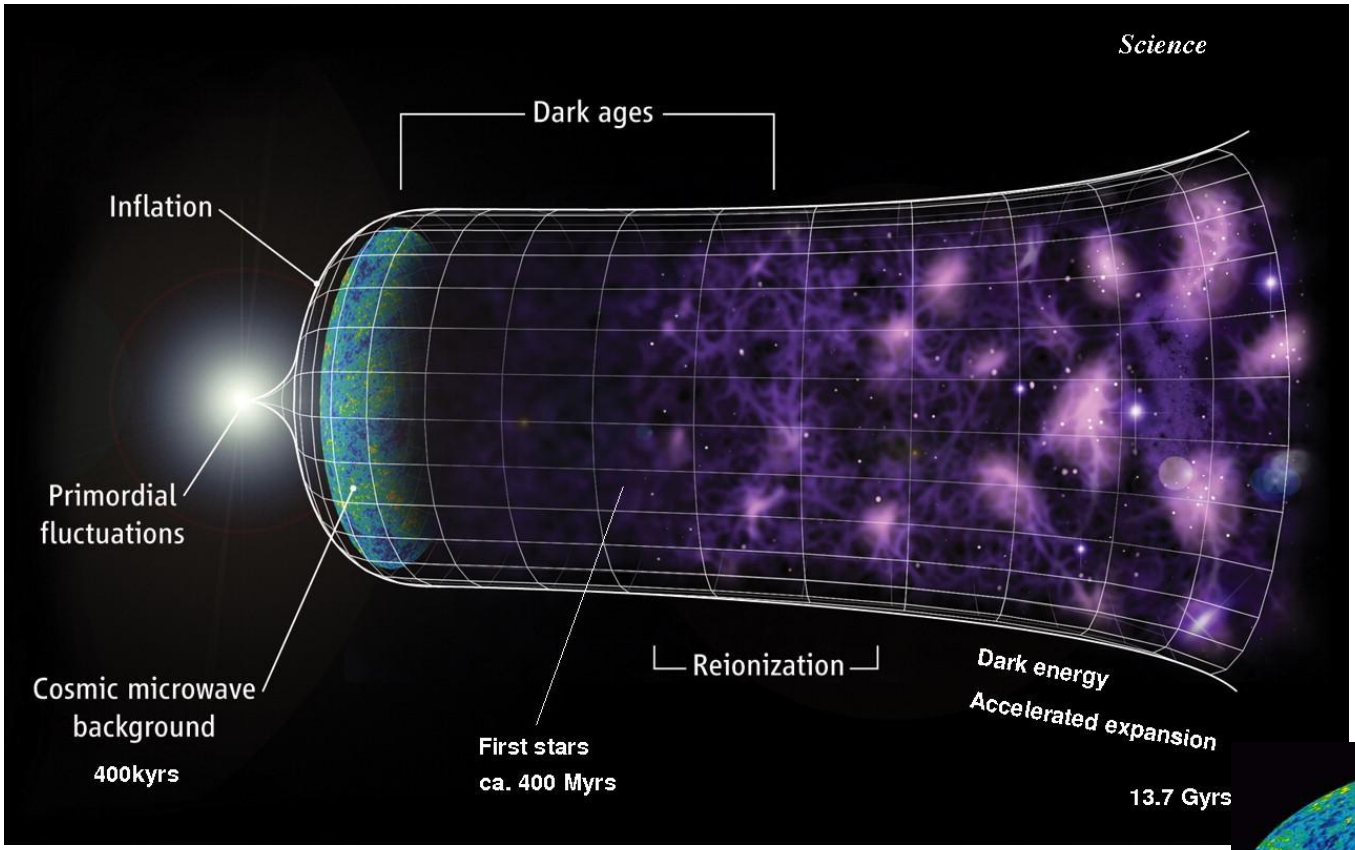
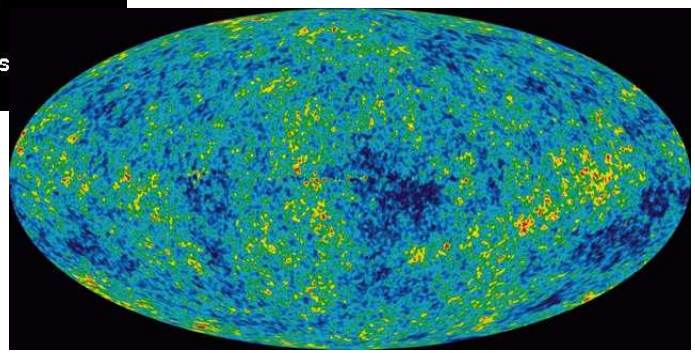
QMUL 31th January 2012

The evolution of the Universe

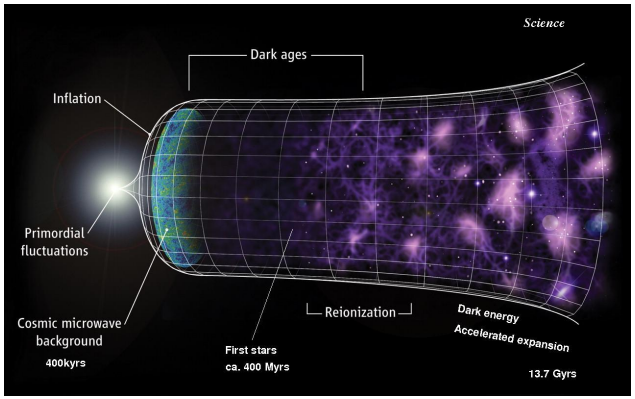
The cosmological standard model





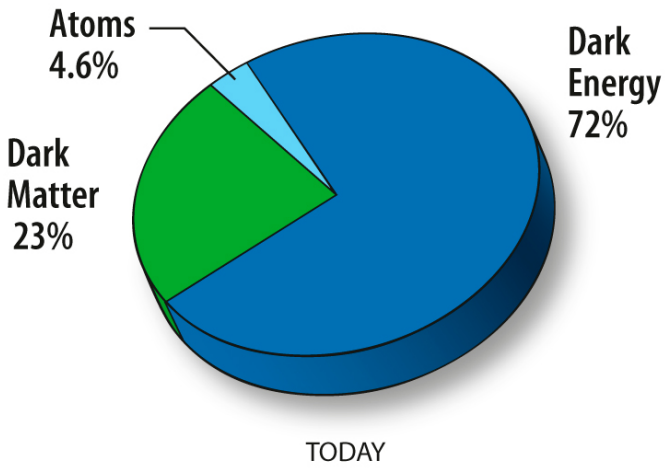
the CMB as seen by WMAP

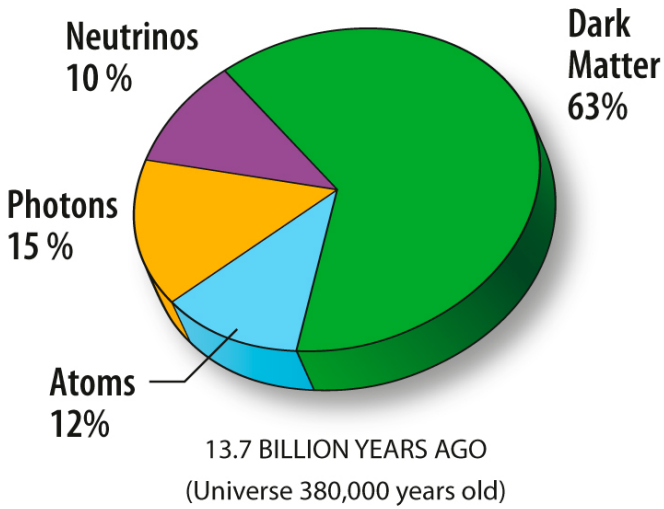
The evolution of the Universe



The evolution is dominated by different types of matter

- scalar field
- radiation
- pressureless matter (dust)
- something like Λ?





WMAP7

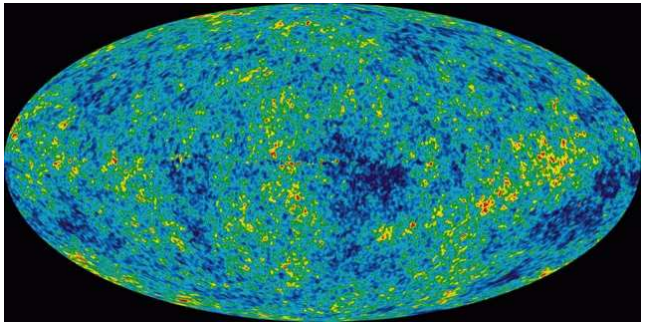
Cosmology in the Astronomy Unit

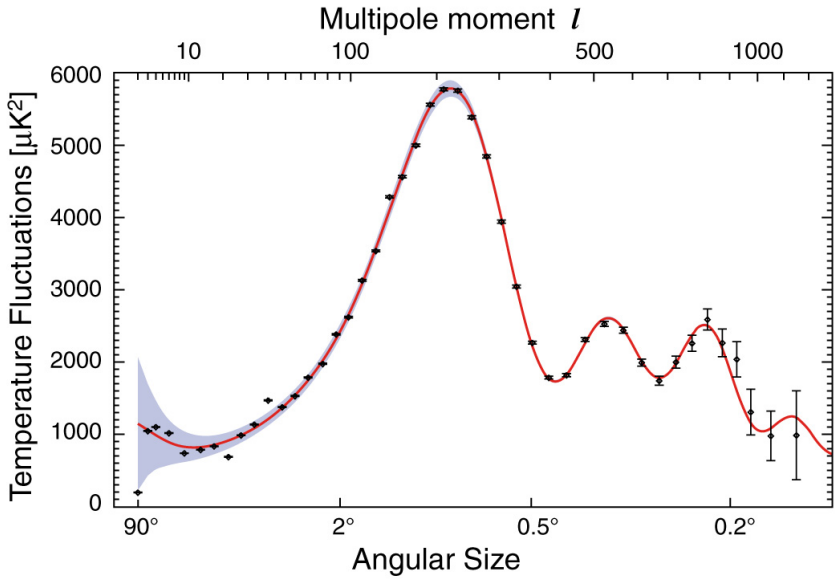
What we work on:

- The physics of the early Universe and models of inflation
- Primordial Black Holes and dark matter
- Cosmic Microwave Background anisotropies
- Large Scale Structure formation
- Dark energy and modified gravity
- Cosmological perturbation theory at linear order and beyond

Theme: Calculating observable effects, making theoretical predictions, comparing theory with observations

CMB anisotropies





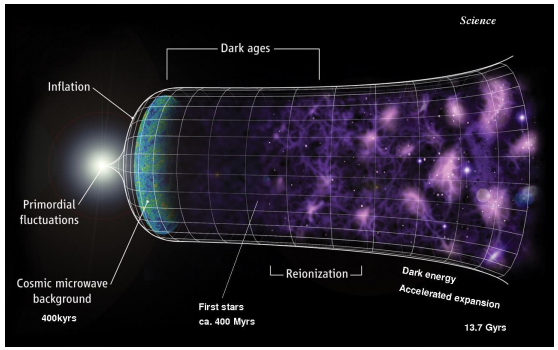
WMAP7

Need input from e.g.

- *Strings*: potential for scalar field(s)
- *Particles*: neutrinos (how many species, chemical potential)
- *Particles*: dark matter (cold, warm, probably not all hot)
- *Astro*: plasma physics

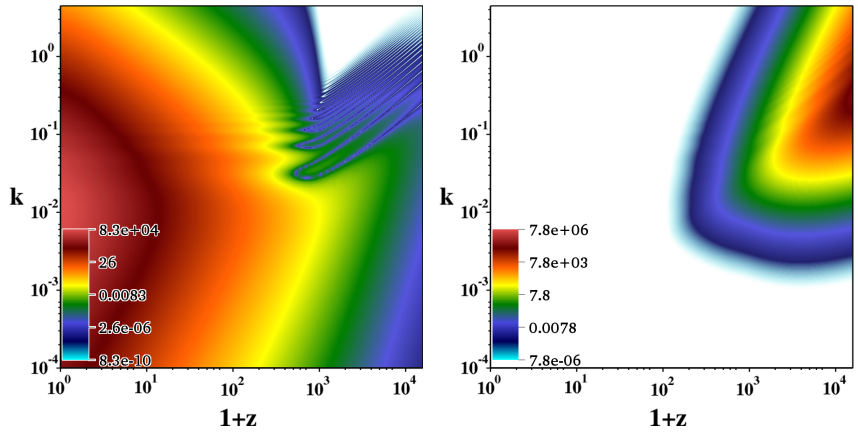
distribution of hot and cold spots in the Cosmic Microwave Background (CMB)

Density fluctuations



The universe at "late times"

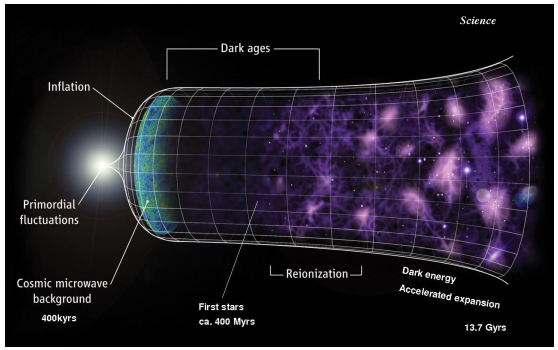
- structure formation
- magnetic field generation



Baryon density contrast and non-adiabatic pressure perturbation $\Rightarrow$ vorticity and magnetic field generation

Brown, Christopherson and Malik (2011)

Dark energy?

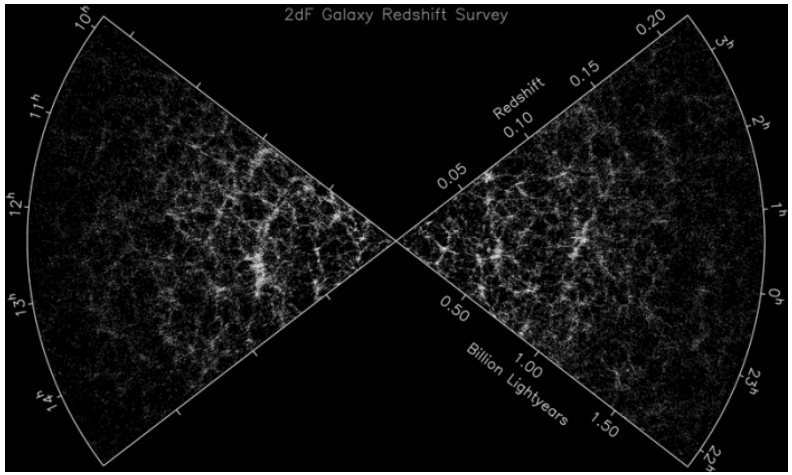


The field equations

$$G_{\mu\nu} = 8\pi G\, T_{\mu\nu}$$

- Einstein tensor, describing the geometry of the universe: $G_{\mu\nu} \equiv R_{\mu\nu} - \frac{1}{2} g_{\mu\nu}$
- Energy-momentum tensor, describing the matter content: $T_{\mu\nu}$

Can modify either LHS or RHS of field equations to explain late time acceleration



Large scale structure and forthcoming 21cm maps (e.g. SEPNET and LOFAR): much more data after decoupling

Conclusions

- Cosmology is at the heart of the Astronomy Unit
- therefore essential for the new School of Physics and Astronomy
- all we need is some office space ...