A The standard cosmological model

The **standard cosmological model**, i.e. the currently agreed representation of the Universe, is based on a theory of **gravitation**, Einstein's **general relativity**. This model takes into account a degree of expansion of the Universe, as evidenced by the observations made by US astronomer E. P. Hubble, showing that **galaxies** are receding from one another at a rate that increases with distance.

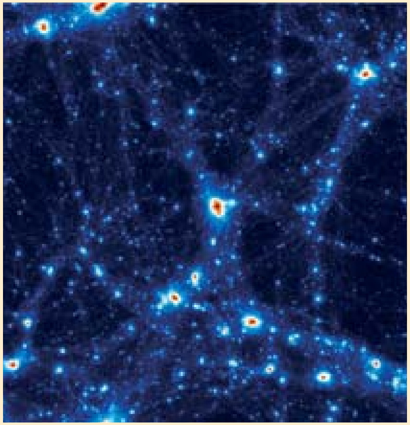
The model's basic assumptions are that the Universe is *homogeneous*, i.e. that it exhibits throughout identical properties (at a cosmological scale, at any rate), and *isotropic*, i.e. its appearance remains unchanged, in whichever direction it is viewed.

Three parameters characterize the evolution of the Universe, in this model: **Hubble's constant**, first, which characterizes its rate of expansion; **mass density** (the ratio of its own density over a *critical density*); and the **cosmological constant**. Introduced by Einstein in the guise of a force acting against gravitation, in order to account for a stable Universe, this constant rather corresponds to the manifestation of the action of *dark energy*, in an expanding Universe. [1]

If mass density is less than, or equal to, 1, that expansion will carry on indefinitely. The latest observations would appear to support a density of matter equal to 1, this implying a "flat" Universe (i.e. one where the sum of the angles in a triangle is precisely equal to 180°).

The current standard cosmological model involved a radius of the observable Universe of some 45 billion light-years, with an age of around 13.7 billion years, as counted from an initial "singularity" (primordial explosion) known as the **Big Bang**, followed, some 300,000 years later, by an uncoupling of matter and radiation, leading to a stage of **inflation**.

The model further makes it possible to account for the **cosmological background** (diffuse radiation), at a temperature of 2.7 K, and for the fluctuations in radiation/density leading, very early on, to the formation of the initial "seed" structures for the galaxies.



D. Aubert/CEA-C. Pichon (IAP)

Numerical simulation of a universe during formation, carried out in the context of the Horizon Project, bringing together, around a program targeted at the investigation of galaxy formation, the numerical simulation activities of a number of French teams, including the DAPNIA team (CEA). Its aim is to gain an understanding of the physical mechanisms leading to the structure and distribution of the galaxies around us – and particularly our own, the Milky Way.

(1) Interpretation of measurements from the WMAP (Wilkinson Microwave Anisotropy Probe) space probe, and from SDSS (Sloan Digital Sky Survey) leads to a value close to 71 (km/s)/Mpc ± 0.03 for Hubble's constant, however surprises as to the value of this parameter remain a possibility, should the disconcerting composition of the Universe, whereby 95% of the Universe is made up of dark matter and dark energy, in fact turn out not to be correct.