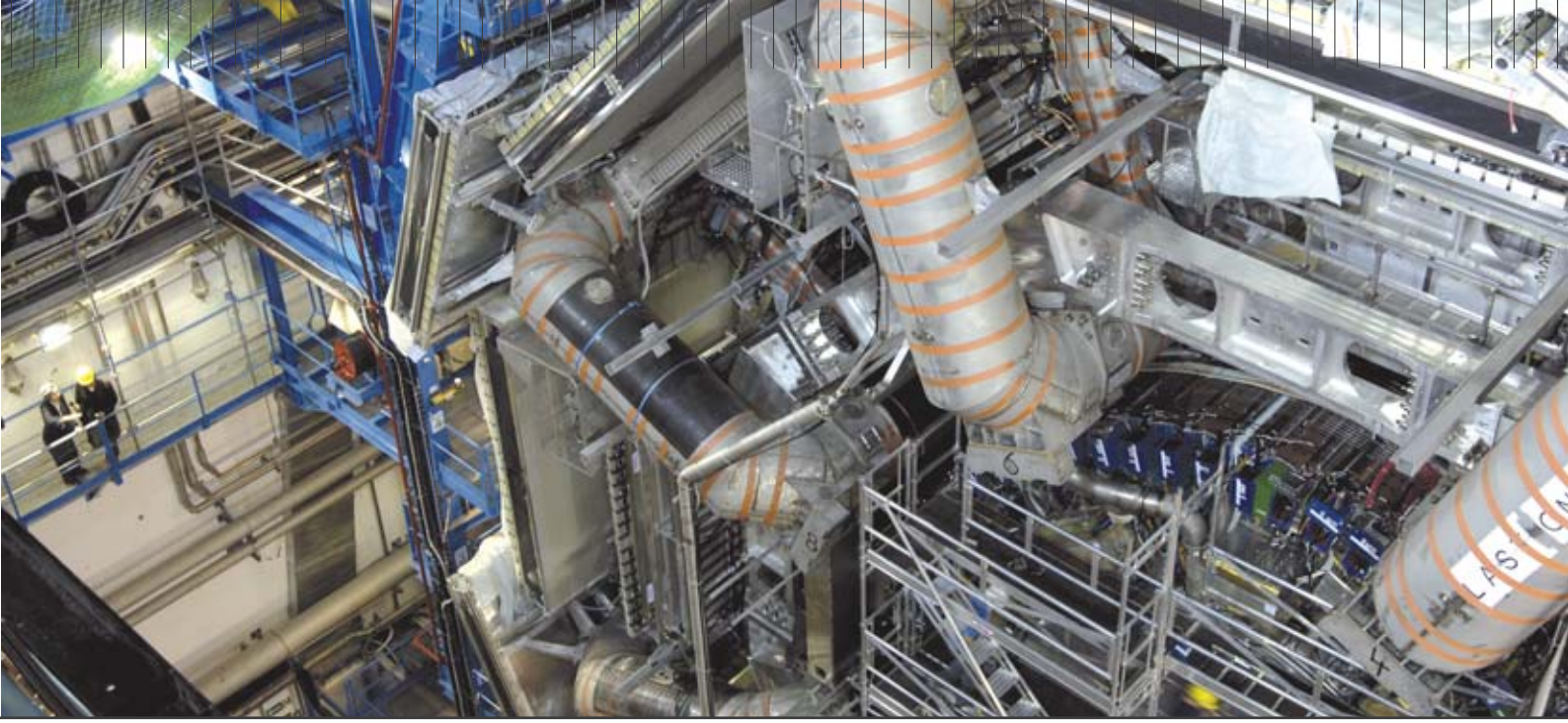

P.Stroppa/CEA

View of Atlas, one of the detectors installed at the Large Hadron Collider (LHC) due to come into service in 2008 at the CERN near Geneva. Four of the eight toroidal superconducting coil magnets in the facility are partly visible. The CEA is contributing to the design of this detector, together with that of the compact muon spectrometer (CMS).

I. MAGNETS AND MAGNETIC MATERIALS

Magnets and magnetic materials are part of our daily lives. Some of their fascination lies in the paradox that these very complex materials are found in objects as familiar as board magnets, compasses and electric motors, and yet at the same time are the essential components of highly, and even extremely sophisticated systems.

Current developments of magnets and magnetic materials are enabling new applications offering characteristics and performances that defy the imagination. Gigantic magnets will allow high-tech physics facilities to make huge steps forward in scientific knowledge, e.g. in particle physics at the CERN's Large Hadron Collider (LHC) from 2008, and in controlled nuclear fusion at the Iter facility from 2016. In both cases, the contributions made by the CEA's pure and applied scientists have been, are, and will be determinant. Both of these major facilities make use of superconductivity, which among other applications also allows magnetic levitation.

Magnetic materials that have long been part of our everyday lives, e.g. in the reproduction of sound (loudspeakers) and image (TV), are also being perfected. In the field of hyperfrequency materials, there have been numerous developments, both civil and military, not all of them spectacular enough to catch widespread attention. Metamaterials, thin layers and magnetic microwires are opening the way to applications that offer additional features for our on-the-move IT devices, and new perspectives for data emission, transmission and reception, plus stealth application and soon even invisibility.

However, ever-greater miniaturisation, probing the ultimate properties of matter, is inevitably generating new problems. Addressing these difficulties has enabled researchers to discover new effects, leading in turn to new applications: an example is 'soft' magnetic materials, described at the end of this section.

Research in new magnetic materials such as hyperfrequency magnetic metamaterials, the miniaturisation of very high resolution magnetometers (in particular through optical pumping), the magnetic confinement of plasmas, the discovery of magnetic properties at nanometric scale, and all the other work referred to here and elsewhere herald new breakthroughs and new applications of magnetism.