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"Spin around"

Equipment for generating hyperpolarised helium provides new opportunities in nuclear research and medical technology.

In conjunction with physicists at the Johannes-Gutenberg University in Mainz, ic-automation, based in Mainz, has now developed the Helios system. Helios is the most efficient commercially available equipment for generating hyperpolarised helium. As with a number of existing developments from ic-automation, this machine is also based on the dynamic MB Building Kit System made by item, in Solingen, Germany.

How the machine works

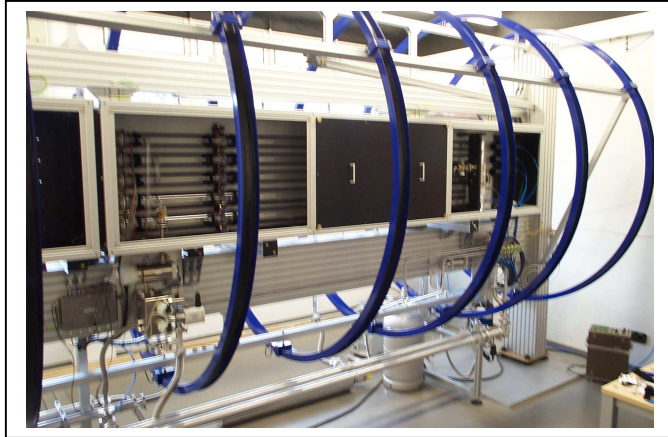
Helium in its natural form consists of a positively charged nucleus (two protons) with two negatively charged electrons circling them. Apart from the normal form of helium (helium-4) there is an isotope which is rarely found on Earth, helium-3, which only has one neutron in its nucleus (or helion). Helium is chemically inert and is not known to have any detrimental effects on human tissue. The helions of helium-3 have a curious property: they exhibit an inherent spin. Like minute gyroscopes they revolve around their own axis in any direction. The machine manufactured by ic-automation produces polarised helium in such a way that all the directions of spin are aligned with each other (hyperpolarisation). At a low pressure, gas is discharged, in a way similar to neon lights. This gas discharge provides the initial energy required to allow the helions to be polarised using lasers. For transport purposes, this polarised gas is pressurised at up to 3 bar.

The polarisation effect can be maintained for several days if correctly stored.



Applications

Taking standard X-ray images of people's lungs has always been a problem. The system does not allow the actual breathing process and the way the parts of the lungs are flooded with air to be recorded. However, with some illnesses, this is of decisive importance because restrictions in the ventilation process may well be symptomatic for the disease. This restriction can now be removed using spin-polarised helium-3 in MRI. The patient, lying in the MRI scanner, breathes in a specific volume of the noble gas (which acts as a contrast



medium), which enables the distribution of the polarised helium (ventilation) in the lungs to be monitored both in time and space. Apart from the medical application, nuclear physicists can use helium-3 for researching amorphous and crystalline materials using neutrons. In this case, it acts as a filter for generating polarised neutrons by allowing the "wrongly" polarised neutrons to be "eaten up" by the helium.

Construction of the machine

Of absolutely crucial importance in constructing a machine for polarising helium-3 is not only a completely rigid construction but also a totally non-magnetic one. The machine is, as a result, built on a frame made of aluminium profiles 320x160 from the item MB Building Kit System, a system which uses aluminium profiles and matching fastening techniques. "The sturdy construction is an essential feature for Helios, in particular because of the size of the gas discharge tubes and the associated size of the overall construction", explains Dr. Decker, Managing Director of ic-automation. In addition to that, the high degree of versatility, quality, the wide range of fastening elements and the availability of these large cross-sectional shapes were decisive when it came to choosing the item Building Kit System, with which the company has already gathered positive experience in the past.

ic-automation has been developing and manufacturing innovative system solutions since 1995 for applications ranging from microelectronics to medical technology. The range of products includes OEM products, machines adapted to meet customer-specific project requirements and from-scratch customer-driven developments.

Thanks to the special construction of the machine from the dynamic Building Kit System made by item in conjunction with the company's own developments, special-purpose solutions can be rapidly realised.