

# Application of hyperpolarised Helium-3 in lung functional magnetic resonance imaging

## Abstract

Looking inside the lungs without the danger of ionizing radiation side effects became available with magnetic resonance imaging using hyperpolarised noble gases. This technique has the potential to become a real tool for assessing in vivo ventilation, perfusion and even lung microstructure.

The work covered in this research was aimed to improve the existing method for  $^3\text{He}$  polarisation and open the possibility to develop new modalities to probe the lung microstructure that could then be used in clinical trials. For this purpose, the polarisation facility was remodelled and new components were added. The rest of the work was focused on developing diffusion techniques that are more appropriate for the assessment of lung diseases. The improvement of the  $^3\text{He}$  polarisation facility consisted in the optimization of the gas flow path, implementation of a new dispensing method and new controlling protocol. The capacity of the polarisation system was increased by using a more powerful laser. The outcome of this was an increase in polarisation rate and a significant reduction of the dispensing time. Altogether this allow for clinical studies to be performed without too much delay.

A clinical study aimed to distinguish differences between children born at term and premature was started on 70 volunteers. Three methods for measuring diffusion were used : spin echo diffusion weighted method, SPAMM (SPAtial Modulation of Magnetization) tagging and MR diffusion spectroscopy. The first was previously used in the group and the last two were developed during this research. The results were correlated with basic pulmonary functional tests (spirometry and plethysmography) and also with the multiple breaths nitrogen wash-out results.

No differences were found in the two groups. The results don't agree with the current theories on lung growth and suggest that alveolarisation occurs even after the age of 8, possibly up to adult age. This is very important to be investigated further due to its clinical importance.