Metastable optical pumping and compression of polarised ^{3}He

S.R.Parnell, C.D.Frost, N.Moore. P.Phillips and R.S.Eccleston

Optical Pumping~ low pressure (~1mBar)

Compression

Accumulation of polarised ^{3}He (high pressure 0.7Bar)

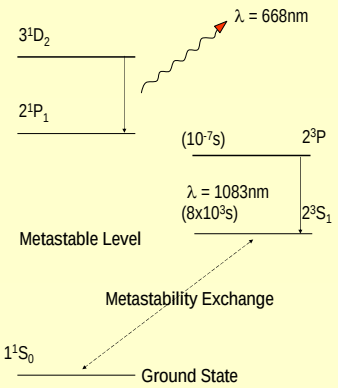
^{3}He "metastables" are produced by RF excitation of ^{3}He gas at ~ 1 mbar pressure.

The metastables are optically pumped at 1083nm by a fibre laser, which produces polarised metastables.

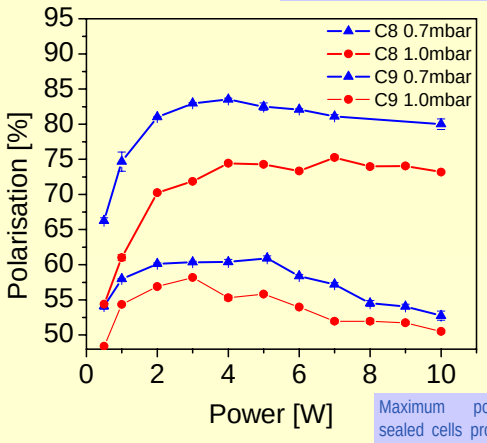
Nuclear ^{3}He polarisation via collisions between polarised metastables and unexcited (ground state) ^{3}He atoms.

The ^{3}He gas is polarised at ~ 1 mbar and subsequently compressed up to pressures near 1 bar suitable for effective neutron polarisation.

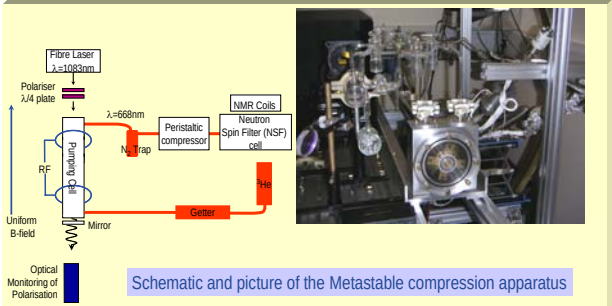
The compressed polarised ^{3}He exits the compressor and enters neutron polarisation cell



Energy Level Diagram showing ground state, metastable and radiation states



Maximum polarisation in sealed cells produced at ISIS for different pressures and pumping lines



Schematic and picture of the Metastable compression apparatus

–Peristaltic compressor based on designs of Fichelle and Nacher

–Non-magnetic - aluminium, glass, plastic and brass construction

–Flow rate 77mbar litres/hour (full speed)

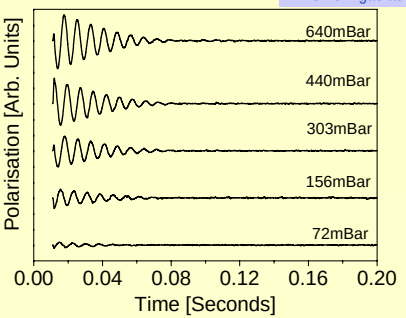
–Cooling to reduce tube wear

–Currently max. pressure 1.8 bar

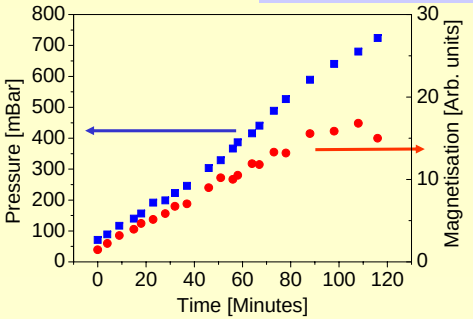
–Systematic investigation of different tube materials

Components for Mrk I peristaltic pump

FID's from gas as function of pressure



Accumulation of magnetisation and pressure as a function of time



—Storage cell (bare glass GE180) ~T116 hours

—Can measure T_1 in various sections of pump apparatus with new in house digital NMR spectrometer (see poster E.Woolley)

—Already compressed to 0.7Bar – have compressed to 1.8Bar with unpolarised gas (^{4}He) – need to change worn rollers

—Next stage is to attach valved cell and test with neutrons – measure pressure and polarisation using the POLTAX instrument which is already used for this with spin-exchange cells (see Polarised Neutrons Poster)

CCLRC

ISIS