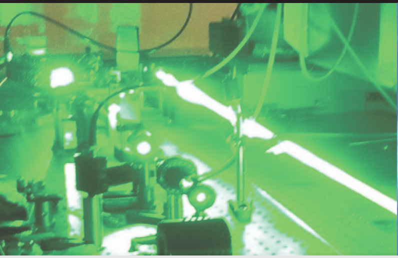
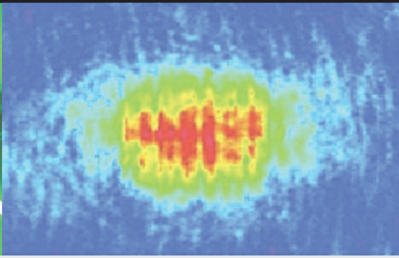
Joint UoC/FORTH AMO Seminar





Advantages of nuclear fusion with polarized fuel

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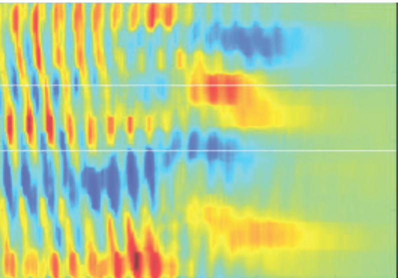
Since more than 50 years it is known that different spin combinations of the fuel nucleons (t, d, or 3He) modify the differential and the total cross section of the d-t and the 3He-d fusion reactions. Therefore, polarized fuel can be used to increase the reaction rate in a fusion reactor or to focus the neutrons on special wall areas. Both options are useful to increase the energy output and to reduce the costs of future fusion reactors. In this talk an overview on various activities in this field of research will be given:

The spin-dependence of the d-d reactions is unknown. The influence of the nuclear and, possibly, of the electron spin on the differential and the total cross section for the double-polarized case is theoretically predicted but was never proved. In collaboration between the PNPI in Gatchina, Russia, the University of Ferrara, Italy, and the FZ Jülich, Germany, the spin-dependence of the d-d fusion reactions will be measured with a polarized deuteron beam at energies below 100 keV on a polarized deuterium jet target.

Does the polarization survive in the different kinds of fusion plasmas?
Beside the magnetic confinement fusion even inertial fusion, e.g. induced with lasers, is tested at several institutes. For both concepts the important question is, if the lifetime of the polarization in the induced plasmas is long enough to support the fusion process.

How to produce and handle polarized fuel?
When polarized fusion might be a reasonable option for energy production then the question of polarized fuel production will become important. This problem is solved for 3He and seems to be within reach for tritium. For deuterium the situation is unclear. One option can be the production and storage of polarized D2 or DT molecules, but even new concepts for polarized ion sources might be useful.

02 May 2018, 16:30, Physics Department 3rd Floor Seminar Room



$$|\Phi_1\rangle = \frac{1}{\sqrt{2}}(|1\rangle \otimes |0\rangle + \tan\theta|1\rangle \otimes |0\rangle + \sqrt{1-\tan^2\theta}|1\rangle \otimes |1\rangle)$$

$$|\Phi_2\rangle = \frac{1}{\sqrt{2}}(|1\rangle \otimes |0\rangle - \tan\theta|1\rangle \otimes |0\rangle - \sqrt{1-\tan^2\theta}|1\rangle \otimes |1\rangle)$$

$$|\Phi_3\rangle = \sqrt{1-\tan^2\theta}|1\rangle \otimes |0\rangle - \tan\theta|1\rangle \otimes |1\rangle_z$$

$$|\Phi_4\rangle = |0\rangle \otimes |1\rangle$$

$$\hat{\pi}_0 = (1 - p)|0\rangle\langle 0| + p|1\rangle\langle 1|$$

$$\hat{\pi}_1 = (1 - p)|1\rangle\langle 1| + p|0\rangle\langle 0|$$