Polarization of a Spin ½ β-NMR Probe ^{11}Be using Collinear Laser Optical Pumping

C.D.P. Levy[1], M. R. Pearson[1], G.D. Morris[1], , J. Lassen[1], K.H. Chow[2], M.D.Hossain[3], R.F. Kiefl[3,1,6] , R. Labbé[4], W.A. MacFarlane[5], T.J. Parolin[5], L.Root[1], H. Saadaoui[3] M. Smadella[3], Q. Song[3] D.Wang[3]

[1] *TRIUMF, 4004 Wesbrook Mall, Vancouver, Canada V6T 2A3*
[2] *Dept. of Physics, University of Alberta, Edmonton, Canada T6G 2G7*
[3] *Dept. of Physics and Astr., University of British Columbia, Canada V6T 1Z1*
[4] *Dept. of Physics, Laval University, Canada*
[5] *Dept. of Chemistry, University of British Columbia, Canada V6T 1Z3*
[6] *Canadian Institute for Advanced Research*

In the field of NMR spin ½ probes have special importance since they can have no electric quadrupole moment. This greatly simplifies the NMR frequency spectrum since there can be no quadrupolar splittings, thus making them pure magnetic sensors. The fact that the muon is spin ½ is one of the reasons it has become so useful as a local magnetic probe. Until now there has been no spin ½ probe suitable for beta-detected NMR. This would be particularly useful in complex materials which are in general non-cubic. In this paper we describe the development of a low energy beam of spin polarized ^{11}Be, which is the lightest spin ½ isotope suitable for β-NMR. The intensity of the $^{11}Be^{+}$ beam is about 10^6 /s and is generated from an ISAC laser ionization source. The nuclear polarization is generated using optical pumping by an externally-frequency-doubled dye laser tuned to the $2S_{1/2}$-$2P_{1/2}$ transition of $^{11}Be^{+}$at 313 nm. The figure shows the beta- decay asymmetry versus downward shift in the beam energy where +1 V corresponds to a Doppler shift of -40 MHz in the laser frequency. The two resonances are due to the hyperfine splitting of the $2P_{1/2}$ first excited state of the $^{11}Be^{+}$ ion.