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# Polarization of Protons by an A. C. Sextapole Magnetic Field

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The d.c. sextapole magnetic field has been proposed as a method of polarizing atomic hydrogen, the motion of the atoms being sinusoidal for one orientation of the atomic magnetic dipole and exponentially divergent for the other. If the polarized atomic hydrogen is ionized in a weak magnetic field, a nuclear polarization of 50% can be achieved.

It appears likely that nuclear polarizations of > 50% can be achieved with an a.c. sextapole field of the form

$$|H| = \alpha\,(1 - \cos \omega t)\, r^2 ,$$

which gives an equation of motion for a magnetic dipole

$$m\ddot{r} = -\,2\mu_{eff.}\,\alpha\,(1 - \cos \omega t)\, r\,.$$

The solutions of this equation are Mathieu functions [1], for $\mu_{eff} = \pm\mu_0$, and, presumably, similar functions for $\mu_{eff} = \pm\mu_0 H(H^2 + H_0^2)^{-1/2}$. For $\mu_{eff} < 0$ the solutions diverge rapidly. For $\mu_{eff} > 0$ the solution may be stable or divergent oscillations depending on the values of $\alpha$ and $\omega$ and it appears likely that one of the two positive values of $\mu_{eff}$ could be kept stable while the other is divergent.

Putting $\alpha = 4 \times 10^4$ gauss/cm$^2$ and $\omega/2\pi = 7.55$ kc/s, the component with $\mu_{eff} = +\mu_0$ would be diverged by a factor of $\sim e^4$ in 1 m while at least some part of the other positive component would remain stable. Alternatively, for $\alpha = 4 \times 10^4$ gauss/cm$^2$ and $\omega/2\pi = 6.16$ kc/s, the component $\mu = +\mu_0\, H\,(H^2 + H_0^2)^{-1/2}$might be largely diverged.

## REFERENCE

[1] N. W. McLachlan, *Theory and Application of Mathieu Functions*, O.U.P., (1947).