

66th International Astronautical Congress 2015

SPACE EXPLORATION SYMPOSIUM (A3)
Interactive Presentations (IP)Author: Dr. Shuangai Wan
China, wsajishe@163.comSPIN EXCHANGE OPTICAL PUMPED ^3He MAGNETOMETER FOR SPACE EXPLORATION**Abstract**

We design a nuclear free precession magnetometer based on spin exchange optically pumped ^3He . This atomic magnetometer utilizes a small glass cell containing the Rb and the ^3He atoms to sense the magnetic field. The Rb atoms absorb light from a laser at 795nm, and then transfer the polarization to the ^3He atoms by spin exchange optical pumping. The spin polarized ^3He atoms will precess around the measured magnetic field at a frequency which is proportional to the magnitude of the field. The precession will induce a voltage in a pick-up coil which is used as the signal detector. The ^3He has a long coherent spin precession time T_2 , which is more than hours in general. That makes this type of atomic magnetometer has a theoretical sensitivity of approximately $0.001\text{pT}/\text{Hz}^{1/2}$. Furthermore, the free precession ^3He atoms are nearly completely decoupled from the environment, making this type atomic magnetometer has a long stability to achieve a high precision. We demonstrated a prototype of such a magnetometer and achieved a sensitivity of $1\text{pT}/\text{Hz}^{1/2}$ level. Application for such a spin exchange optical pumped ^3He magnetometer would be used for deep space exploration, due to its high precision and low power consumption.