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Novel Glass for Distributed Magnetic Sensing

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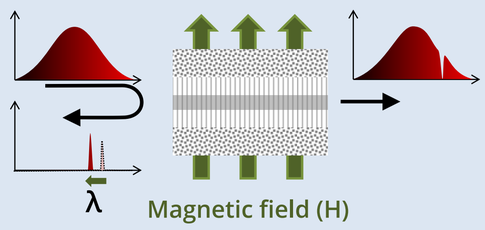
Concept



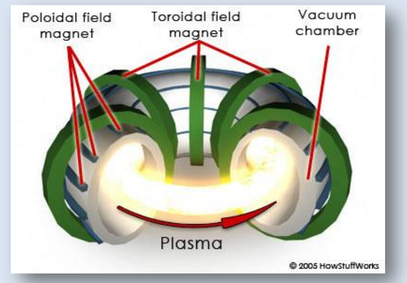
Fiber Bragg gratings (FBGs) are regions of an optical fiber which reflect a single wavelength. Using glass effected by magnetic field, would make them magnetometers.

$$\lambda = 2\Lambda n(H)$$

Sensor Goal

1. Measure magnetic field every cm for 100's meters at 0.01Oe
2. Single, low profile fiber for all 10,000+ sensors
3. Not orientation dependent

Monitoring magnetic containment fields



History

1995 – Magneto Refractive Effect (MRE) in metal films

1997 – MRE in $La_{0.1}Sr_{0.9}MnO_3$ (LSMO)

2005 – Room Temperature MRE in LSMO

2009 – Visible range MRE in LSMO at 20C

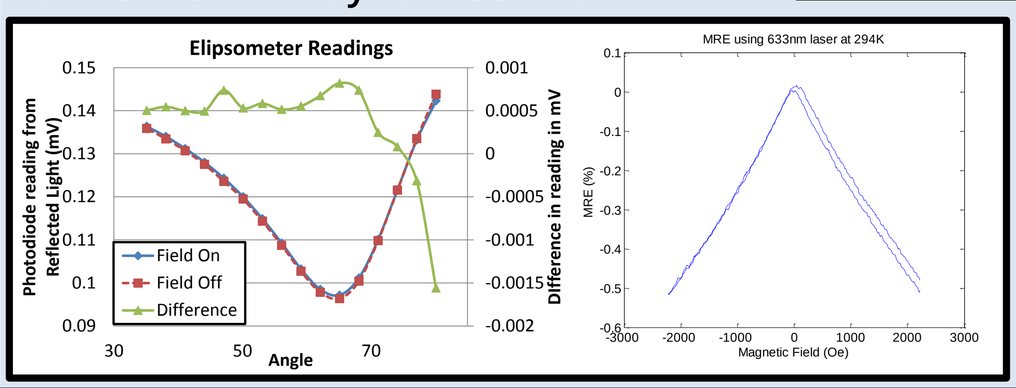
2012 – Stronger visible range MRE in $La_{0.7}Ca_{0.3}MnO_3$ (LCMO) at -8C and $La_{0.9}Ag_{0.1}MnO_3$ (LAMO) at 40C.

2013 – Fixed field test shows index of refraction changing at UCLA

Testing for magneto-optical coupling

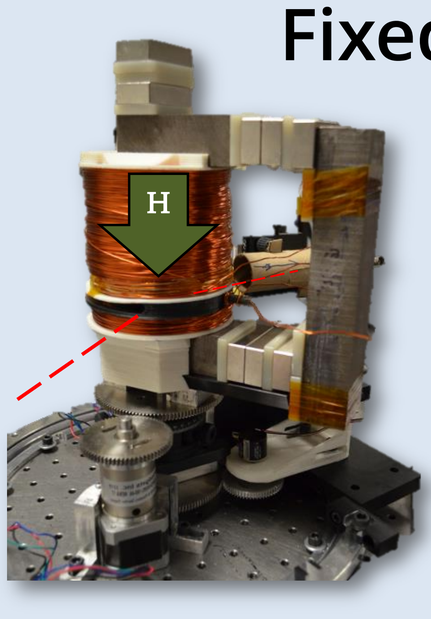
Changing *n,* changes the reflectivity of a boundary, such as a sample in a vacuum. From the Fresnel equation, there are two ways to use this.

$$R = \left(\frac{n_2^2\cos\theta - n_1\sqrt{n_2^2 - n_1^2\sin^2\theta}}{n_2^2\cos\theta + n_1\sqrt{n_2^2 - n_1^2\sin^2\theta}}\right)^2$$

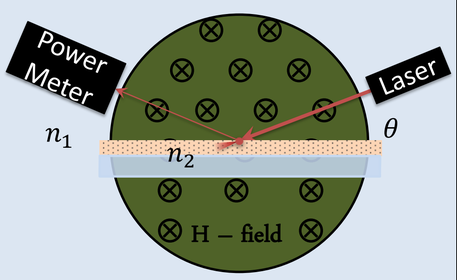


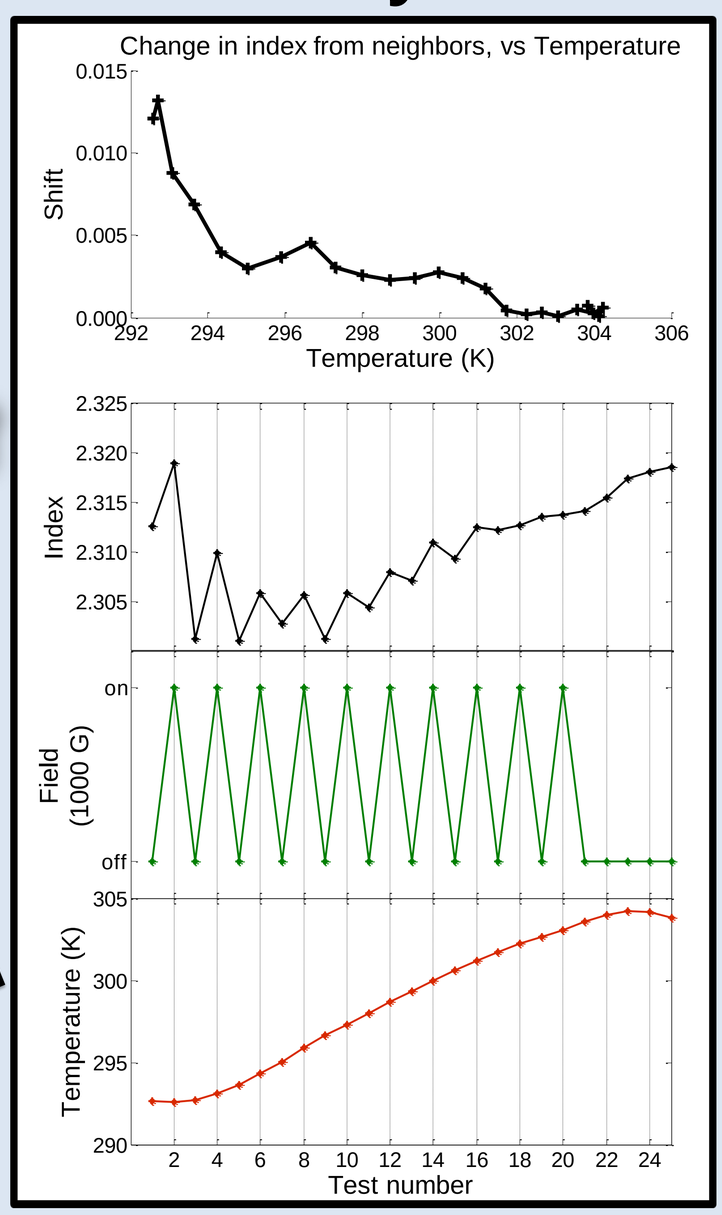
Reflectivity (*R*) of a sample can be used to characterize its index of refraction (*n*), and so show its change under magnetic field (*H*).

Fixed Field Study

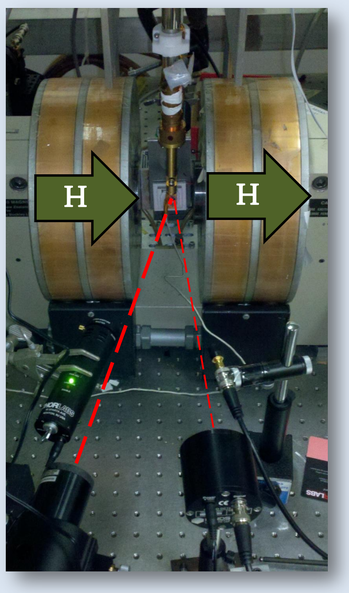


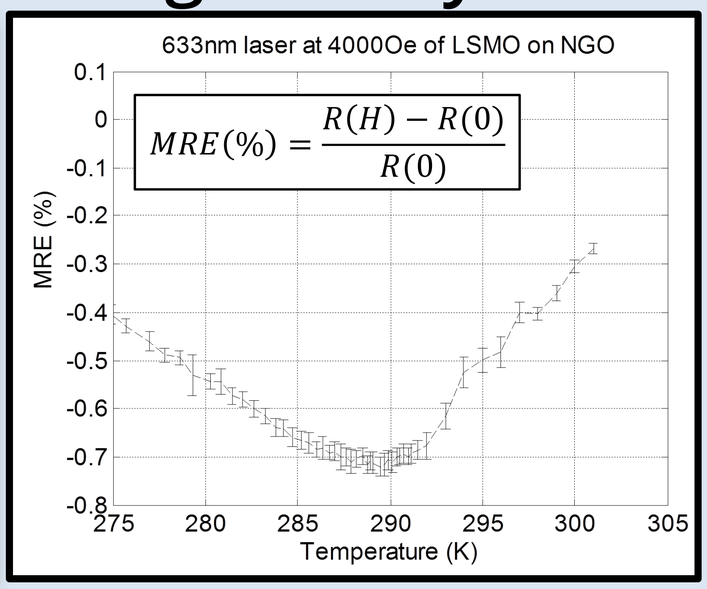
Scanning the angle of the laser, and fitting the curve to the Fresnel equation, n, and a shift in n is found



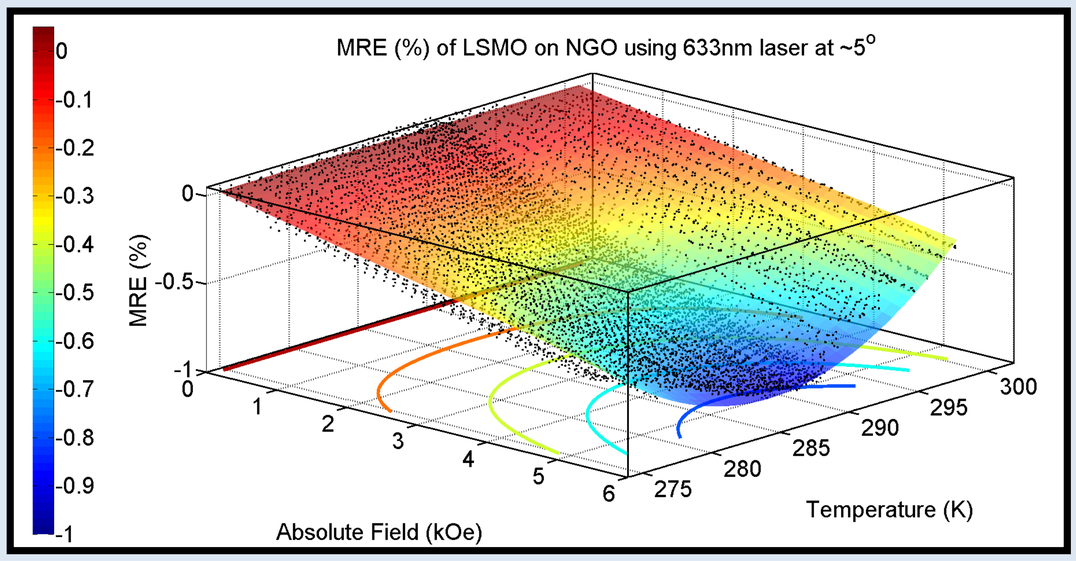


Fixed Angle Study





At an angle, the temperature and magnetic field are swept



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