

Matter-Wave BEC Magnetometer: A Breakthrough In Ultra-sensitive Magnetic Measurements

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Project objectives:

- to develop theoretical model of ultra-sensitive coherent dark-state magnetometer operating with EIT effect in alkali media.
- to investigate the ways to improving the maximal sensitivity using thermal alkali clouds and BEC media.
- to investigate the improvement in sensitivity of the magnetometer with different source of optical pulses in the interferometer
- to investigate the possibility of ferromagnetic detection from space.

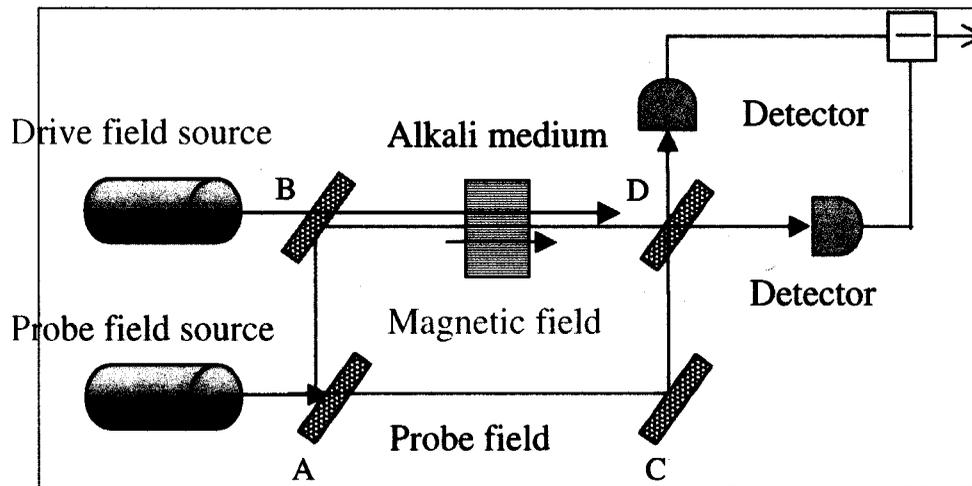


Fig. 1 The optical EIT magnetometer

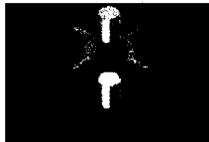


Fig. 3 BEC in the magnetic trap.

Benefits:

The EIT magnetometer is a very sensitive sensor of the magnetic field. The maximal sensitivity of the magnetometer is 10^{-12} Gauss for coherent light beam and 10^{-14} Gauss for the correlated beam.

For example, the magnetometer with sensitivity of 10^{-14} Gauss will detect a ferromagnetic target of 300 kg at the distance of 200 km.

Magnetometers with the sensitivities $<10^{-12}$ Gauss can be useful for the detection of ferromagnetic targets from space.

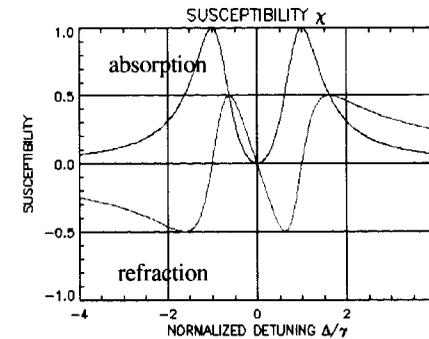


Fig. 2 Real and imaginary parts of susceptibility versus normalized detuning.

Ferromagnetic target detection

Objective of follow-on project is the developing the algorithms for ferromagnetic target detection from space. Tasks:

- 1) Adapt magnetic gradiometer algorithms for Earth orbit environment.
- 2) Develop simulation to test algorithms, including modes for the space-craft orbit, Earth's magnetic field, target fields, and clutter.
- 3) Investigate the problem of submarine detection.
- 4) Test the algorithms against the model and develop realistic expectations for locating classes of targets from low-Earth orbit.

