CLAIMS:

1. A magnetic field strength measurement system comprising:

a vapor chamber holding alkali metal vapor;

a light source unit configured to supply circularly polarized laser light and positioned to feed a first pass beam of said circularly polarized light into said vapor chamber;

a retroflection unit comprising least one optical element and configured to reverse a direction, while maintaining polarization, of said first pass beam upon exit from said vapor chamber to provide a second pass beam to said vapor chamber, said second pass beam having an opposite direction, and same circular polarization as said first pass beam;

a detector positioned to measure light emitted from said vapor chamber; and

circuitry configured to:

provide a modulating signal to said source, said modulating signal configured to modulate said first pass beam;

receive a measurement signal from said detector;

demodulate said measurement signal using said modulating signal to provide a demodulated measurement signal; and

determine a resonance frequency from one or both of said modulating signal and said demodulated measurement signal.

2. The system according to claim 1, wherein said circuitry is configured to provide said modulation signal at a plurality of modulation frequencies,

wherein said demodulated measurement signal comprises a plurality of amplitudes each amplitude associated with a frequency of said plurality of modulation frequencies.

3. The system according to claim 1, wherein said circuitry is configured to extract a resonance frequency from said demodulated measurement signal.

4. The system according to claim 3, wherein said circuitry comprises a lock-in amplifier configured to receive said measurement signal and said modulating signal and outputting said demodulated measurement signal.

5. The system according to claim 3, wherein said demodulated measurement signal comprises a quadrature plot and where said circuitry is configured to extract a resonance frequency as a zero-crossing of a said quadrature plot.

6. The system according to claim 1, wherein said circuitry is configured to use said demodulated measurement signal as feedback to said modulation signal to maintain said demodulated measurement signal at a set value, where said resonance frequency is extracted as a steady state frequency of said modulation signal.

7. The system according to any one of claims 1-6, wherein said light source unit comprises a laser source of linearly polarized light and one or more optical element configured to convert the linearly polarized light into circularly polarized light.

8. The system according to any one of claims 1-7, wherein said first pass beam is fed to said vapor chamber in a first direction and where said retroflector is positioned to reverse a direction of said first pass beam to provide said second pass beam.

9. The system according to any one of claims 1-8, comprising a loss compensation unit configured to increase a resonance light signal produced by said vapor chamber and associated with said second pass beam.

10. The system according to claim 9, wherein said compensation unit comprises at least one heater configured to heat at least a portion of said alkali metal vapor through which said second pass beam passes.

11. The system according to any one of claims 9-10, wherein said loss compensation unit comprises one or more temperature controller configured to control temperature of one or more portion of said vapor chamber.

12. The system according to any one of claims 9-11, wherein said loss compensation unit comprises one or more beam broadening element in a path of said second pass beam prior to entry of said second pass beam to said vapor chamber as said second pass beam.

13. The system according to any one of claims 1-12, wherein said detector comprises a photodiode.

14. The system according to any one of claims 1-13, wherein said retroflector unit comprises at least two light diverting elements.

15. The system according to claim 14, wherein each of said at least two light diverting element comprises a reflecting prism or a mirror.

16. The system according to any one of claims 14-15, wherein said at least two light diverting elements comprises three light diverting elements.

17. A method of magnetic field strength measurement comprising:

supplying a first beam of circularly polarized light and a second beam of circularly polarized light, the second beam derived from the first beam, to a pumped vapor chamber holding alkali metal vapor, the first beam occupying a first portion of the pumped vapor chamber and the second beam occupying a second portion of the pumped vapor chamber;

measuring light emitted from said vapor chamber to provide one or more measurement signal;

balancing an effect of the first and second light beams on the alkali metal vapor by controlling one or more of:

temperature of one or more portion of said alkali metal vapor; and

beam cross sectional area of one or more of said first beam and said second beam.

18. The method according to claim 17, comprising determining a magnetic resonance frequency from said measurement signal.

19. The method according to claim 18, comprising determining the magnetic field strength using said magnetic resonance frequency.

20. A system of magnetic field strength measurement system comprising:

a vapor chamber holding alkali metal vapor;

a source of laser light;

one or more optical element configured to receive said laser light and provide a first circularly polarized beam of light to a first portion of said vapor chamber and a second circularly polarized beam of light to a second portion of said vapor chamber, the second circularly polarized beam being derived from the first beam;

one or more sensor configured to measure one or more of:

said first circularly polarized beam of light;

said second circularly polarized beam of light;

light emitted from said vapor chamber;

a compensation unit comprising one or more temperature controller and one or more beam area controller;

a controller configured to receive one or more measurement from said one or more sensor and to provide control signals to said compensation unit to balance the effects of the first beam and the second beam on the metal vapor in the vapor chamber.

21. A method of measuring magnetic field strength comprising:

providing a modulating signal at a plurality of modulation frequencies;

directing a first pass beam of circularly polarized light into a vapor chamber of pumped alkali metal atoms in a first direction, where said first pass beam is modulated according to said modulating signal;

reversing a direction, while maintaining polarization, of said first pass beam upon exit from said vapor chamber to provide a second pass beam to said vapor chamber, said second pass beam having an opposite direction, and same circular polarization as said first pass beam;

acquiring a measurement signal of light emitted from said vapor chamber;

demodulating said measurement signal using said modulating signal to provide a demodulated measurement signal;

determining a resonance frequency from one or both of said modulating signal and said demodulated measurement signal.

22. The method according to claim 21, wherein said demodulated measurement signal comprises a plurality of amplitudes, each amplitude associated with a frequency of said plurality of modulation frequencies.

23. The method according to claim 21, wherein said determining said resonance frequency comprises extracting said resonance frequency from said demodulated measurement signal.

24. The method according to claim 23, wherein demodulated measurement signal comprises a quadrature plot and where said determining said resonance frequency comprises extracting a zero-crossing of a said quadrature plot.

25. The method according to claim 21, comprising using said demodulated measurement signal as feedback to said modulation signal to maintain said demodulated measurement signal at a set value, where said resonance frequency is extracted as a steady state frequency of said modulation signal.

26. The method according to any one of claims 21-25, comprising compensating loss to said second pass beam to increase a resonance light signal produced by said vapor chamber and associated with said second pass beam.

27. The method according to claim 26, wherein said compensating loss comprises receiving a measurement from one or more sensor.

28. The method according to claim 27, wherein said compensating loss comprises controlling a temperature, based on said measurement from one or more sensor, of at least a part of a portion of said alkali metal vapor through which said second pass beam passes.

29. The method according any one of claims 27-28, wherein said compensating loss comprises controlling a beam cross area of said second pass beam, based on said measurement from one or more sensor.