a power amplifier to receive the first signal and produce therefrom a second signal, said amplifier being disposed between the VCO and the cavity; and

said first signal being phase locked by a phase locked loop (PLL) to receive a fourth signal and produce therefrom the third signal as a voltage-control tuning signal, said PLL being disposed between said amplifier and said cavity,

wherein, said PLL comprises a feedback loop that receives a phase error between the second signal and an amplification of a reflection of the oscillating signal from the cavity to produce therefrom the fourth signal, said feedback loop being disposed between the EFC and the power amplifier output and the amplification of the reflection of the oscillating signal from the cavity,

wherein, said cavity resonance mode is selected by a VCO frequency and said VCO is phase-locked to a center of said cavity resonance mode.

13. The oscillator of claim **12**, wherein said cavity is a high-Q air/vacuum dielectric cavity comprising at least one material selected from the group consisting of a high conductivity metal and metalized material.

14. The oscillator of claim **12**, wherein the reflection of the oscillating signal from the cavity further comprises a carrier-suppression technique whereby a signal to noise ratio of a phase detector component thereof is increased by the amplification of said reflection of the oscillating signal from the cavity, said phase detector component producing a fourth signal that is proportional to the phase error between the oscillating signal and said cavity resonance mode.

15. The oscillator of claim **13**, wherein said VCO is selected from the group consisting of a Gunn oscillator, Yttrium-Iron-Garnet (YIG) oscillator, dielectric resonator oscillator (DRO), and coherent pulsed laser utilizing its repetition rate frequency, wherein a frequency of the VCO may be one of multiplied and divided to match a cavity resonance frequency.

16. The oscillator of claim **15**, wherein the coherent pulsed laser is a femtosecond laser.

17. The oscillator of claim **12**, wherein said cavity is a high-Q air/vacuum dielectric cavity comprising a material selected from the group consisting of a high conductivity metal and metalized material.

18. The oscillator of claim **17**, wherein said cavity is selected from the group consisting of TE023 resonance mode and TE025 resonance mode.

19. The oscillator of claim **18**, wherein said TE023 resonance mode at 100 GHz is a right circular cylindrical cavity having an approximate 1 cm cylindrical diameter and height in an open bore at a center of the cavity.

20. The oscillator of claim **12**, wherein:

said cavity is fabricated from an ultra-stiff material; and

said cavity is fabricated such that it is isolated from at least one effect selected from the group consisting of acoustic, structure-borne vibration, external temperature variation, magnetic field, electric field, and radiation field.

21. The oscillator of claim **20**, wherein said ultra-stiff material is a ceramic.

22. The oscillator of claim **20**, wherein said ultra-stiff material is a synthetic diamond.

23. The oscillator of claim **20**, wherein said ultra-stiff material is modified to include a mechanical design that stabilizes the frequency of the at least one cavity resonance mode.

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