which need affect the desirable signal properties of the air/vacuum cavity. In contrast, when high-Q, solid dielectrics are used, this limits the choice of materials and strategy for mitigating environmental sensitivities because desirable signal properties of the dielectric can be readily compromised.

While there has been shown, described, and pointed out fundamental novel features of the present invention as applied to preferred embodiments thereof, it will be understood that various omissions and substitutions and changes in the apparatus described, in the form and details of the devices disclosed, and in their operation, may be made by those skilled in the art without departing from the spirit of the present invention. It is expressly intended that all combinations of those elements that perform substantially the same function in substantially the same way to achieve the same results are within the scope of the invention. Substitutions of elements from one described embodiment to another are also fully intended and contemplated.

We claim:

1. A cavity stabilized oscillator for producing an oscillating signal, comprising:

a voltage controlled phase shifter (VCP) to receive a second signal and a third signal and to produce therefrom a first signal;

a cavity to receive a fourth signal and produce therefrom the oscillating signal, said cavity having at least one cavity resonance mode;

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

a feedback loop to receive the fourth signal and a reflection of said oscillating signal and produce therefrom the second signal, said feedback loop being disposed between the VCP and the power amplifier,

wherein, said at least one cavity resonance mode is employed to satisfy at least one pre-determined oscillation condition in the feedback loop, and a phase noise due to the power amplifier is corrected by the VCP; and wherein:

said second signal comprises a phase error between the oscillating signal and the at least one cavity resonance mode; and

said at least one mode is selected by a bandpass filter disposed between the cavity and the VCP to receive the oscillating signal and provide the selected at least one cavity resonance mode as the third signal, wherein said cavity is a high-Q air/vacuum dielectric cavity.

2. The oscillator of claim **1**, wherein said cavity is selected from the group consisting of TE023 resonance mode and TE025 resonance mode.

3. A cavity stabilized oscillator for producing an oscillating signal, comprising:

a voltage controlled phase shifter (VCP) to receive a second signal and a third signal and to produce therefrom a first signal;

a cavity to receive a fourth signal and produce therefrom the oscillating signal, said cavity having at least one cavity resonance mode;

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

a feedback loop to receive the fourth signal and a reflection of said oscillating signal and produce therefrom the second signal, said feedback loop being disposed between the VCP and the power amplifier,

wherein, said at least one cavity resonance mode is employed to satisfy at least one pre-determined oscillation condition in the feedback loop, and a phase noise due to the power amplifier is corrected by the VCP;

wherein a 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 amplification of said reflection.

4. The oscillator of claim **3**, wherein said phase detector component produces the second signal as a signal proportional to the phase error between the oscillating signal and said cavity resonance mode.

5. The oscillator of claim **4**, wherein said at least one cavity resonance mode is selected by a bandpass filter disposed between the cavity and the VCP to receive the oscillating signal and provided as the third signal.

6. The oscillator of claim **5**, wherein said cavity is a high-Q air/vacuum dielectric cavity.

7. The oscillator of claim **6**, wherein said cavity is selected from the group consisting of TE023 resonance mode and TE025 resonance mode.

8. The oscillator of claim **7**, 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.

9. A cavity stabilized oscillator for producing an oscillating signal, comprising:

a voltage controlled phase shifter (VCP) to receive a second signal and a third signal and to produce therefrom a first signal;

a cavity to receive a fourth signal and produce therefrom the oscillating signal, said cavity having at least one cavity resonance mode;

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

a feedback loop to receive the fourth signal and a reflection of said oscillating signal and produce therefrom the second signal, said feedback loop being disposed between the VCP and the power amplifier,

wherein, said at least one cavity resonance mode is employed to satisfy at least one pre-determined oscillation condition in the feedback loop, and a phase noise due to the power amplifier is corrected by the VCP;

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;

wherein said ultra-stiff material is a ceramic.

10. The oscillator of claim **9**, wherein said ultra-stiff material is a synthetic diamond.

11. The oscillator of claim **9**, wherein the ultra-stiff material is modified to include a mechanical design that stabilizes the frequency of the at least one cavity resonance mode.

12. A cavity stabilized oscillator for producing an oscillating signal, comprising:

a voltage controlled oscillator (VCO) coupled to an electronic frequency control (EFC) to receive a third signal to tune the generation by the VCO of a first signal phase locked to a cavity resonance mode;

said cavity being a high-Q having a linear air/vacuum dielectric to receive a second signal and produce the oscillating signal, said cavity having at least the cavity resonance mode;