measured value of the finesse and the power transmitted trough PBC, P_{tr}:

$$\frac{P_{tr}}{\epsilon P_{in}} = 4T_1T_2\left(\frac{\mathcal{F}}{2\pi}\right)^2, \tag{B2}$$

where P_{in} is the input power, and ϵ is a mode-matching factor. For two arbitrary mirrors, for which neither $T_{1,2}$ nor $l_{1,2}$ are known the Eq. (B1,B2) do not provide a solution, since a number of variables exceeds the number of equations. Nevertheless, for two mirrors from the same coating run when one can assume that $T_1 = T_2 = T$ and $l_1 = l_2 = l$, the equations (B1,B2) become

$$\mathcal{F} = \frac{\pi}{T+l}.$$
$$\frac{P_{tr}}{\epsilon P_{in}} = 4T^2\left(\frac{\mathcal{F}}{2\pi}\right)^2,$$

and for known mode-matching factor ϵ the parameters of the mirrors (T and l) can be determined. The factor ϵ depends on the geometry of the cavity, and is assumed to stay constant upon replacing of the mirrors, if the geometry of the input laser beam and the configuration of the PBC are unchanged. This gives the possibility to calibrate this factor by using a mirror set for which the transmission is known. We used for this purpose the mirror set purchased from Advanced Thin Films, Inc., for which reliable data on the transmission of the mirrors is provided by the supplier. By measuring the finesse of the PBC comprised of these mirrors and the ratio of the transmitted-to-input power, the mode-matching factor and the A+S mirror losses l are found. This set is not an actual mirror set that was used in the PV experiment, nevertheless, the parameters of other mirrors were determined by replacing one mirror in the "reference" set by the "test" mirror, parameters of which are sought. The geometry of the cavity was unchanged during the replacement. This tactic allows for the measurement of parameters of any arbitrary mirror.

Appendix C: Impact of the phase mixing effect on the harmonics ratio

Atoms undergo the 6s^2 ^{1}S$_0$ $\rightarrow$ 5d6s ^{3}D$_1$ transition in the interaction region where they are illuminated by 408-nm light and are exposed to the static magnetic field and the oscillating electric field $E(t)$. Excited atoms then spontaneously decay from the 5d6s ^{3}D$_1$ state to the metastable 6s6p ^{3}P$_0$ state. The population of 6s6p ^{3}P$_0$ is proportional to the transition rate R_M for $M = 0, \pm 1$. Without loss of generality, we assume that the constant of proportionality is equal to one.

The rate R_M is measured in the probe region. The probe region is located a distance $d \approx 20$ cm away from the interaction region. Therefore, an atom that arrives at the detection region at time t experienced an electric field with magnitude $E(t-d/v_z)$ in the interaction region, where v_z is the atom's speed and d/v_z is the amount of time required for the atom to travel a distance d.

Because some atoms travel faster or slower than others, the detection region is full of atoms that have each experienced a different electric field while in the interaction region. Each atom contributes to the total rate and hence the observed rate $\overline{R}_M$ is the thermal average of every contribution:

$$\overline{R}_M(t;\omega,d,v_0) = \int_0^\infty R_M(t-d/v_z) f(v_z;v_0)\,dv_z, \tag{C1}$$

where

$$f(v_z;v_0)\,dv_z = 2(v_z/v_0)^3 e^{-(v_z/v_0)^2} dv_z/v_0, \tag{C2}$$

is the probability for an atom to have speed between v_z and $v_z + dv_z$. Here $v_0 = \sqrt{2k_BT/m} = 2.9\times10^4$ cm/s is the thermal speed, $T \approx 873$ K is the oven temperature, and $m = 161$ GeV/c^2 is the atomic mass of Yb.

It is convenient to introduce the dimensionless variables $x = v_z/v_0$ and $\tau = \omega t$, and the dimensionless parameter $\alpha = \omega d/v_0$. Then the average rate $\overline{R}_M(t;\omega,d,v_0) \to \overline{R}_M(\tau;\alpha)$ depends only on the dimensionless quantities α and τ, and Eq. (C1) becomes

$$\begin{aligned}\overline{R}_M(\tau;\alpha) = \mathcal{R}_M^{[0]} &+ \mathcal{R}_M^{[1]}|I(\alpha)|\cos(\tau + \mathrm{Arg}[I(\alpha)]) \\ &+ \mathcal{R}_M^{[2]}|I(2\alpha)|\cos(2\tau + \mathrm{Arg}[I(2\alpha)]),\end{aligned} \tag{C3}$$

with

$$I(\alpha) \equiv \int_0^\infty e^{-i\alpha/x} f(x;1)\,dx. \tag{C4}$$

Note that $|I(\alpha)| \to 0$ as $\alpha \to \infty$ whereas $|I(\alpha)| \approx 1$ when $\alpha < 1$. This places a limit on the modulation frequency: We require that $\omega < v_0/d = 2\pi\times$ 230 Hz in order to avoid a significant decrease in signal.

The lock-in amplifier receives an input signal proportional to $\overline{R}_M$ and returns two output signals $S_M^{[1]}$ and $S_M^{[2]}$ corresponding to the first and second harmonic components, respectively. This process can be modeled as

$$\begin{aligned}S_M^{[n]}(\phi_n;\alpha) &= \frac{1}{\pi}\int_0^{2\pi} \overline{R}_M(\tau;\alpha)\cos(n\tau+\phi_n)\,d\tau \\ &= \mathcal{R}_M^{[n]}|I(n\alpha)|\cos(\mathrm{Arg}[I(n\alpha)]+\phi_n),\end{aligned} \tag{C5}$$

where the phases $\phi_{1,2}$ of the lock-in amplifier are chosen to maximize the signals $S_M^{[1,2]}$. That is,

$$\phi_n = \phi_n(\alpha) \equiv -\mathrm{Arg}[I(n\alpha)]. \tag{C6}$$

Our measurement s_M is the ratio of the first- and second-harmonic signals:

$$s_M = \frac{S_M^{[1]}(\phi_1;\alpha)}{S_M^{[2]}(\phi_2;\alpha)} = \frac{\mathcal{R}_M^{[1]}|I(\alpha)|}{\mathcal{R}_M^{[2]}|I(2\alpha)|} = r_M \times C(\alpha), \tag{C7}$$