Progress of making the MOT for neutral mercury atoms

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Due to less blackbody radiation shifts, mercury atoms are regarded as one of the best candidates for realizing the neutral atomic clock approaching the highest accuracy of 1×10^{-18}. Here we report our recent progress toward making a magneto-optical trap for mercury atoms, as a cold atom source for our future optical lattice clock of mercury. We designed and installed the ultra-high vacuum system. The mercury source and the cold pump can be cooled down to $-80\,^{\circ}\mathrm{C}$ and $-100\,^{\circ}\mathrm{C}$ by TEC, corresponding the saturated vapor pressure of mercury with 2.5×10^{-9} Torr and 3×10^{-11} Torr, to enhance the background vacuum pressure. To improve the power of the cooling laser, we are developing a new kind of Yb-doped fiber amplifier operating at 1014.8nm, which could be used as the fundamental frequency laser of the frequency quadrupling to 253.7 nm. We numerical simulated several spectroscopy of 6 naturally abundant isotopes of mercury atoms including: the saturated absorption spectroscopy (SAS), DAVLL spectroscopy and polarization spectroscopy (PS), and proposed the sub-dopplor DAVLL and PS for frequency stabilization, which has advantage of simple, compactable and good signal to noise ratio.
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