FIRST

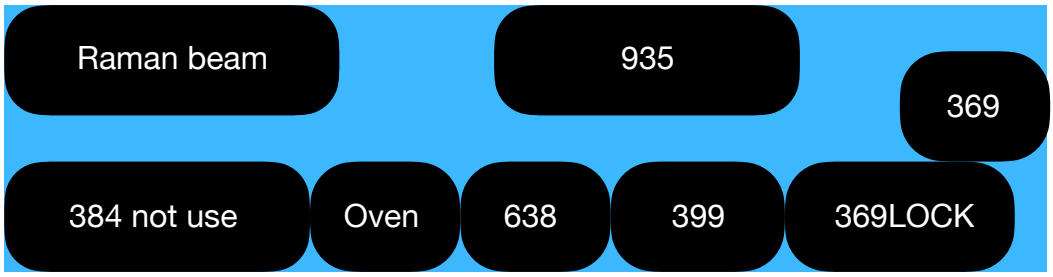
turn on the 369 laser control panel, wait for 20 mins and locked the laser.
(if necessary also ,turn on the raman laser, open the shutter and shift the power to ten watt, wait for 30 minutes and locked the raman beam.)

BEAM WAVELENGTH

369 beam:739.05250 nm(will be double, the most important)
for doppler cooling, sisyphus cooling, state detection and optical pumping
Re-pumping beam:935.18854 nm(no feedback control)
Red:638.6098/638.6149nm(no feedback control, if ion disappear then check this one)
ionization beam:398.91074 nm(just use it several times a week, but keep it open.)

BASIC SET UP

There are four knobs in the main control panel.
And the illustration of optical table.



Re-pumping(not so sensitive)
Doppler(ok sensitive)
IONIZATION (sensitive)

Ionization

The ionization beam share the optical path with red beam for wave meter, and the moveable mirror is close near side of the optical table, make sure do not crunch the mirror, move it slowly.

Open the oven for about two minutes (first make sure the back ground noise is no very high), once see the counter change dramatically, BLOCK the beam to just ionize one YB atom.

Put the wave meter optical path back to the control of red beam. Not just put the mirror back, but also totally shield the beam with optical component.

Beams wavelength
(Never switch the temperature control)

make sure the laser has enough power(10k).
adjust all the three beams to the above precision.

For the 369 beam, use cavity feedback control first, tune the knob on the **right hand side** (clockwise) to make the yellow line (transparency) reach maximum, then turn on the lock.(always ask if something is not sure, or it will be a disaster.)

Then, use spectroscopy feedback control, tune the same knob (counter clockwise), make the purple line goes up, down and up. Stop when the line reach 0, then turn on another lock.
#use both hands, one for turning the knob, one for locking the mode.

369 beam : control detail
main panel, it will drift
cavity, it lock on relative frequency feedback, and in long term it will also drift
spectroscopy, it lock on absolute frequency(absorption), so it is very stable.

Red beam control knob is on **left hand side**.

SOFTWARE AND MICRO-MOTION

Open the main window first then all the other three control windows.
(order matters, and lots of small control window)
Then open left two panel(tdc first.)
In theory the four rods will only be grounded or AC, but since micro-motion will decrease substantially in the middle of trap center, we apply DC on three rods.

Use the control panel to minimize the micro-motion.
First, do ten times the measurement, and check for the b.

Move the counter tab to far side monitor, flip the mirror in the middle of table from far side
the number B should be less than 3,4 (less than 2 is even better), 6-7 is acceptable.

Just change the mode of setting and fit.
Write down the micro-motion b.
After minimizing the micro-motion, put the mirror back, switch the top side beam to normal doppler beam.

Doppler check

the photon count only work for doppler beam.
to prevent saturation problem, decrease the power from 10k count to 5k count.
Go to the middle of two optical table, at the left hand side, fine-tune the polarization pad (in the very center of the table) and knobs(on the right side of the trap).

State detection and Optical pumping(369 beam)

Use Alignment test. Make the photon counter from normal standard 10 to 5, to achieve more sensitivity and prevent saturation problem(the control attenuation wheel is in the left of trap).

Walk into the middle of two optical table, in the left of trap and inside optical table.
Tune the first polarization pad to maximum and turn the second polarization pad to maximum.(a little of inside compared with the previous micro motion one.)
Tune the angle of mirror before the beam went into trap.(very tricky this one!!)

Run alignment test.
state detection should be >0.96 optical pumping should be <0.02
With raman beam on, the number will be worse.
#paddle use geometry phase to switch the polarization.

Microwave Frequency Scan and PI time (Zeeman 00 0-1 01)

Copy the setup file from the latest file.
If something went wrong, should be related to magnetic field.
Run frequency scan.
Input the start, stop frequency. Also input the step(resolution).Then scan the system and fit.
Write down the new frequency, SAVE THE FILE.
PI time scan.
Input the updated frequency and scan for two cycle then stop and fit.
Write down the new pi time, SAVE THE FILE.
Repeat

Raman single beam

After warm up, switch the laser from cw mode to pulse (3ps).
Choose the single raman frequency, input the number in the machine.
Press the prism button to very right(maybe 10) till it be cw and roll back to pulse(maybe 2)
then press the prism button to very lest(maybe 22) till it be cw and roll back to pulse(maybe 4)
Finally, press right for 11 times.

not stable left	stable left	stable right	not stable right
4	18	8	2

Use the computer to achieve our set up, press turn right or turn left the bottom to minimize the voltage, when voltage<1 use the small difference setup up, then press the two lock bottom.
Next, touch the closest bottom to make sure the yellow line on the screen overlap the blue line.

two ramen beam on, shift the graph about 400k hz(4 roll of mouse for easy check up)
one beam just AC shift the graph for 200k and not destroy the shape.
change to the number of two phonon raman frequency.

Raman sideband cooling

Doppler beam + sisyphus cooling + optical pumping.
Then measure the frequency scan and pi time scan for three normal mode.
(why it do not need three set up??)

Sisyphus cooling(369 beam)

the spatial mode and polarization are sensitive, should never be touched.

Emergency process

when there is more than one ions, dump the trap to release the ion and make doppler beam to be more on resonance to decrease the cooling domain.(make the hot ion leave)

Magic number

for the default frequency F and Rabi frequency W, the starts should be F+(20/W)/10, end should be F-(20/W)/10. The step should be (1/W)/10, so totally the system got 40 data point.
The above set up will make the graph looks super good!!