**Manual Tuning**

**EPR Instrumentation**

**Safety:**

* **Do not remover any protective covering or panels of the instrument while the instrument is in operation or the power supply is on.**
* **Power off the instrument and disconnect the line cord before starting any maintenance or cleaning work**
* **Do not have the wave-guide open when the microwave power is on.**
* **Always switch the bridge to standby when you removing or changing EPR cavities.**
* **Never look down an open wave-guide when there is microwave power.**

**Before staring experiments:**

1. Turn on the cooling system water supply
2. Turn on the heat exchanger
3. Turn on the power supply, the console and the microwave bridge.
4. Check to make sure that all the LEDs are not showing any errors.
5. Open XEPR and connect to the spectrometer.

Check to make sure there is no error LEDs on.

**Manual Tuning:**

1. Open the microwave bridge to tuning button in the tool bar to open the microwave bridge tuning dialogue box.
2. Switch the microwave bridge to tuning mode.
3. Set the microwave attenuator to 30dB. Note that the arrows on the left side change the attenuation in 10dB increments and those on the right side changes in 1dB increments.
4. Turn the reference arm off. This makes finding the cavity “dip” easier.
5. Observe the tuning display on the monitor. If the mode pattern amplitude is too small increase the microwave power by decreasing the attenuation in 1dB steps. If the amplitude is too large then decrease the microwave power by increasing the attenuation in 1dB steps.
6. Tune the microwave source by adjusting the Frequency slider bar to center the tuning pattern “dip” in the display monitor. The “dip” corresponds to the microwave power absorbed by the cavity and thus is not reflected back to the detector diodes. By centering the “dip” on the display monitor the microwave is set to oscillate at the same frequency as the cavity resonant frequency.
7. Clean the sample tube to be inserted into the cavity.
8. Insert the sample tube into the cavity very carefully using the appropriate collet size for your tube. Make sure that you are in tube mode when you are inserting the sample so you can see a change in the cavity “dip” as your sample perturbs the cavity. The tube should be slightly loose before you tighten the collet nut. The bottom of the sample should rest in the indentation of the pedestal to ensure that your sample is centered horizontally.
9. Retune the microwave source, by repeating the procedure in step 6 using the Frequency slide bar.
10. Turn the reference arm on.
11. Tune the signal phase until the depth of the dip is maximized and somewhat symmetrical.
12. Fine-tune the microwave source frequency, by clicking the Operate button in the dialogue box and adjusting the frequency slider until the needle of the AFC meter is centered. If the needle rushes to the left or right edges of the meter, this means that the AFC channel is no longer locked. If this happens you will need to go back to Tune mode and repeat step 9 and try step 12 again.
13. Change the microwave attenuation to 50dB and adjust the Bias slider until the Diode current meter needle is centered. The center corresponds to 200 microamperes of diode current. When the cavity has low Q, the AFC meter may lose lock at 50dB. In most cases the AFC will lock again at higher microwave power levels. If not switch between Operate and Tune modes and back again at 30dB attenuation will lock the AFC once more.
14. For maximum sensitivity, we will need to critically match the cavity to the wave-guide. Increase the microwave power by 10dB (start at 50) and click the iris bar up or down until the diode current returns to 200 microamperes. Repeat this until you have reached 10dB attenuation setting.
15. If the AFC meter changes with the iris screw position, simply adjust the Frequency slider until the needle is centered again.
16. At 10dB attenuation, adjust the Signal Phase slider until you achieve a local maximum in the diode current meter.
17. Verify that you have reached critical coupling by changing the attenuation from 10dB to 50 dB with virtually no change in diode current.

**Note:** if you are still off you can use the auto tune options and the fine tune to properly tune and match after manual tuning.

On resonance,

phase 180 degrees off

On resonance, phase 90 degrees off

Slightly off resonance

Off resonance

On resonance

Correct phase

Overcoupled

On resonance