Running the STM

1. **Read the instructions!** Yeah OK, so there is lots to read, but the sections in the original Burleigh Instruments manual that describe the settings for tunneling on gold and on graphite are very helpful. Try reading them before you start. They have good advice on cutting a new tip, on the settings for fine approach, and on general operation of the instrument.
2. **How does Scan Range work anyway?** Here's how you calculate the approximate distance of the tip scan: First, "MAX Scan Range" is a guess about how far the tip moves if you apply the maximum scan voltage (about +/- 500V, but it's generated by a +/-5V control signal and a x100 gain high voltage amplifier). Max Scan Range is usually set to 40,000 angstroms when you start. Mostly, don't touch it. "Scan Range" is set to the distance that you would LIKE the tip to scan. The Burly Labview software applies a control voltage of 5V*(Scan Range)/(Max Scan Range) to make the scanner move. In addition, when you set the Magnification knob on the controller, it divides the control voltage by an additional amount shown on the knob. For example, if you set the knob to x10, the control voltage is whatever you asked for with 5V*(Scan Range)/(Max Scan Range) and then divided further by 10. Be sure that your Configuration page has the magnification control set to match the Burleigh control box, otherwise the scale on your image will be incorrect.
3. **Fine Approach does not work?** Remember that you need to tap the Coarse Retract before the Fine Approach will work. If everything appears to be working, but the red LED does not flash during Fine Approach, the controller thinks that you already had or have tunneling current. Usually, it's fooled by unusually large noise on the tip current. Watch the tip current signal with an oscilloscope and be sure that there's no noise that could appear to be tunneling current. It usually comes from electrostatic pickup on the sample stage because you have removed the STM housing, etc.
4. **Approach with correct feedback settings** An easy way to wreck a fresh tip is to crash upon approach. Be sure that the Filter is on MAX, that the proportional gain is on MAX, and the integral time constant is on MIN. Always use these settings during the approach to tunneling.
5. **For gold, use a smaller scan range first.** When imaging gold or other materials that run in Topographic mode, remember that you are trying to scan the surface and use feedback to the z-piezo to maintain a constant tunneling current. This job is easier if you don't scan too far too fast, or both. It's easier to avoid scanning too fast if you are on the high magnification ranges. Start at X250 and be sure that the feedback system can hold a stable tunneling current during the scan. THEN move to the X50 and verify that the feedback can hold the tunneling current steady. At each mag, be sure that you dwell at each position long enough to avoid ramming into the surface. Large scan ranges will naturally take longer periods of time than smaller ranges.
6. **Imaging atoms.** To get atomic resolution on objects like graphite, remember that you are trying to see individual atoms! Give yourself a better chance by scanning at highest magnification, and scan quickly, so the sample does not have much time to thermally drift about. A typical scan would be 50 by 50 points, Dwell set to the minimum of 0.05msec, and scan a region that is only

8 or 10 angstroms across, by going to the X250, and set the Scan Range to 2000 (assumes that the Max Scan Range is 40,000). Try to get the image in less than 30 seconds and you'll probably see the atoms.