Energy Change for TUDA-I – August 14th, 2014 – SK

1. Take cup readings and save tune. Put into E-Log.
2. Measure current energy @ Prague to confirm that energy is still where we expect it to be. E-Log.
3. Adjust last accelerating cavity in the DTL (either tank 4 or 5) to adjust the energy to the energy that TUDA has requested. If unfamiliar with DTL energy changes, see the DRAGON energy change document, as measuring and changing the energy is the same as in that procedure.
4. Scale HEBT -> HEBT3 optics for the new energy. This can be done with the old or new scaling program. The scale factor should be the square root of the ratio of the energies. HEBT3:MB0 and HEBT3:MB1 don't scale properly with the new scaling program, so take note of their initial fields, and scale them manually. Note that HEBT3:Q9/10/11 and HEBT3:X/YCB11 are not in use (they are off and should not be scaled).

$$\text{Scale Factor} = \sqrt{[(Final\ Energy)/(Initial\ Energy)]}$$

5. Turn off the HEBT Buncher. This is necessary because once the energy coming out of the DTL has been changed, the HEBT buncher phase will no longer be correct, and so it will either accelerate or decelerate the beam, causing transmission to be quite low (beam won't make it around the dipoles).
6. Check transmission through to HEBT3:FC4. Transmission should be close to where it was before the energy change, but if it's not try optimizing it quickly using the last 3 DTL quads, and the MEBT re-buncher amplitude and phase slightly.
7. Save the tune and take cup readings. E-Log.
8. Setup of the HEBT Buncher will now begin. In the event of issues with the scope, contact ####
9. Close HEBT3:IV8, put in IOS:FC6, put in HEBT3:FFC4 (requires FC4 out), and remove any attenuation (IOS attenuators out and MEBT collimators wide open).
10. Open up the scope webpage by selecting "SeaMoney" from the right click menu on any ICR Console. Ensure that the refresh rate is set to 1 second on the bottom left corner of the webpage. On the menu at the top of the page click "Control" to bring up the scope controls at the bottom of the page.
11. On the "subsystem" menu at the bottom of the page, click "ACQ". Next from the "acquire" menu to the right, click "MENU". This will bring up two more menus, one on the bottom side of the scope screen, and one on the right side. Ensure that "Mode Average" is selected on the bottom menu, and "Average a 128" is selected on the right menu. Note that these things shouldn't change.
12. If at any time the scope doesn't seem to be running, you can start and stop the acquisition in the "acquire" menu at the bottom of the screen by pressing "RUN/STOP". Note that this too shouldn't change, the scope should just run continuously. Pressing "MENU" again in the "acquire" menu will remove the horizontal and vertical menus from the scope screen.
13. Under "subsystem" click "HORIZ". Next to the right of this in the "horizontal" table, adjust the horizontal scale using the up/down arrows to 10 ns/div. The horizontal scale is displayed on the

scope page, it is the very first number displayed below the Y-axis of the scope. Note that it will give nS as the units, this is ns/div (ie you want this number to be 10).

14. Under “subsystem” click “VERTICAL”. Next to the right of this in the “vertical” table, adjust the vertical scale using the up/down arrows to 5 mV/div. The vertical scale is displayed on the scope page, it is the yellow number after the ‘1’ just below the bottom left corner of the scope page. Note that it will give mV as the units, this is mV/div (ie you want this number to be 5).
15. Send the full beam through to HEBT3:FFC4. You may not see anything on the scope right away. To find beam on the scope you will likely have to adjust HEBT3:X/YCB2 (fiddle-save first so that you can return these steerers once setup of the buncher is complete). Try moving these steerers every which way until you begin to see a peak(s) start to grow in on the scope. Maximize the size of this peak with these steerers.
16. Centre one of the peaks on the centre axis of the scope page using the “position” arrows on the “horizontal” menu (remember get here from “subsystem” -> “HORIZ”).
17. Zoom in on one peak using the up/down “scale” arrows in the horizontal section one step at a time. You want to be zoomed into the 1 ns/div scale. If at any time you see a strangely shaped peak, or two peaks, adjust HEBT3:X/YCB2 as necessary to recover one nice Gaussian shaped peak (two peaks can arise from hitting the side of FFC4).
18. Turn on the 35 MHz HEBT Buncher, and set it for whatever amplitude it was previously at. You may find that your peak disappears. Scan the buncher phase to find the peak again, and ensure that it is the bunching phase and not the de-bunching phase. If you are on the bunching phase, when you tap the phase to the left, the peak should move to the left (same convention as the prague harp w/ DTL bunchers). Adjust the phase to bring the centre of the peak right back to the centre axis of the scope page.
19. As before, if at any time (aka now) you see a strangely shaped peak, or two peaks, adjust HEBT3:X/YCB2 as necessary to recover one nice Gaussian shaped peak (two peaks can arise from hitting the side of FFC4).
20. Adjust the amplitude of the buncher as needed to maximize the height of the peak (and conversely minimize the width). As we go up in energy, the buncher amplitude should want to increase as well. At half max, the width of the peak should be roughly one division on the scope screen (See E-Log entry 2014-08-14 11:32:42 for an example of what the peak may look like after the buncher is set). This corresponds to 1 division of the set scale, which is 1 nS. Once this is complete, setup of the buncher is finished. Insert IOS:F6, remove FFC4, return HEBT3:X/YCB2 to their previous values, and insert HEBT3:FC4.
21. Check transmission through to HEBT3:FC4. It should be approximately where it was before setting up the buncher. If transmission is worse, the buncher may have been set up incorrectly.
22. Take cup readings, save the tune, and put into the E-log.
23. Inform TUDA that the energy is ready and that you are ready to begin tuning through their collimators. They will specify how much beam they want you to begin with on HEBT3:FC4. Adjust attenuation as needed to achieve the requested beam intensity. Remember when you are ready to send beam into TUDA’s chamber that HEBT3:IV8 is closed and will need to be opened first (check with experimenters before opening IV8).

24. You will (likely) tune through TUDA's blank position, followed by the 6 mm collimator, followed by the 3 mm collimator. The same procedure applies to each:
    - Maximize transmission through to TUDA's Faraday cup, which is being read out on EPICS through the top vane on "TUDA VANE 2". The variable name is 'HEBT3:CHAN9CI:SCALECUR'.
    - While tuning use HEBT3:X/YCB2, and HEBT3:X/YCB6, all in steps of 0.01. Also try HEBT3:MB1 in steps of 0.05 (must first be taken out of PID loop, and placed back in PID loop once tuning is finished).
    - 95% transmission should be achievable from HEBT3:FC4 to the TUDA FC for each of the three positions (blank, 6 mm collimator, 3 mm collimator).