Instructions for pulse-slicing at FELIX

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1 Initial preparation

Prepare the following items:

1. Insert in your setup a removable fine-tuning mirror that reflects the IR beam through a focusing lens (i.e. 2" ZnSe) on to a fast detector. The working detector is ironically labelled 'RIP'. Note the fast detector is most sensitive at λ=8μm, but we have been able to detect signal (from a focused FELIX pulse) up to λ=18μm.

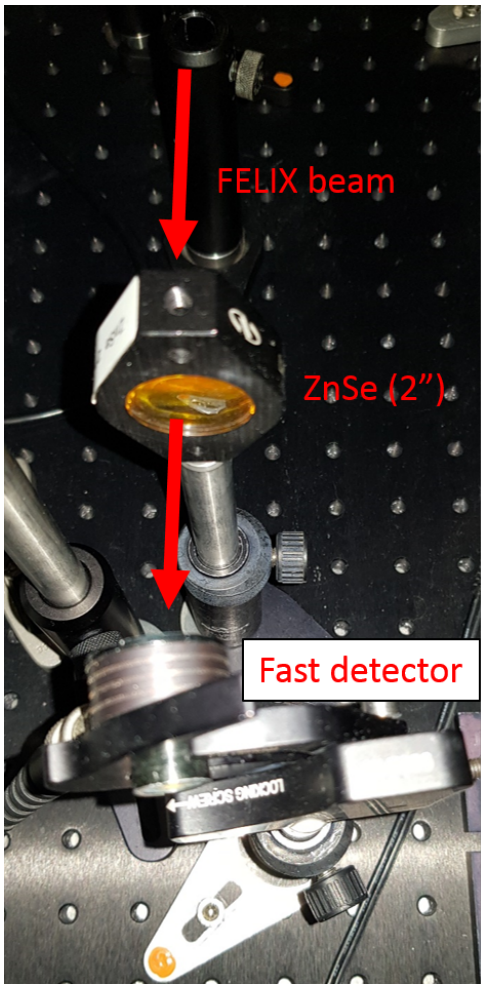

Figure 1: Focusing of beam on to the fast detector

2. Connect the fast detector to an oscilloscope in the user station (via a T-junction) and to a wall socket (e.g. US-11.3) that connects to the patch board at the diagnostic station.

3. At the diagnostic station, connect FELIX trigger DS.1 (at the patch board) to “LAMP TRIG” (back of Nd:YAG).

4. At the diagnostic station, connect FELIX trigger DS.2 (with the brown tape labeled ‘Trig’) to “Q-SW TRIG” (back of Nd:YAG).

5. At the diagnostic station, connect “Q-SW SYNC” (back of Nd:YAG) to i) trigger the oscilloscope at the diagnostic station, and ii) a wall socket that connects to your user station (e.g. US-11.2).

6. At your user station, connect “Q-SW SYNC” (e.g. US-11.2) to your oscilloscope, and use this as a trigger.

7. At the diagnostic station, connect the signal obtained from the detector (e.g. US-11.3) to the oscilloscope.

Figures 2 and 3 show a schematic overview of the connections in the user station and diagnostic station respectively.

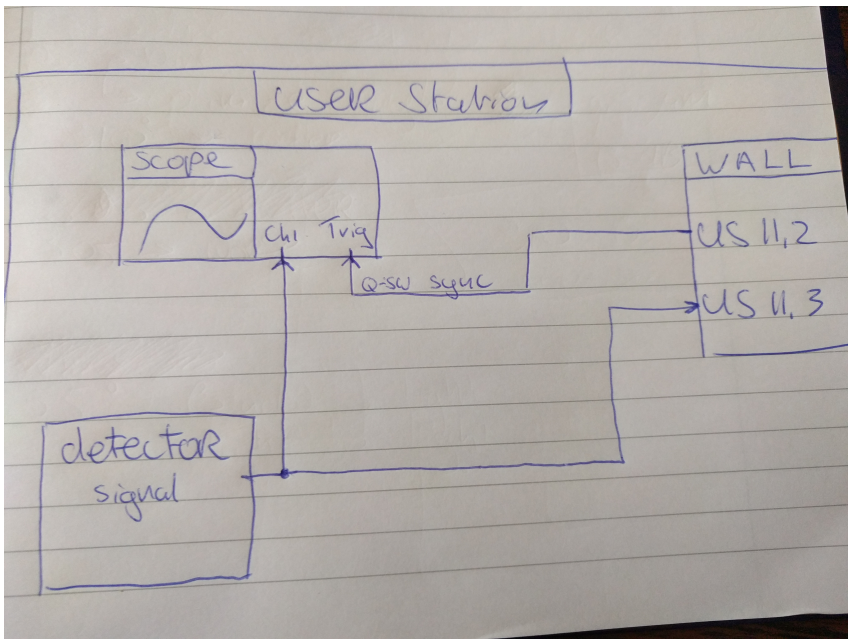

Figure 2: Connections in the User Station. (temporary)

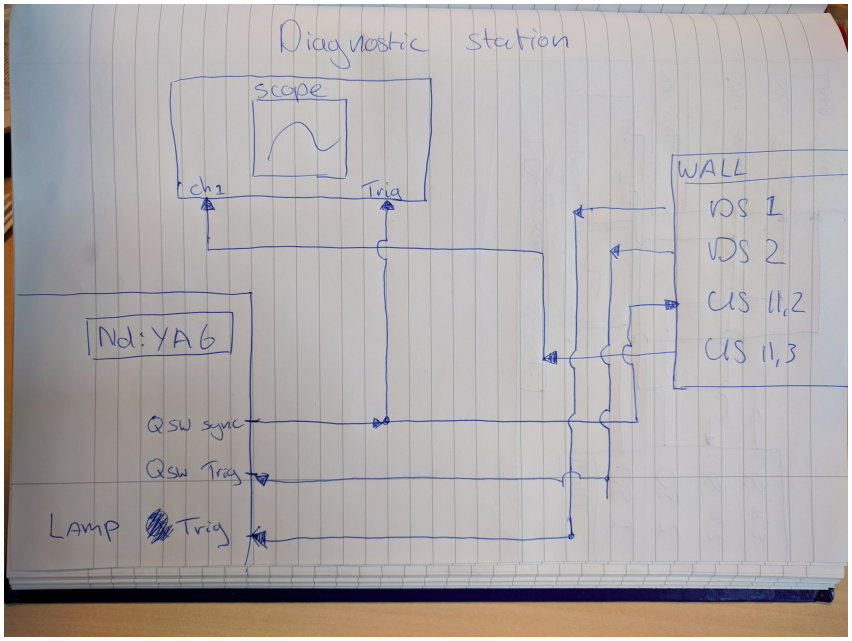

Figure 3: Connections Nd:YAG. (temporary)

2 Switching on the Nd:YAG laser

1. Turn the key on the back of the Nd:YAG, to switch it on.

Figure 4: Controller of Nd:YAG laser

2. On the controller, press “Enable” (1) and wait for the LEDs above simmer (2) to stop blinking.
3. If the Nd:YAG does not switch on, check the coolant fluid level, and refill it with demi water

(supplied from the tap in the chemical lab) if necessary.

4. Check if the 'SOURCE' and 'MODE' knobs are set on 'EXT'

5. Block the Nd:YAG laser with some black screen, and turn "OSC" (3) to a low number (e.g. 2/10). The laser should produce pulses at this point.

6. If the laser does not produce pulses, check the delays set on DS1 and DS2. The trigger sent by 'DS1' triggers the LAMP and should be 236 μs in advance of 'DS2'. 'DS2' should trigger the Q-switch roughly in the middle of the macropulse.

7. Check that the FEL is operating at 10 Hz. The Nd:YAG laser will operate at the same frequency.

3 Pulse Slicing

1. Ask the operator to remove the (He:Ne) beamsplitter, and identify the macropulse on the scope, using the trigger from the Nd:YAG laser. Some attenuation (about 13dB) should be inserted to make sure that the detector will not saturate. In the case of saturation, some vertical offset (in the form of a strong dip) appears after the macropulse.

2. With the macropulse on the scope, maximize its amplitude by adjusting the fine-tuning the beam incident on the fast detector. Make a note of the maximum amplitude $V_{macropulse}$.

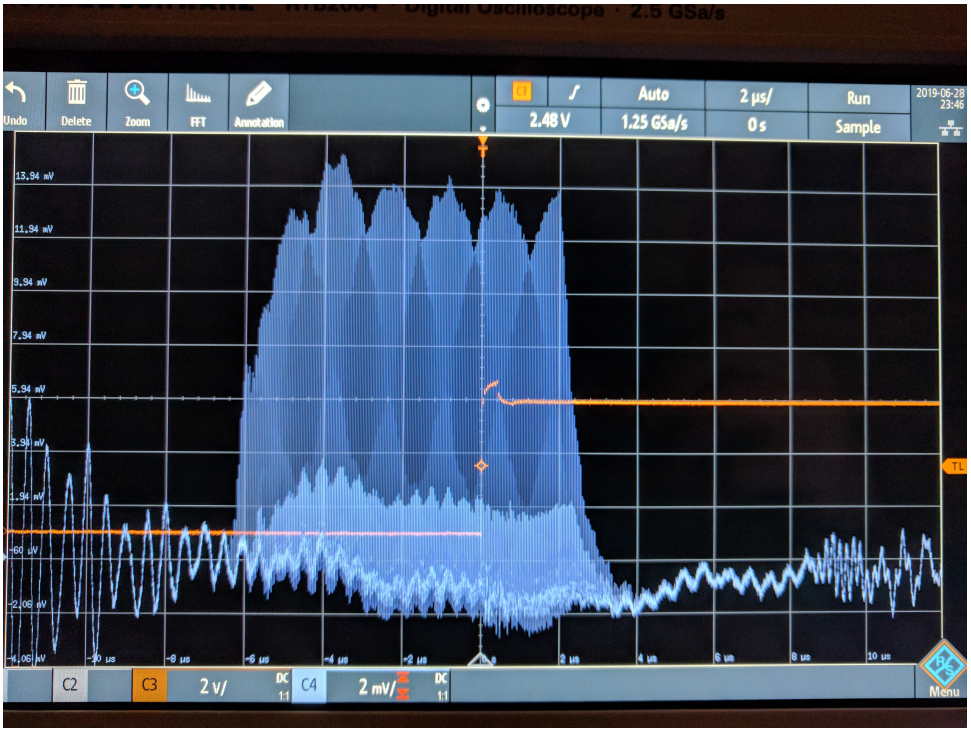

Figure 5: Entire macropulse on scope before slicing.

3. At the diagnostic station, ensure that you observe the same signal on the scope as in the user station.

4. At the diagnostic station, open the shortcut to the program "Diagnostic Station FX". For the tab "Pulse Slicer" (1), press the button "Move in" (2), thus rotating the Si plate in the path of the IR beam. Wait until "Motor position" stops increasing (about 89k, in terms of the motor position). If the program does not work, there is a comm error - the computer needs to be rebooted.

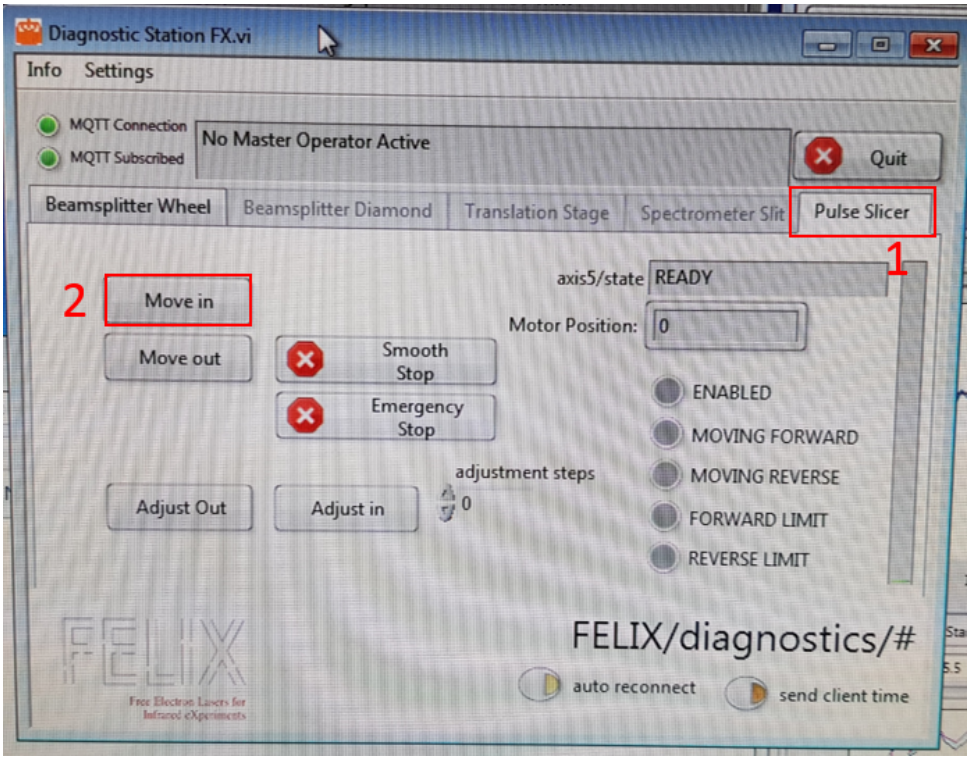

Figure 6: Front panel of "Diagnostic Station FX"

5. Open the Nd:YAG beam, and turn "OSC" on the Nd:YAG laser controller to full power. Remove all attenuators, so that we can observe residual reflections from the Si slab.

6. Open the program "TM sync phaseControl GUI.exe", and adjust the time delay on the computer in steps of 5ns between 0 and 39ns. While tuning the time delay, one of the micro-pulses should rapidly grow on the oscilloscope, with an amplitude $V_{micropulse}$. Continue tuning the time delay (in smaller steps of 1ns) for optimal slicing efficiency.

7. Adjust the mirror reflecting the Nd:YAG pulse into the diagnostic station to further improve the slicing.

8. At best, we have achieved an efficiency of 60% (the ratio sliced micropulse/macropulse, $V_{micropulse}/V_{macropulse}$).

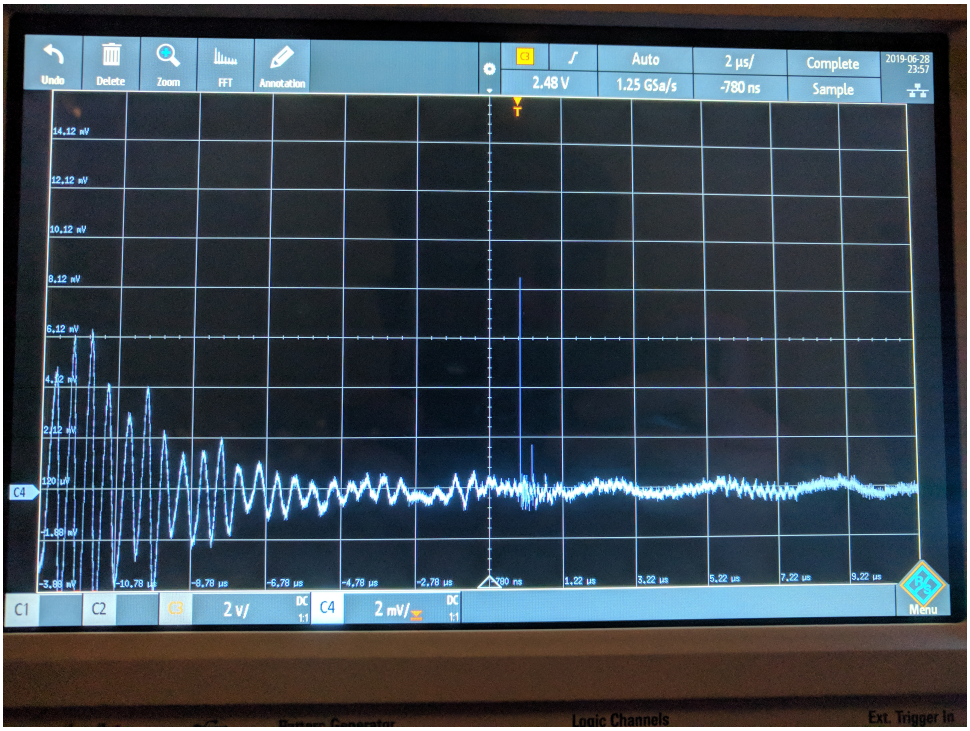

Figure 7: Single micropulse on the scope after successful slicing.

9. As soon as the desired slicing efficiency is reached, remove the mirror inserted within the setup so that the micropulses now follow the desired path towards your sample.

4 At the end of the shift, remove the slicer!!