

Whisper Detector Assembly

Part Number:	700004598	Where Used:	Xevo TQ-S
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Functional description



- The detector assembly is mounted orthogonal to the ion beam and consists of a dynode, ring-dynode, phosphor disc, photomultiplier tube, and headamp PCB.
- The dynode, ring-dynode, phosphor disc, and photomultiplier tube convert ions into photons then into an electrical signal.
- The headamp supplies the PMT HV and also amplifies the electrical signal from the PMT. This signal is digitized on the lens control PCB.

WARNING: Do not disconnect the dynode, ring-dynode or phosphor leads while the instrument is in Operate. Test leads must be used to measure the HVPSU output voltages.

CAUTION: Do not disconnect the D-Type connector from the headamp PCB while the instrument power is switched on.

Care must be taken when handling this detector as any scratches will result in increased electronic noise.

Location

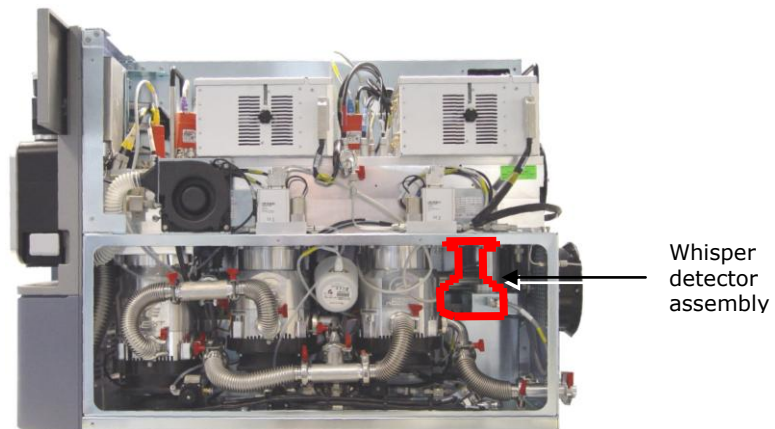


Figure 1 - Right side internal view of the instrument

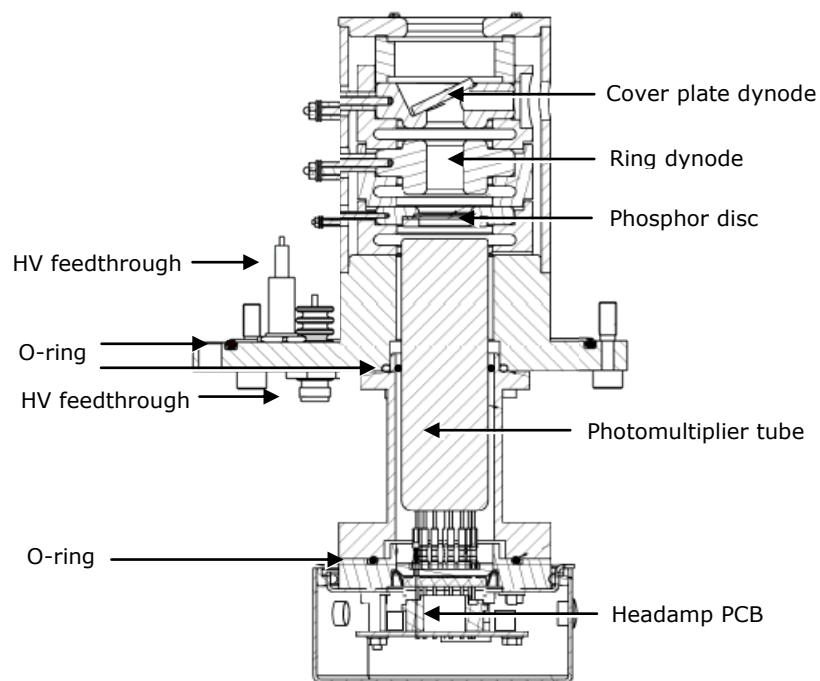
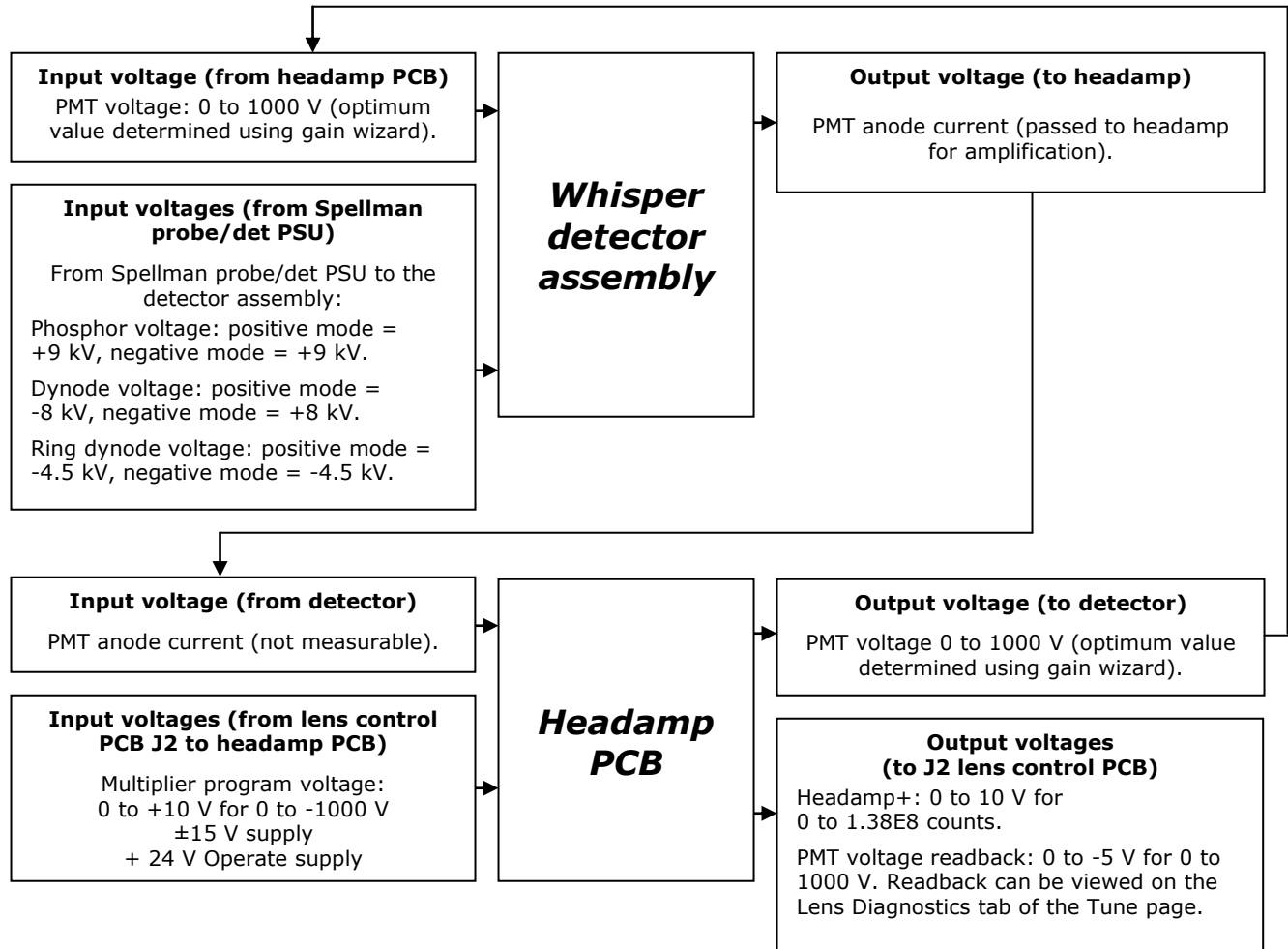


Figure 2 - Cross section of the detector assembly

Inputs/outputs

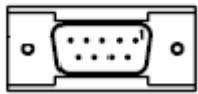
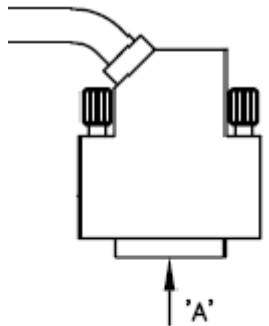


NOTE: The multiplier voltage is passed to the photomultiplier tube (PMT) via a chain of resistors, which provide each dynode within the PMT with sequentially higher voltages.

The signal received from the PMT anode is a very small current (0 to -10 μ A). This signal is inverted and passed through a series of amplifiers, which then outputs a 0 to +10 V signal.

Detector voltages and connections

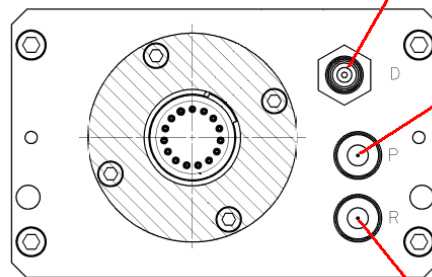
From lens control PCB J2 to head amp via cable 4300032BC1.



VIEW DIRECT ON
ARROW 'A'

Headamp	Color	Signal	Description
4	Green	15 V	+15_FILT (used to amplify PMT anode current)
2	Black	0 V	AGND
8	White	-15 V	-15_FILT used to amplify PMT anode current)
3	Black	-	RB OFFSET
1	Red	0 to 10 V	HEADAMP+ (amplified 0 to 10 V signal from the PMT)
6	Black	0 V	HEADAMP- (reference for headamp + signal)
7	Blue	0 to +10 V for 0 to -1000 V	MULT PRG (multiplier program voltage) 0 to +10 V signal that corresponds to the multiplier value set in the instrument Tune page. The PSU multiplies this input voltage 100 times (0 to +10 V input -> 0 to -1000 V output).
9	Black	0 to -5 V for 0 to -1000 V	MULT RIB (multiplier readback voltage) pre-set to give the correct readback ± 10 . It can be adjusted using RV2 on the headamp PCB. The readback voltage is 0 to -5 V signal corresponding to a 0 to -1000 V output voltage.
5	Yellow	24 V	+24 V Operate signal switches on PSU

Dynode feedthrough connector



Phosphor feedthrough connector

Ring dynode feedthrough connector

Mode	Dynode (kV)	Ring Dynode (kV)	Phosphor (kV)
Positive	-8	-4.5	+9
Negative	+8	-4.5	+9

WARNING: Use test leads and an HV probe to measure the HVPSU output voltages.

NOTE: A 1000 M Ω HV probe will load the power supply giving a lower reading than the actual voltage by up to 10%.

Diagnostic procedures

Resolving noise issues

High noise in an MRM chromatogram can be either chemical or electronic. To determine whether noise is chemical or electronic in origin perform the following procedure:

1. Run an MRM acquisition while pumping mobile phase into the probe.
2. During the run, set ion energy one and ion energy two to their minimum values.

NOTE: *This stops any ions reaching the detector. The chromatogram with negative ion energy is the electronic noise chromatogram. Ideally the chemical noise level will be only a little higher than the electronic noise level.*

The advanced settings on the Tune page must be activated in order to allow the ion energy's to be altered during an acquisition.

The absolute values of electronic noise will depend on the dwell and number of channels in the acquisition.

3. Establish whether the noise in the chromatograph is predominantly chemical or electronic, and take the appropriate action, as described [Table 1](#).

Table 1: Noise issue resolution

Noise	Action
Predominantly chemical	Change the mobile phase, or clean the LC system. Chemical noise can also originate from a contaminated capillary or dirty cone.
Predominantly electronic	Perform the test described in the "Noise in operate test" to determine if the detector and associated electronics are performing within specification.

Noise in operate tests

Perform these tests in MS1 mode. Set up the ion beam for MS1 conditions.

NOTE: *Place the instrument in Operate for at least 30 minutes before testing for noise due to peak charging.*

Ensure that on the Instrument Threshold page the ion counting threshold has been set to 0 and that the Spike Removal checkbox has been deactivated. After completing the noise in operate tests return the ICT to 25.

1. Set the following parameters to stop the beam in both Positive and Negative Ion modes.

Table 2: Noise in operate test parameters

Location	Parameter
Capillary	0 V
Sample cone	50 V
Desolvation temperature*	150 °C
Ion energy 1 and 2	Fully negative
Multiplier	Normalized gain value
Source transfer offset	50 V

2. Turn on the API gas.
3. Perform the following procedures as required.

Testing for noise in Positive Ion mode

1. Switch the instrument into Operate.
2. Place the instrument in Positive Ion mode.
3. From the sample list, acquire an MS1 experiment under the following conditions:
 - Start mass **500 Da**
 - End mass **1500 Da**
 - Scan time **10 s**
 - Run time **5 minutes**
 - Acquisition mode **Continuum**
 - ESI **+ve**
 - Collision and cone voltage check boxes **Selected**

4. Acquire **10** scans.
5. Display a 10 scan BPI chromatogram:
 - a. Click **Chromatogram** on the MassLynx front page, and then click **Display > TIC**.
 - b. Select **BPI Chromatogram**, highlight **replace trace**, and click **OK**.
 - c. Click on the **Stopwatch** icon for real time update and the **four arrow** icon for auto ranging.
 - d. Click **Display > View**, select **horizontal axis**, and then change it to **Scan**.

CAUTION: *The trace must not be above 1.0E5 units at any point along 10 scans. At least 50% of the 10 scans must be below 5E4 counts.*

6. Check all ten of the spectra for pulses greater than 5E3 above the mean of the baseline noise.

NOTE: *There must be no more than three pulses per second in Positive Ion (30 pulses per 10 second scan).*

7. Select the spectrum with the maximum number of pulses for printing.
8. Combine two scans over the range **500 to 1500 Da** and check that the mean of the noise is horizontal (that is, whether it drifts up and down).
9. Display from **800 to 1000 Da** and check that there is no sinusoidal pattern present in the noise.

Testing for noise in Negative Ion mode

1. Place the instrument in Negative Ion mode.
2. Ensure that the settings for capillary, heaters, and ion energy one and ion energy two are the same as in the "Testing for noise in Positive Ion mode" section.
3. Change the ionization mode in the experiment to -ve.

NOTE: *The specifications are the same as for positive ion mode except that the number of pulses allowed per second is 4 (40 pulses per 10 second scan).*

Ion counting threshold

The Xevo TQ-S can run at faster dwell and inter-channel delay times than previous tandem quadrupole instruments. At fast speeds there is a risk of cross talk between MRM channels caused by the finite time it takes for PMT signal to decay after it has been exposed to a large photon current.

The default ion counting threshold used on instruments before the Xevo TQ-S was 30, corresponding to a threshold at 3 times the standard deviation of the electronic noise (as calculated from the pre-scan statistics).

The standard deviation of the noise is not used to calculate the ion counting threshold on the Xevo TQ-S; the mean electronic noise value is used instead (also measured during the pre-scan). The default setting on Xevo TQ-S instruments is 25, corresponding to a threshold set 25 bits above the average electronic noise, a much higher level than would typically be applied using 3 times the standard deviation.

One consequence of this is that with the ICT set to 25 all electronic noise is discarded, and if there are no ions reaching the detector no signal will be seen in the chromatogram, that is, you will see a flat line response. This is not a fault. Lowering the ICT so that electronic noise can be seen increases the risk of cross-talk and is not recommended.

When using a clean system the chromatographic base line will be very low, particularly at fast dwell times, and it is possible to measure a flat zero response and signal-to-noise measurements will therefore give very high results. Since it is now possible to get high s/n value from a small signal intensity, an absolute area specification has been included in the installation sensitivity tests to ensure that signal intensities are above an acceptable value. See the [Xevo TQ-S Installation Manual](#) (p/n 715002461) for details.

Figure 3 shows an example chromatogram from the Xevo TQ-S acquired using default ICT settings for that instrument type. This trace shows occasional spikes from chemical background. There is zero electronic noise between the spikes because all the electronic noise falls below the ICT.

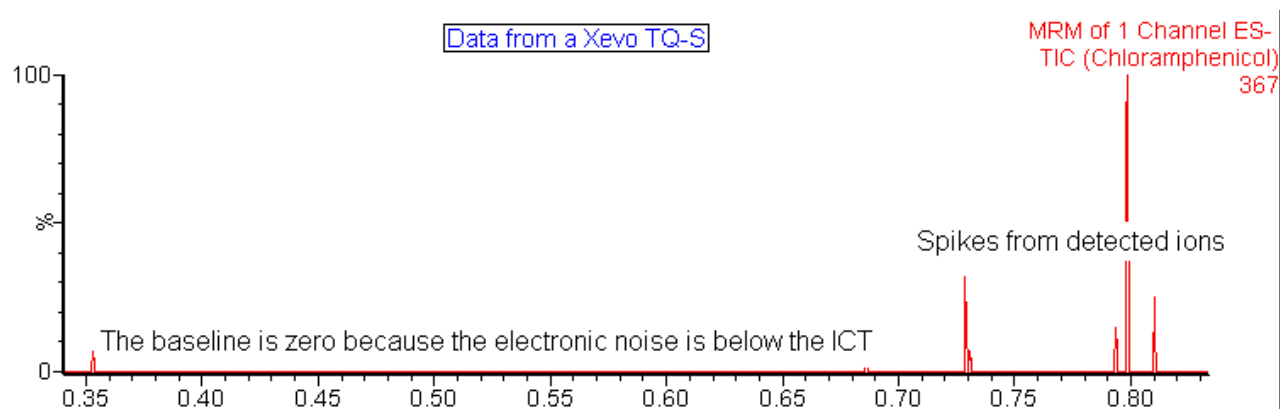


Figure 3- Xevo TQ-S example chromatogram

Figure 4 shows an example chromatogram from the Xevo TQ acquired using default ICT settings for that instrument type. This trace shows a non-zero baseline because the electronic noise from the detector is greater than the ICT.

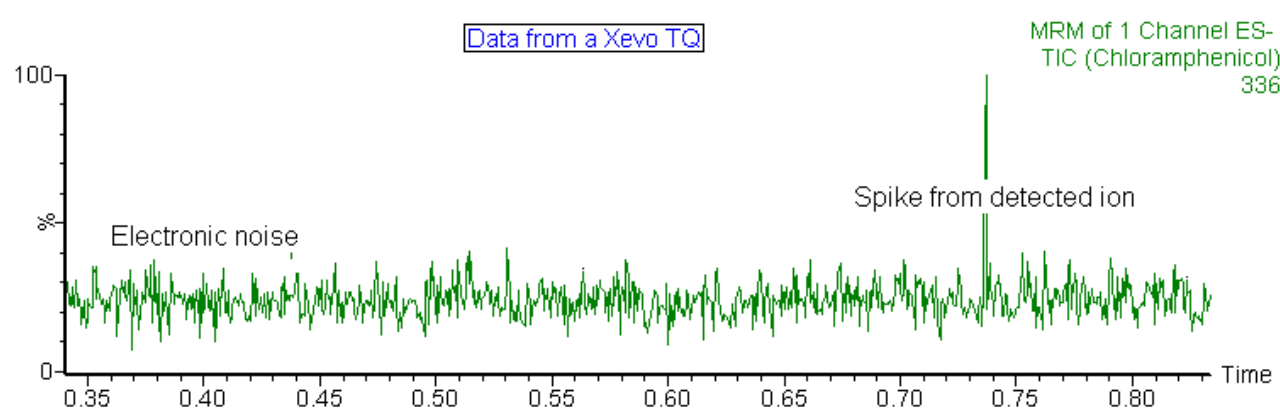


Figure 4 - Xevo TQ example chromatogram

Other relevant information

Running the Detector Gain wizard

The Detector Gain wizard calculates the gain of the detector in the instrument. The PMT voltage is then adjusted so that the gain of the detector/PMT is approximately the same across all instruments. The Detector Gain wizard is run during factory set up and the calculated optimum PMT voltage setting is stored in the target registry on the flash memory card in the EPC.

NOTE: *It is not normally necessary to run the wizard on site, unless the detector has been replaced or the target registry parameters have become corrupted.*

CAUTION: *Run the Detector Gain wizard in both Positive and Negative Ion modes.*

1. Click **Setup > Reset Detector Gain Parameters** on the Tune page to ensure the detector gain has been reset.

NOTE: *If the detector has already been reset, this option will be unavailable. The PMT will default to 550 V.*

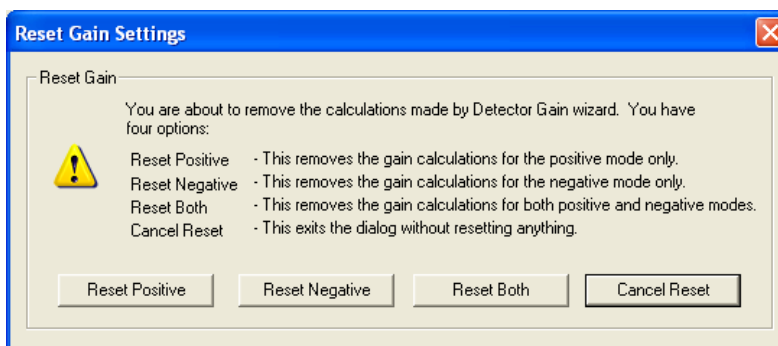


Figure 5 - Reset gain settings

2. Set up the instrument for MS2 positive beam (MS mode) and switch the instrument into Operate.
3. Open the Diagnostics Tune page and ensure that the PMT Voltage (V) is **550 V**.
4. Infuse QP leucine enkephalin setup solution flow at **5 µL/min** to ensure it lasts for the entire experiment.

CAUTION: *To perform the gain test, the photomultiplier tube needs to see some ion events for the software to function. Monitor the syringe pump throughout the experiment to ensure the sample does not run out.*

5. Click **Set Up > Scope Parameters** on the Tune page and set the scan time to **0.03** and the inter-scan delay to **0.03** to observe single ion events (or as close as possible).

- Open a single MS mode mass window set to **556.3 Da** for positive ionization using a span of **5 Da**.

NOTE: When running the Gain wizard in Negative Ion mode use the leucine enkephalin peak in QP leucine enkephalin set up solution at 554.3 Da.

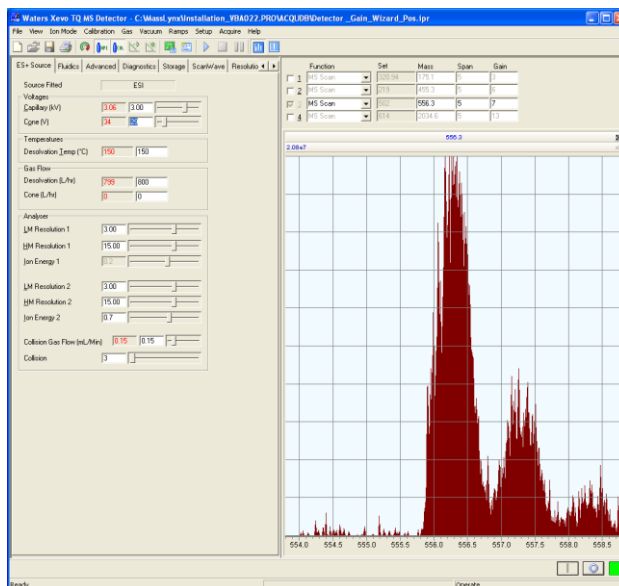


Figure 6 - Initial tuning of the leucine enkephalin positive ion at 556 Da

- Adjust the slider to increase the Source Tune page MS2 high mass resolution value.

NOTE: This reduces the number of single ion events being monitored.

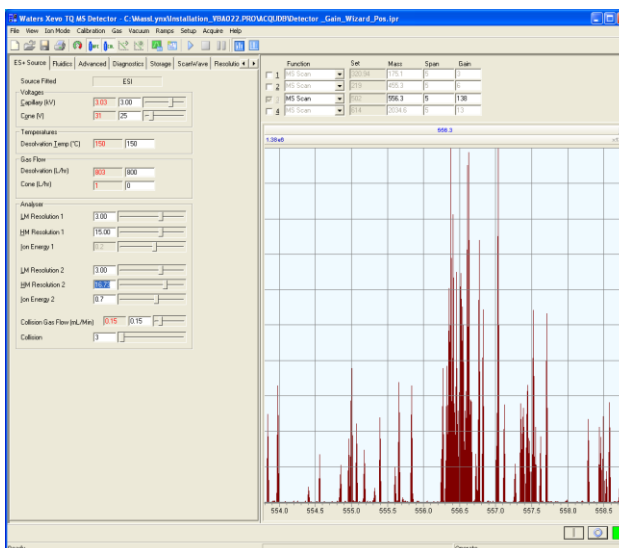


Figure 7 - Increased HM resolution of the leucine enkephalin positive ion at 556 Da

NOTE: This lowers the amount of ions striking the PMT, and shifts the ions to a higher mass position.

8. Alter the window's mass value to move the peak into the centre of the window.
9. Repeat the increasing of the MS2 high mass resolution, and if necessary the MS2 low mass resolution and re-centering.

NOTE: *It will be necessary to increase the window gain to see the peak as more mass resolution is applied.*

10. Once the peak is centred within the window, reduce the span to **0**.

NOTE: *This fills the window with the ion events associated with this peak.*

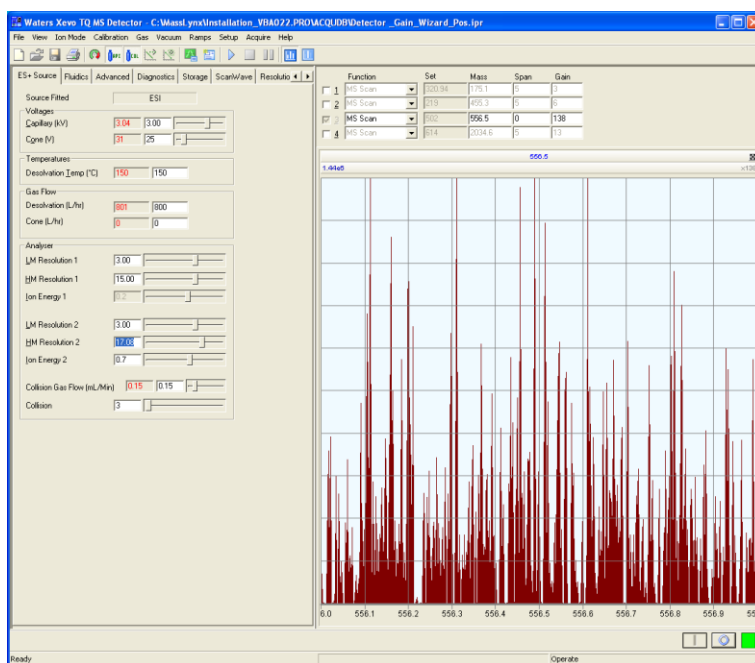


Figure 8 - Resolved peak with a span of 0 showing multiple (>100) ion events

11. Decrease the MS2 ion energy to reduce the number of ion events to **~5 to 10** per scan.

NOTE: *This can be approximated, but a printed window must look similar to Figure 9. The live Tune page will appear to have more ion events due to the high scan speed.*

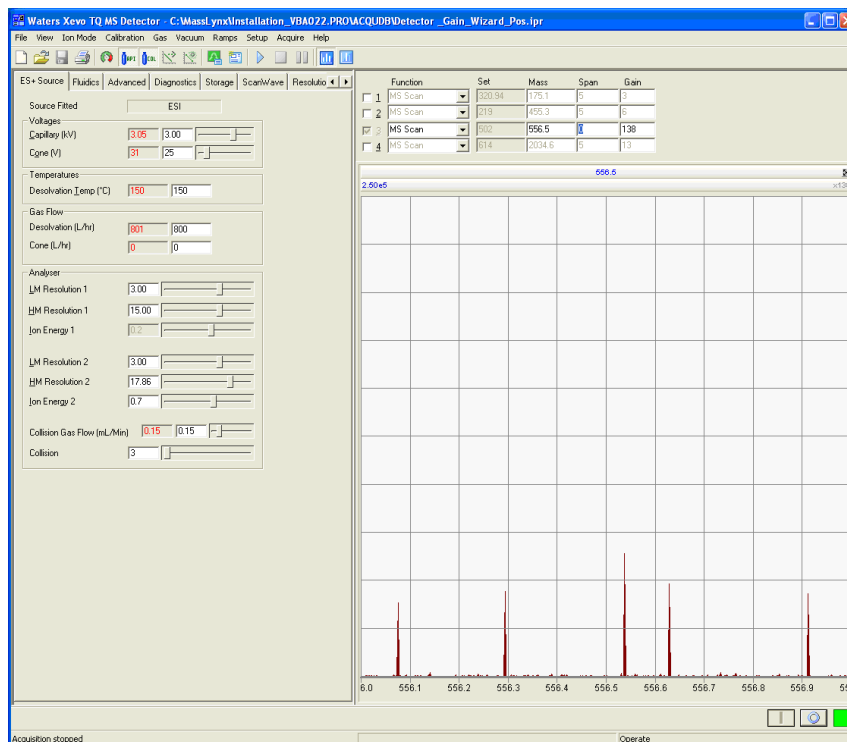


Figure 9 - Reduced ion energy to set the number of ion events to about 5 per scan

12. Click **Setup > Detector Gain Wizard** to open a password request window.
13. Type the password **1147**, and then click **OK**.
14. Enter the exact mass centre of the ion events. This is the centre of the 0 span window set on the Tune page.
15. Click **Next**.

Detector Gain Wizard

Inputs

Mass:

Measure gain at given multiplier ☐

Multiplier value to measure gain for:

< Back Next > Cancel Finish

Figure 10 - Ion event exact mass

16. Click **Next**.

NOTE: Click **Back** to change the mass position of the ion events.

17. Examine the "Registered events/s" count on the Detector Gain wizard (Figure 11).

18. If the value is not between 300 and 600, perform the following steps:

- Click **Back**.
- Reduce/increase the HM resolution or ion energy to decrease/increase the amount of ions.
- Repeat steps 14 to 18 until the registered events/s count is between 300 and 600.

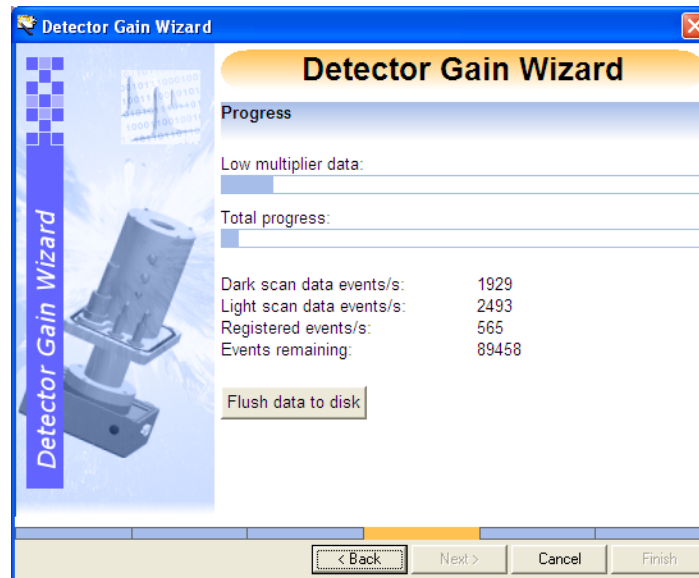


Figure 11 - Low multiplier data

NOTE: The Wizard calculates a high optimum PMT voltage or fail if the number of counts is above 600.

The Events remaining and the Total progress bar gauge the amount of time left before the Detector Gain Wizard completes its measurements.

Once the wizard has completed the low voltage test, it performs a high voltage test, then a gain check using the optimal multiplier voltage.

19. Open the Diagnostics page to see the optimal value.

NOTE: The instrument automatically uses this when the Wizard has completed.

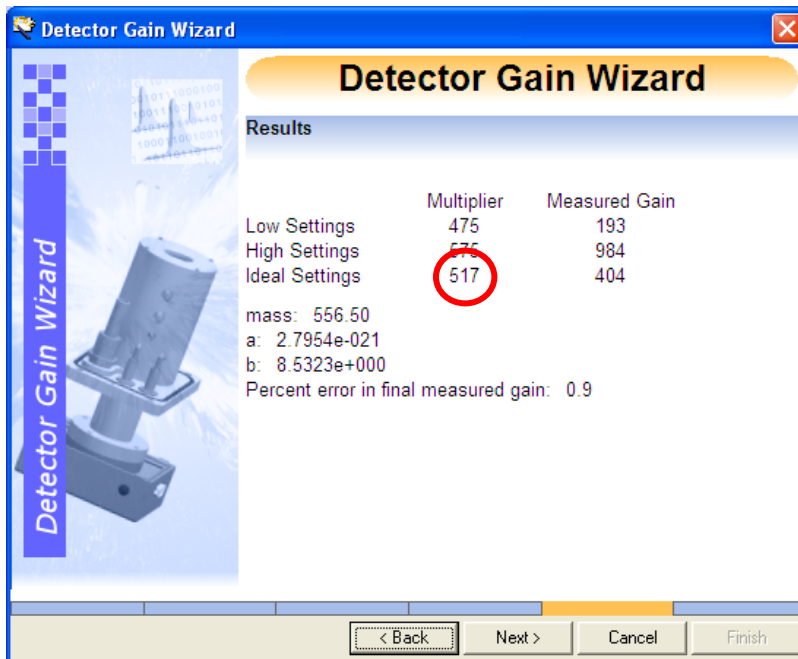


Figure 12 - Detector gain results

20. Ensure the calculated multiplier setting is at an acceptable figure of between 475 and 650.

21. If the calculated multiplier voltage is <475 V, perform the following steps:

- Reset the gain.
- Ensure the multiplier voltage is 550 V.
- Run the test again.

NOTE: Starting the run with high multiplier voltages results in artificially low gain results.

22. If the calculated multiplier setting is still outside the acceptable range, the detector PSU may be faulty. Measure the detector voltages using an HV probe and suitable adapter.

23. Open the Diagnostics Tune page and check that the PMT Voltage (V) matches the multiplier setting ± 5 V.

Removing/installing a detector assembly

1. Vent the instrument and close down MassLynx.
2. Switch the power off and disconnect the power supply to the instrument.
3. Disconnect the phosphor, dynode, ring dynode, and headamp connections at the detector assembly.
4. Remove the screws holding the detector assembly to the analyzer housing.
5. Remove the detector assembly.

CAUTION: *Care must be taken when handling this detector as any scratches on this item will result in increased electronic noise.*

6. Place the new detector assembly in the analyzer housing, using the guide rods to line it up with the analyzer housing, and screw into place.
7. Refit the connections to the phosphor, dynode, and headamp.
8. Reconnect the power, turn on MassLynx, and pump down.