NAIS troubleshooting by eliminating potential causes of a problem

Written by John Backman

Department of Physics, University of Helsinki

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NOTICE THAT THESE INSTRUCTIONS ARE WRITTEN FOR NAIS2

WHICH IS A 1-BLOWER TYPE NAIS!!!

Table of Contents

NAIS problems breakdown instructions.....1
- How to recognize a faulty spectrum and its possible sources.....1
- Cleaning the sheath filters.....2
- Cleaning the chargers.....3
- Adjusting the post-filter voltage.....7

How to recognize a faulty spectrum and its possible sources

The offset mode of the NAIS is used to remove particles so that they do not en up at the electrometers in the DMA. This is done by charging the particles (to opposite polarity) with the pre-charger and removing them with a electrical filter. If there is a problem with removing the particles for the offset mode the result will be a faulty number size distribution spectrum both for the ion and particle mode of the instrument.

The sheath filters of the NAIS are used to filter out any excess particles which have made it trough the DMA. If these are not filtered away it will result in

Also, the NAIS post-filter current and voltage is not controlled by the instrument and has to be tuned manually. If the post-filter is not working the main charger ions will show up at the lower end of the spectrum and dominate the number size distribution by numbers.

Below is a example of a faulty number size spectrum.

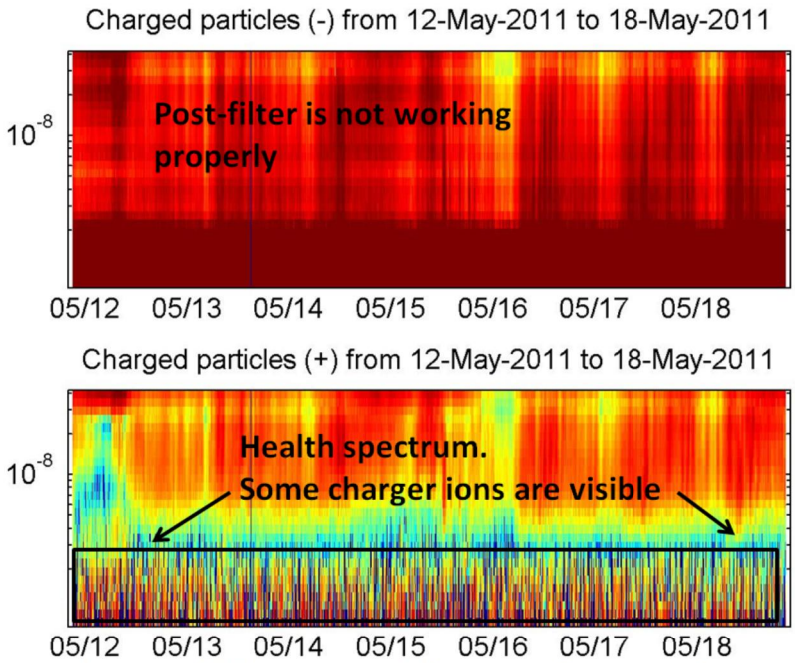

Figure 1: NAIS spectrum. The upper shows a faulty spectrum and the lower one a healthy.

Cleaning the sheath filters

First you need to **power off the NAIS** so that all high voltages inside the instrument are turned off. Secondly you need to remove the sheath filter from the instrument. This can be done by removing all the connectors and tubing's as shown in Figure 2.

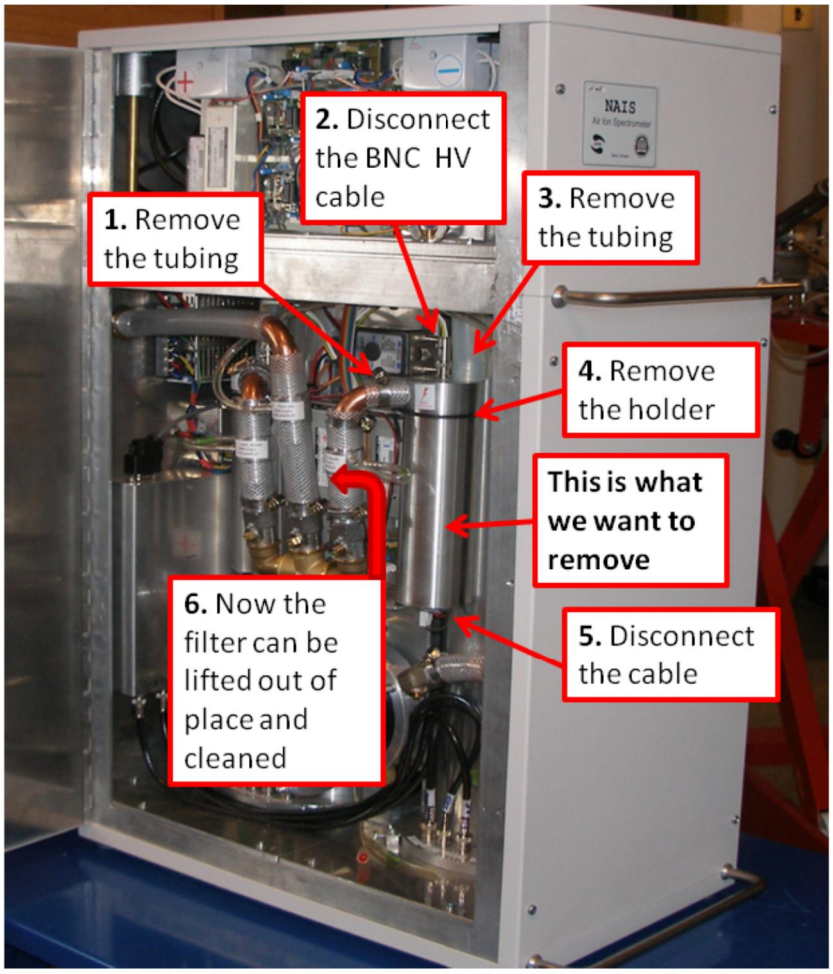

Figure 2: Connectors needed to bedisconnected in order to get the sheath air filter removed for cleaning.

After removing the filter it needs to be cleaned. There are three parts in the sheath filter. The outer and inner electrode and the corona needle rod. These can all be screwed apart and cleaned separately (Figure 3). This can be done using a clean cloth and some strong solvent like alcohol or isopropanol. The corona needle can be cleaned from dirt collecting on the tip by gently scraping the tip with a sharp knife. **The corona needles breaks easily** so no pressure should be applied.

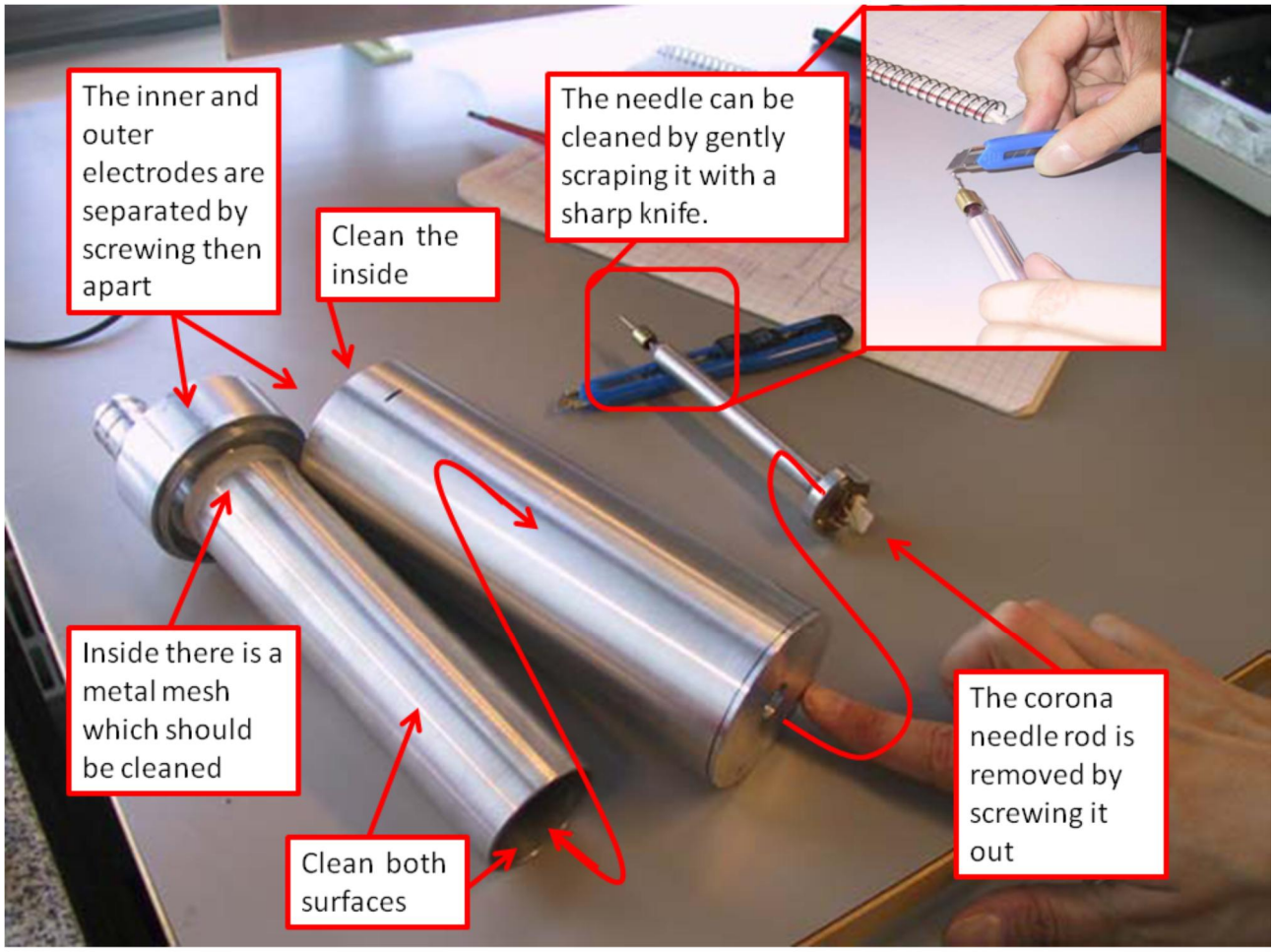

Figure 3: Taking the sheath air filter appart and cleaning the different parts.

When all the surfaces, the mesh grid and the corona needle is cleaned the filter is ready to be assembled and reinstalled. Be sure to turn on the power after everything is securely connected to ensure safety.

Cleaning the chargers

The chargers and the filters associated with them are all in the upper level of the NAIS leaving the lower part to the DMA and electrometers with peripherial electronics. By removing the top cover and the upper side panels the compartment with the chargers are revield.

To be able to clean the chargers the inlet copper tubing have to be removed. The L-bar in aluminium is holding the chargers into place so before you can lift out the chargers for cleaning you need to remove the three bolts pressing the L-bar against the chargers (Figure 4). **Mark the BNC connectors before you remove them.**

After removing the top cover and the upper side panels the NAIS should look like this. **Before removing any cables make sure they are marked** and you know were they should be connected.

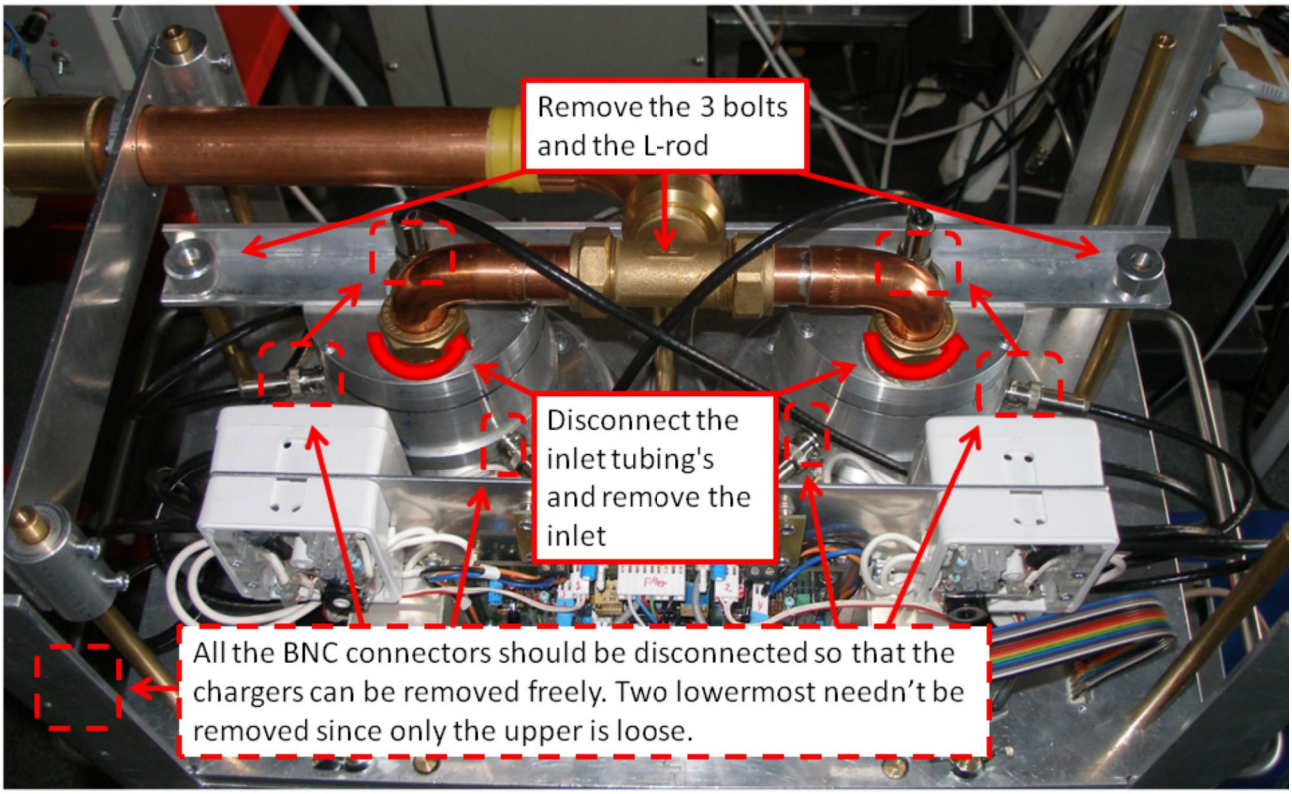

Figure 4: The parts that need to be disconnected to be able to remove the chargers for cleaning.

When you have done what is showen in Figure 4 the chargers can be lifted out of place (Figure 5).

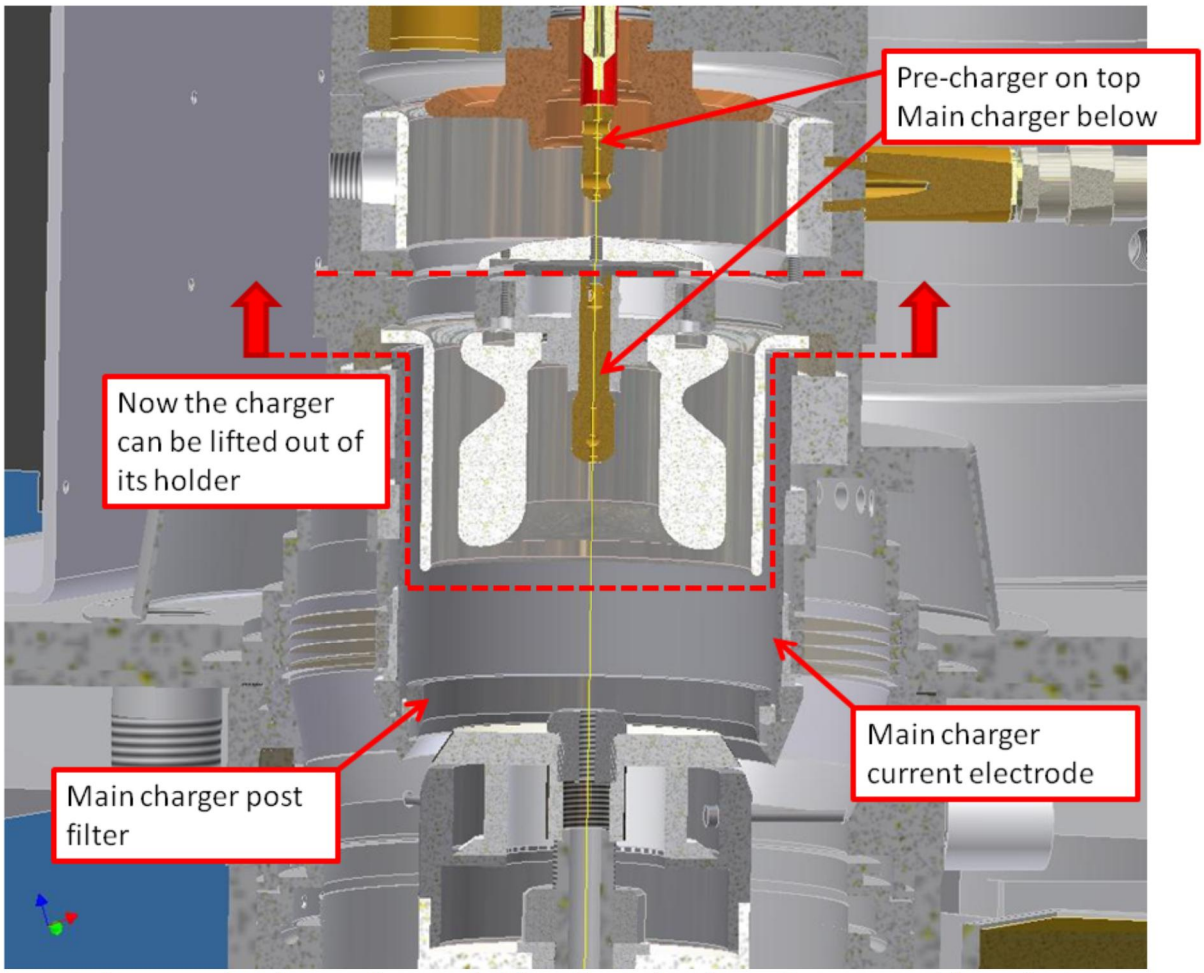

Figure 5: Lifting out the charger from its hilder after it has been disconnected from the instrument.

After the charger is removed the parts can be separated and cleaned separately. The **pre-charger can be separated from the main charger** (Figure 5) by removing three screws on top of the charger module recently removed. Be sure to mark the alignment of both the two parts separated before removing them from each other. When the pre-charger has been separated from the charger module previously removed all surfaces that the aerosol is exposed to should be cleaned.

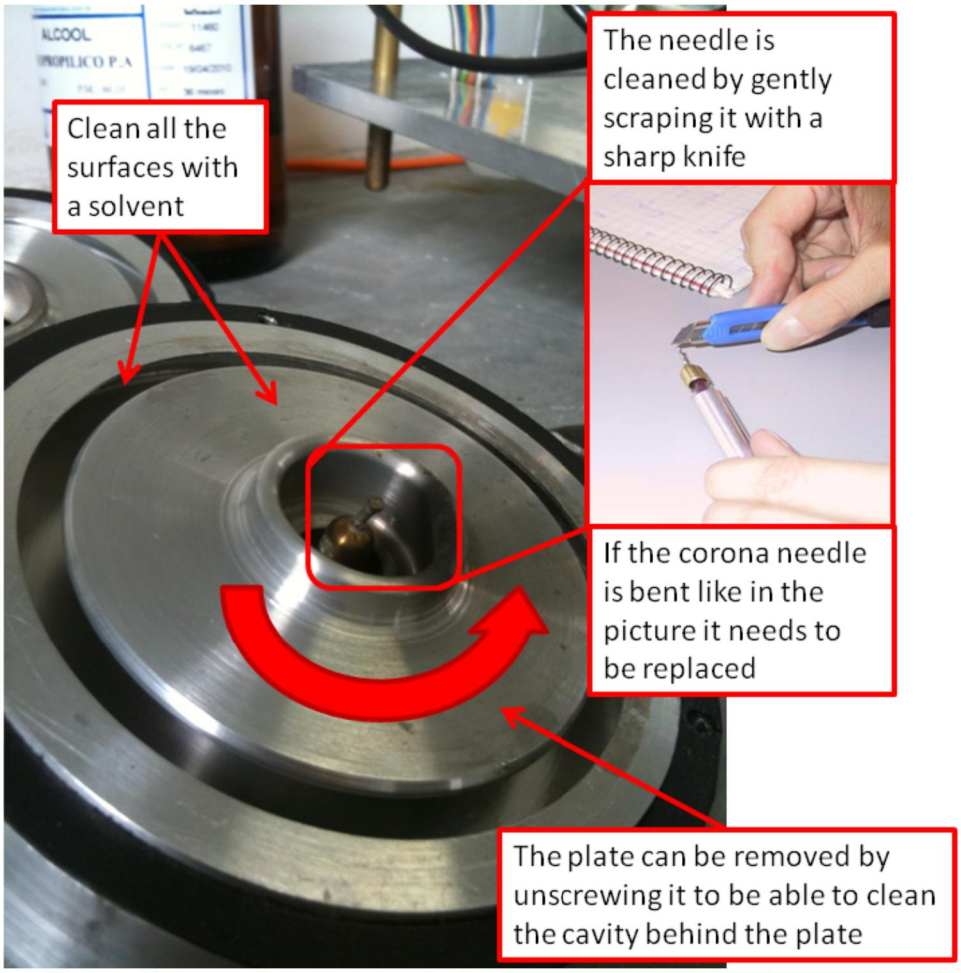

Figure 6: Clean all the surfaces exposed after separating the pre-charger from the charger module. At the same time also the main charger surfaces can be cleaned. In principle all the surfaces the aerosol is exposed to inside the instrument should be cleaned.

When the upper part is cleaned the lower part of the charger module can be cleaned (Figure 7).

After the cleaning of the main charger the parts can be assembled and up back to the instrument. The BNC connectors can be reconnected and the L-bar keeping the charger modules in place can be reattached. Finally the inlet tubing can be fastened. Only had force is needed to tighten the connectors of the inlet tubing.

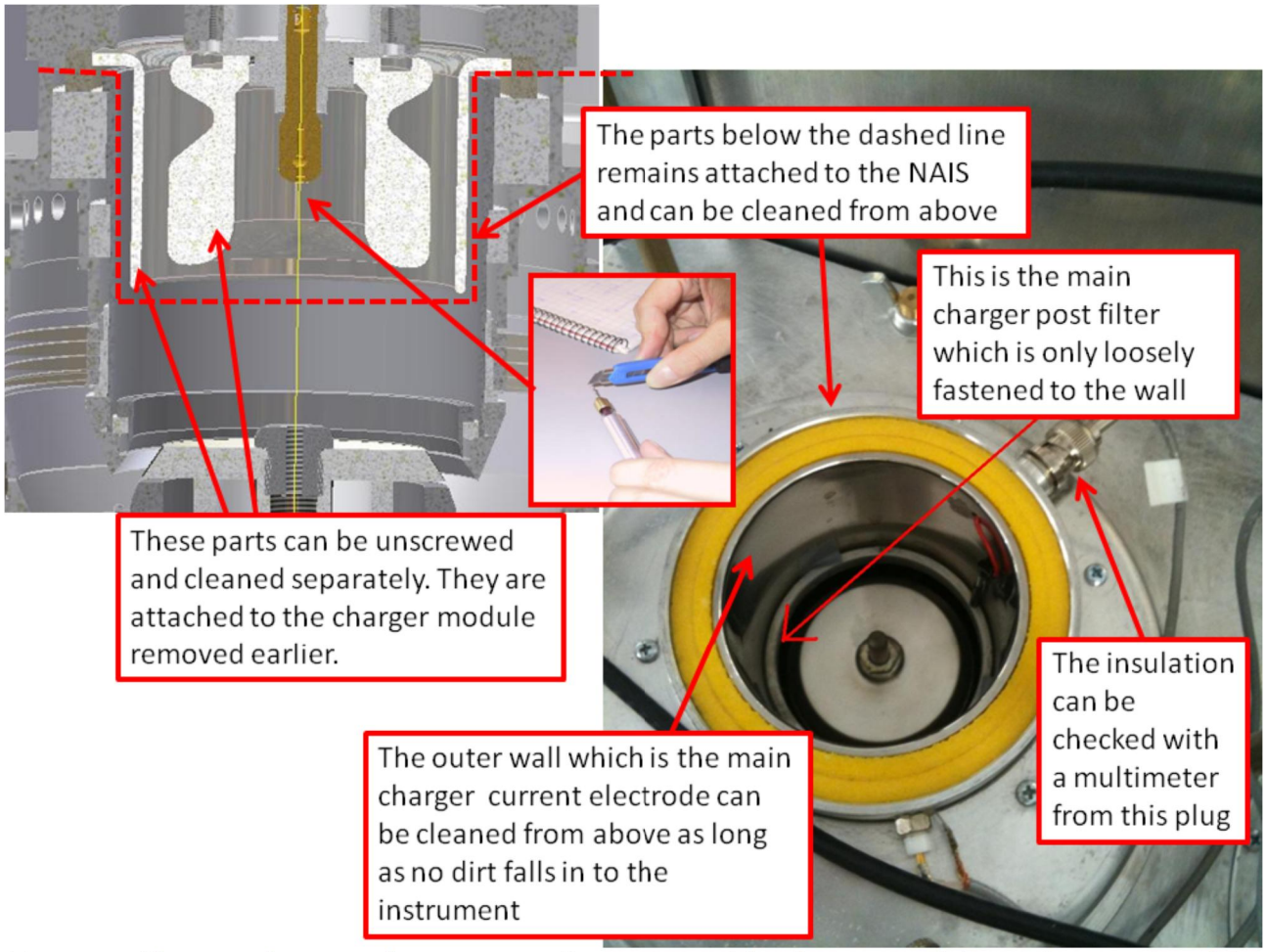

Figure 7: Cleaning the main charger parts. Some parts of the charger module can be unscrewed for easier cleaning. The parts not removed with the charger module can be cleaned from above. The insulation between the post filter and charging current electrode can be checked with a multimeter. The resistance should be in the Mohm range.

Adjusting the post-filter voltage

If the post-filter voltage for some reason is wrong we can begin with trying to adjust it to proper levels. This can be done by opening the front panel by turning the post-filter potentiometer without having to remove any parts of the NAIS. To do this use a **insulated** screwdriver during operation. Figure 8 show how to increase the voltage of the post-filter.

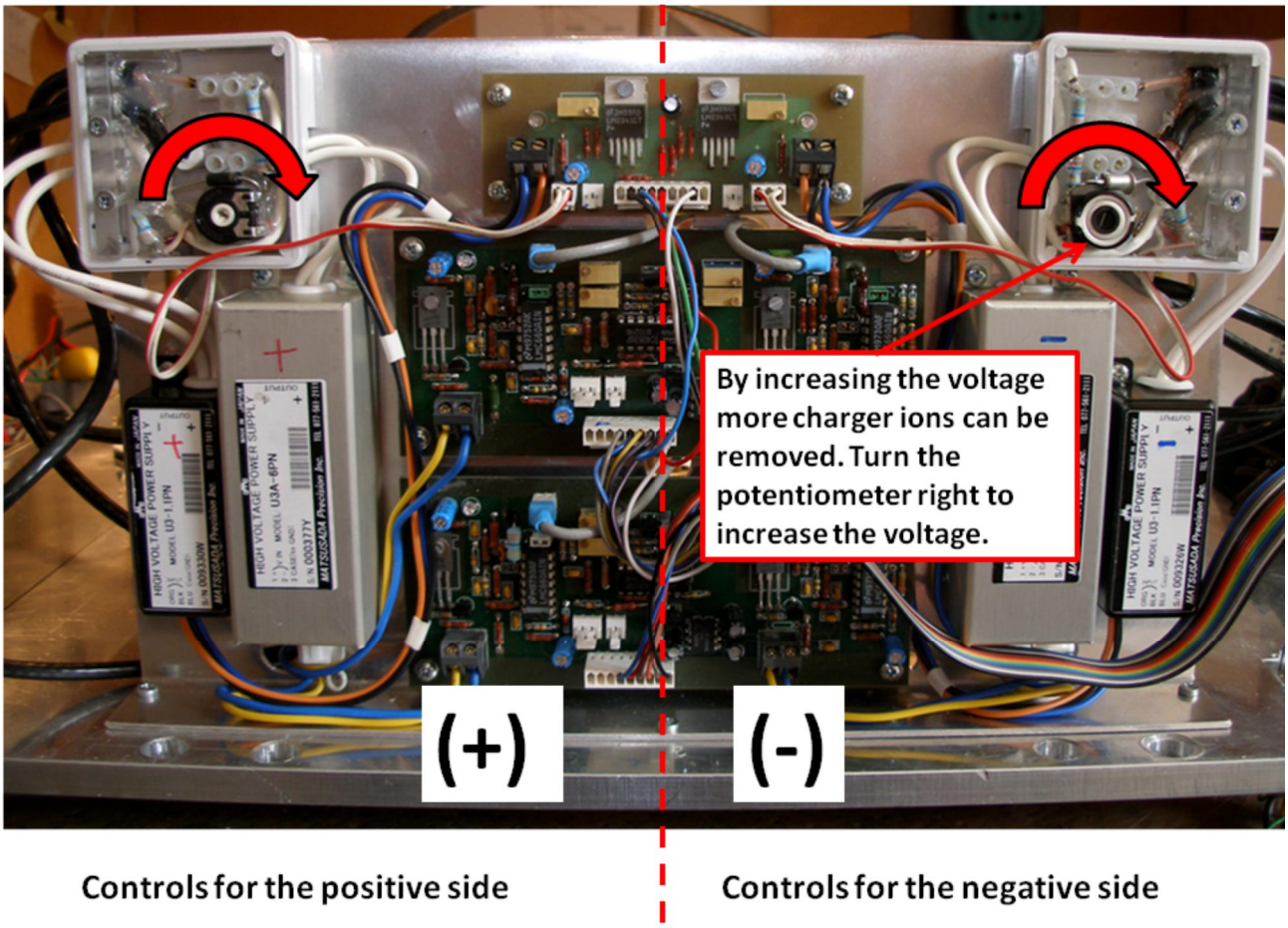

Figure 8: By carefully ajusting the voltage of the post-filter more charger ions can be removed.

When adjusting the voltage the measurement program Spectops can be used in manual mode. By clicking the manual control in the Spectops program the particle mode can be turned on continuously by selecting Run in... "Particles" as is shown in Figure 9.

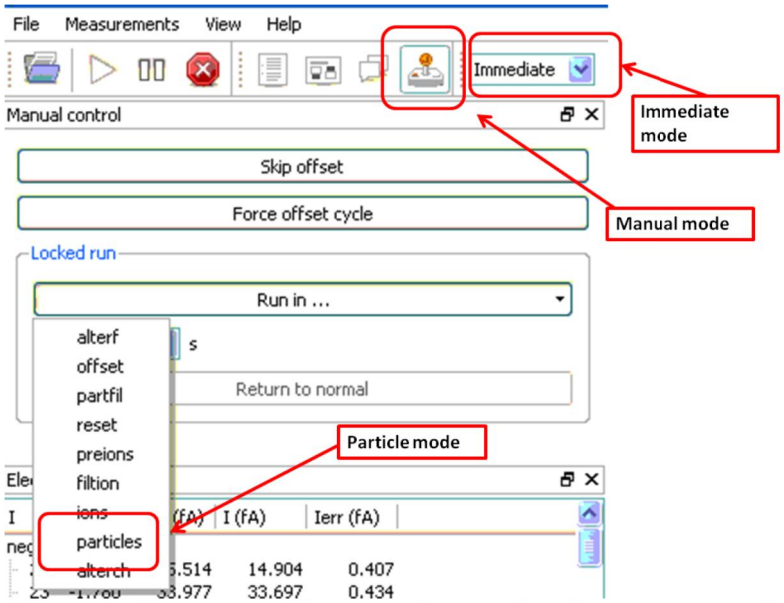

Figure 9: How to enable manual mode for the finetuning of the post-filter. Remember press the Force offset cycle every five minutes.

When you have the Spectops running in particle mode make sure that the graph is plotted in Immedate mode (Figure 9).

Now you can start tuning the NAIS post-filter. Move the different panels arround so you have a clear view of the *particles pos*, *particles neg* and *concentrations* as indicated in Figure 10. The aim now is to get the particle concentrations in the positive channel to be equal to the negative channel.

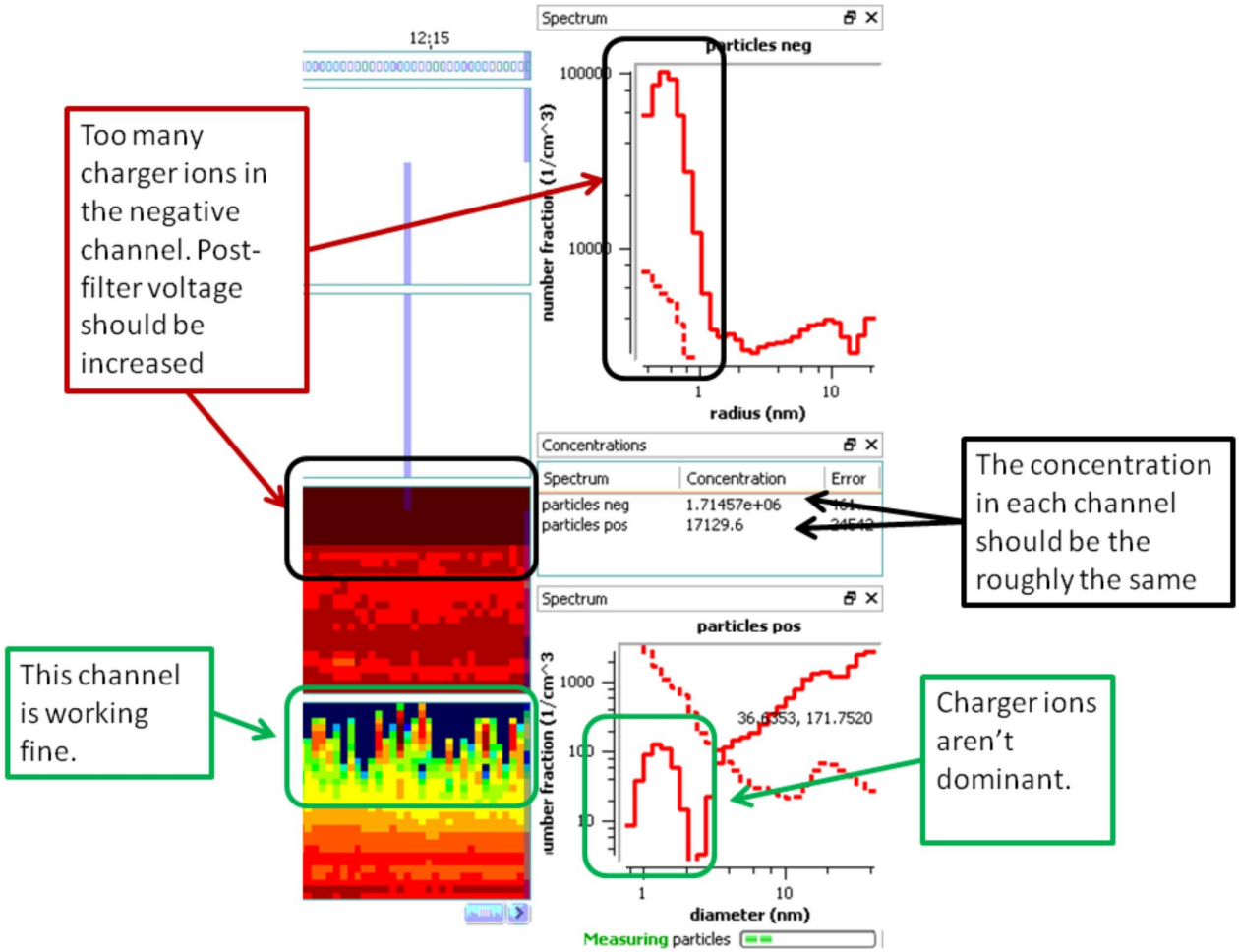

Figure 10: What to look for when tuning the post-filter voltage for the bad channel. The charger ions with a diameter arround 1.5 nm should not dominate the total particle concentration.

The fine tuning can take a while to perform. The ajustments should be made in small steps. After a small ajustment wait for the measurement so do a couple of cycles (1 min) and then ajust some more. It's hard to get the concentrations to be perfectly equal. If it seems impossible to get them equal it is enough if they are within a factor of 2 from each other so that for example the negative is not double that of the positive. Figure 11 gives an example of how it should look like. Often the particle spectrum plots are showing values close to zero (1e-40). Then you can just use the keyboard arrow keys to go to the next spectrum to see if it is a better plot.

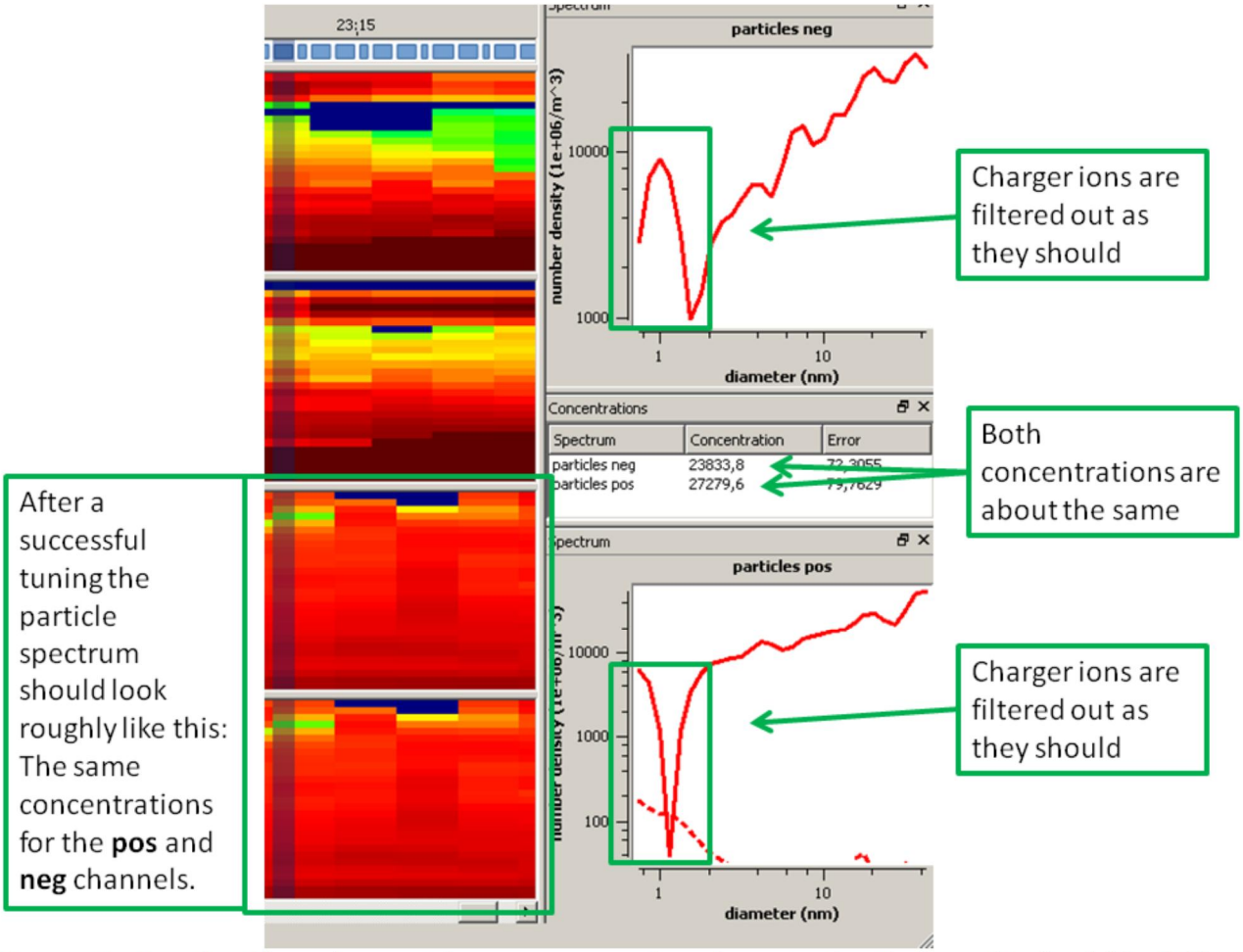

Figure 11: Exaple of how the particle spectrums and number size distribution plts should look like after tuning. Note that the total number particle concentrations for both particles pos and particles neg are roughly the same.