Monday, May 5, 2025

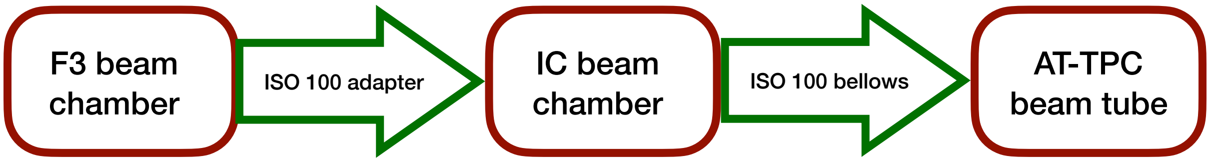
AT-TPC preparations for RCNP campaign

General list of tasks

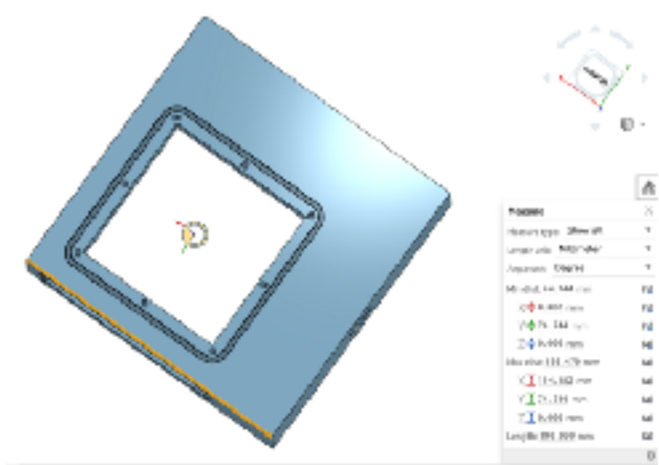
- Mechanical coupling to beam line and alignment
- Assembly of vacuum and gas systems
- Mounting of electronics and controls racks
- AT-TPC GET electronics assembly and cabling
- Trigger logic (GET & FRIB)
- Gas filling and recovery procedures testing using C3H8
- Silicon box detectors mounting and testing
- Testing of AT-TPC signals using internal alphas and C3H8
- Time stamp synchronization testing with RCNP DAQ

Mechanical coupling to beam line and alignment

Schematic of beam line assembly



1. We might need some kind of weight support for the IC beam chamber to avoid stressing the ISO 100 connection to the adapter.
2. The IC beam chamber should be aligned on the beam axis first, because this alignment will determine the alignment of the entrance window of the AT-TPC.
3. The IC alignment can only be done in one direction, usually we choose the vertical direction.
4. The IC should be aligned first before assembling the ISO 100 bellows that couples it to the AT-TPC.
5. The entrance window of the AT-TPC is an aluminized 12 micron PPTA foil sandwiched between the AT-TPC beam tube and the AT-TPC flange.
6. It is not possible to look through the AT-TPC with the scope from the back, so the alignment of the entrance window and AT-TPC beam tube relies on the alignment of the IC beam chamber (see 2 Above).
7. The exit (back) of the AT-TPC should be aligned by looking at a mark locating the beam axis on the silicon box cover. The distance of the beam axis from the closest edges of the box is 74.7 mm (see drawing below).



Assembly of vacuum and gas systems

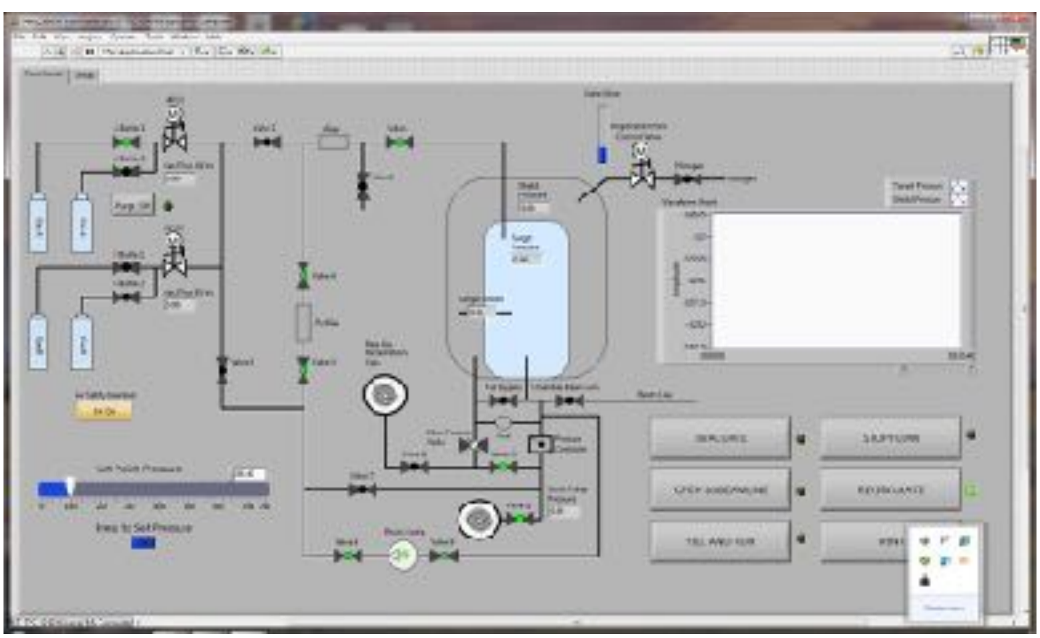
Gas handling systems and high voltage power supplies rack configuration

1. The rack pictured should be assembled first
2. It should be placed close to the downstream side of the AT-TPC
3. Ion Chamber Gas Handling System

- Install a bypass on the IC beam chamber using a manual valve, placed as close as possible to the beam chamber vacuum.
- The IC GHS is rather straightforward to assemble. Smaller metallic hoses (KF16) should be used.
- Place Isobutane bottle and pump close to the rack and connect to the IC GHS

4. AT-TPC Gas Handling system (see diagram below)

- The AT-TPC GHS has two circuits: one for the inner volume (metallic hoses), the other



for the outer volume (plastic hoses)

- Nitrogen gas should be connected to the nitrogen inlet
- Beam line inlet should be blanked off (not used)
- The propane gas bottle should be connected to inlet A bottle 1
- The gas recovery system should be connected to valve 3 of the AT-TPC GHS
- We need to discuss the filling and recovery procedures

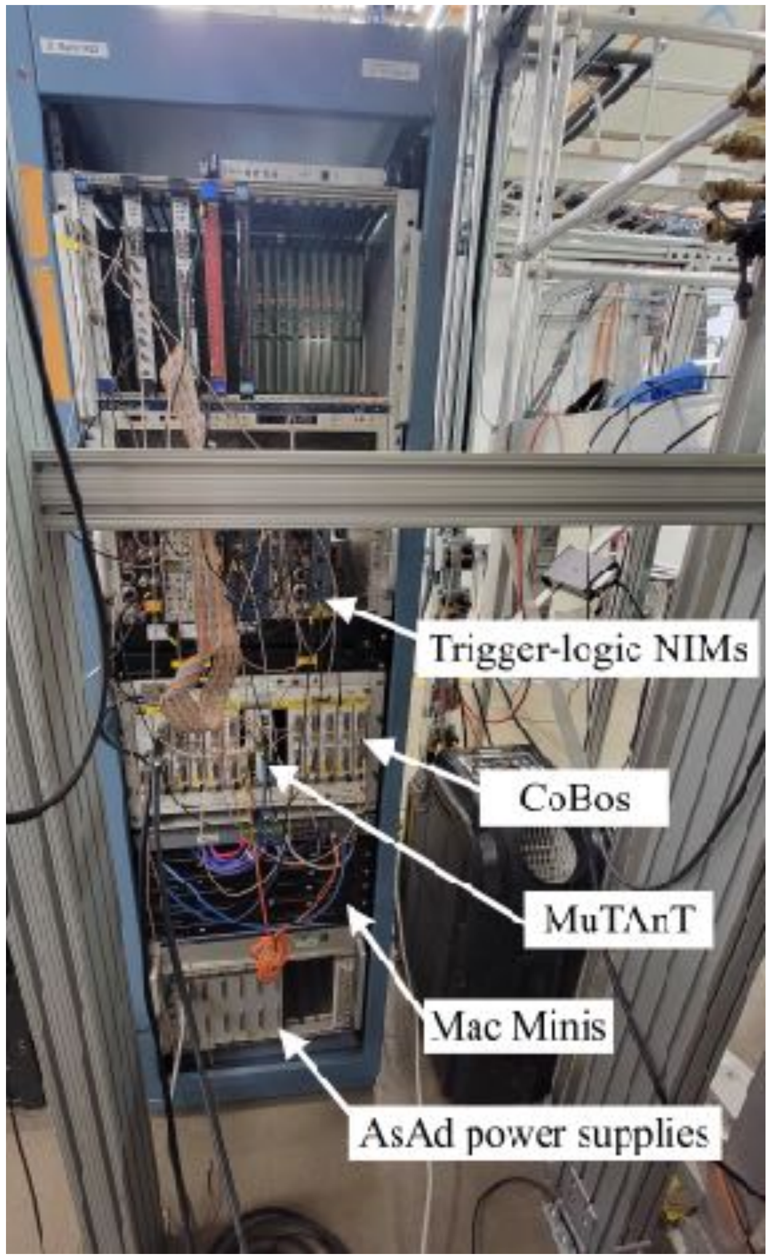
Mounting of electronics and control racks

The configuration of the electronic rack is pictured below

The network switch is installed between the Mac minis and the microTCA crate that contains the CoBos and the MuTAnT.

The VME crate for the FRIB DAQ should be mounted at the top of the rack.

The NIM crate for the trigger logic should be below.



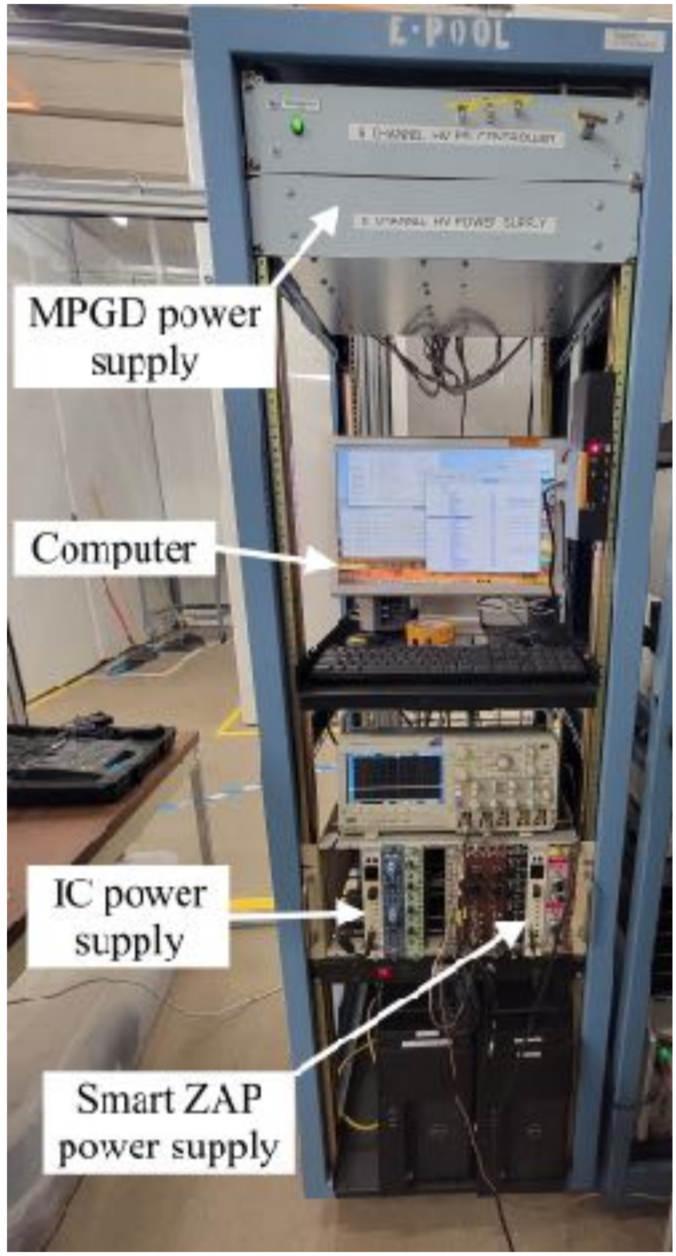
The configuration for the controls rack is shown below. It should be placed to the left of the electronics rack.

The various control computers should be placed at the bottom of the rack. They are:

- Windows PC for GHS and other controls
- Linux PC for FRIB DAQ (spdaq26)
- Linux PC for high speed data transfer (attpc_gw)

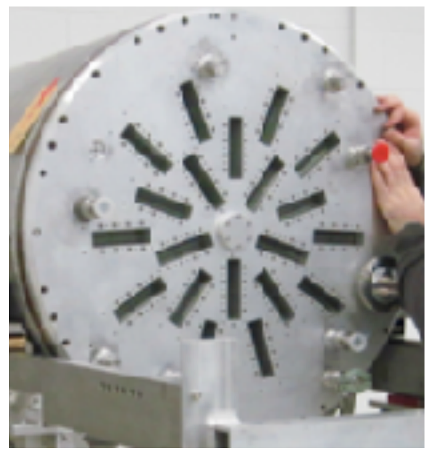
The screen, keyboard and mouse are shared between the 3 PC computers and the AT-TPC server machine (Mac mini) located in the electronics rack.

The switch used to go to different computers should be installed in a convenient accessible location (it is on the right side of the rack in the picture).



AT-TPC GET electronics assembly and cabling

- GET electronics modules assembly
  - There are 20 GET electronics modules to mount on the upstream flange of the AT-TPC, numbered from 0 to 19.
  - Each module contains 2 AsAd boards and their associated ZAP boards. Each module is labeled with its number and goes in a specific location on the flange, which is also labeled with the same number.
  - It is good to check on each module that the VHDCI connectors of the AsAds have their securing bolts, and install one or both if they are missing.

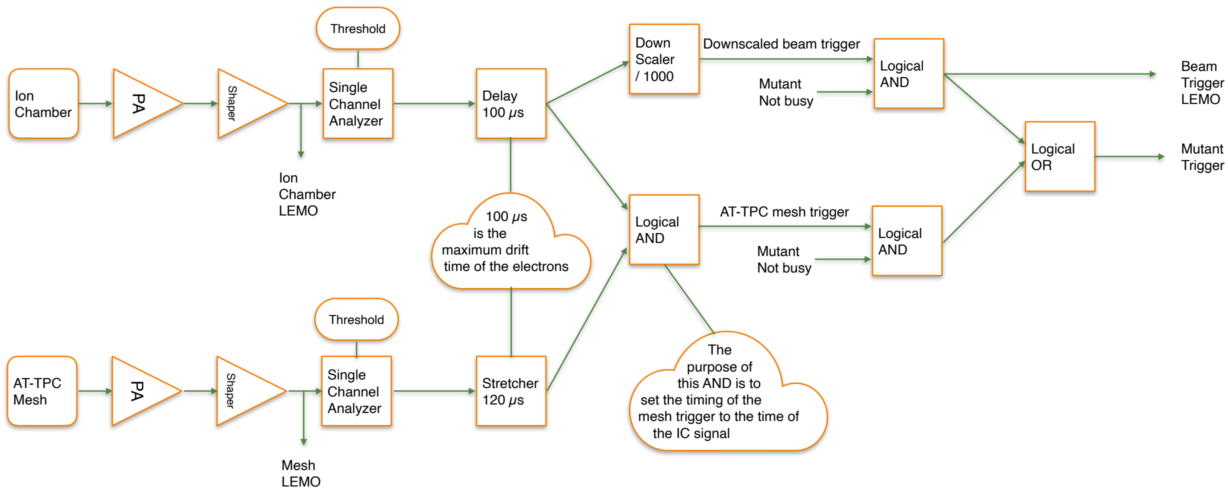


  - The connectors on the back of the micromegas are arranged in 3 rings of 5, 5 and 10 modules respectively (see picture).
  - The numbering goes clockwise from the innermost ring to the outermost ring.
  - It is easier to start from the innermost rings and finish with the outermost, so just following the module numbers from 0 to 19.
  - The connectors to the AT-TPC micromegas are very high density and quite fragile, so the modules should be inserted carefully and not forcefully.
  - Once connected to the micromegas, each module is secured mechanically to the flange using 4 screws. A special screwdriver is used to reach the holes on the brackets and the flange, as space becomes quickly cramped as more modules are mounted.
  - Once all modules are mounted, the data and power cables can be installed.
- VHDCI and power cables assembly
  - The VHDCI cables connecting the AsAds to the CoBos are grouped by 4 and labeled at each end.
  - It is important to follow the labeling scheme otherwise the electronics map becomes very difficult to determine.

- Since there are 4 AsAds connected to a single CoBo, 2 modules are connected to each CoBo.
- The cabling scheme follows the increasing number of the modules to increasing CoBo number (0 through 9), so CoBo n is connected to modules 2n and 2n+1 (for instance CoBo4 is connected to modules 8 and 9).
- The cables are labeled by CoBo and AsAd numbers, so in our previous example the cables CoBo4AsAd0 and CoBo4AsAd1 go to module 8, and the cables CoBo4AsAd2 and CoBo4AsAd3 go to module 9.
- To determine which AsAd is which for each module, the rule of clockwise=even and counterclockwise=odd is applied: the hand of a clock going clockwise reaches AsAd0 and AsAd2 first, whereas the hand of a clock going counterclockwise reaches AsAd1 and AsAd3 first.

Trigger logic (GET & FRIB)

Below is a schematic of the trigger logic of the AT-TPC.



- The trigger is built from a delayed coincidence between the IC and the mesh signal.
- The purpose of this coincidence is to set the trigger timing relative to the IC signal rather than mesh signal.
- This is because the timing of the mesh signal depends on the geometry of the tracks, and therefore varies greatly from event to event as the rising edge corresponds to the time when the first electrons arrive at the micromegas.
- The trigger logic also includes a downscaled single IC trigger (usually a factor of 1000) to record the incoming flux of particles (assuming 100% transmission between the IC and the AT-TPC).
- The diagram also shows the vetoing of the trigger from the busy signal of the Mutant. For RCNP experiments, this busy will the logical OR of the busy signals of all 3 DAQs (GET, FRIB and RCNP).
- The FRIB DAQ uses a coincidence register V977 to record the state of each trigger source (mesh and downscale IC).
- The live trigger is distributed to all 3 DAQ systems, as is the synchronization time stamp (a 1 MHz clock).