

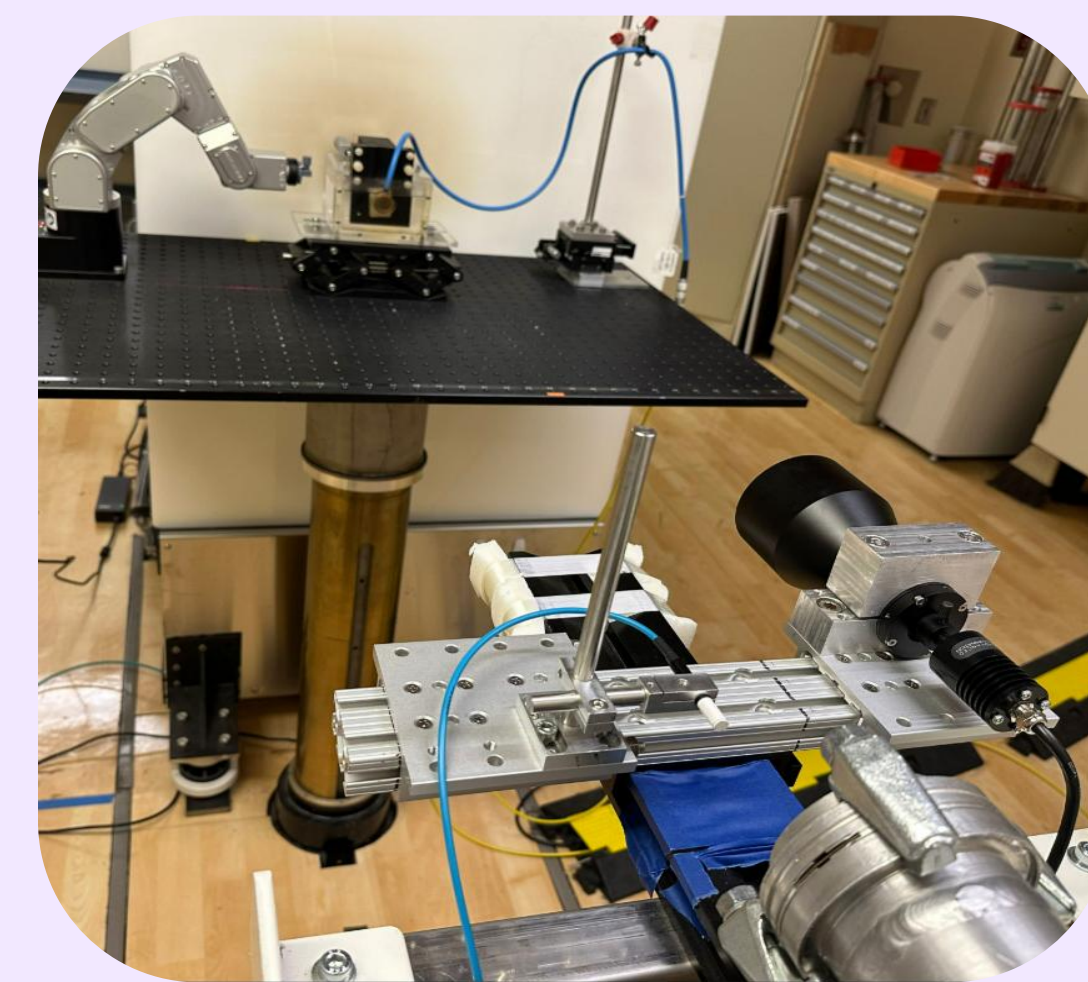


DATA ACQUISITION FOR PARTICLE ACCELERATOR EXPERIMENTS



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THE UW MEDICAL CYCLOTRON FACILITY



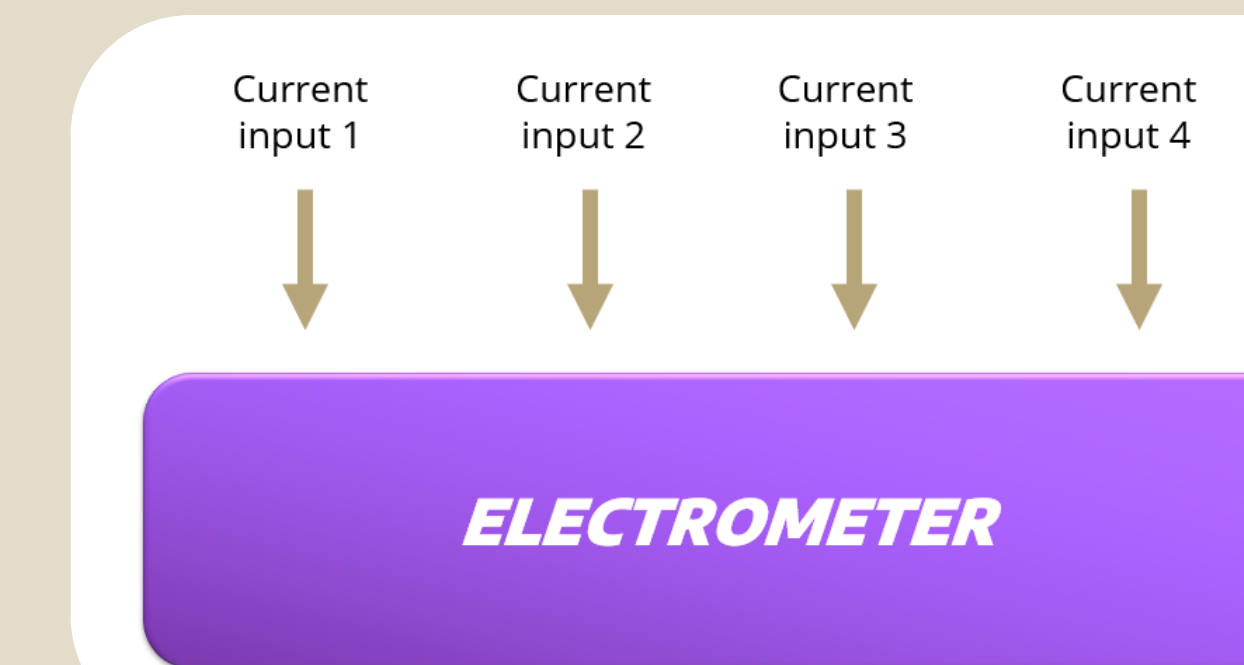
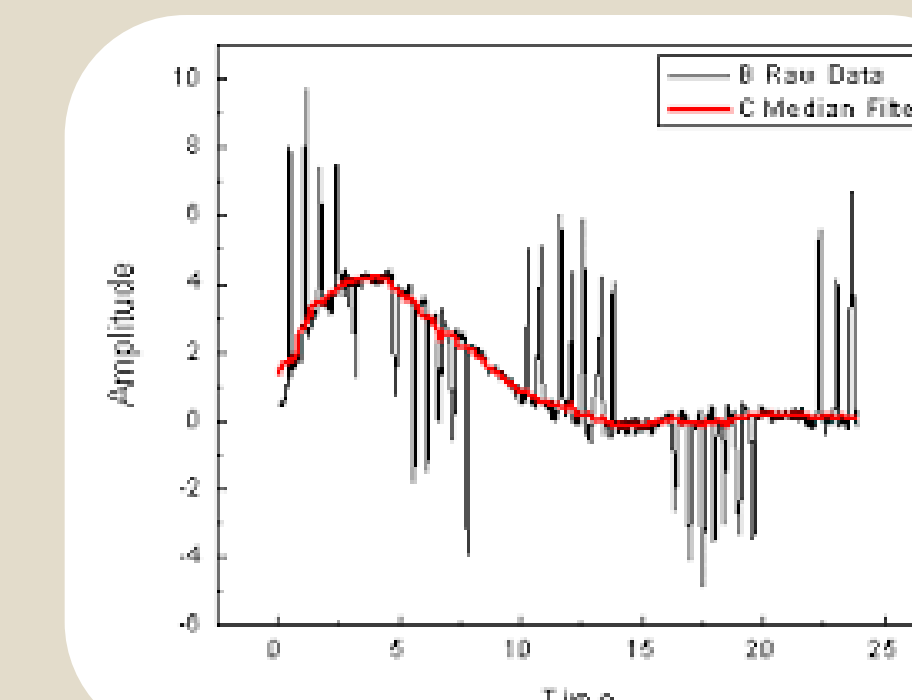
- A cyclotron creates ion beams that travel through beam lines to targets
- UWMCF is the only fast-neutron cancer therapy clinic in the world
- UWMCF also delivers beams for cancer therapy research and other projects
- Particle detectors in the right-hand photo are used to calibrate research beams
- We are working to improve data acquisition systems for these detectors

RESULTS

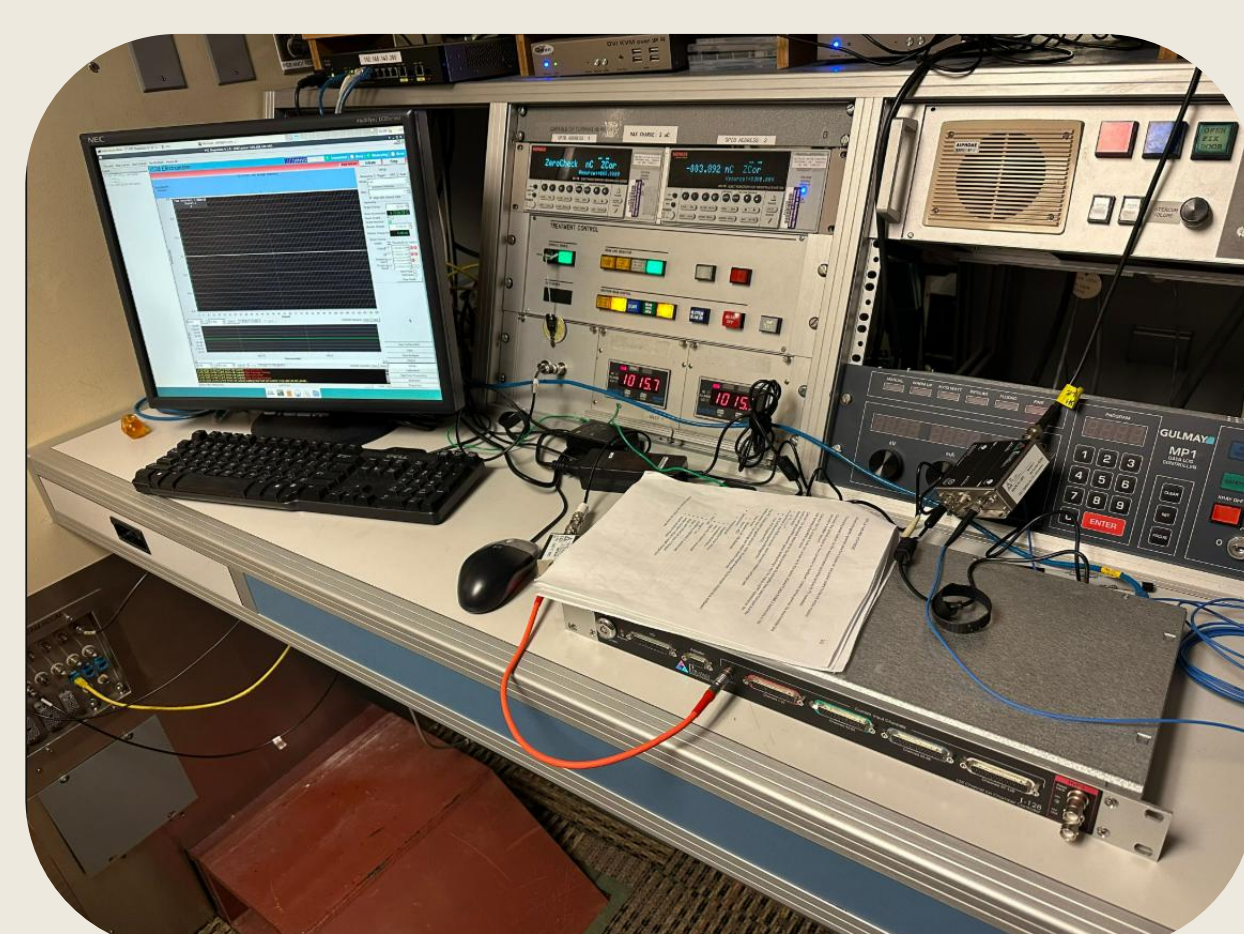
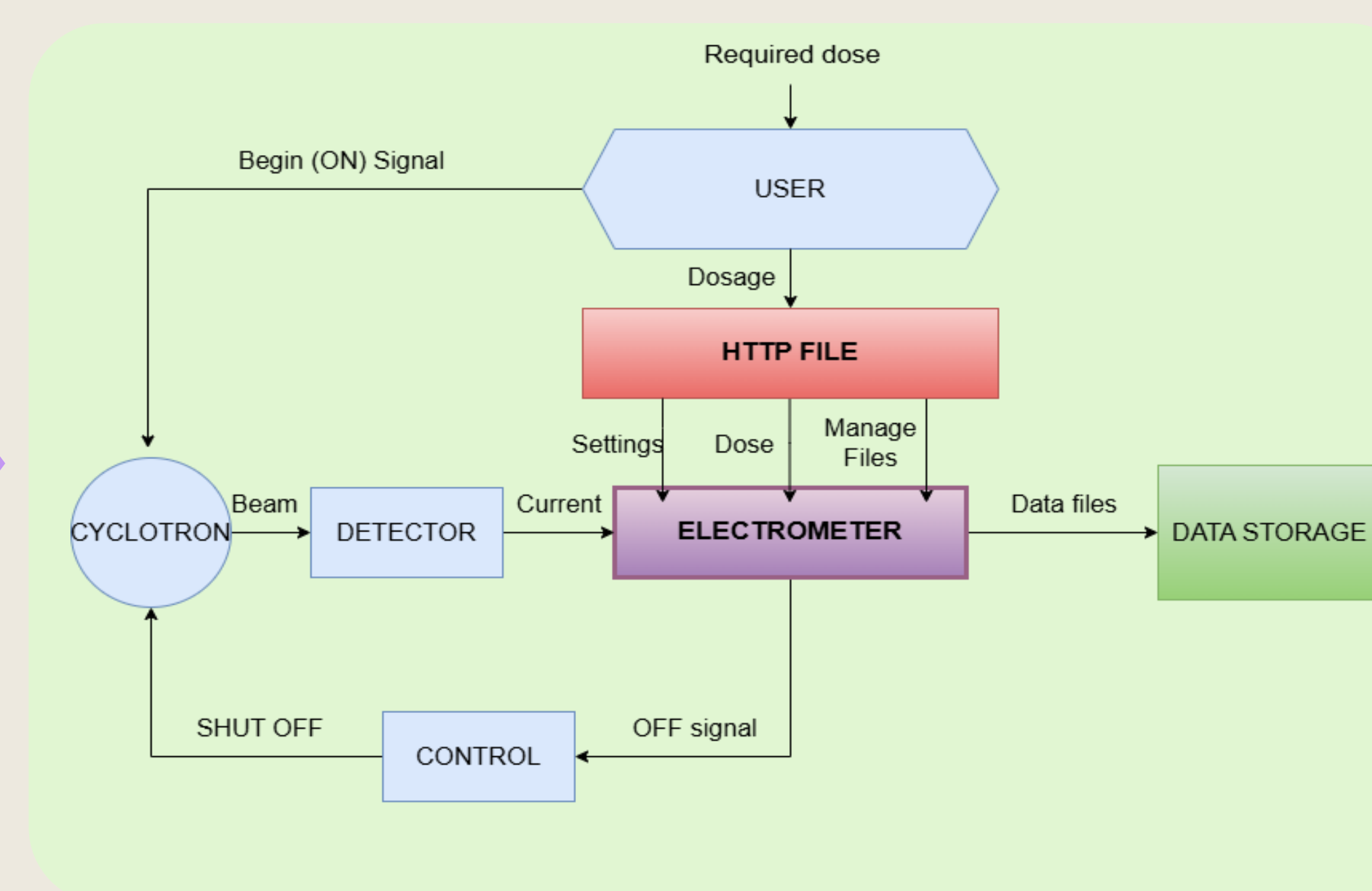
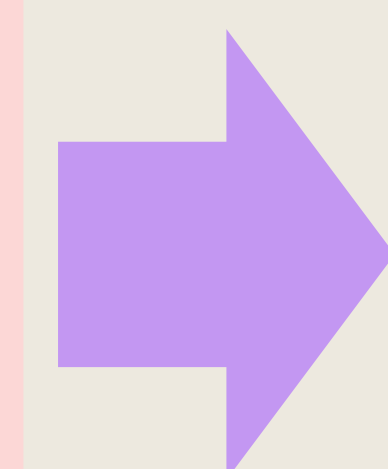
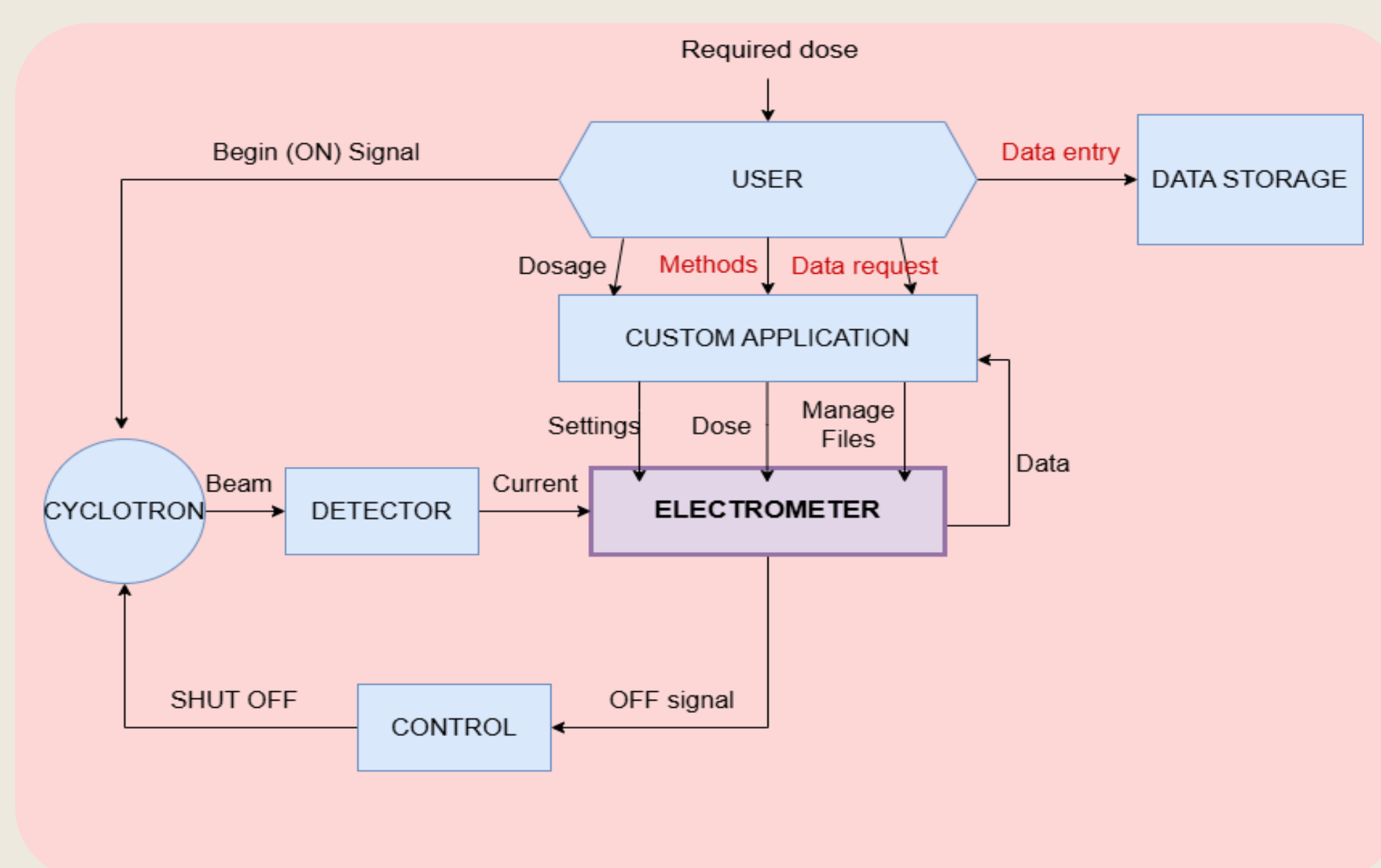
- Improved the cyclotron facility's workflow by building custom software, which made data collection during cancer treatment runs faster and smoother
- By using an external current source connected to our testbench, we measured the current and confirmed that the electrometer's automatic OFF signal shut it off correctly
- Wrote a user manual for the electrometer's new software controls, covering setup and troubleshooting. This guide explains how to use the system and can be easily updated in the future since the facility keeps detailed records

FUTURE WORK / CONCLUSION

- Integration of the electrometer into the facility's work operation station within real cancer treatment experiments
- Improvement of testbench operation at the lower spectrum of input currents via hardware solutions and additional signal processing for the output current via a software solution
- Connection of the electrometer to the other systems within the facility for instantaneous current monitoring



SETUP



- Bulky configuration
- Frequent data loss
- Difficult interface
- One usable channel

- Compact configuration
- Efficient data transfer
- Simple interface
- Four usable channels



- Our objective is to program the new electrometer for UWMCF
- Test charge collection procedures with a hardware testbench
- Set up automatic saving of test beam run information
- Determine the best steps to integrate the electrometer into the facility
- Prepare documentation for how to properly set up and operate the electrometer

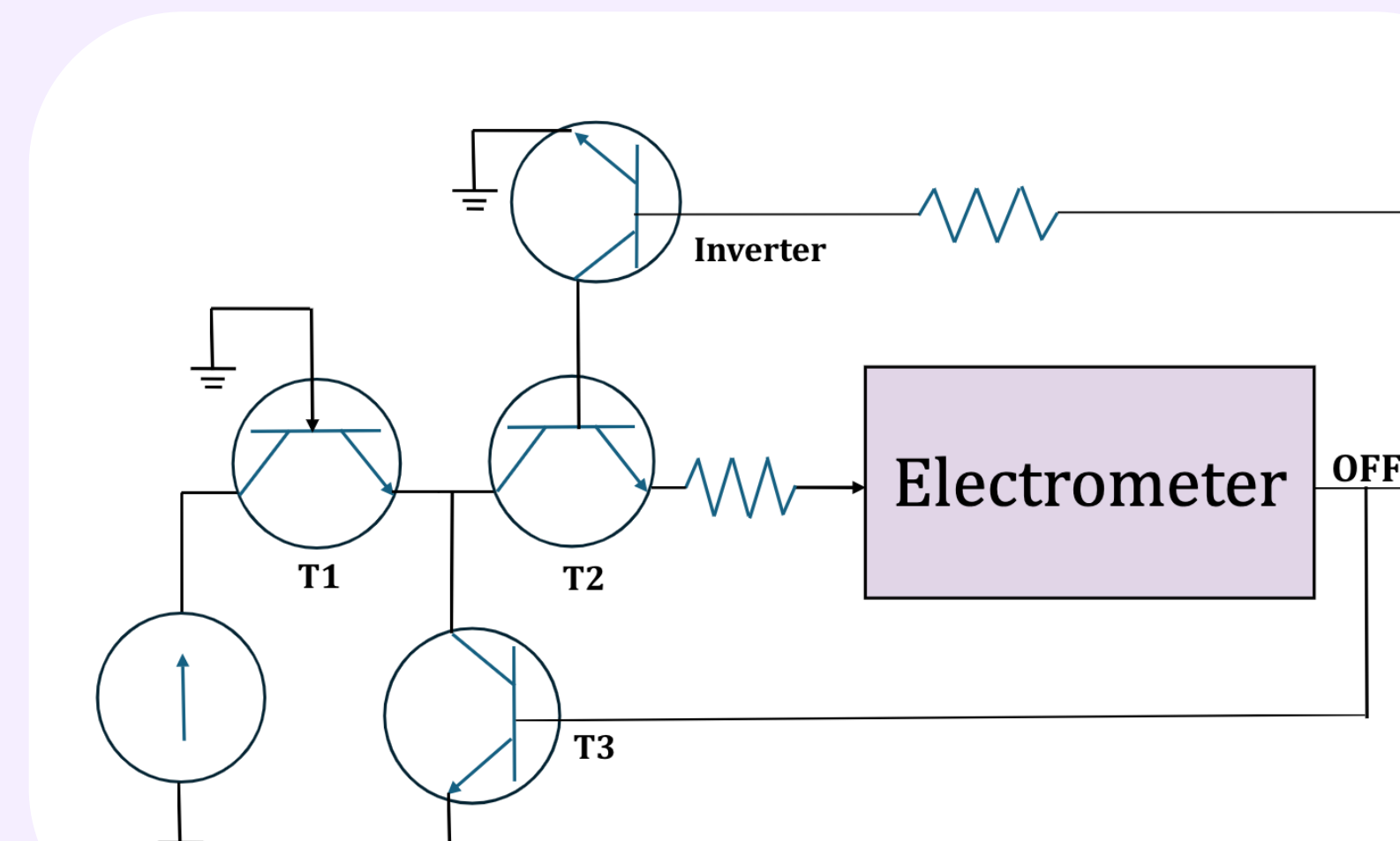
SOFTWARE



Ch	FX4
1	+0.000 nA
2	+0.000 nA
3	-0.000 nA
4	-0.000 nA
Σ	-0.000 nA

- Change settings and control electrometer with custom Python code, which interfaces with the electrometer via HTTP protocol
- A template is selected for electrometer settings and dosage is manually input for patient or experiment
- Experimental data and settings automatically saved to client computer in .csv and custom .fx4 format respectively

HARDWARE



- When turned on, a current signal is sent through T1 and T2 and is measured by the electrometer
- The electrometer then sends an OFF signal that goes through the inverter to shut off current to the electrometer through T2
- The OFF signal turns on T3 which grounds any remaining current in the circuit

REFERENCES

- <https://pyramid.tech/products/fx4>
- <https://pyramid.tech/contact>
- [2N3704 Transistor Data Sheet](#)
- [2N3904 Transistor Data Sheet](#)
- [J113 Transistor Data Sheet](#)