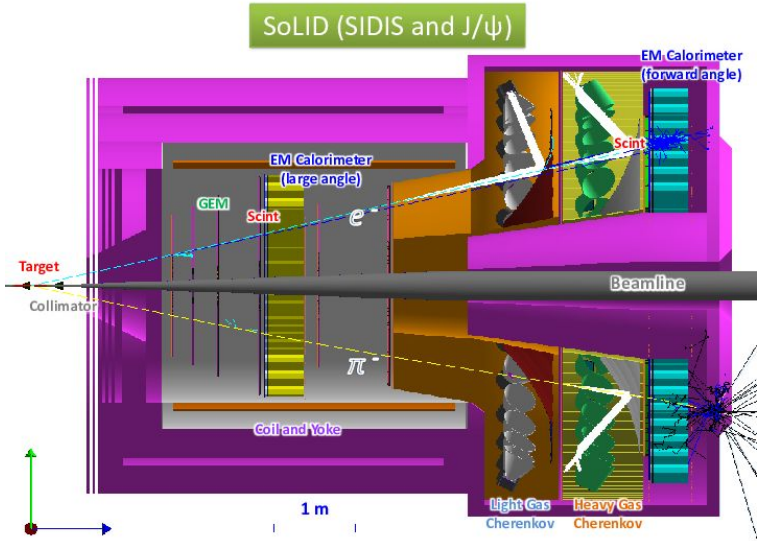
Slow Control Discussion



Bill Henry, Brad Sawatzky, Chandan Ghosh

Jefferson Lab

Dec 8 2023

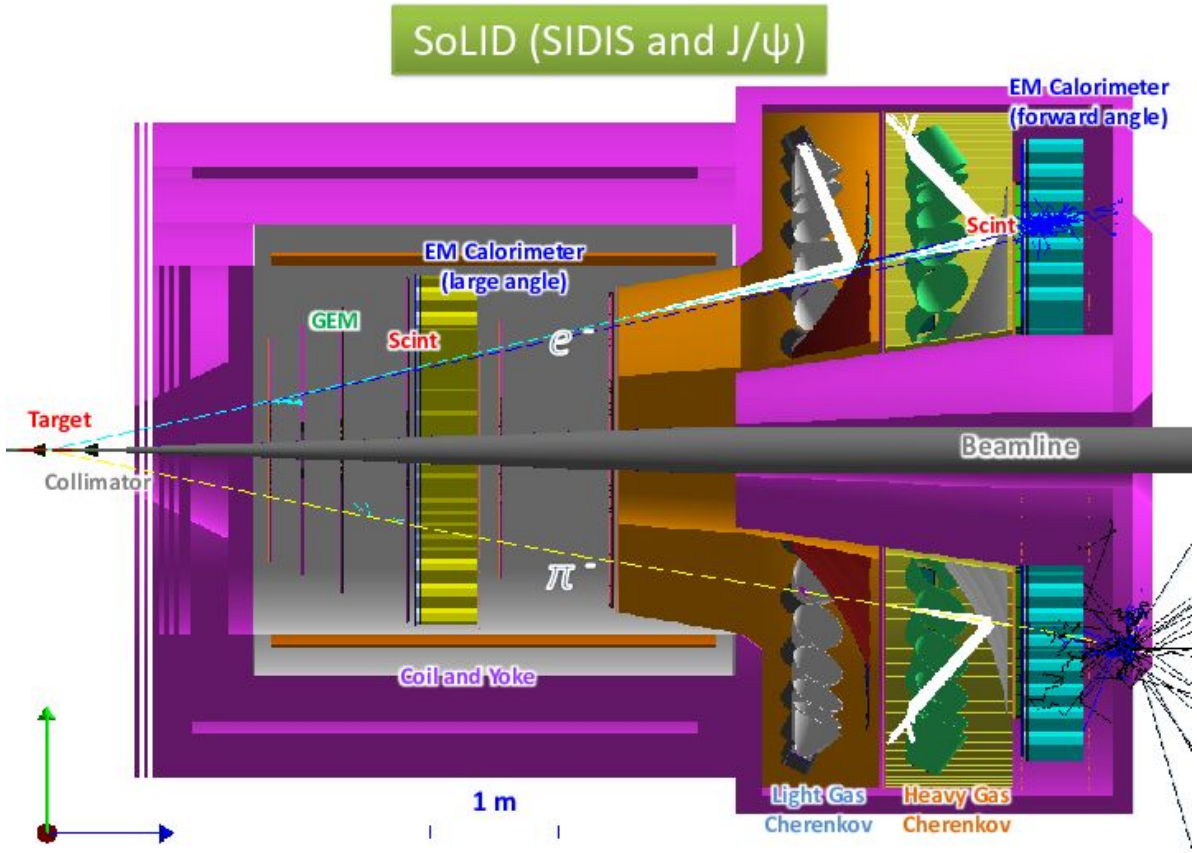
What are Slow Controls

- **“Infrastructure Support” systems and logging**
  - Status monitoring of power, vacuum, temperatures, etc
    - Includes logging alarms/notifications services
    - Safety interlocks between systems (fast valve close, ramp downs HVs/LVs)
  - Remote control of motors, pumps, actuators, stepper motors, etc…
  - Typical measurement/response time on the order of 1 Hz
- **User Interface**
  - Frontend GUIs
  - Alarm systems

SoLID Subsystems

- Magnets, target
- DAQ/Detectors -
  - Power (HV, LV)
  - Crate/Chassis
- Detector subsystems
  - ECal
  - Cherenkovs
  - GEMs
  - LA/FA SPD

Slow control requirement for SoLID is significant!



Systems that need Slow Control

- ★ **DAQ Crates - should plan to purchase standard items**
  - Power/temperature monitoring
  - Remote power cycle
- ★ **High Voltage**
  - Monitoring and control
- ★ **Low Voltage (GEM/PreAmp?)**
  - Monitoring and control
- ★ **Gas Systems**
  - Monitor flow (GEM/LGC)
  - Monitor pressure and temperature (HGC) -Flow(?)
- ★ **Fast interlocks that cross system boundary***
  - Trip HV if gas flow stops on the GEMs
  - Spark potections for HVs
- ★ **Motion control - needed?**
  - Move/rotate

Slow Control System Overview

Detector	HV/LV Power	LED flasher/ pulser	DAQ Crate Monitoring /Control	Gas System Type	Temp Monitoring	Flow	Pressure	Fast Interlock	Comments
GEMs	x		x	Flow Through		x		x	Define ratio
LA/FA SPD	x	?	x						
ECal	x	?	x						
Light Gas Cherenkov	x	x	x	Flow Through		x			1 atm (abs) CO_2, N_2
Heavy Gas Cherenkov	x	x	x	Fill & seal	x	x (?)	x		1.5-1.7 atm (abs) C_4F_{10} (?)

FIXME: Double check and inform us

General requirements

- **HV/LV controls, Temperature, Pressure GUIs with EPICS compatible logging and alarms.**
  - Appropriate crate selection makes this straight forward. Recommended systems have control, monitoring and alarm loops already implemented, no IOC/PLC development needed
- **LED Gain monitoring (“on/off”) remote controls are straight forward**
- **“Flow-through”/Open-loop (need to be defined by the detector subsystem)**
  - Standard MFC and other gas components - can use the existing GUIs
- **Heavy Gas Cherenkov gas system**
  - Infrastructure (recirculating/variable pressure/ distillation gas systems) can be complex, but slow controls are minimal since fills are done manually - need to monitor T and P. Need online flow?
- **Fast interlocks across systems needs to be defined clearly** (trip GEM HVs if no gas, close gate-valve if there is a vacuum problem). These systems should have EPICS logging capabilities.
- **Automated motion/positioning systems are more complicated -(needed?)**
  - Custom IOC/PLC development, fail-safe design and interlocks

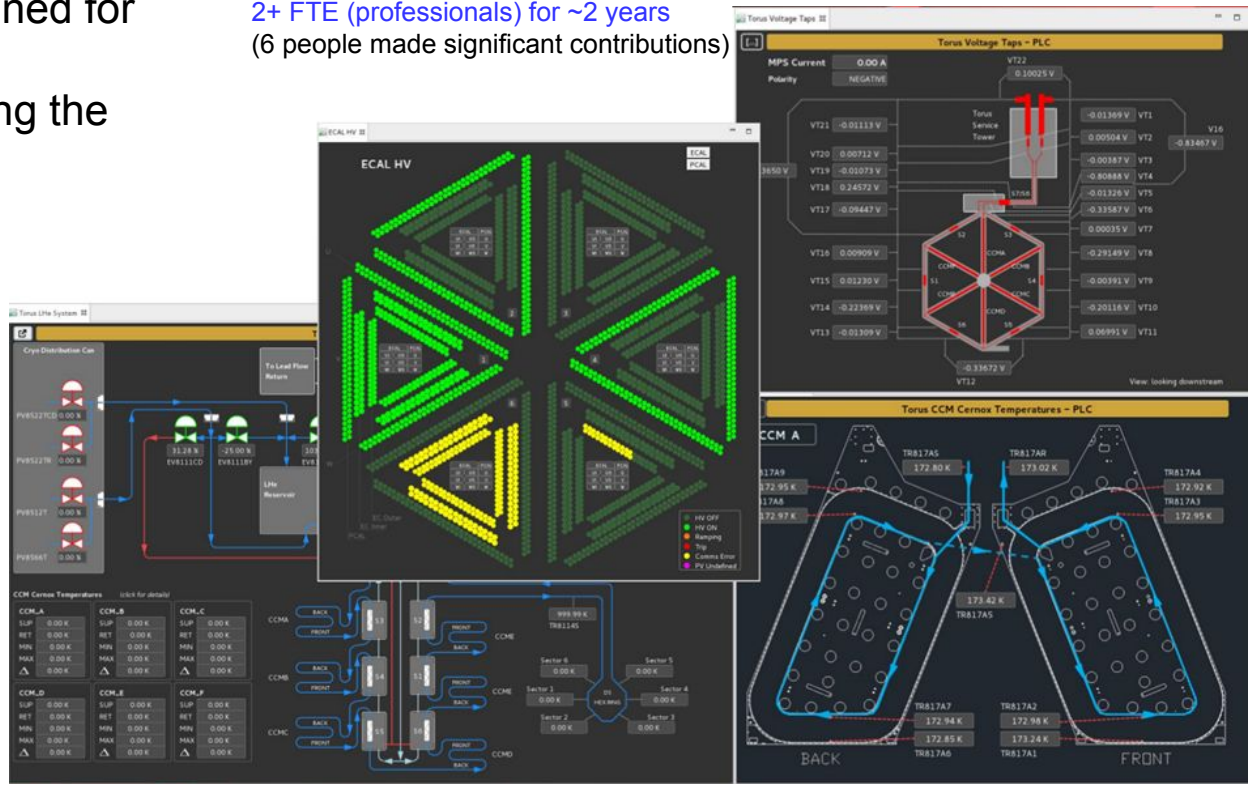
Fronted GUIs

- **Control Systems Studio**
  - Eclipsed-based toolkit designed for systems using in the lab
  - Moving to Phoebus (replacing the Eclipse UI framework)

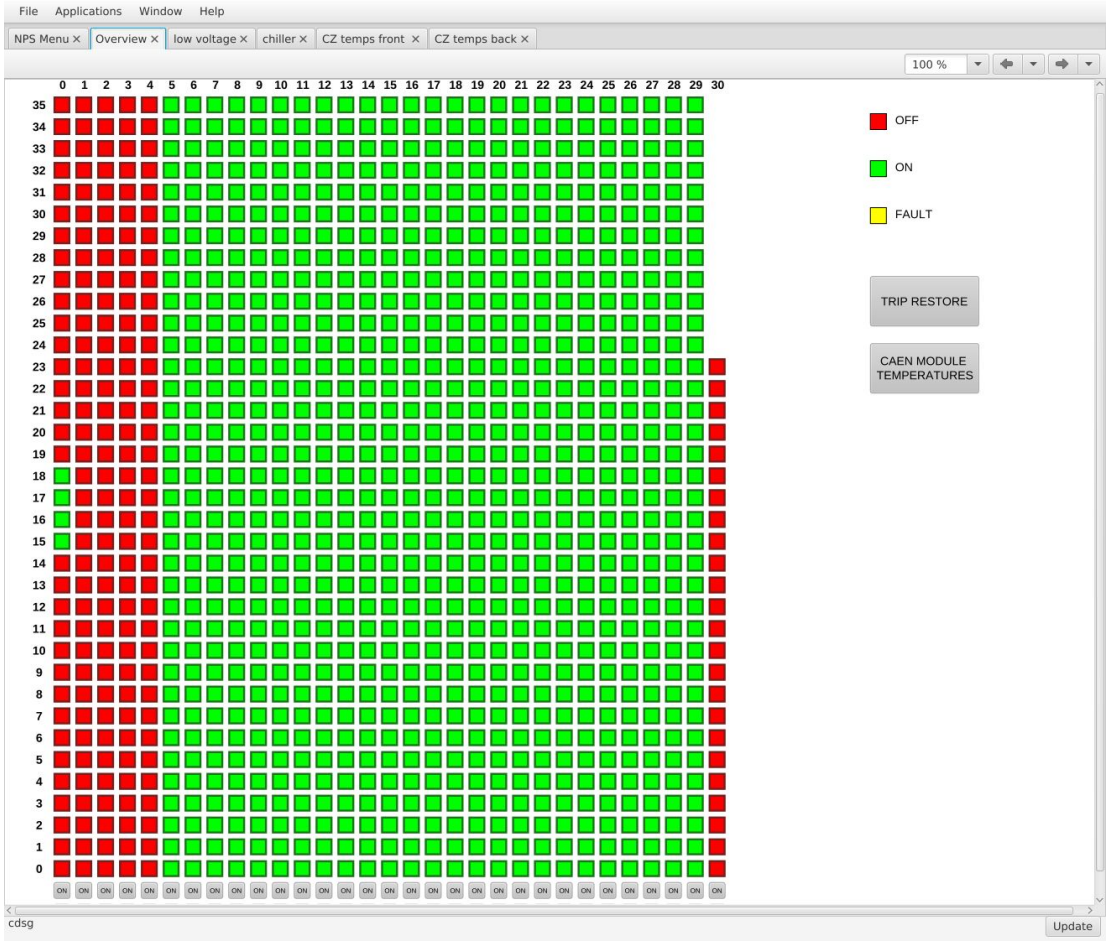
- **Avoid using..**
  - LabView
  - Custom/proprietary code
  - If not possible, provide EPICS interface for integration

Hall B Slow control GUIs

2+ FTE (professionals) for ~2 years
(6 people made significant contributions)



Phoebus example - NPS HV setting.



Summary

- Even with component standards enforced, and fairly modest requirements, slow controls for project on this scale is still significant
  - Hall B → 2+ FTE (professionals) for ~2 years (6 people made significant contributions)
- Standardization and cross-system oversight is critical prior to purchase to avoid issues (CAM?)
  - Ensure EPICS and other low level interface support is present and to spec
  - Avoid home-built and proprietary software where possible
  - Identify and communicate system needs that may cross subsystem boundaries
  - EPICS will be our common API/Protocol
- Maintainable Frontend GUIs/software require sufficient time *and* professional software developers
  - Control Systems Studio (CSS) / Phoebus framework is recommendation