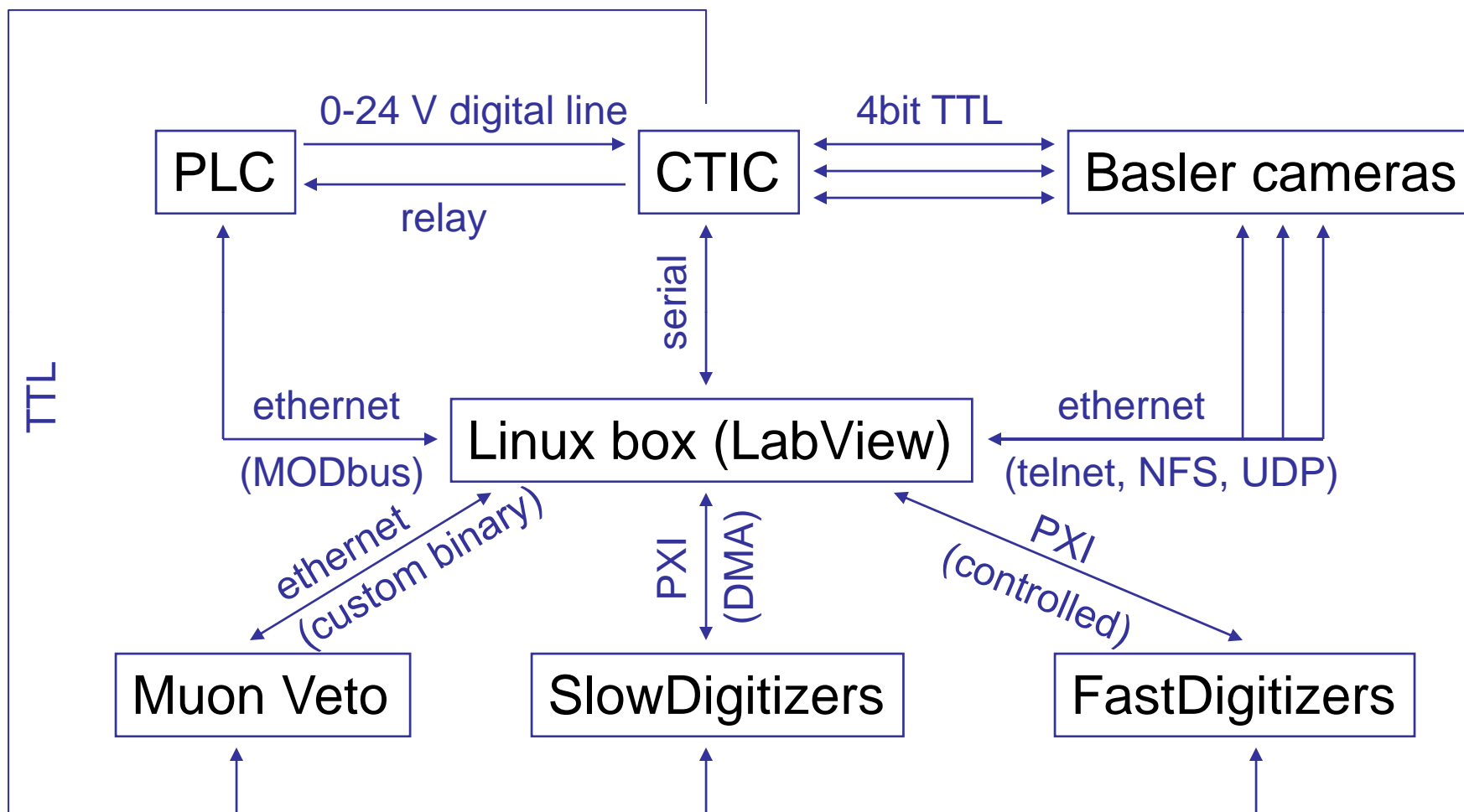# COUPP 60

Status report on DAQ
Hardware, Software, and Integration

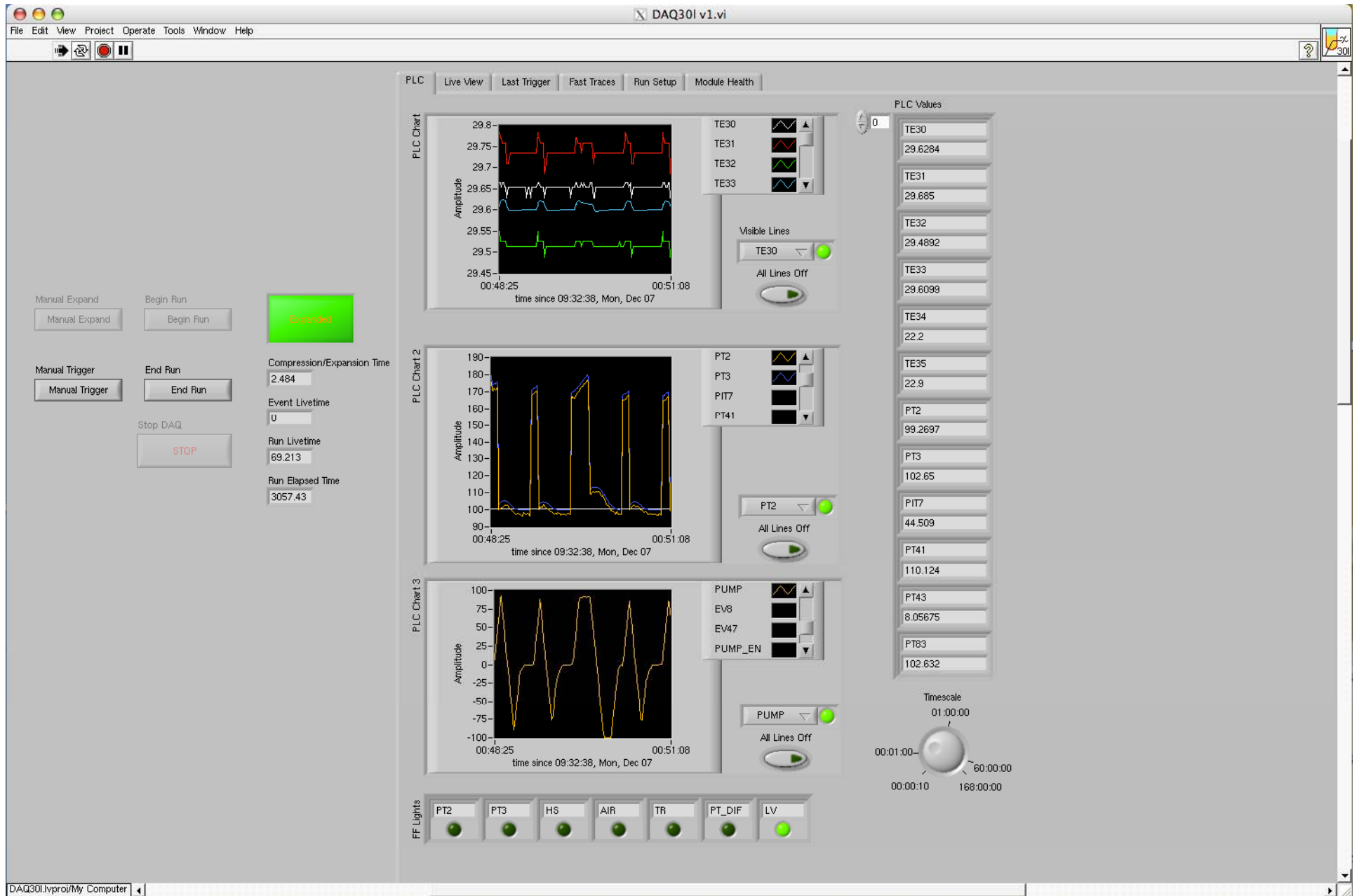WBS 1.5

Peter Cooper, C. Eric Dahl, Dan Broemmelsiek,
Rick Kwarciany, Greg Deuerling

DAQ Modules

Diagram showing DAQ module connections:
- PLC → CTIC: 0-24 V digital line; CTIC → PLC: relay
- CTIC ↔ Basler cameras: 4bit TTL
- CTIC ↔ Linux box (LabView): serial
- PLC ↔ Linux box (LabView): ethernet (MODbus)
- Basler cameras → Linux box (LabView): ethernet (telnet, NFS, UDP)
- Muon Veto ↔ Linux box (LabView): ethernet (custom binary)
- SlowDigitizers ↔ Linux box (LabView): PXI (DMA)
- FastDigitizers ↔ Linux box (LabView): PXI (controlled)
- TTL line connecting PLC region to Muon Veto and FastDigitizers
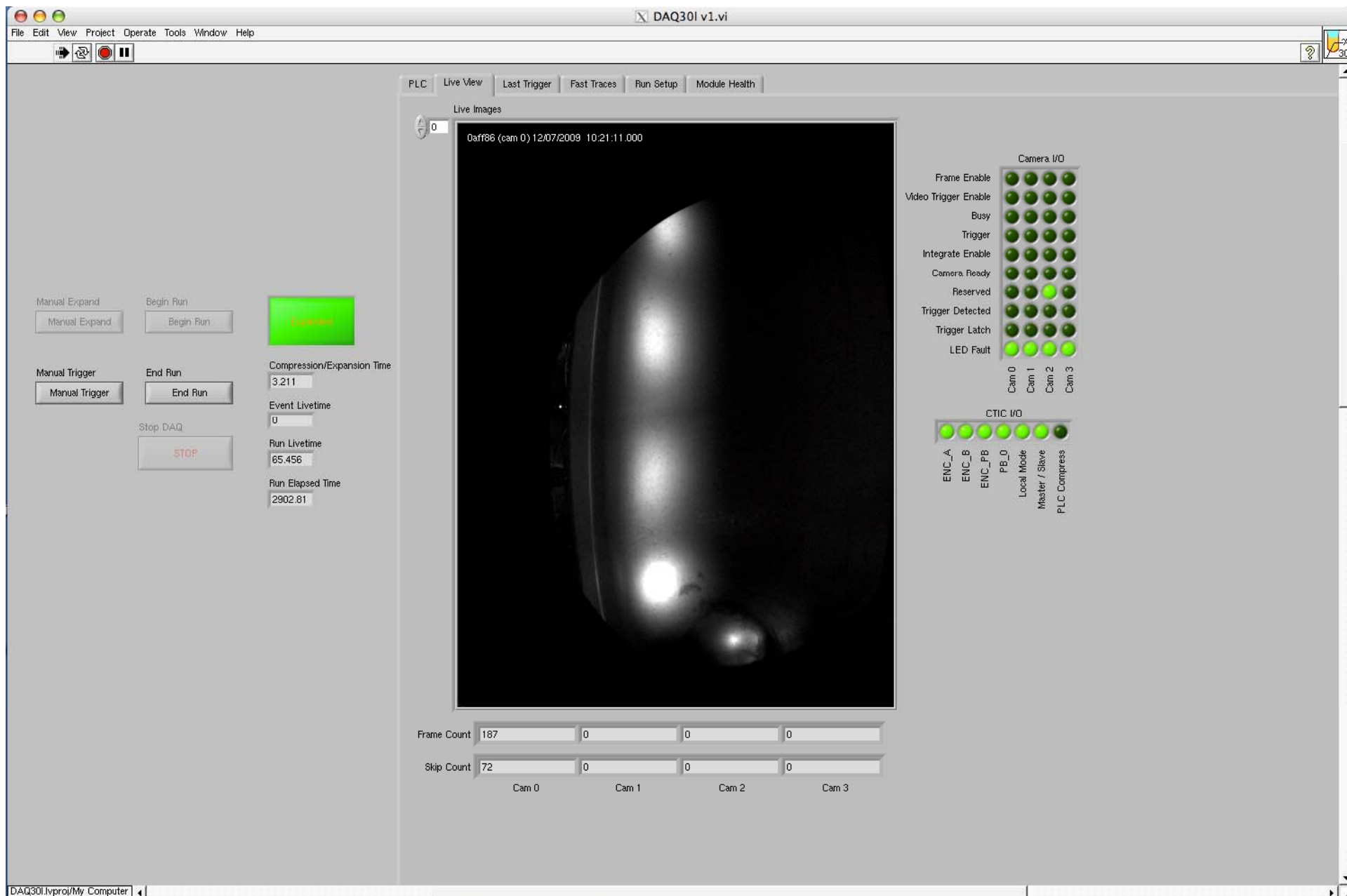
Linux box (LabView)

- Each module has corresponding LabView "virtual instrument", that
  - Handles communication to physical module
  - Responds to notifiers from "Main"
    - (Re)Launch
    - Arm for Trigger
    - Report on Event
    - Module-specific commands
      - Expand (PLC), Manual Trigger (PLC), Enable Video Trigger (CTIC)
  - Writes data for each event
  - When idle, sends log info to "Main"

Completion Status: PLC

- Hardware
  - Working in current state since spring
  - Building list of minor fixes for next run
    - Additional self-trigger condition
    - Changes to power-on state
    - Repair/remake cable to CTIC
- Software
  - Low-level (MODbus) code written and working
  - Virtual instrument written and working
  - Settings, event output, idle output defined and implemented
    - Need to tune piston position (compressed setpoint) to match pressure (expanded setpoint)
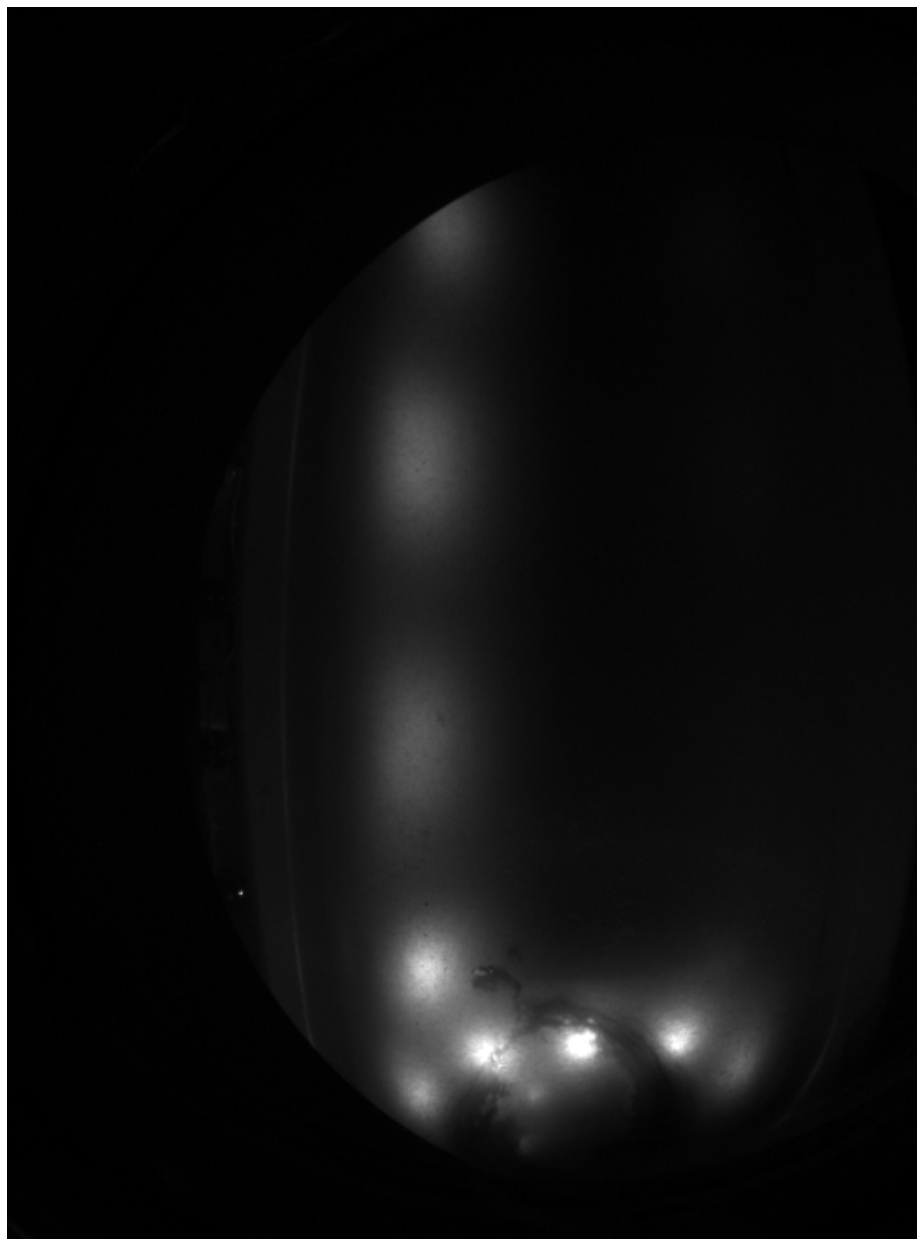
Completion Status: CTIC

- Hardware / Firmware
  - Operational unit completed Dec 3
    - Oct 1 - Firmware changes in CTIC requested (video trigger enable bit)
    - Nov 11-19, CTIC tested at D0, successfully triggered on bubbles and fanned signal to PLC, but full trigger fanout is missing
    - Nov 30, TTL output to Veto/Digitzers added, 0-24 V input from PLC added
    - Dec 2, frame-count and frame-skip-count fixed in firmware
    - Dec 3, 0-24 V input from PLC properly isolated
    - Dec 5, PLC <-> CTIC cable repaired

Completion Status: CTIC

- Software
  - Communication with module not robust, improved error handling necessary
    - Serial communication hang-up after 2 hour run
  - Virtual instrument written and working
  - Settings, event output, idle output defined and implemented

Completion Status: Cameras

- On-camera Software (operational Dec 4)
    - Multi-threaded Operation:
        - Main Thread
            - Receives settings from LabView via UDP
            - Updates settings in thread-safe manner
            - Starts/Stops imaging thread
        - Imaging Thread
            - Receives external triggers
            - Calculates video triggers
            - Communicates with CTIC (4bit TTL)
            - Writes images to NSF mounted disk
            - Operates up to 50 fps, more possible with reduced region-of-interest for trigger
        - Remaining issues
            - Late images for PLC triggers
            - Frame skipping
            - Synchronization of cameras untested at D0
            - Occasional failure to launch Imaging thread

COUPP 60 Installation Readiness
Review

Completion Status: Cameras

- LabView Software
  - Main camera threads launched by hand over telnet
    - Re-launching cameras from LabView not yet possible
  - Simultaneous read-write problem for live images (idle output)
  - Virtual instrument written and working
  - Settings, event output defined and (mostly) implemented

Completion Status: Veto

- Hardware / Firmware
  - Operational on 4kg chamber
  - Installed at D0
  - see Jeter's talk…

- Software
  - Low-level software written and working on 4kg chamber
  - Virtual instrument not yet written for COUPP60 DAQ

Completion Status: Digitizers

- Hardware
  - Limited to National Instruments boards supported on Scientific Linux
  - PXI-6115 (4 channels, 10 MHz per channel) in hand for Fast Digitizers
    - Less expensive options available on other platforms
    - Can run isolated Windows machine to manage digitizers
  - PXI-6221 (16 channels, 250 kHz total) in hand for Slow Digitizers

Completion Status: Digitizers

- Software
  - Low-level software provided by National Instruments
    - Tested on test-stand at FCC
    - Bugs in NI code found, corrected, reported
    - Fast digitizers (controlled memory access) working
    - Slow digitizers (DMA) working at rates below NI specifications, sufficient for our needs
  - Virtual instruments not yet written for COUPP60 DAQ

COUPP 60 Installation Readiness Review

Summary

- On verge of long-term data taking
  - Remaining issue (CTIC serial) will be addressed this week
- Veto and digitizer virtual instruments needed
  - Operating bubble chamber not necessary to integrate these components
  - 1-2 post-doc weeks to finish
- Cannot further test video triggering on bubbles with current lighting
- Current D0 run can end next week, DAQ will be complete for next run