

# DPS test results in preparation for Li oven test

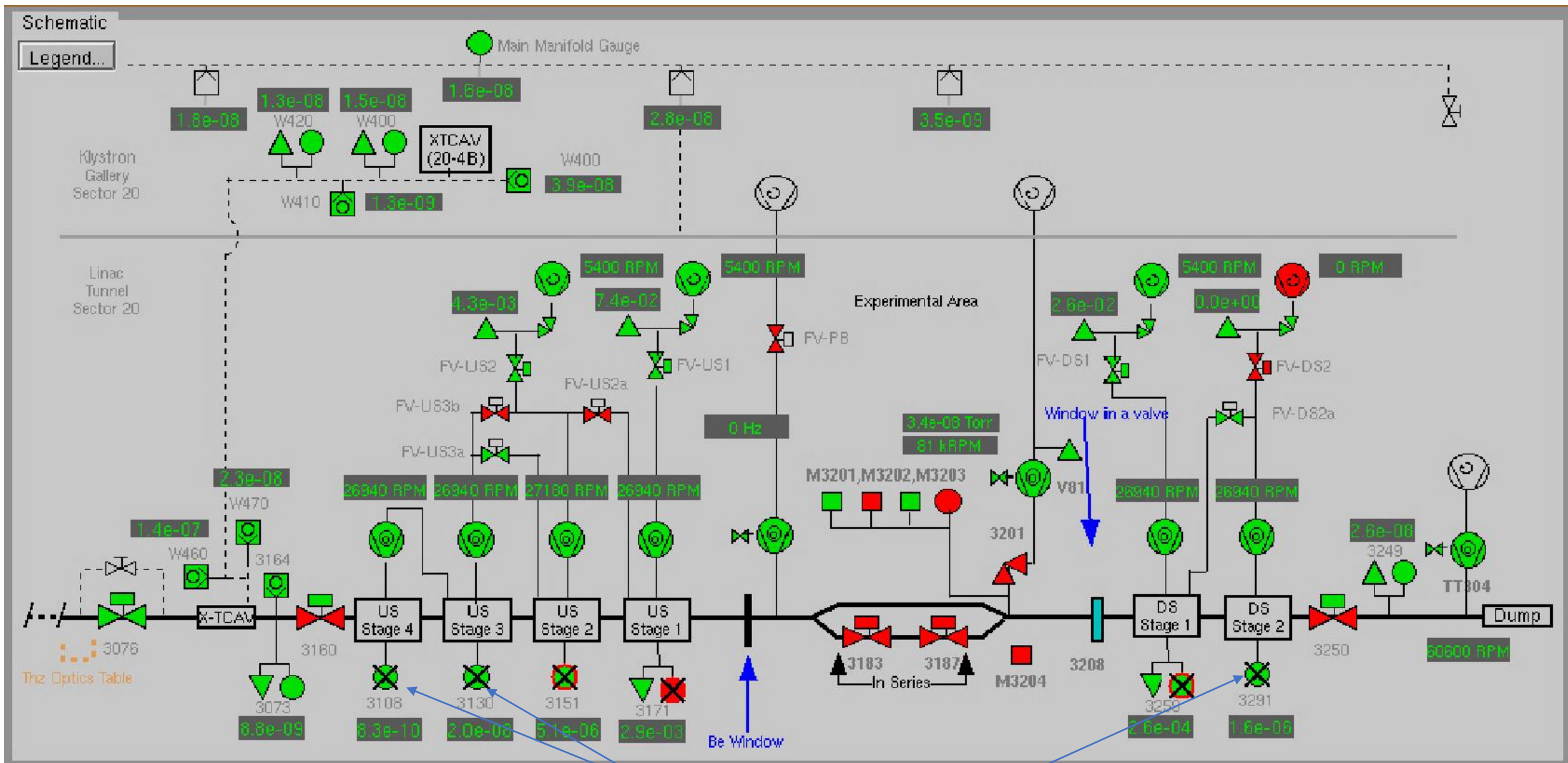
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# Test goals

- Stability
  - Record IP pressures over long term
- Failure mode tests
  - Record IP response to possible DPS failure modes
    - Trip off each US-DPS pump
    - Trip off the entire DS-DPS
    - Trip fill valve
    - Re-open fill valve after being closed
- Demonstrate readiness for Li oven test with DPS

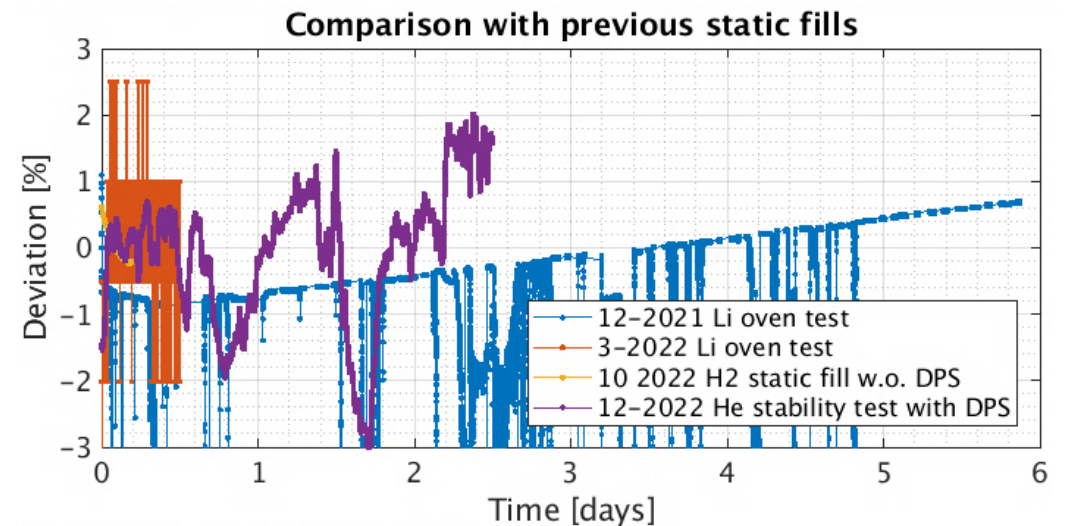
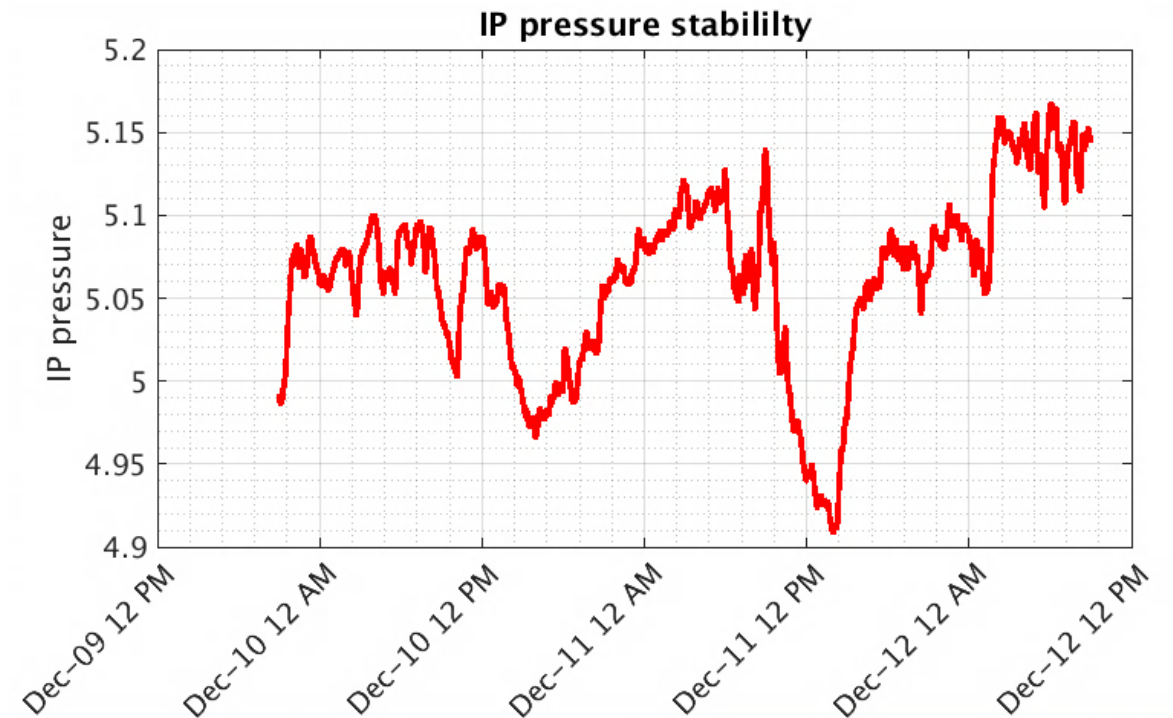
# Nominal operating state of DPS with 5 Torr He fill



Not normally bypassed

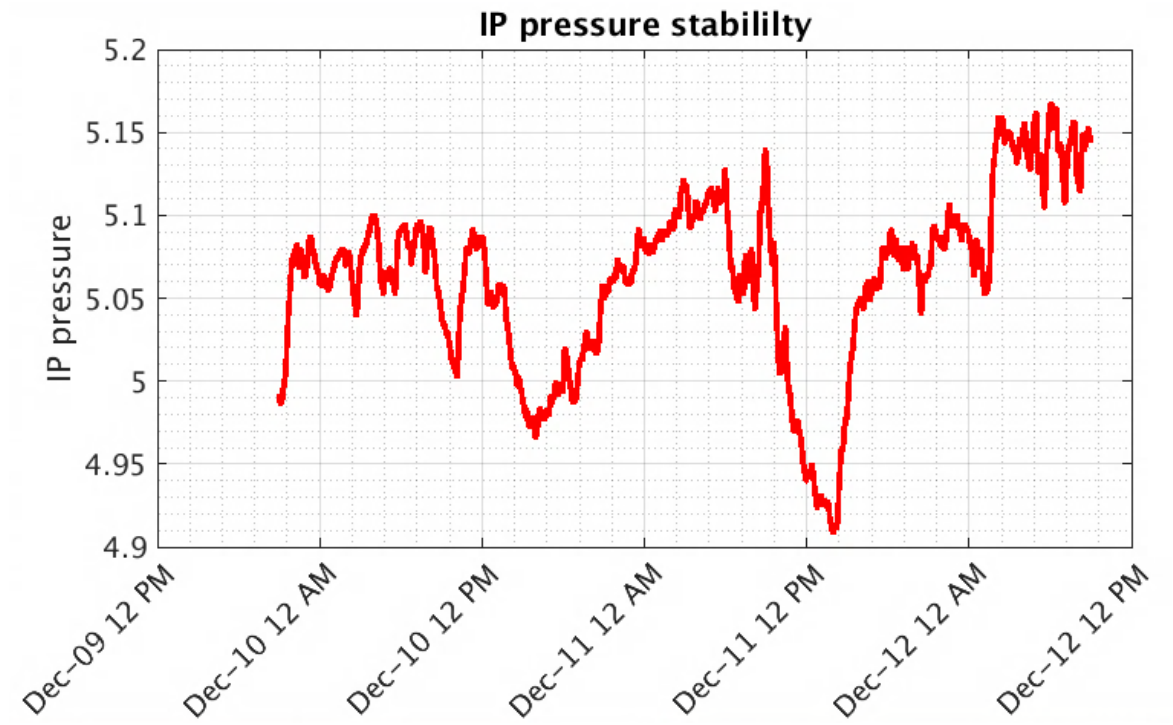
# Stability results

- Pressure stayed within  $\pm 2\%$  of the  $\sim 5$  Torr setpoint
- Largest deviation appears to be a diurnal component
- Likely the result of a change in flow rate
  - Still using Dwyer mechanical flow meter
  - Working on replacing this with MKS GM50A
- Note that this is still a very slow drift
  - i.e. hours for %-level change, not minutes
- This variation was not seen during other long term static fills



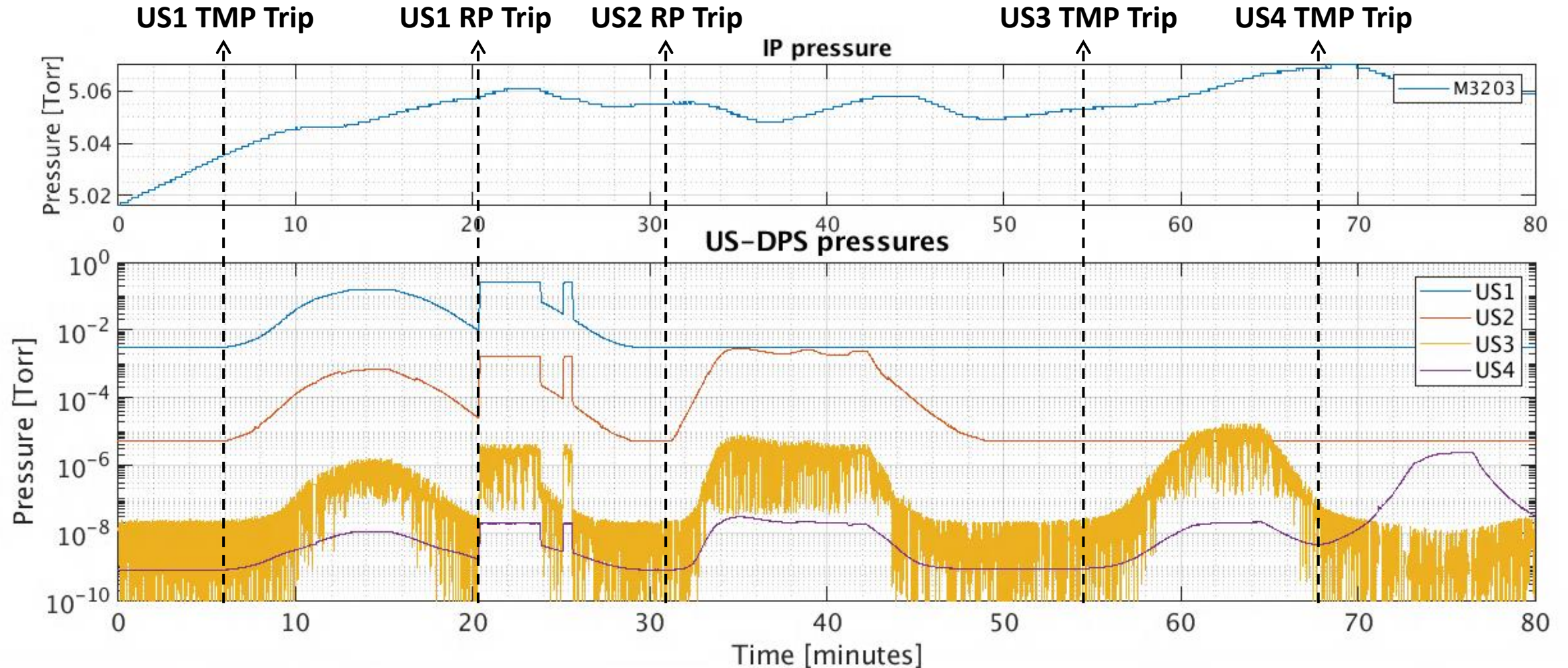
# Pressure stability

- This pressure variability should have no impact on Li oven operation
- %-level drift over an entire E300 shift should not significantly affect the experiment
- And finally - we can improve on this with the electronic mass flow regulator.



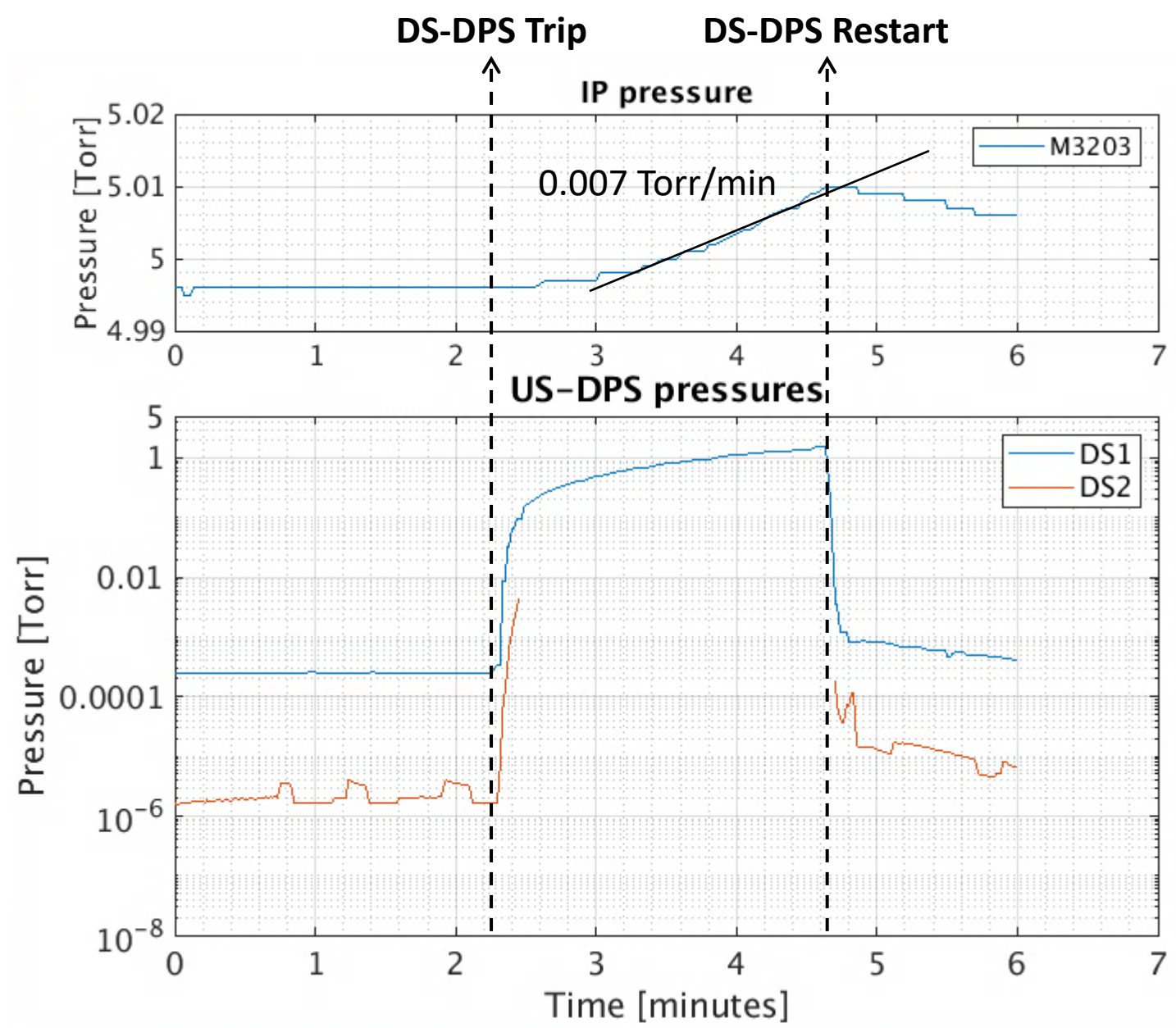
# Failure mode test results - single stage failure

- IP pressure stays unchanged at sub %-level for every trip type
- US4 pressure only raises enough to stop beam operation if US4 turbo stops
- *Note - Interlock on fill valve bypassed in these tests*



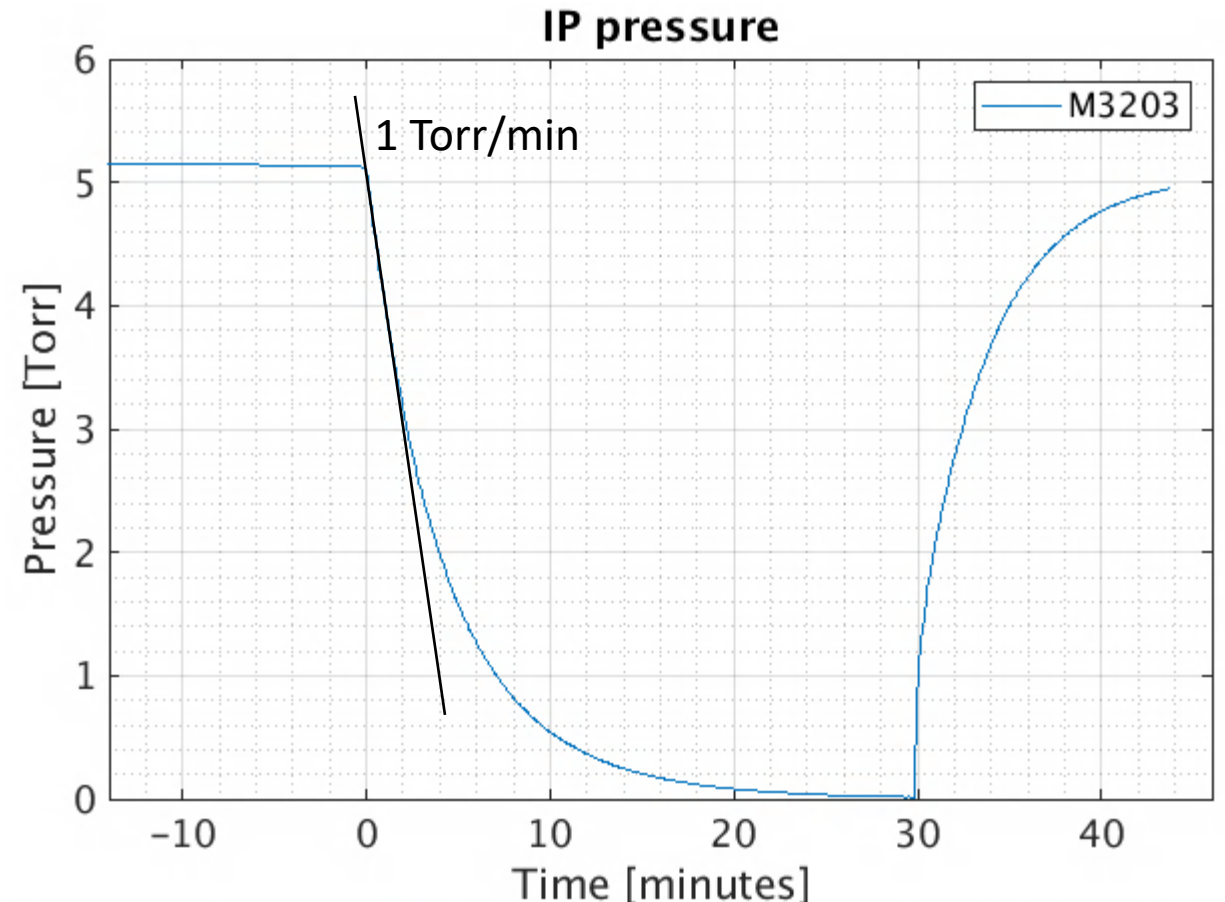
# Failure mode test results – Entire DS-DPS failure

- Entire DS-DPS tripped off
  - DS1 roughing pump
  - DS1 and DS2 turbos
- DS1 increases to 1 Torr quickly
- IP pressure rises at rate of 0.007 Torr/minute
- *Note – the hole in the DS-DPS is quite small, so this would be somewhat faster with a straw aperture*



# Failure mode test results – Fill valve trip

- IP pressure falls at  $\sim 1$  Torr/min if the fill valve closes
  - Lots of time to close the oven valves
- About 10 minutes to evacuate the IP to  $< 0.5$  Torr
- About 15 minutes to recover stable IP pressure after opening the fill valve
- Currently the fill valve trips on a beamline pressure fault:
  - i.e. US4 pressure  $>$  set point
  - Or, US3 CC gauge turns itself off because the US2 CC gauge faults

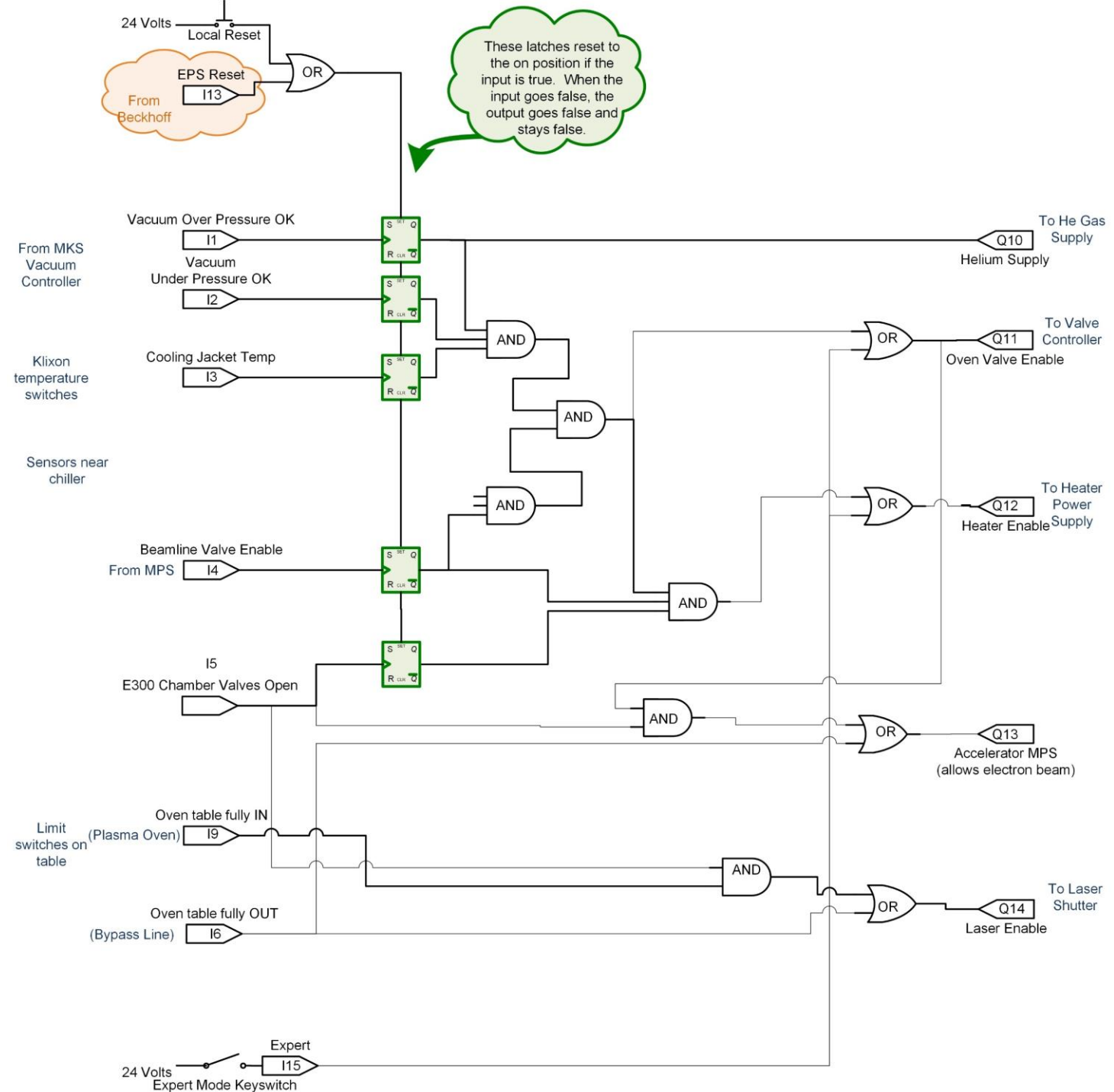




# EPS

- Current trip conditions:

- Pressure in oven too high
- Pressure in oven too low
- Loss of oven cooling water (over-temperature ~75 deg C)
- Loss of beamline valve enable from MPS which may be due to one or more of:
  - Pressure high in FACET beamline
  - Differential Pumping System failure
  - Sector 19/20 access



# My recommendations

- Pressure stability is good as is, but planned upgrades should improve this further
- We should add additional logic to EPS to prevent an unnecessary trip of the fill valve and oven recovery
  - i.e. Do not trip the fill valve on a beamline vacuum fault
- The shielding added to all 4 roughing pumps should reduce the frequency of trips in any case
  - No trip of shielded DS1 pump during Nov-Dec run
  - One trip each for the unshielded US1 and US2 pumps- shielding being added now
  - *DS2 was off for this period*
- Readiness for Li oven test?