Equipment and e-linac commissioning

Kate & Ethan

Multiple stages to commissioning

1. **No beam**: does everything turn on? Is the polarity right? Can we read it out? Is it in EPICS if it should be? Etc, etc

   - Estimated time: a couple days

2. **Beam, but no target**: this allows us to commission the optics, in particular to make sure the PMQs are producing a field sufficiently close to what we simulated that the beam transport will work. Essentially pure e-linac tasks, rather than DarkLight

   - Estimated time: could be a couple days, could be longer if the optics give trouble

3. **Beam on target**: now we start the “real” experiment commissioning. Follow procedures described in Section 10 of commissioning plan attached to this agenda item

   - As far as I know, the 300 hours of data taking that we requested for commissioning counts in this section, not before. Not sure who to clarify that with but if Stephi is present maybe she knows?

   - Produces data for measurements Ethan will discuss shortly

Commissioning the detectors

- Note that we can start commissioning the detector system before we get beam on target, both using cosmic rays and for studying backgrounds/noise in environment

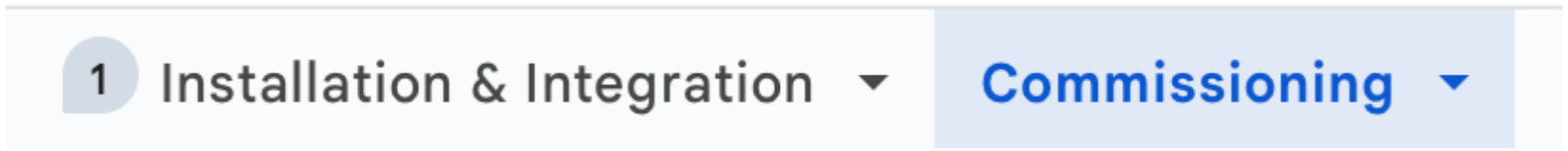
- Believe we are all on the same page that we should begin this

- However, commissioning with electrons & positrons of known/expected energy will require beam on target

- I'm mostly focusing on the non-experiment equipment in these slides on pre-target commissioning, but I am not meaning to exclude these studies.

Commissioning checklist

- Made a new tab in DarkLight to-do-list sheet.
  - https://docs.google.com/spreadsheets/d/17ZQipk7hrhHMKlkH7NgX8mNZbqcx0eAG6KceL1h046g/edit?usp=sharing
- Click “Commissioning” at the bottom:



- Please help me spot anything missing or offer suggestions! Especially useful: help with defining clear acceptance criteria for each test
- Let’s use this sheet collectively for tracking commissioning progress. If you mark an item as done or in progress, add your name to the “Checked by” column so we can follow up if needed
- Example screenshots coming up, just skim them ->

DarkLight Commissioning Tasklist

Commissioning plan Docushare number: Document-20244078
Commissioning report Overleaf link: [not yet created]
Example commissioning plans: Document-191059, Document-241968, Document-171793

Yellow: e-linac co
Pink: experiment

Object	Task	Sub-task	Checked by	Required energies:	Checked at energies:	Checks completed?	Succeeded?	Documented?	Method of validation or acceptance criterion
Stage 1: to be done before beam									
Steerers									
	Steerer 1 (EHDT:YCB4B)	Correctly named and visible in EPICS							Self-evident
		Can be turned on/off							Check that readback says it's on or off. Actual effect
	Steerer 2 (EHDT:XCB7 and	Correctly named and visible in EPICS							Self-evident
		Can be turned on/off							Check that readback says it's on or off. Actual effect
EMQs									
	EMQ 1 (EHDT:Q8)	Correctly named and visible in EPICS							Self-evident
		Can be turned on/off							Can we confirm with hand-held magnet?
		Polarity correct							Check polarities with same magnet
	EMQ 2 (EHDT:Q9)	Correctly named and visible in EPICS							Self-evident
		Can be turned on/off							Can we confirm with hand-held magnet?
		Polarity correct							Check polarities with same magnet
BPMs									
	BPM 1 (EHDT:BPM4)	Named, visible, and readout visible in EPICS							Self-evident
		Integrated into interlock?							Can only check that implementation exists until bear
	BPM 2 (EHDT:BPM7)	Named, visible, and readout visible in EPICS							Self-evident
		Integrated into interlock?							Can only check that implementation exists until bear
	BPM 3 (EHDT:BPM9)	Named, visible, and readout visible in EPICS							Self-evident
		Integrated into interlock?							Can only check that implementation exists until bear
Camera at DarkLight target ladder									
		Distance calibration done and recorded in system							Self-evident
		Can see viewscreen and calibration points when screen is in place							Self-evident
		Integrated in e-linac system however other cameras are							Self-evident
Viewscreen in front of dump (EHDT:VS9)									
		Distance calibration done and recorded in system							Self-evident
		Can see viewscreen and calibration points when screen is in place							Self-evident
		Integrated in e-linac system however other cameras are							Self-evident
Collimator (EHDT:COL9)									
	Correctly named and visible in EPICS								Self-evident
	Current readback visible								Should be zero with no beam
	Flow rate accurately displayed								Turn water on/off to validate
	Integrated into interlock								Can only check that implementation exists until bear
Target ladder									
	Can move up and down from e-linac EPICS								Hit the button and check what happens
	Position calibration aligned with visual feedback								Once it's installed, best thing we can do to check po
Experiment spectrometers									
	Visible in and controllable from DarkLight EPICS (DL EPICS)								Self-evident
	Software interlock in place (current based? confirm with Jan)								?
	Hardware interlock connected to water flow meters in place								?
	Flow rates accurately displayed in DL EPICS								Turn water on/off to validate
	Hall probes correctly installed and reading out successfully								Should report fields appropriate for settings
	Polarities set correctly for electrons in both arms								Check polarities with hand-held magnet
GEMs									
	Gas flow established and monitoring working smoothly								Self-evident
	New power cables and hookups working correctly								Confirm hits being successfully read out
	Read back of voltage settings working in DL EPICS								Confirm visually on power supply
	Successful readout triggering re-established with setup in hall								Test with cosmics run; should be able to reconstruct

Stage 2: beam; no target								
Steerers								
	Steerer 1 (EHDT:YCB4B)	Beam moved correct amount and direction: x axis	Only one; any					Monitoring of beam with downstream screen or BPM should indicate appropriate
		Beam moved correct amount and direction: y axis	Only one; any					Monitoring of beam with downstream screen or BPM should indicate appropriate
	Steerer 2 (EHDT:XCB7 and	Beam moved correct amount and direction: x axis	Only one; any					Monitoring of beam with downstream screen or BPM should indicate appropriate
		Beam moved correct amount and direction: y axis	Only one; any					Monitoring of beam with downstream screen or BPM should indicate appropriate
EMQs								
	EMQ 1 (EHDT:Q8)	Correctly named and visible in EPICS	Only one; any					Self-evident
		Can be turned on/off	Only one; any					Self-evident
		Polarity correct	Only one; any					Adjust beam and verify with downstream viewscreen that impact is as expected
	EMQ 2 (EHDT:Q9)	Correctly named and visible in EPICS	Only one; any					Self-evident
		Can be turned on/off	Only one; any					Self-evident
		Polarity correct	Only one; any					Adjust beam and verify with downstream viewscreen that impact is as expected
BPMs								
	BPM 1 (EHDT:BPM4)	Reported beam position consistent with other diagnos	Only one; any					Compare to neighbouring viewscreen reports and/or dump current
	BPM 2 (EHDT:BPM7)	Reported beam position consistent with other diagnos	Only one; any					Compare to neighbouring viewscreen reports and/or dump current
	BPM 3 (EHDT:BPM9)	Reported beam position consistent with other diagnos	Only one; any					Compare to neighbouring viewscreen reports and/or dump current
Camera at DarkLight target ladder								
	Confirm visible beam on viewscreen		Only one; any					Self evident
	Confirm calibration of size		Only one; any					Size as calculated by calibration should agree with optics model within uncertain
Viewscreen in front of dump (EHDT:VS9)								
	Confirm visible beam on viewscreen		Only one; any					Self evident
	Confirm calibration of size		Only one; any					Size as calculated by calibration should agree with optics model within uncertain
Collimator (EHDT:COL9)								
	Interlock working		Only one; any					Misalign beam to increase current to collimator and watch for interlock trip at ex
	Current readout working		Only one; any					Nonzero and sensibly sized readout that changes with above test
	Water flow monitoring working		Only one; any					Turn on and off and verify that EPICS displays state correctly
PMQs								
	Confirm alignment by confirming successful beam transport to dump		Only one; any					All beam position monitors downstream must show position as expected; beam
Tune/optics								
	Performance is as expected when EMQs set to field strengths specified in optics c		All					All beam position monitors downstream must show position as expected; beam
	Collimator current readout shows acceptable values		All					Should be very minimal without target in, but technical requirement is < 10 W. R
	Radiation survey shows acceptable levels		All					Below TRIUMF mandated dose limits while beam on

Paperwork - what can we do when

- A question earlier this week about whether we can really proceed to take beam for commissioning.
- First, no paperwork required to commission detectors with backgrounds/cosmics, we can do that whenever we are ready.
- Where we need all approvals in line is when we start running beam to the dump (with or without target in)
- Got: CNSC license update, divisional safety review passed
- Need: official sign off on Gate 4a (waiting on engineering ECO that took a long time to finalize) and for another safety document to be emailed to the operators (it's signed and ready, but person responsible is on vacation - looking for a backup)
- CNSC license was the point of most concern. With that in hand, confident the rest will converge on the timescale of a week or two.

Post-commissioning commissioning

- Reminder that when we want to swap from commissioning to physics running, we need to physically exchange the PMQs by swapping the spool piece downstream from the chamber

- With new PMQs in place, optics need to be re-commissioned (basically a repeat of Step 2 above)

- Nothing else should need to be redone