Commissioning Procedure for bKAGRA Phase 1 (2017.9-2018.3)

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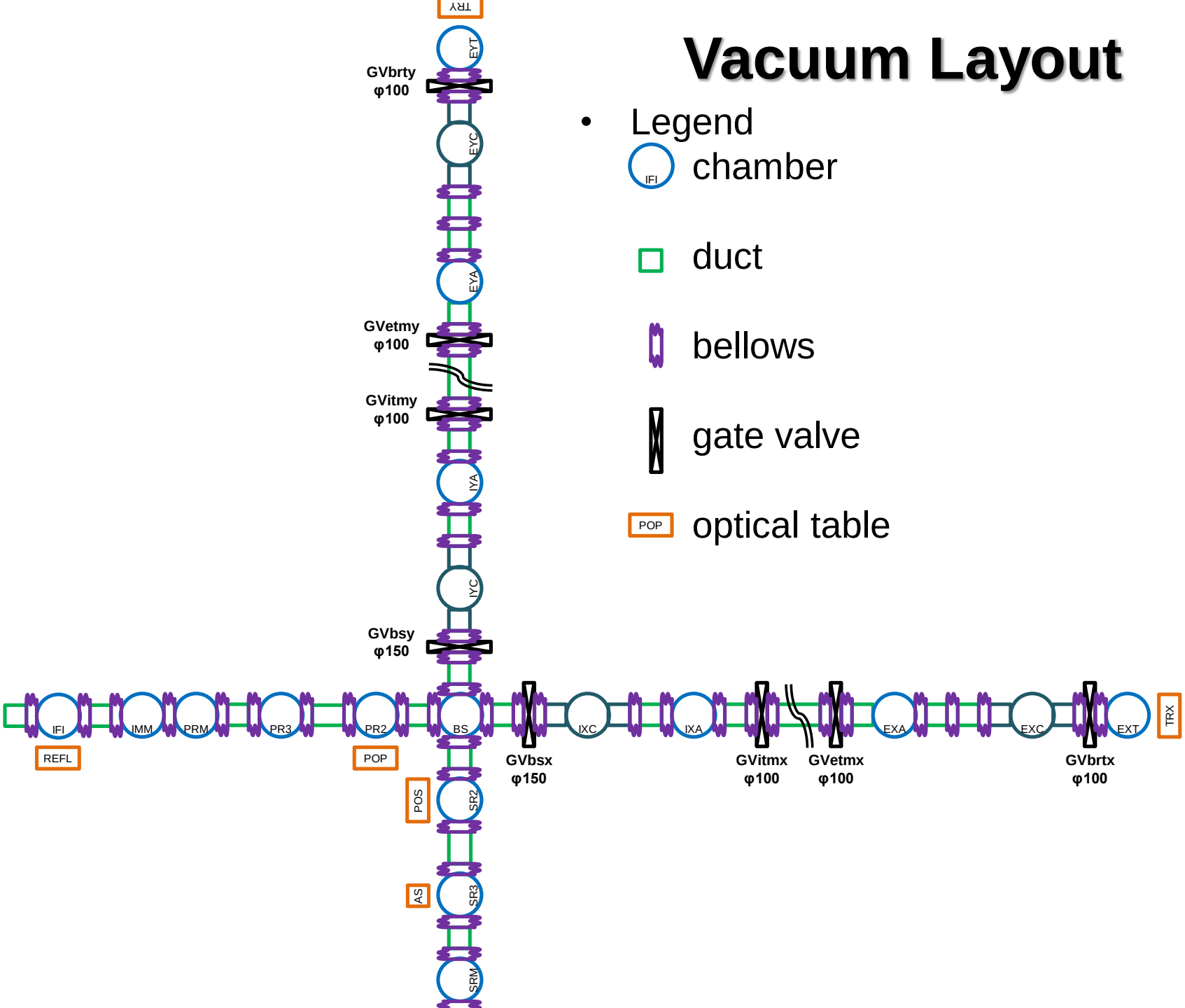
see, also, JGW-T1605595
for interferometer design and commissioning schedule

Vacuum Layout

- Legend
  - chamber
  - duct
  - bellows
  - gate valve
  - optical table



8.31

Expected Situation

- PSL & IMC ready, beam reached PRM (by 8.31)
- BS (by 4.13) and PRs (by 7.6) ready
- SR2 also ready (by 7.31)

EYT BRT installation (7.11-10.2)

Yarm evacuated

PR3-2 not connected

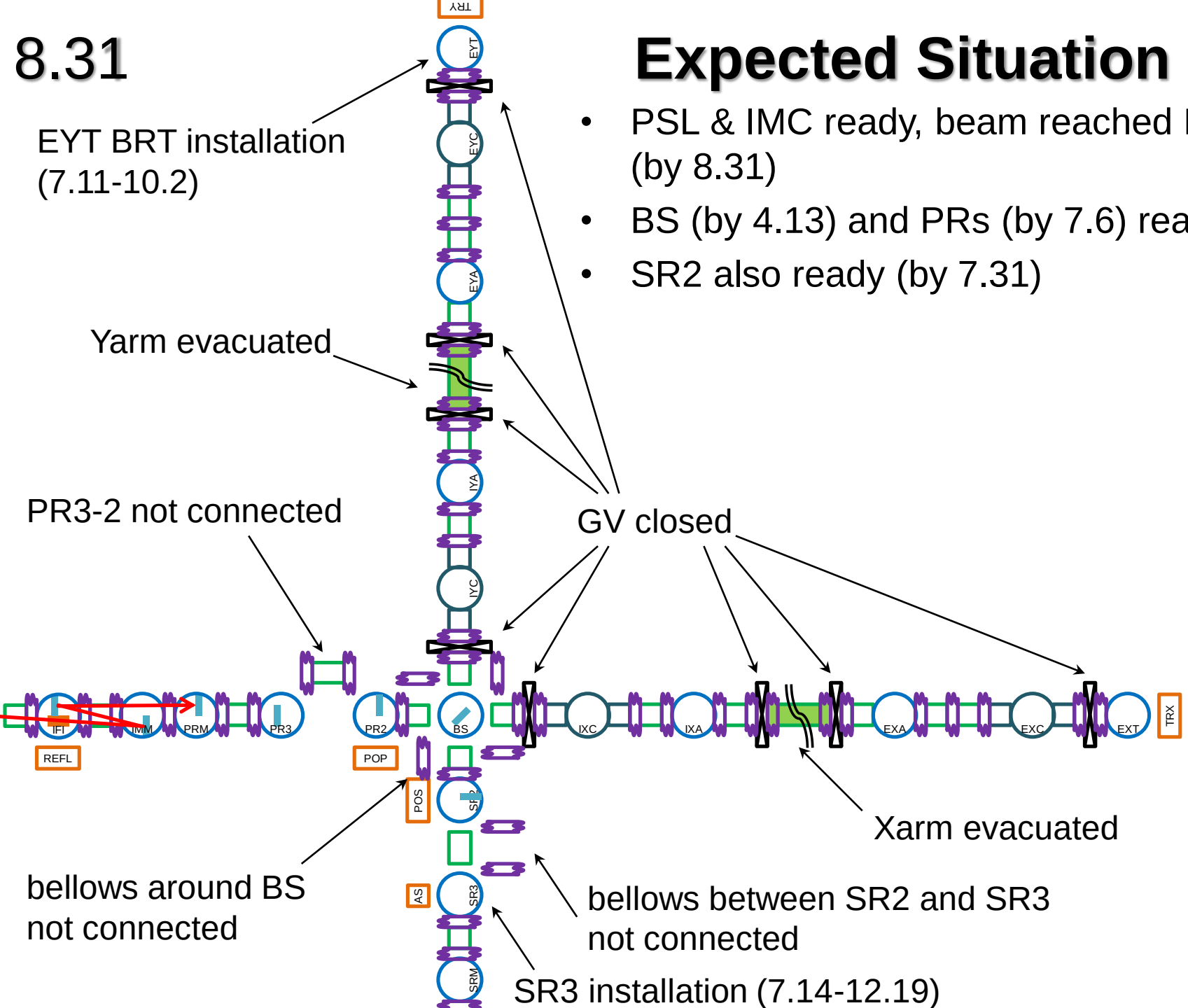
GV closed

Xarm evacuated

bellows around BS not connected

bellows between SR2 and SR3 not connected

SR3 installation (7.14-12.19)



9.1-9.8

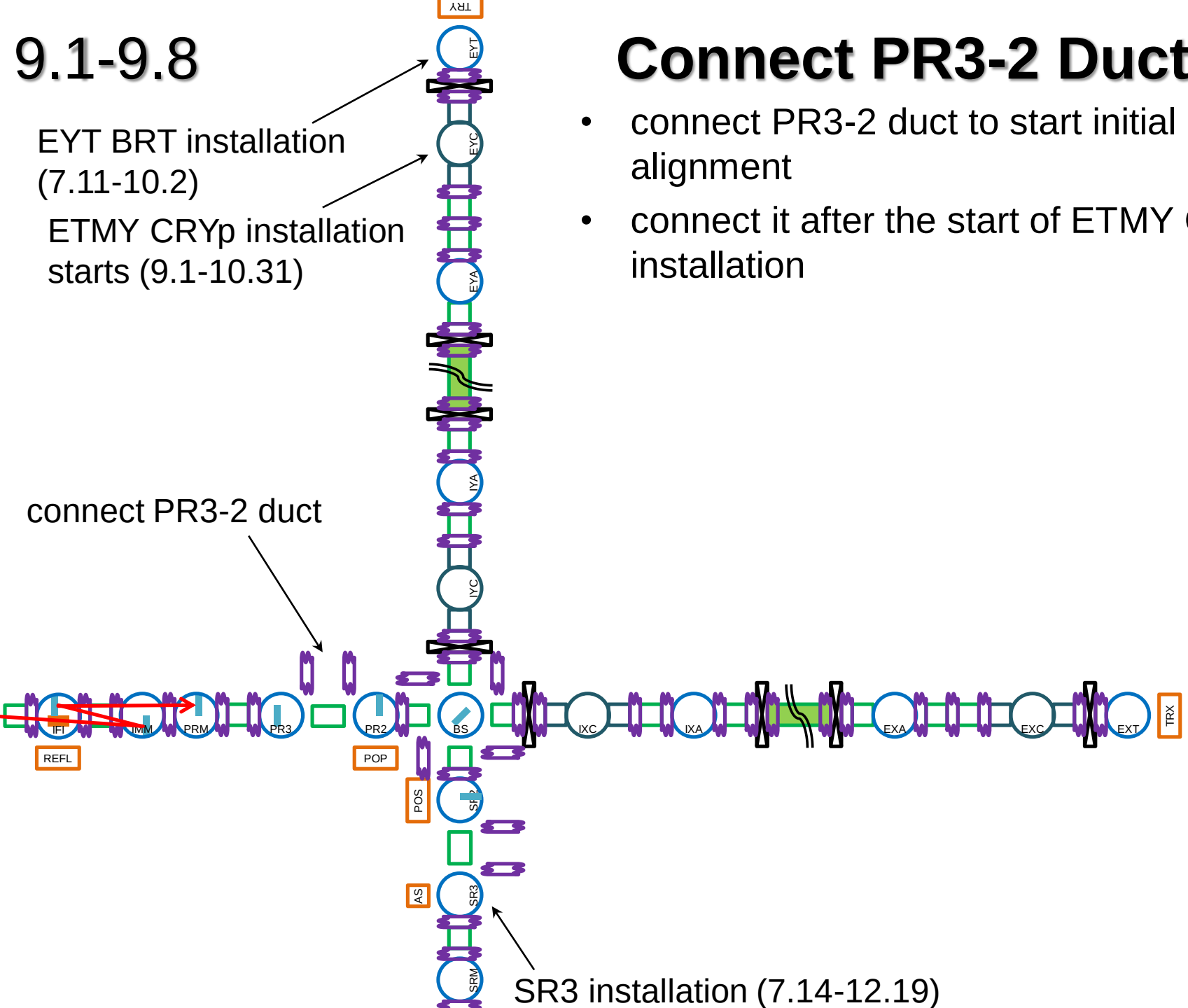
Connect PR3-2 Duct

- connect PR3-2 duct to start initial alignment
- connect it after the start of ETMY CRYp installation

EYT BRT installation (7.11-10.2)

ETMY CRYp installation starts (9.1-10.31)

connect PR3-2 duct



SR3 installation (7.14-12.19)

9.11-9.15 Alignment from IMMT to PR3

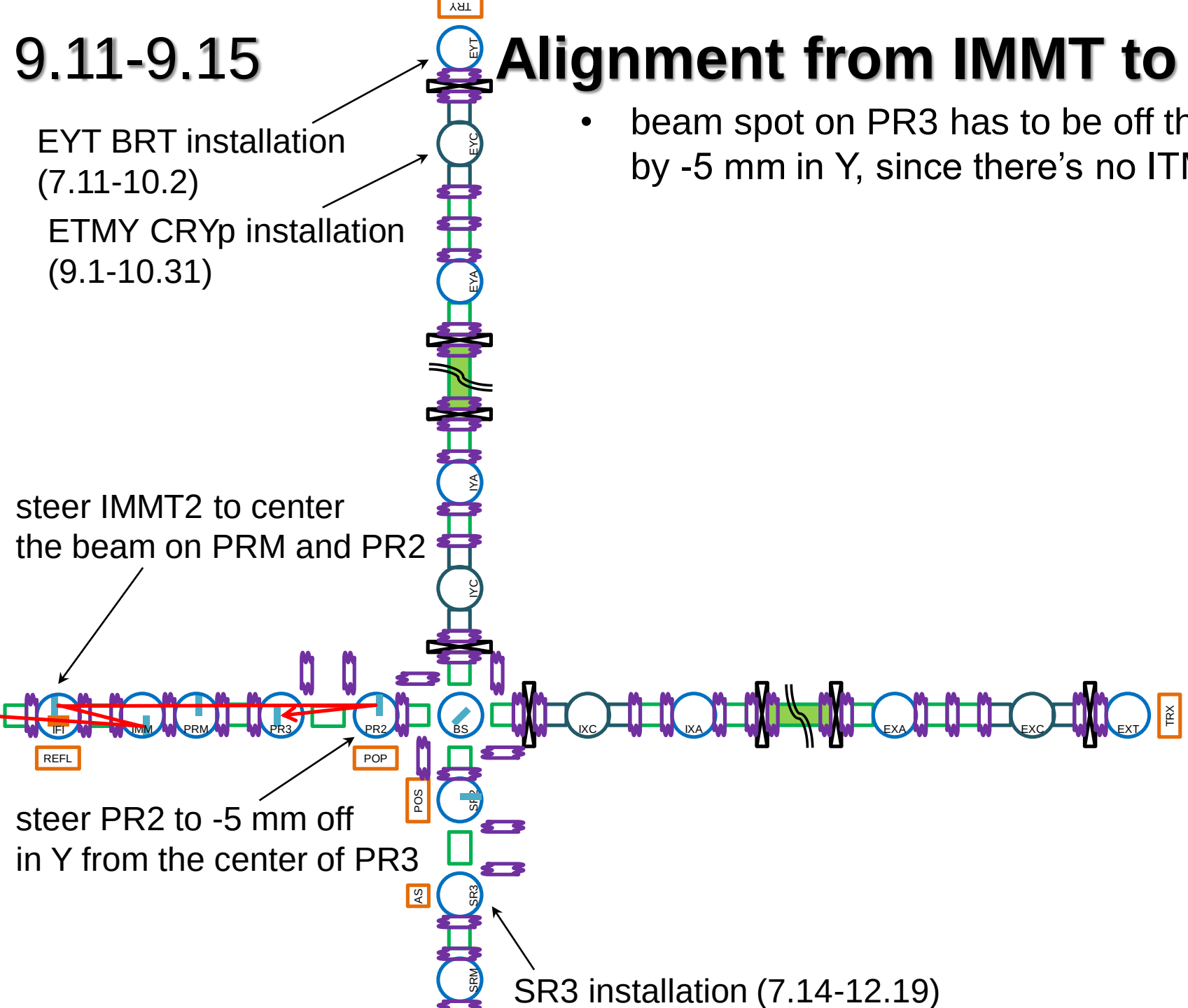
- beam spot on PR3 has to be off the center by -5 mm in Y, since there's no ITM wedge

EYT BRT installation (7.11-10.2)

ETMY CRYp installation (9.1-10.31)

steer IMMT2 to center the beam on PRM and PR2

steer PR2 to -5 mm off in Y from the center of PR3



SR3 installation (7.14-12.19)

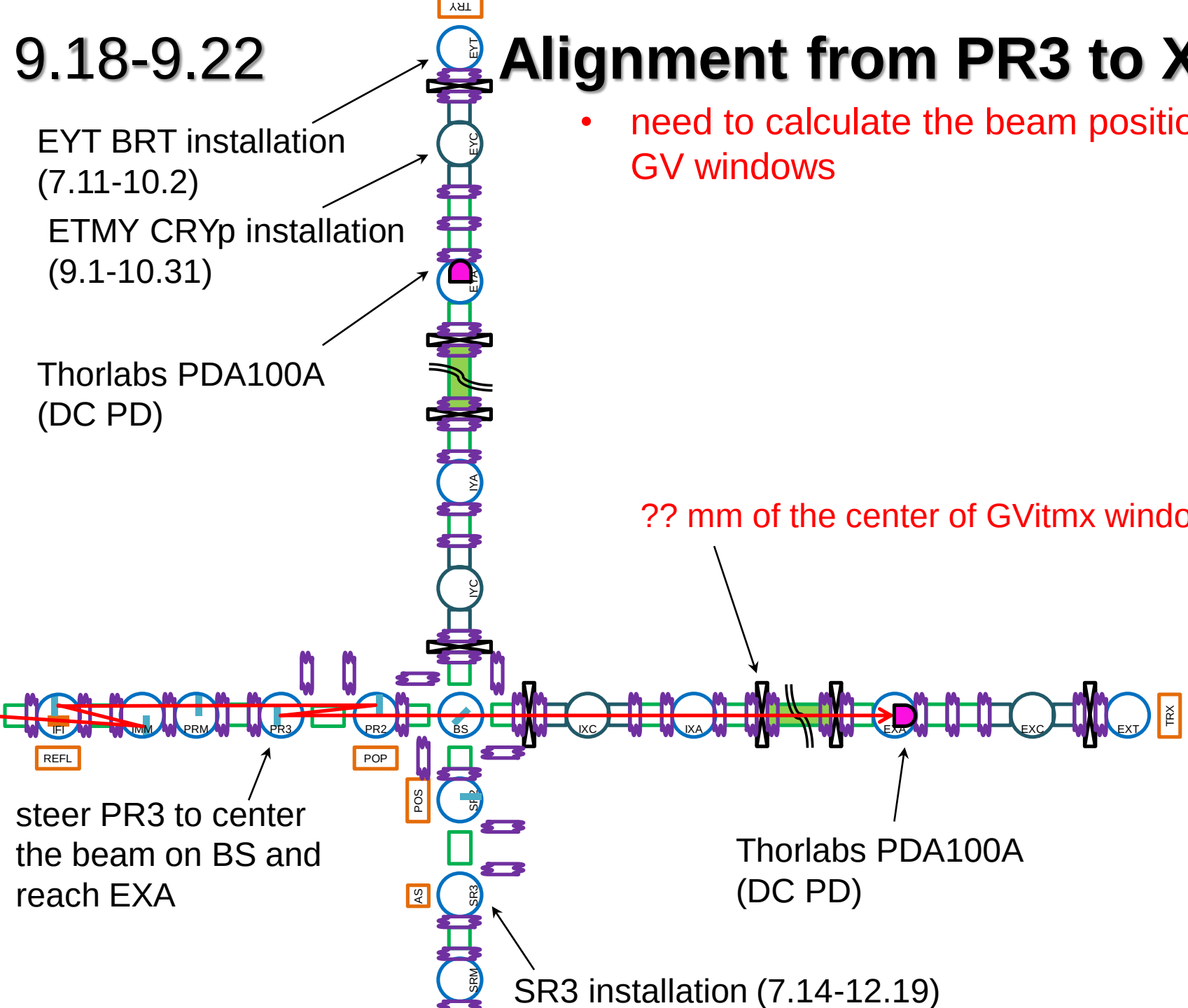
9.18-9.22 Alignment from PR3 to Xend

- need to calculate the beam position on GV windows

EYT BRT installation
(7.11-10.2)

ETMY CRYp installation
(9.1-10.31)

Thorlabs PDA100A
(DC PD)



?? mm of the center of GVitmx window

steer PR3 to center the beam on BS and reach EXA

Thorlabs PDA100A
(DC PD)

SR3 installation (7.14-12.19)

9.25-9.29

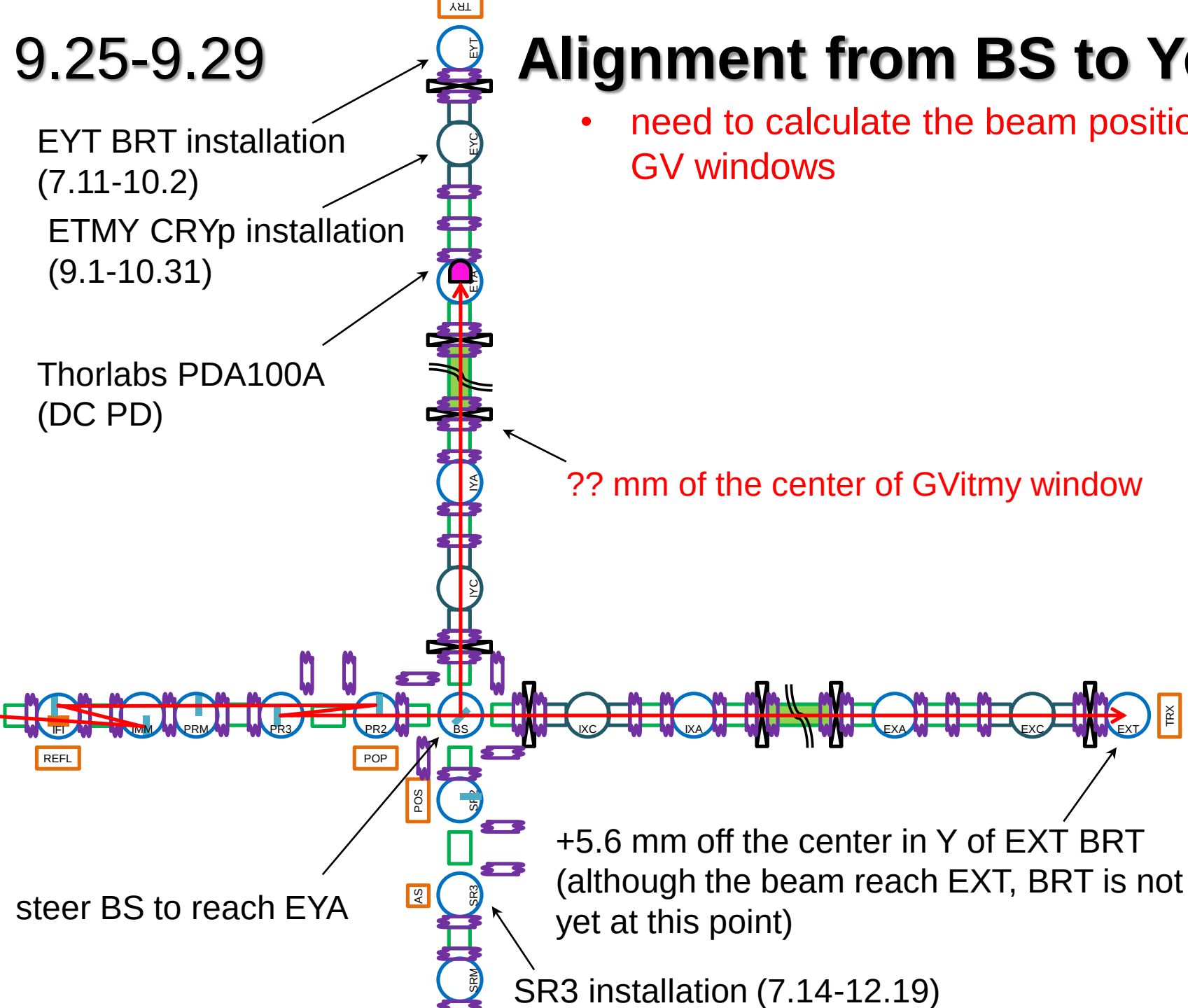
Alignment from BS to Yend

- need to calculate the beam position on GV windows

EYT BRT installation
(7.11-10.2)

ETMY CRYp installation
(9.1-10.31)

Thorlabs PDA100A
(DC PD)



?? mm of the center of GVitmy window

steer BS to reach EYA

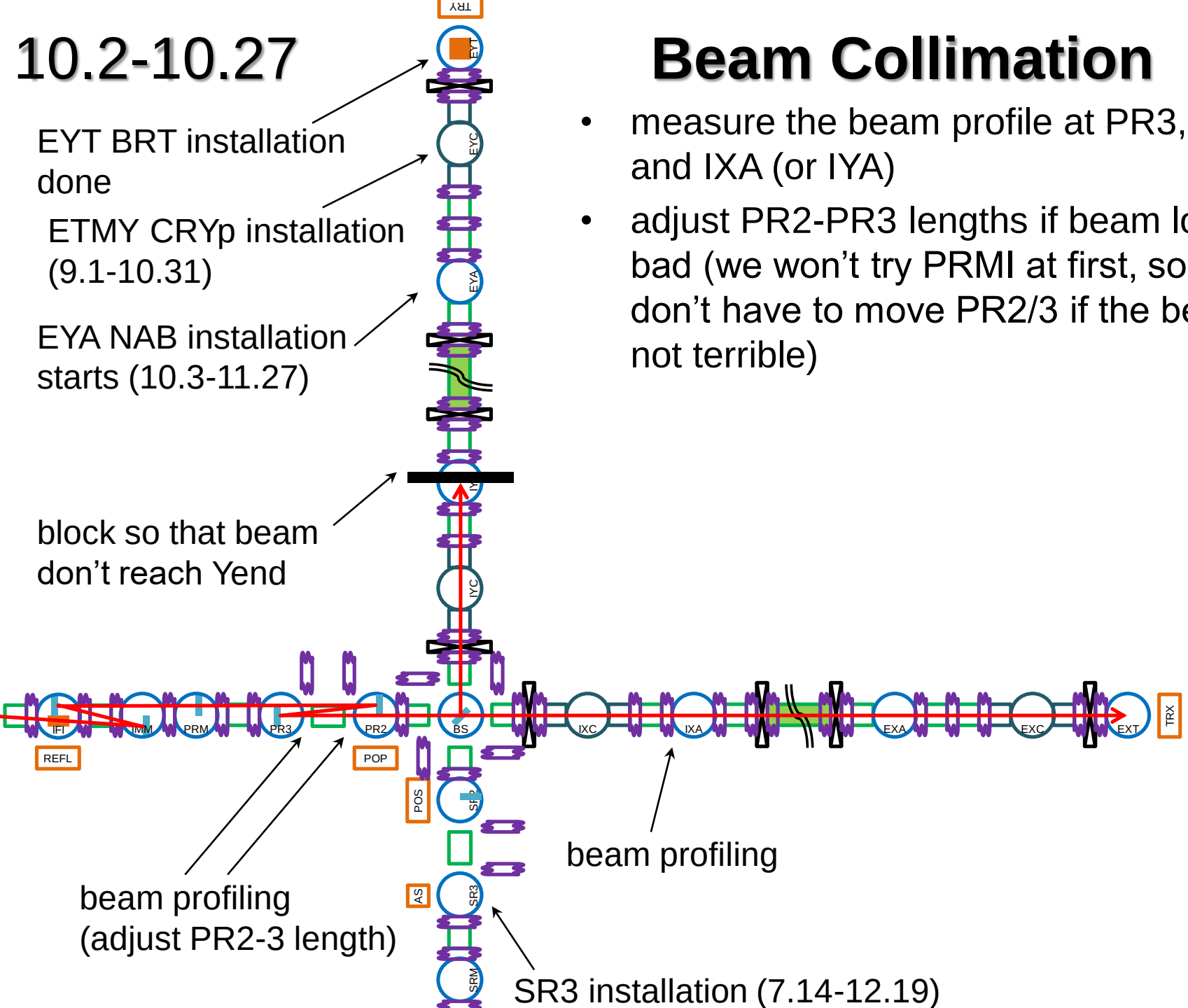
+5.6 mm off the center in Y of EXT BRT
(although the beam reach EXT, BRT is not ready yet at this point)

SR3 installation (7.14-12.19)

10.2-10.27

Beam Collimation

- measure the beam profile at PR3, PR2 and IXA (or IYA)
- adjust PR2-PR3 lengths if beam looks bad (we won't try PRMI at first, so we don't have to move PR2/3 if the beam is not terrible)



11.1-11.7

Align ETMY

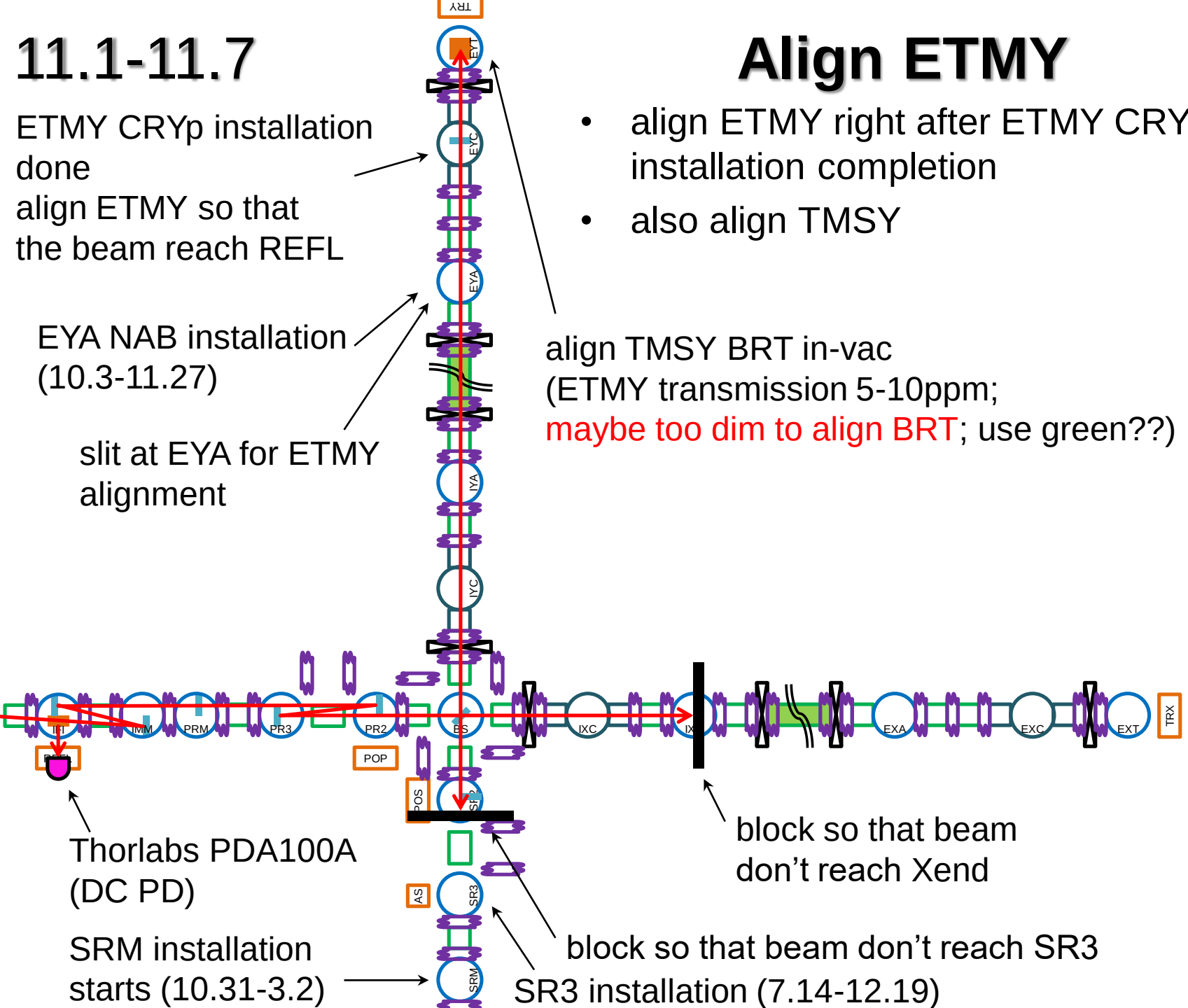
- align ETMY right after ETMY CRYp installation completion
- also align TMSY

ETMY CRYp installation done
align ETMY so that the beam reach REFL

EYA NAB installation (10.3-11.27)

slit at EYA for ETMY alignment

align TMSY BRT in-vac
(ETMY transmission 5-10ppm;
maybe too dim to align BRT; use green??)



Thorlabs PDA100A
(DC PD)

SRM installation starts (10.31-3.2)

block so that beam don't reach Xend

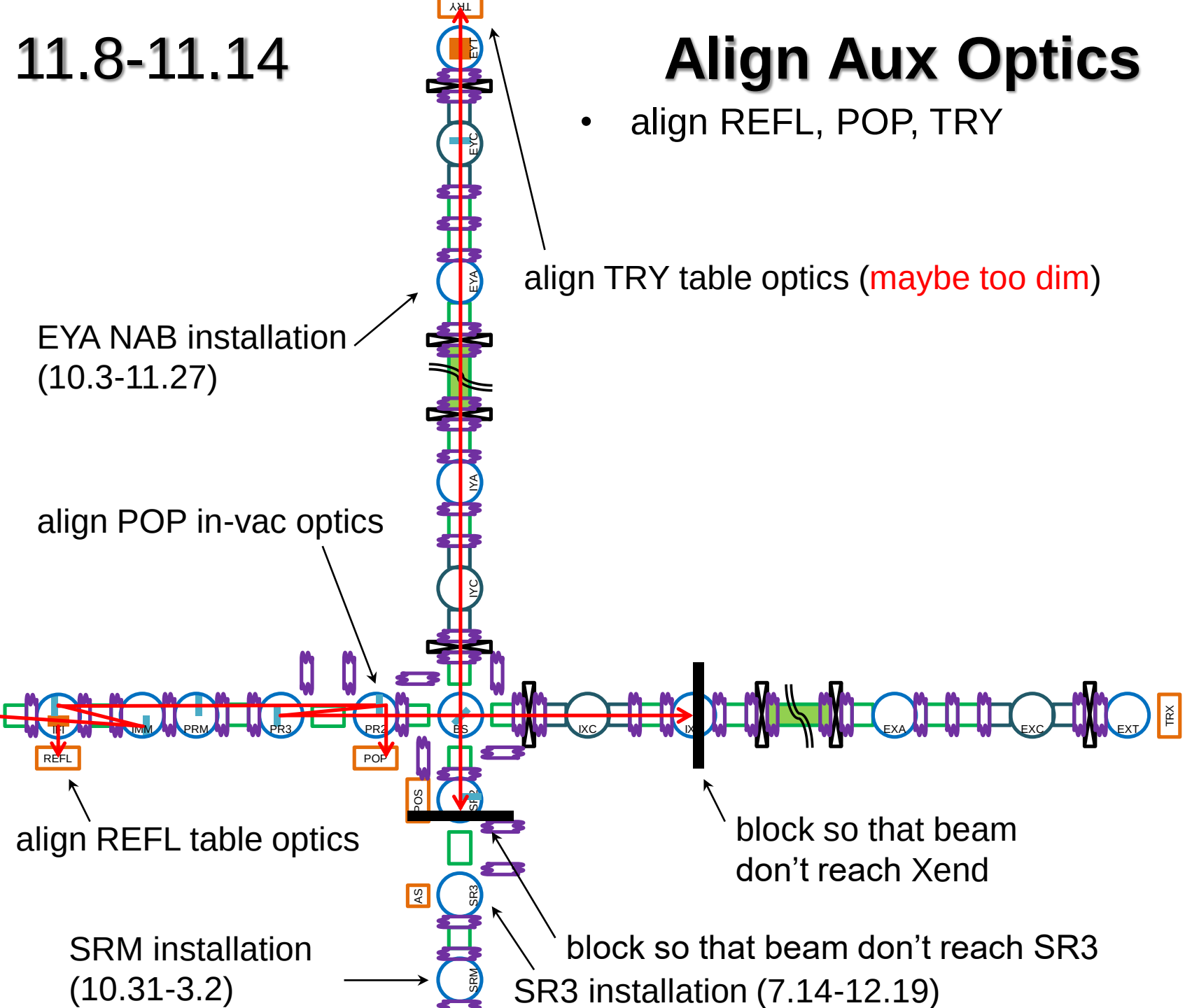
block so that beam don't reach SR3

SR3 installation (7.14-12.19)

11.8-11.14

Align Aux Optics

- align REFL, POP, TRY



align TRY table optics (maybe too dim)

EYA NAB installation (10.3-11.27)

align POP in-vac optics

align REFL table optics

block so that beam don't reach Xend

SRM installation (10.31-3.2)

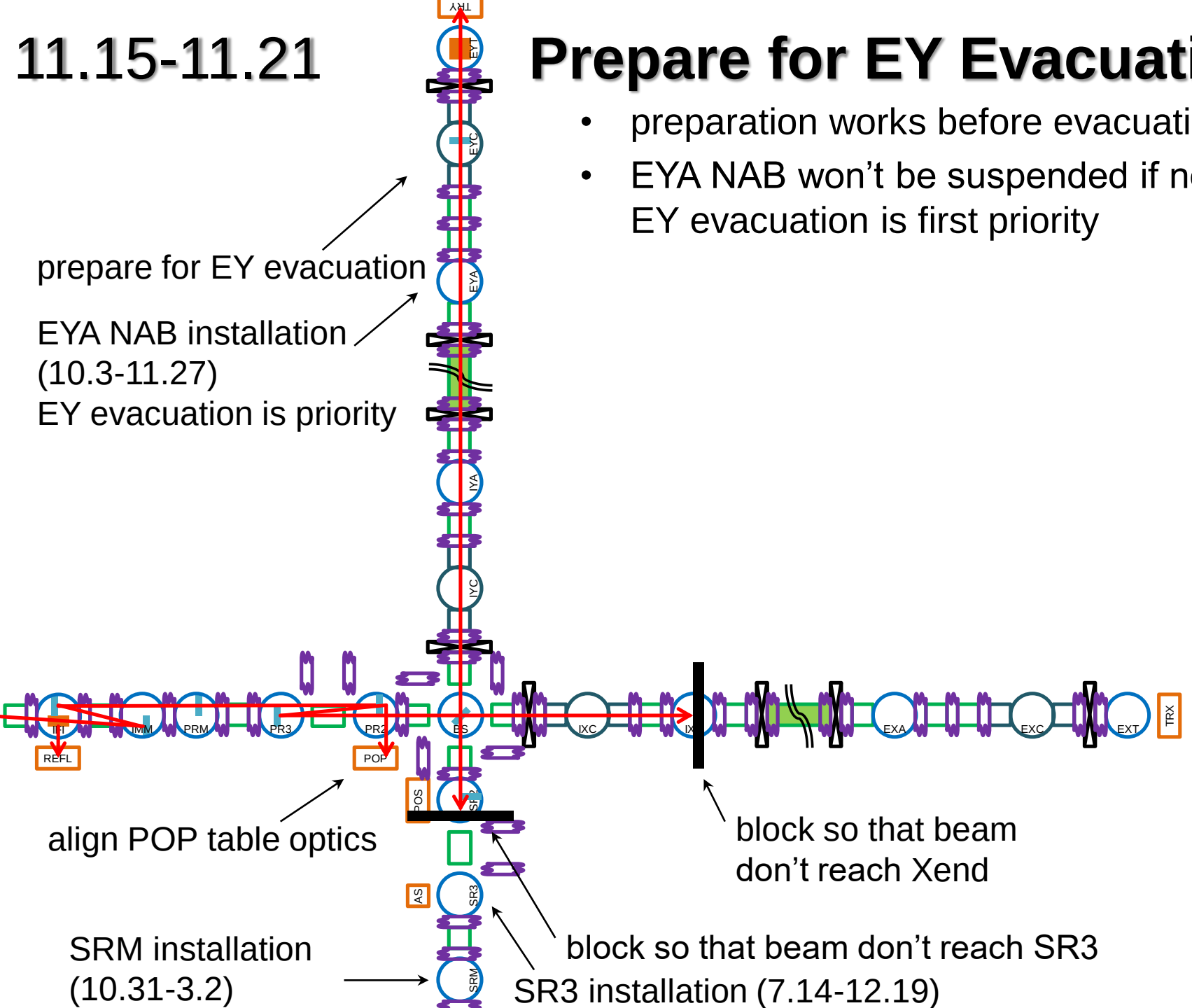
block so that beam don't reach SR3

SR3 installation (7.14-12.19)

11.15-11.21

Prepare for EY Evacuation

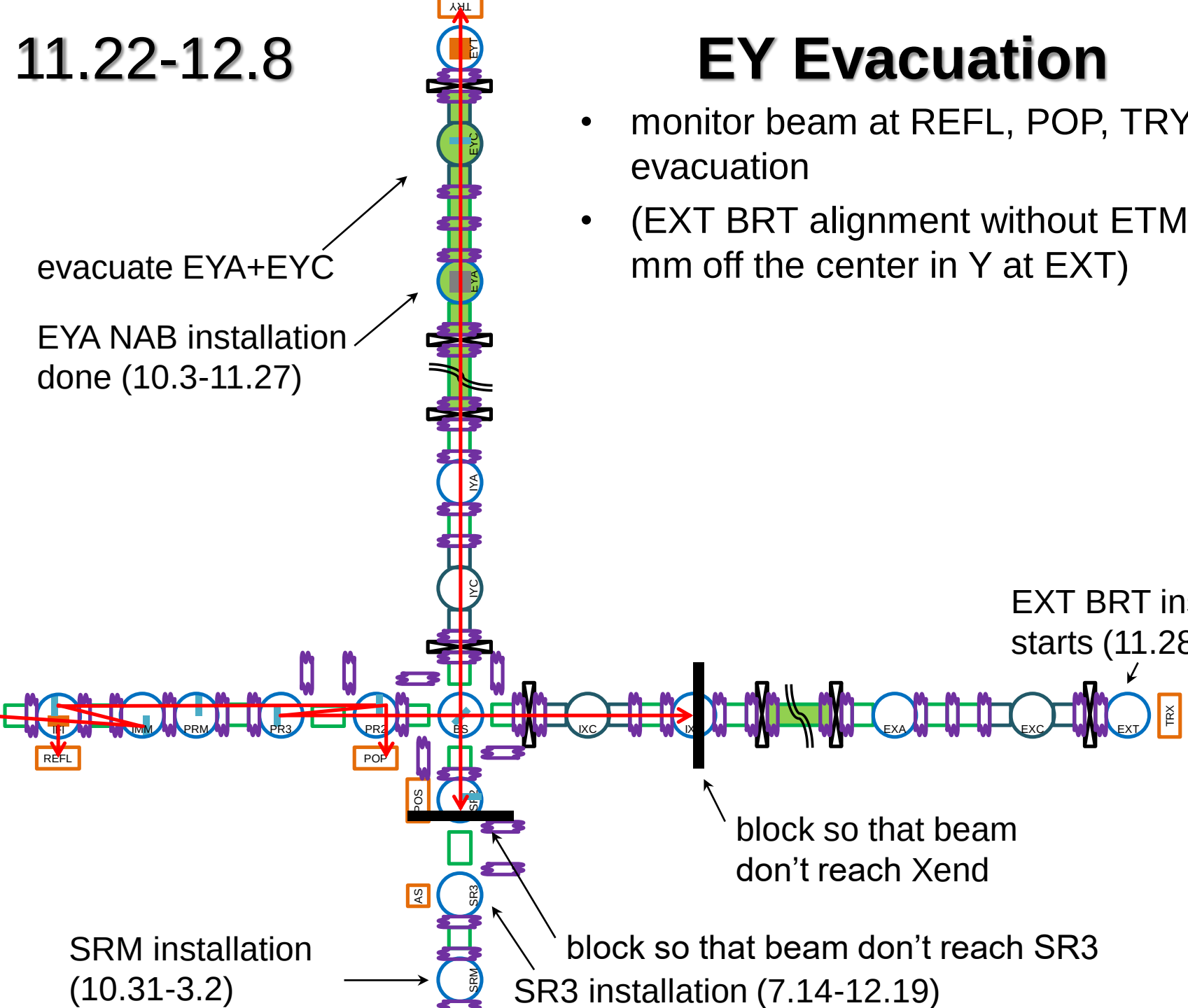
- preparation works before evacuation
- EYA NAB won't be suspended if no time; EY evacuation is first priority



11.22-12.8

EY Evacuation

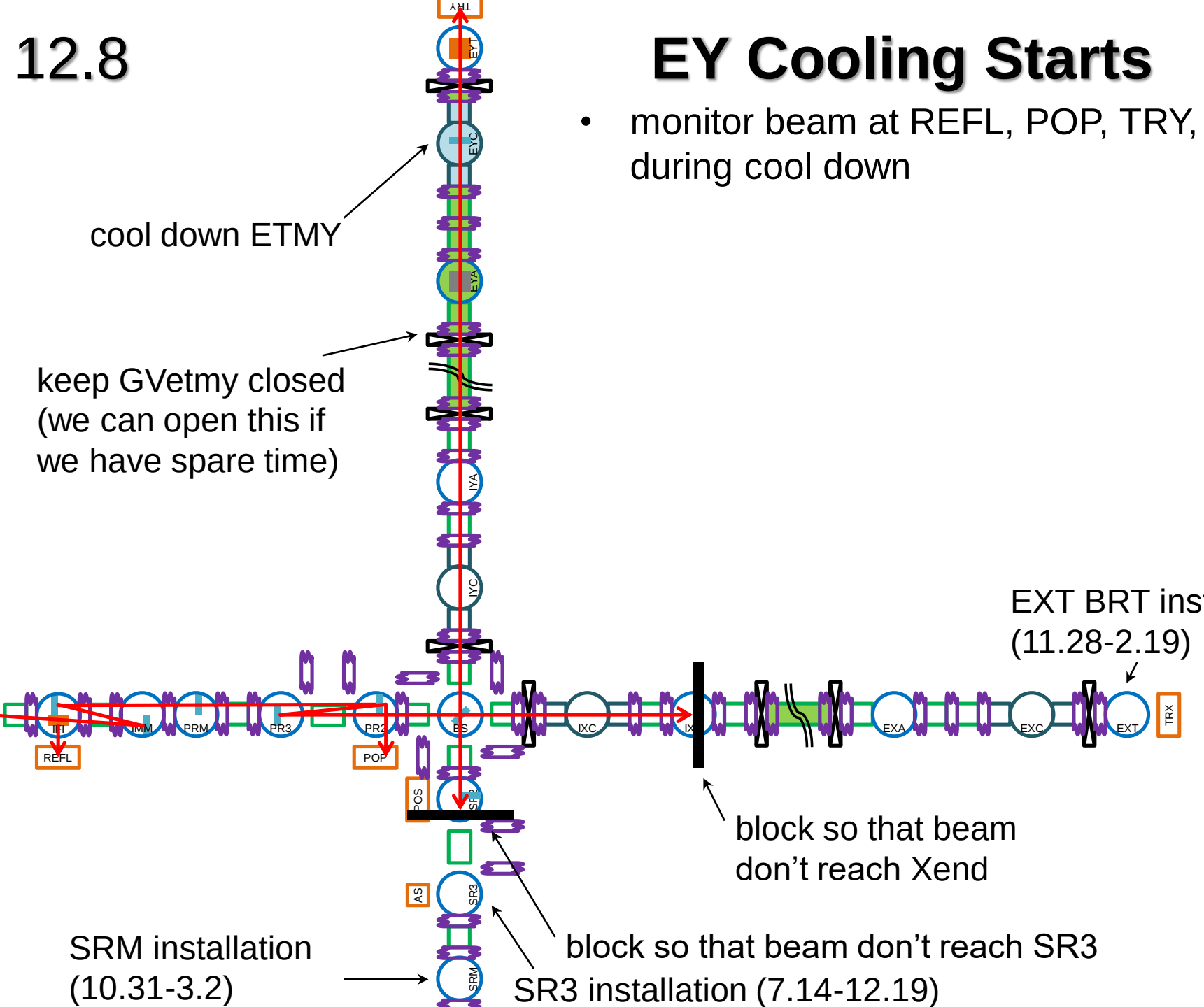
- monitor beam at REFL, POP, TRY during evacuation
- (EXT BRT alignment without ETMX; +5.6 mm off the center in Y at EXT)



12.8

EY Cooling Starts

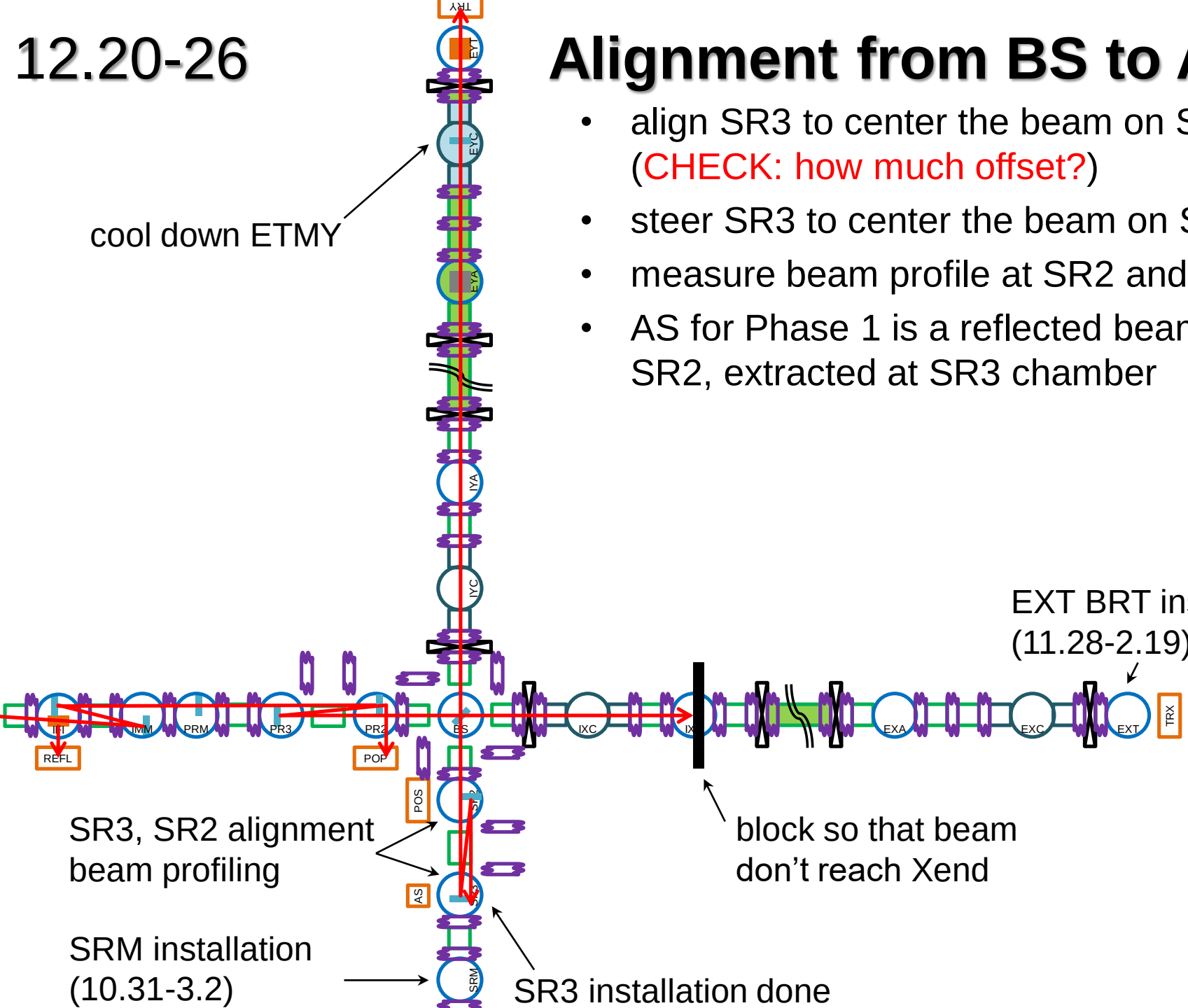
- monitor beam at REFL, POP, TRY, TRX during cool down



12.20-26

Alignment from BS to AS

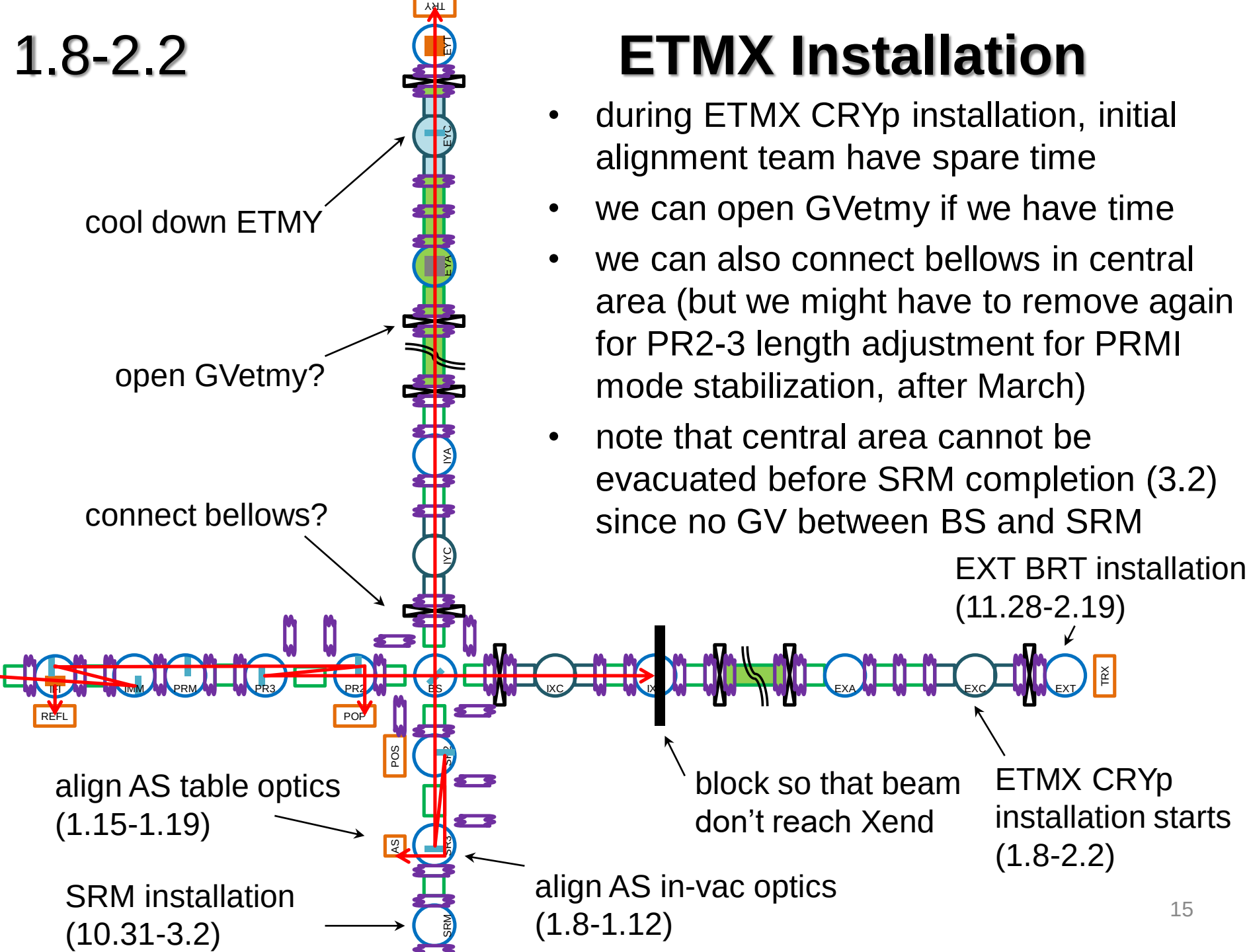
- align SR3 to center the beam on SR3 (CHECK: how much offset?)
- steer SR3 to center the beam on SR2
- measure beam profile at SR2 and SR3
- AS for Phase 1 is a reflected beam from SR2, extracted at SR3 chamber



1.8-2.2

ETMX Installation

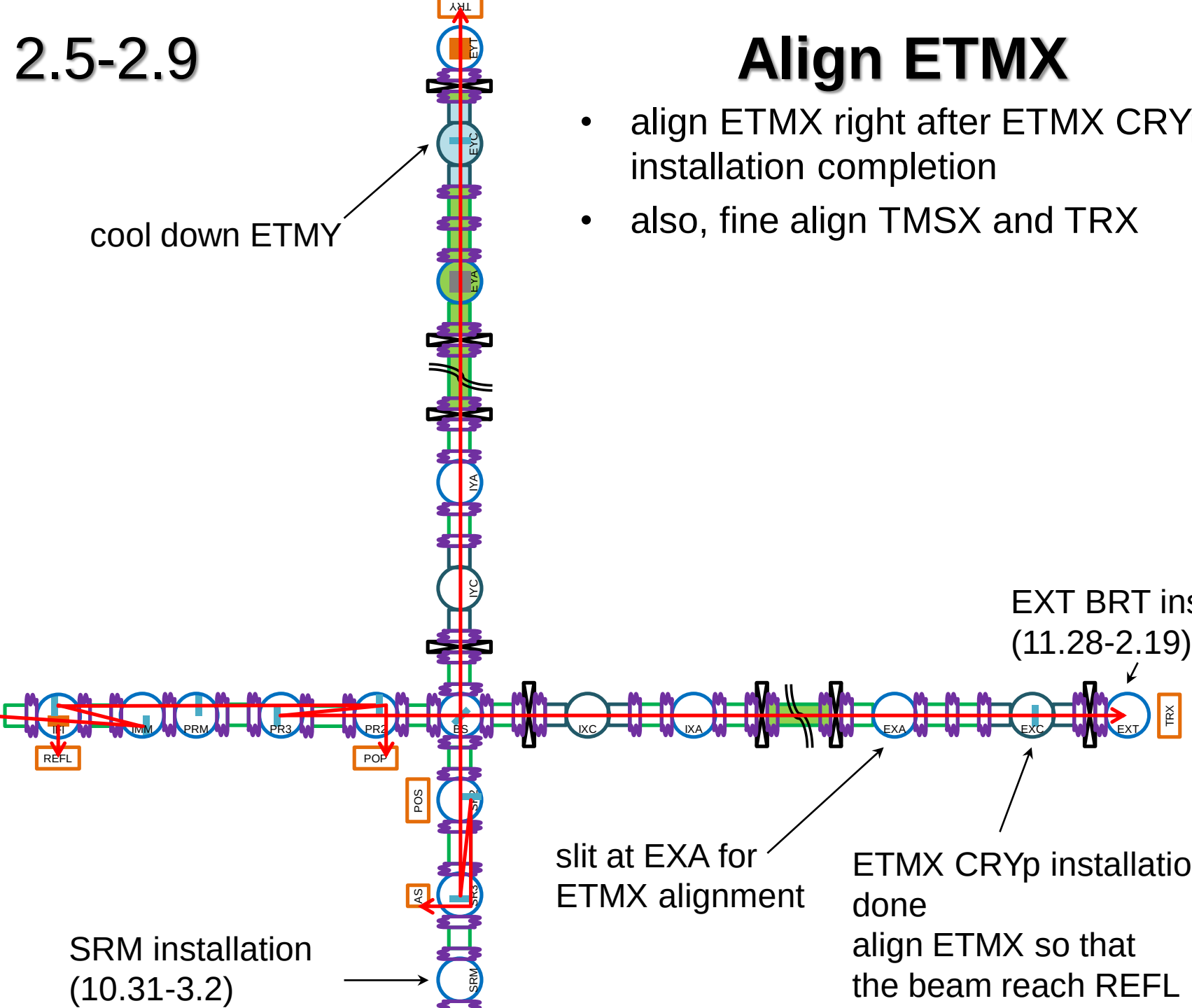
- during ETMX CRYp installation, initial alignment team have spare time
- we can open GVetmy if we have time
- we can also connect bellows in central area (but we might have to remove again for PR2-3 length adjustment for PRMI mode stabilization, after March)
- note that central area cannot be evacuated before SRM completion (3.2) since no GV between BS and SRM



2.5-2.9

Align ETMX

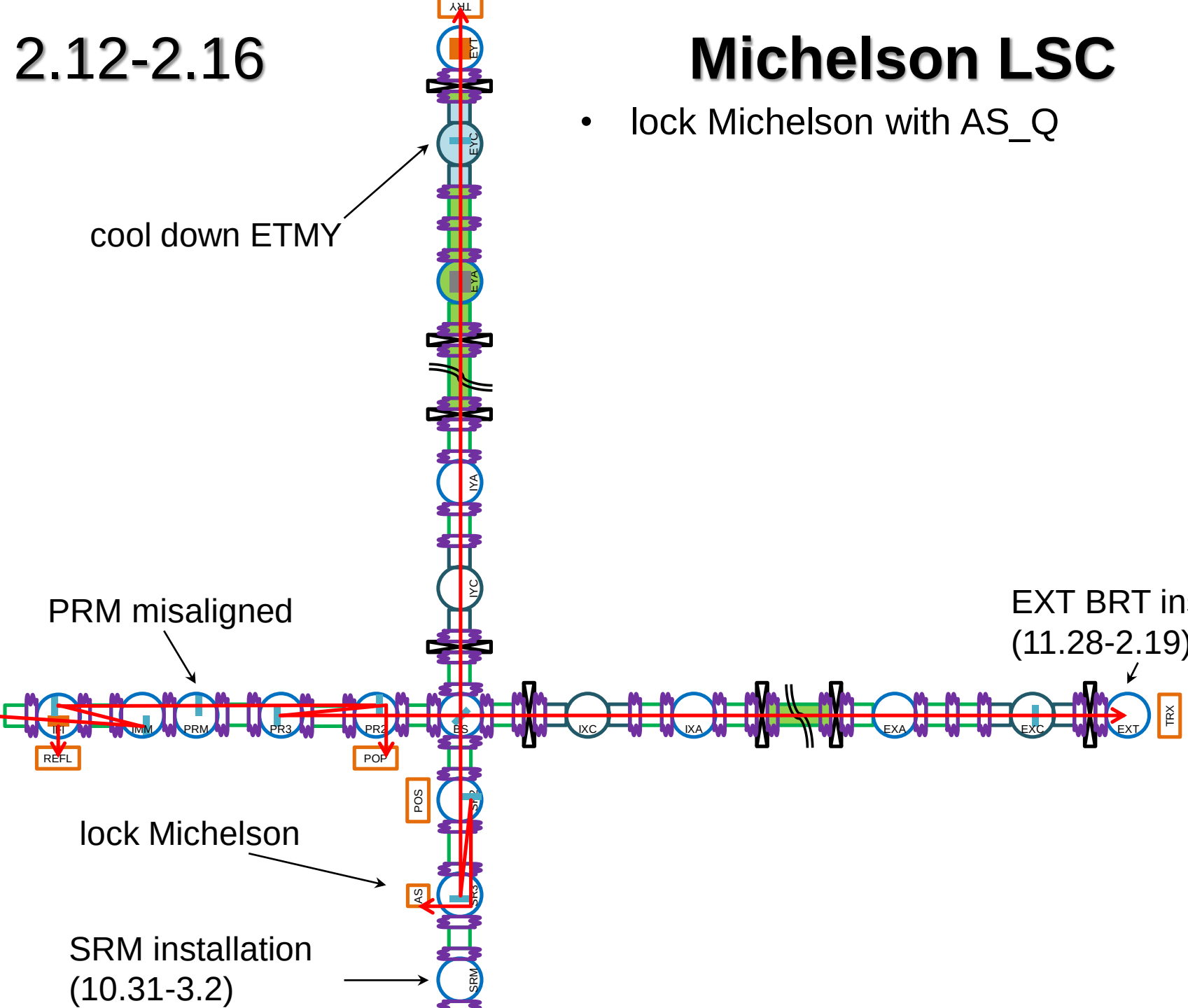
- align ETMX right after ETMX CRYp installation completion
- also, fine align TMSX and TRX



2.12-2.16

Michelson LSC

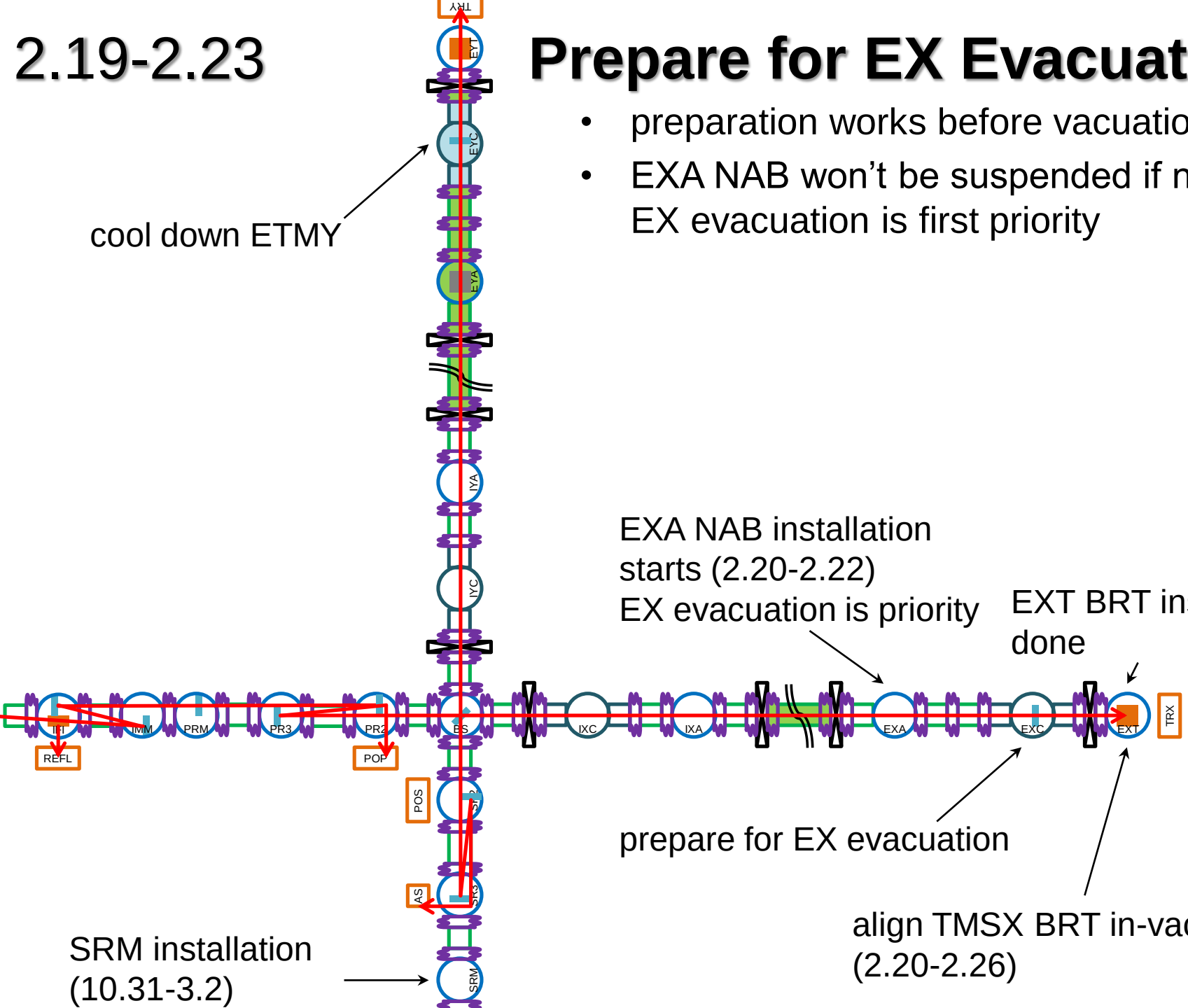
- lock Michelson with AS_Q



2.19-2.23

Prepare for EX Evacuation

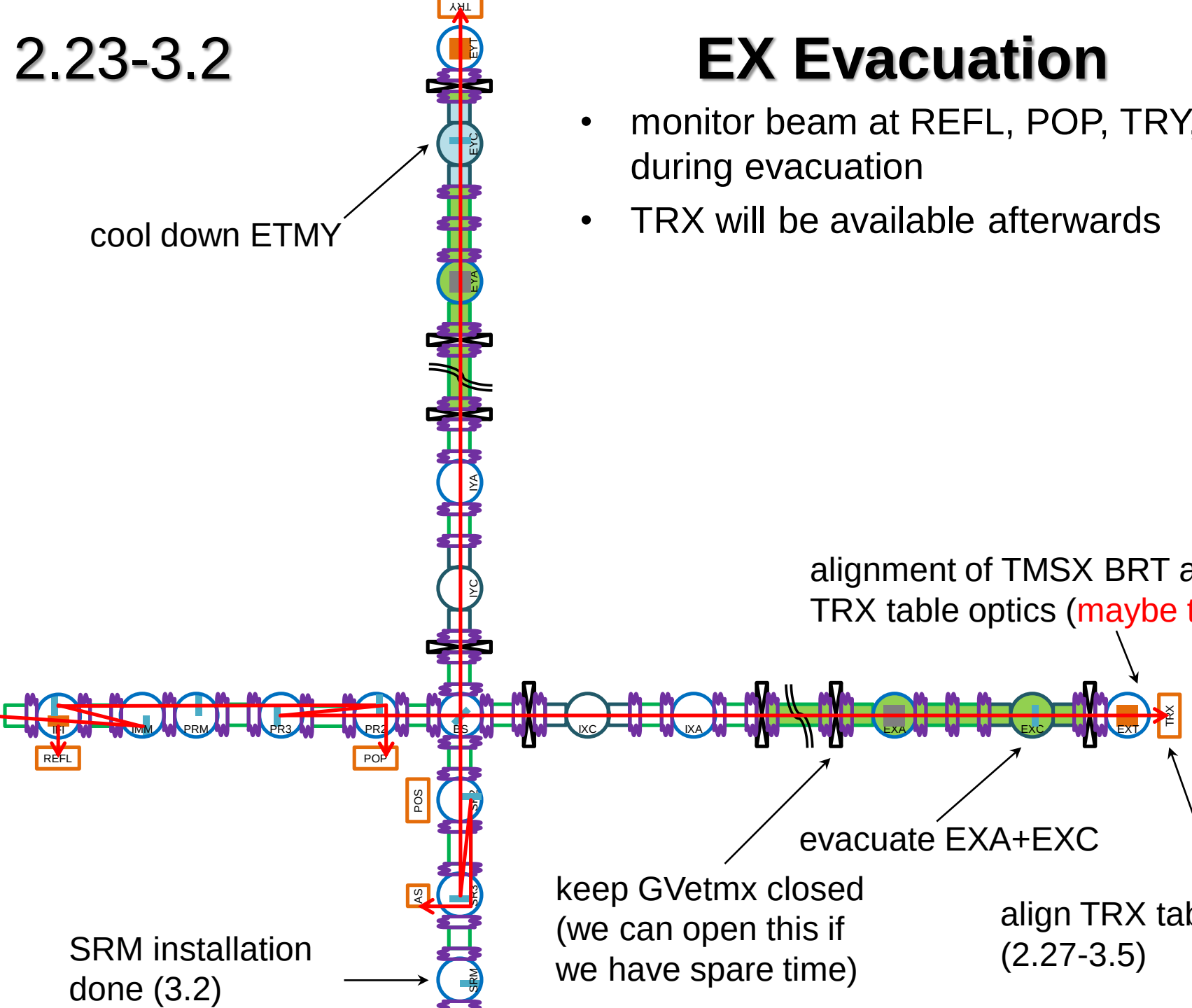
- preparation works before vacuation
- EXA NAB won't be suspended if no time; EX evacuation is first priority



2.23-3.2

EX Evacuation

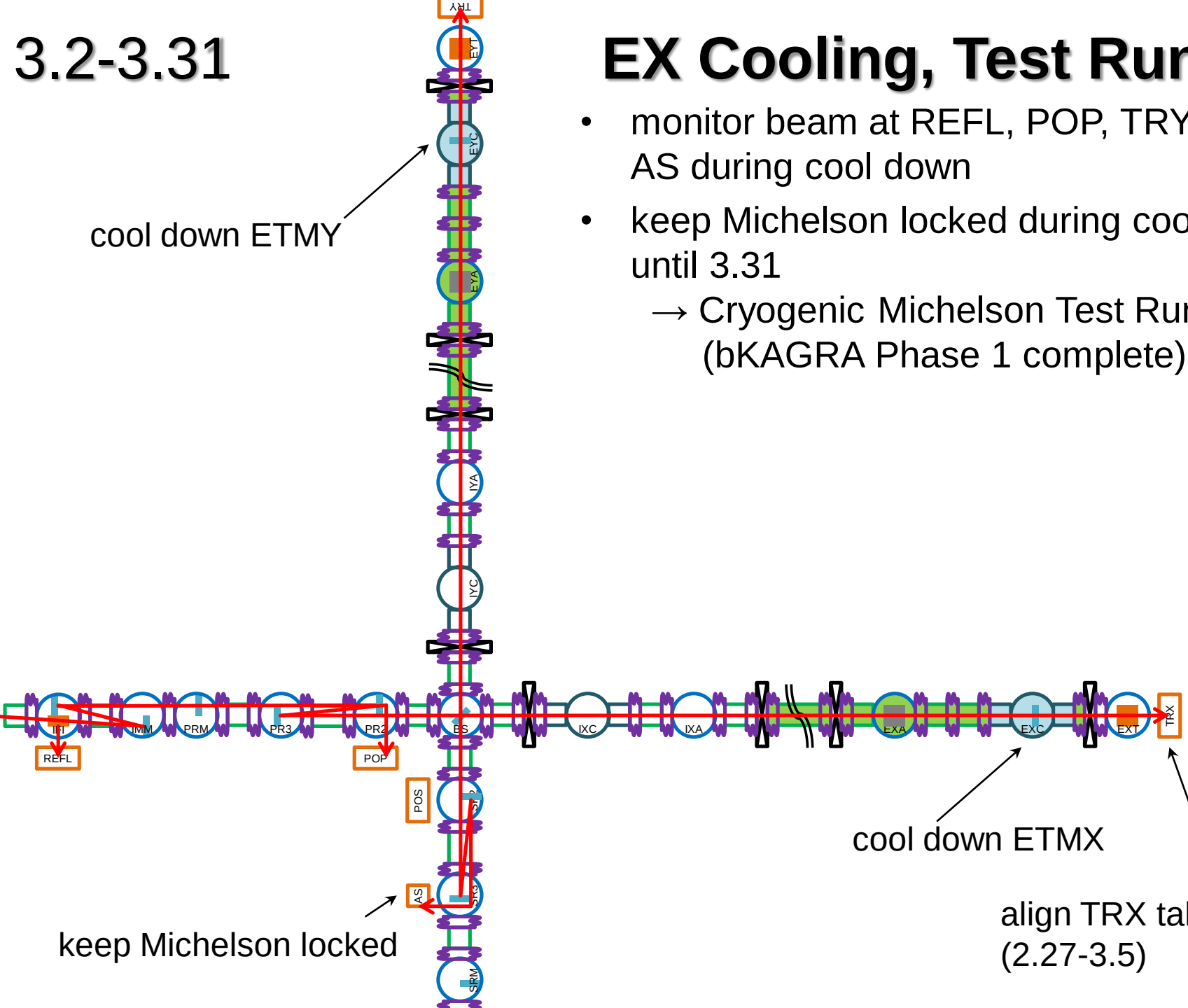
- monitor beam at REFL, POP, TRY, AS during evacuation
- TRX will be available afterwards



3.2-3.31

EX Cooling, Test Run

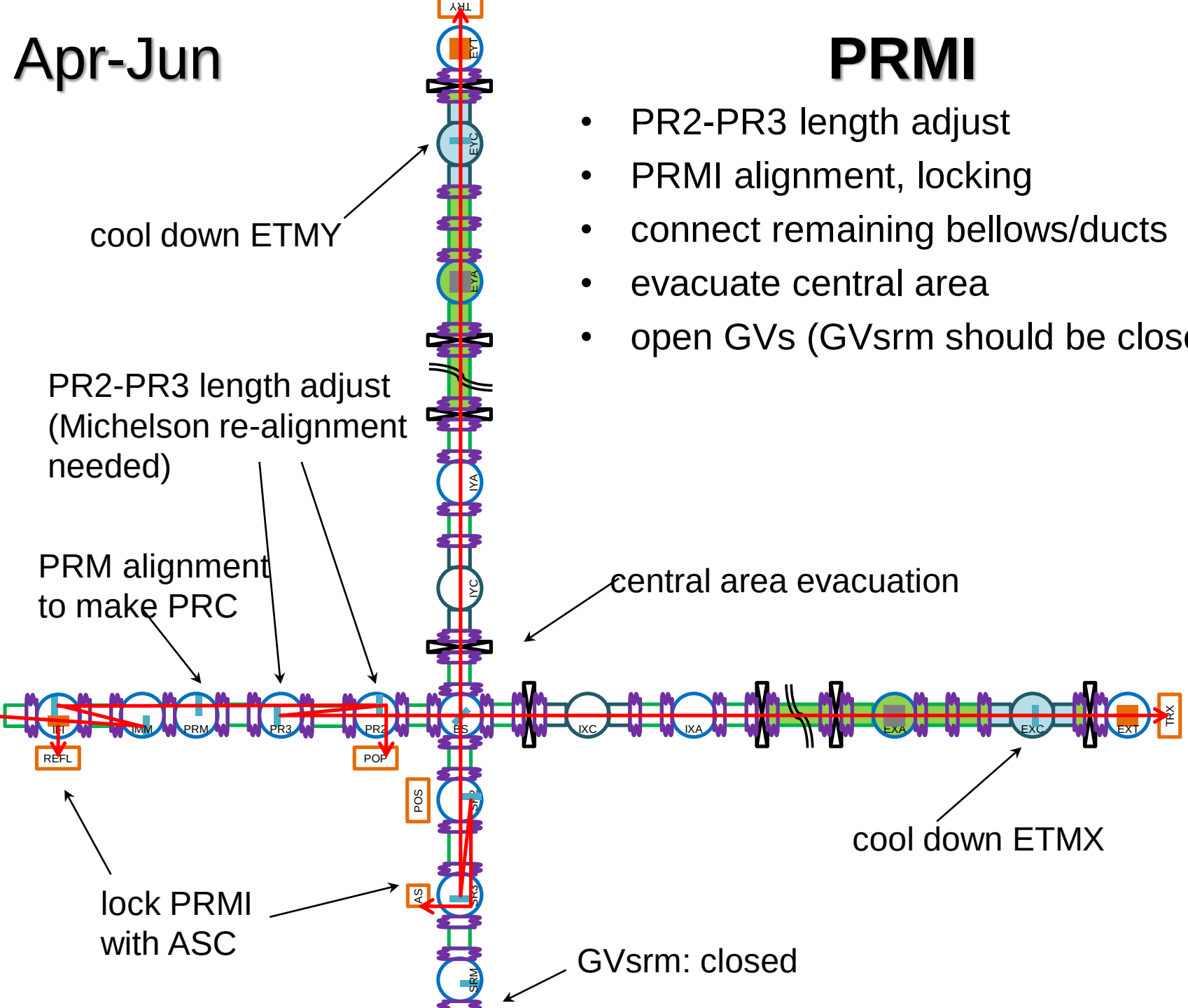
- monitor beam at REFL, POP, TRY, TRX, AS during cool down
- keep Michelson locked during cool down until 3.31
  → Cryogenic Michelson Test Run
  (bKAGRA Phase 1 complete)



Apr-Jun

PRMI

- PR2-PR3 length adjust
- PRMI alignment, locking
- connect remaining bellows/ducts
- evacuate central area
- open GVs (GVsrm should be closed)



To Be Discussed

- TMS BRT installation schedule and other AOS related issues [Akutsu, Uchiyama, Michimura]
  - considering wedge, ETMs should be installed before BRT alignment, but transmitted beam from ETM is too dim (~ 0.1 uW); use green?
  - when to install narrow-angle baffles?
- Wide-angle baffles (for Pcal and main beam) compatible with ETM HR camera? [Akutsu, Kokeyama, Inoue]
- Confirm beam spot positions at GVs [Michimura, Aso]