






Commissioning Procedure for bKAGRA Phase 1

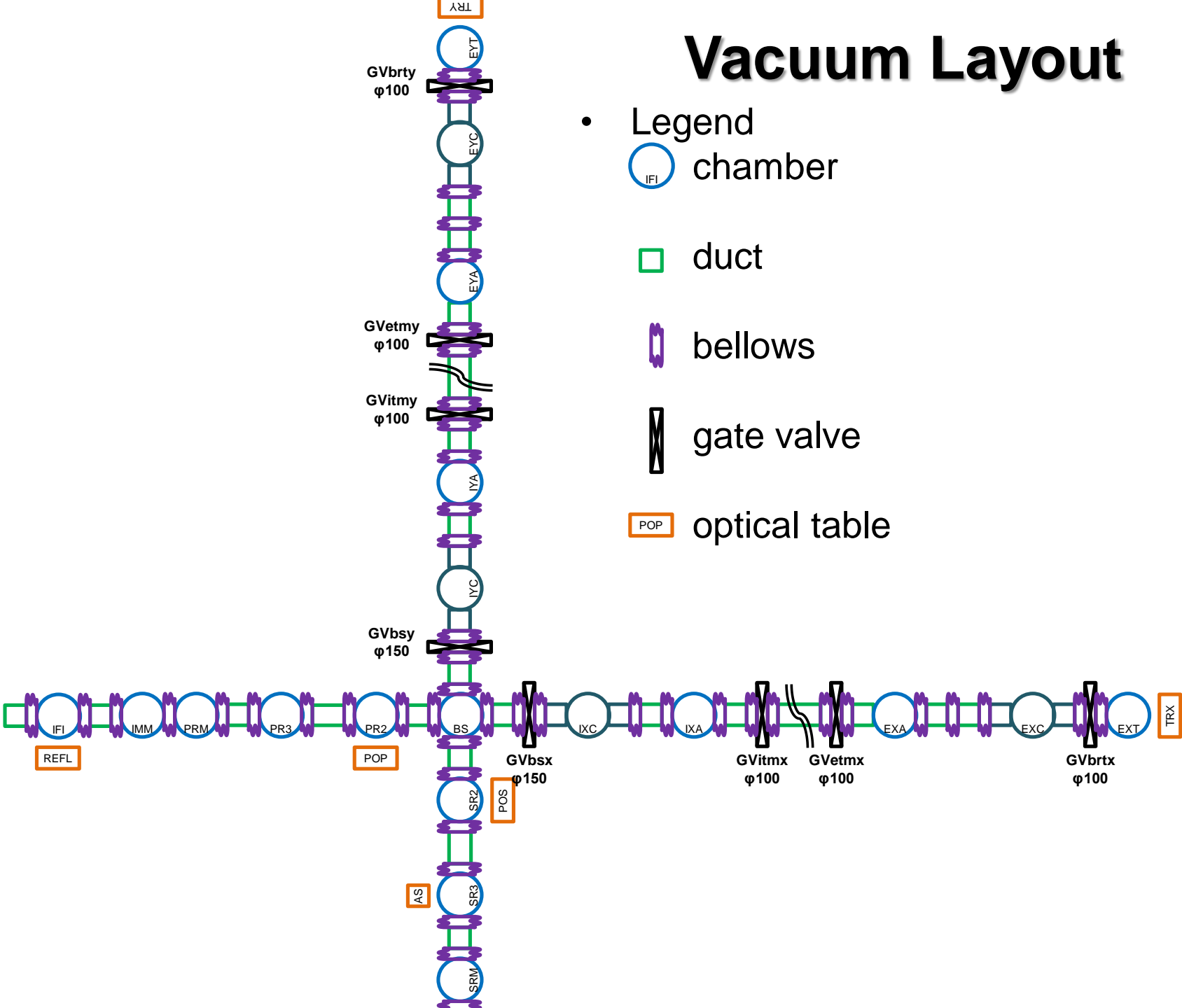
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see, also, [JGW-T1605595](#)
for interferometer design and commissioning schedule

Vacuum Layout

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



8.31

Expected Situation

EYT BRT installed
(6.2-8.24)

- 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)

Yarm evacuated

GV closed

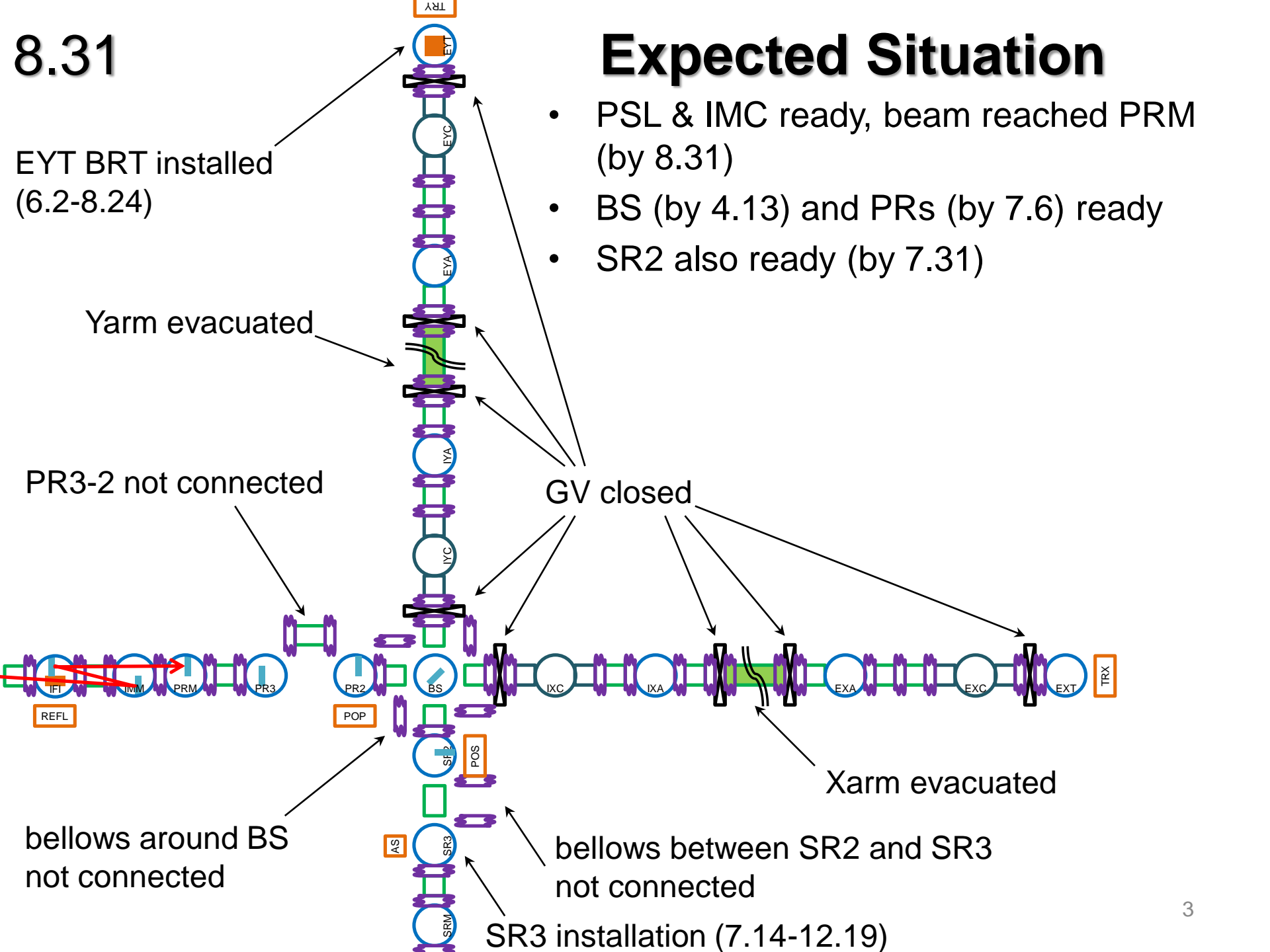
PR3-2 not connected

Xarm evacuated

bellows around BS
not connected

bellows between SR2 and SR3
not connected

SR3 installation (7.14-12.19)



9.1-9.8

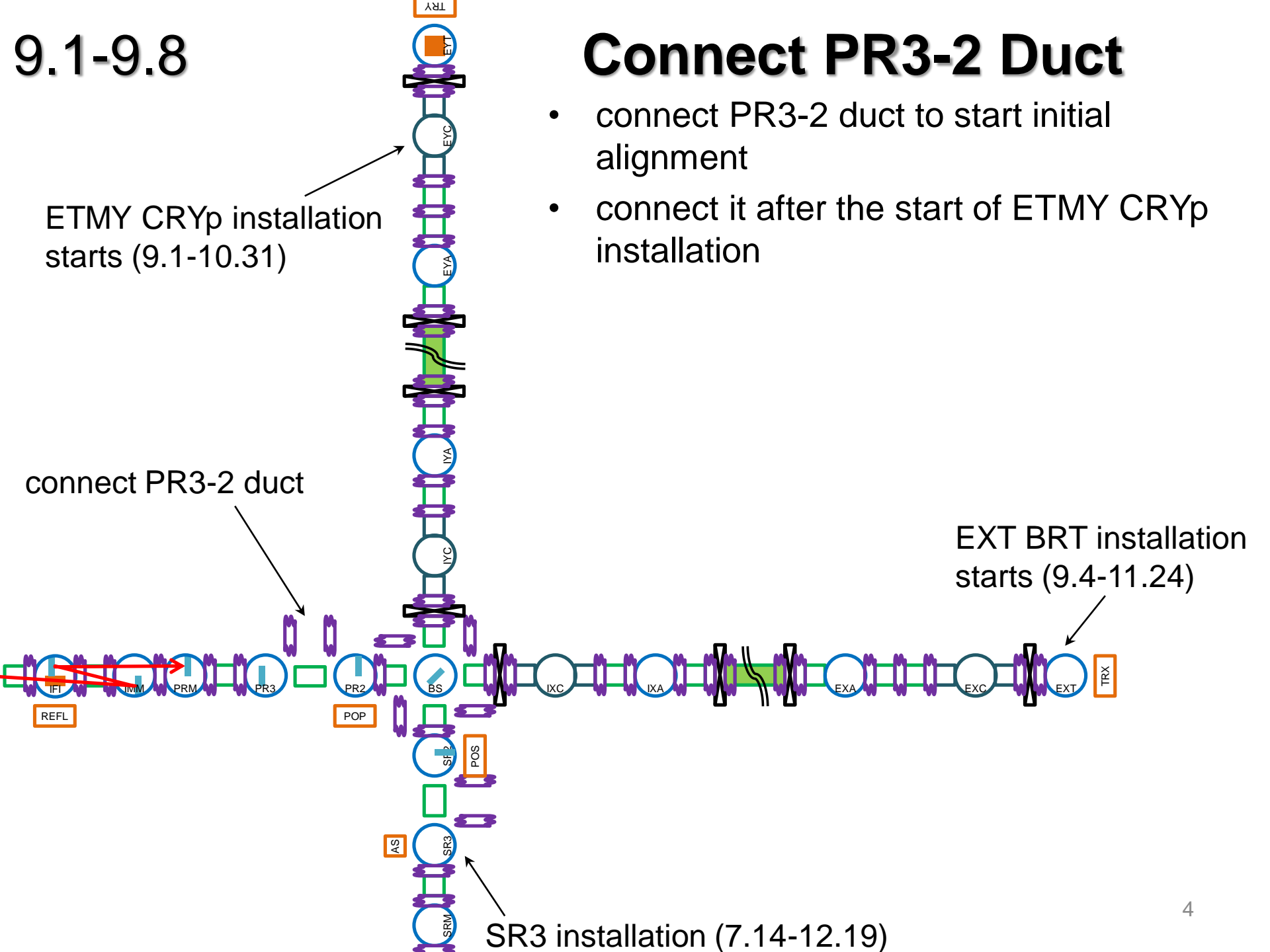
Connect PR3-2 Duct

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

ETMY CRYp installation starts (9.1-10.31)

connect PR3-2 duct

EXT BRT installation starts (9.4-11.24)



9.11-9.15

Alignment from IMMT to PR3

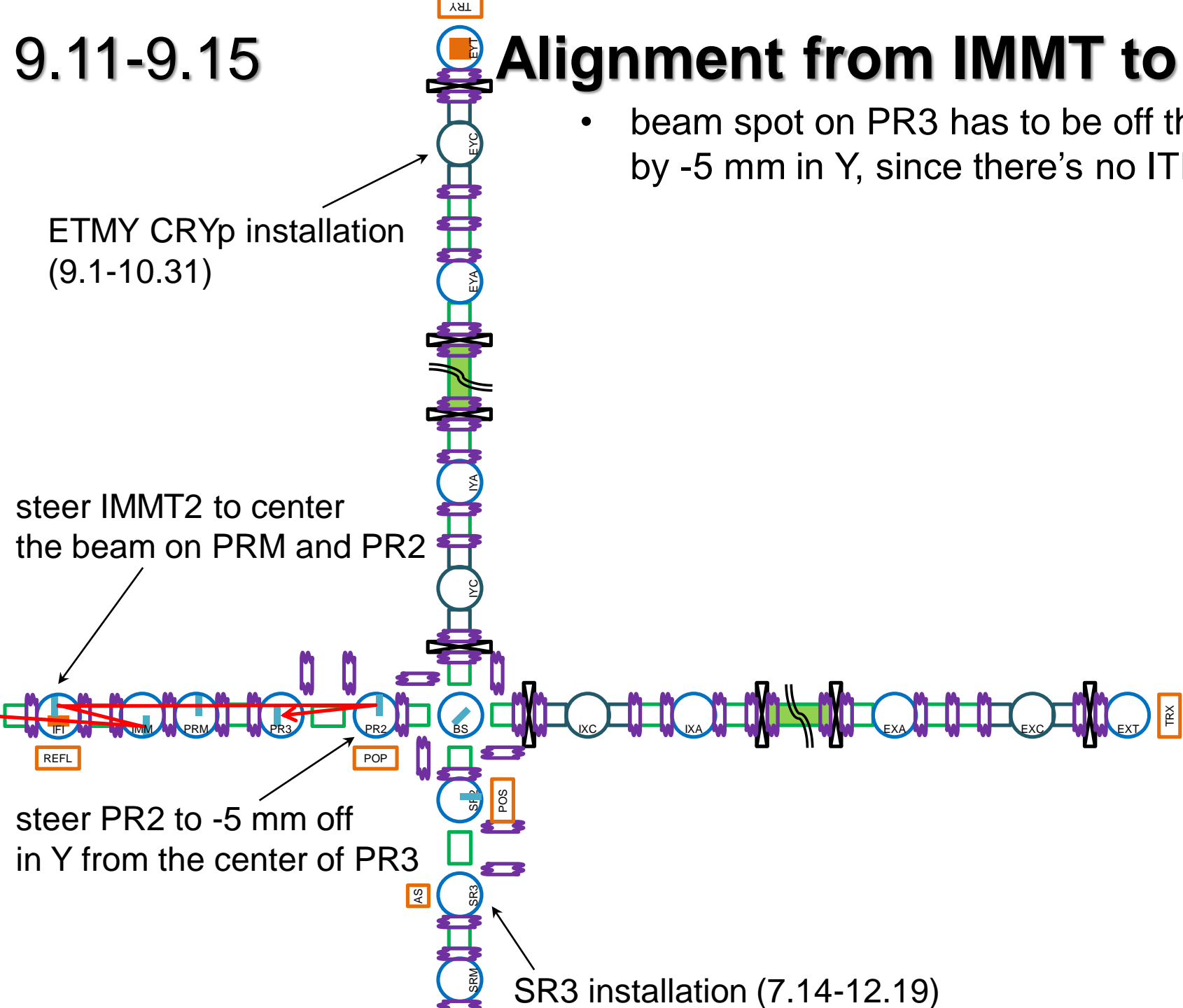
- beam spot on PR3 has to be off the center by -5 mm in Y, since there's no ITM wedge

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

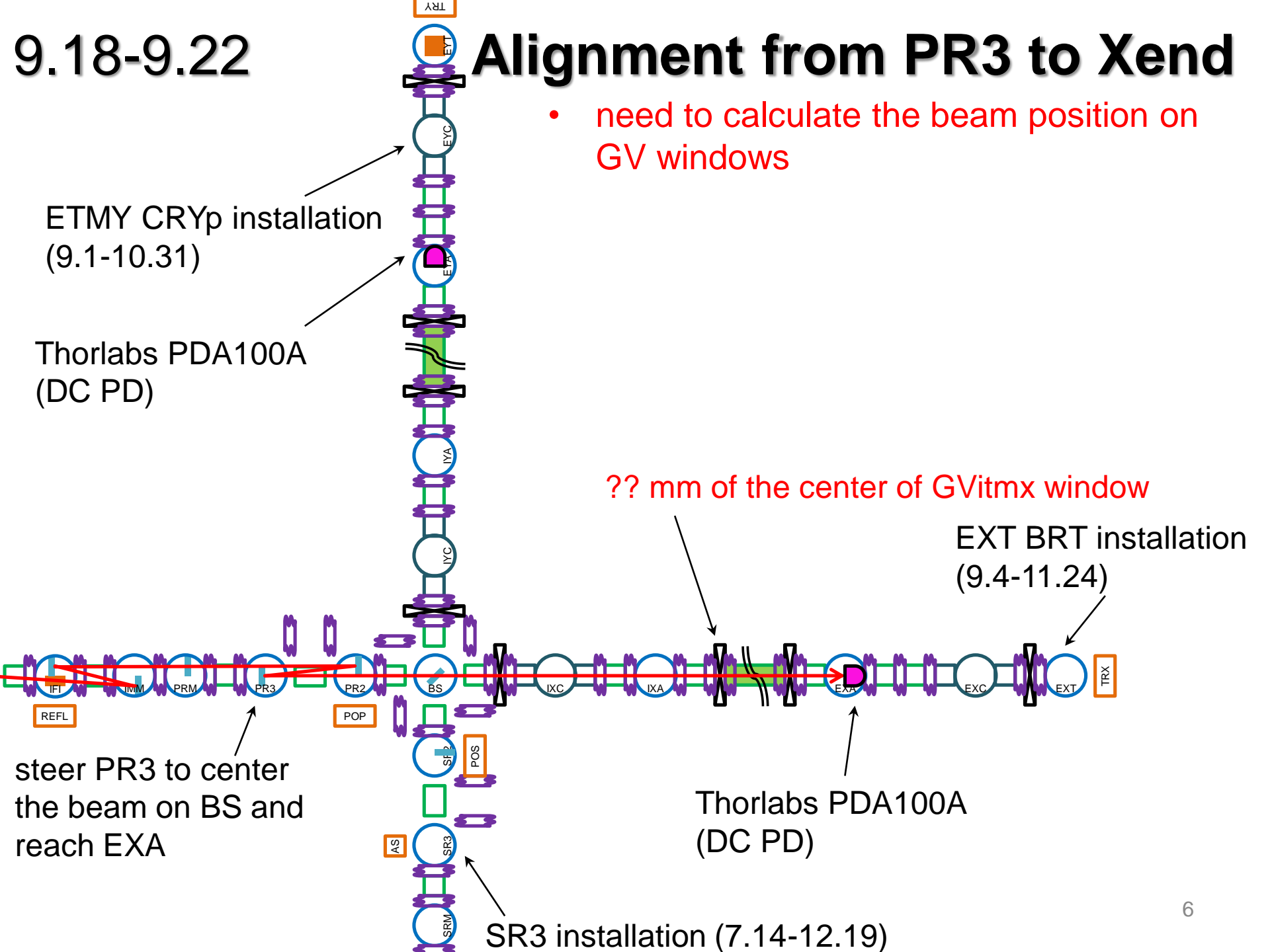
SR3 installation (7.14-12.19)



9.18-9.22

Alignment from PR3 to Xend

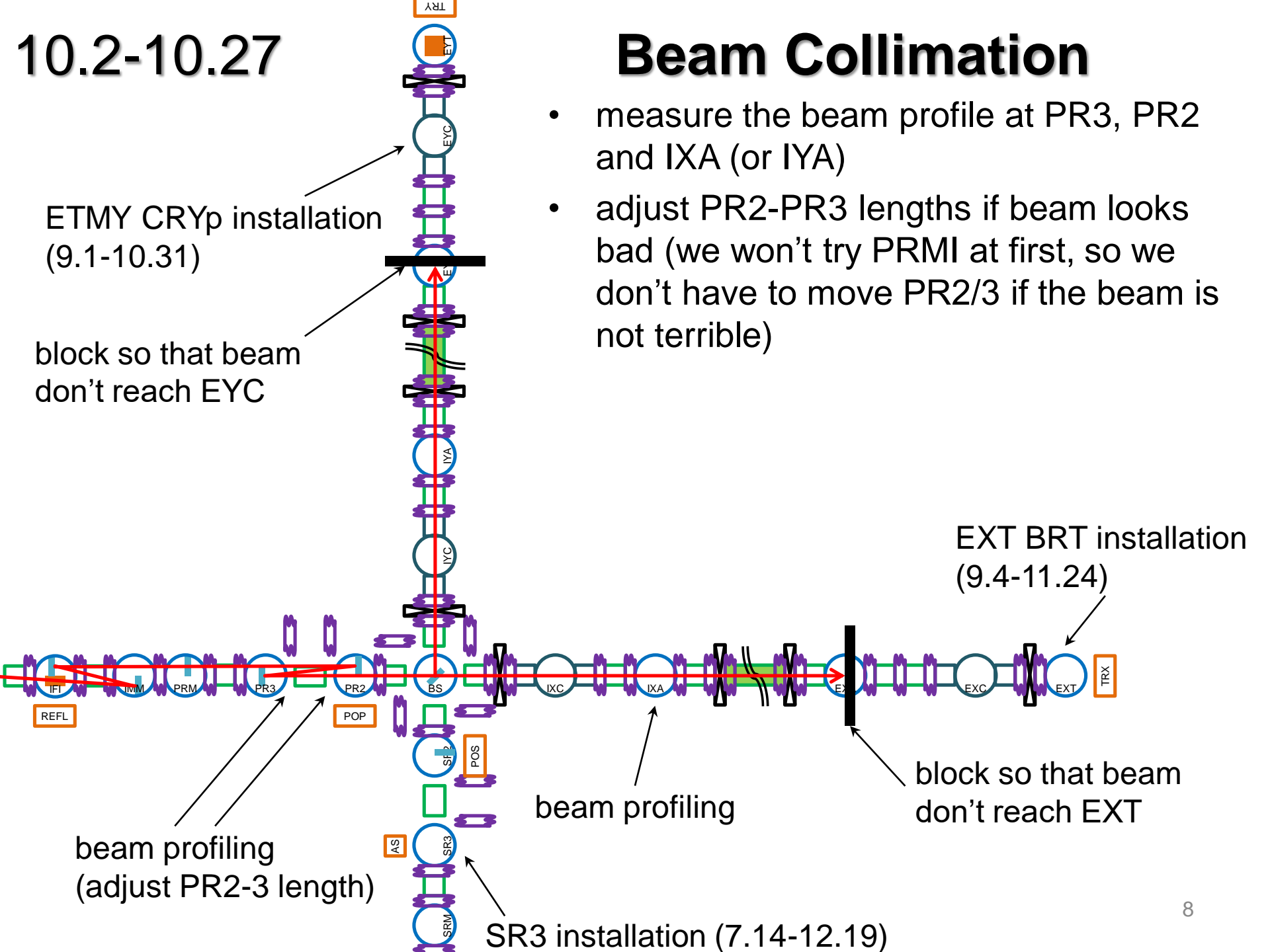
- need to calculate the beam position on GV windows



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)



ETMY CRYp installation (9.1-10.31)

block so that beam don't reach EYC

EXT BRT installation (9.4-11.24)

block so that beam don't reach EXT

beam profiling (adjust PR2-3 length)

beam profiling

SR3 installation (7.14-12.19)

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

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

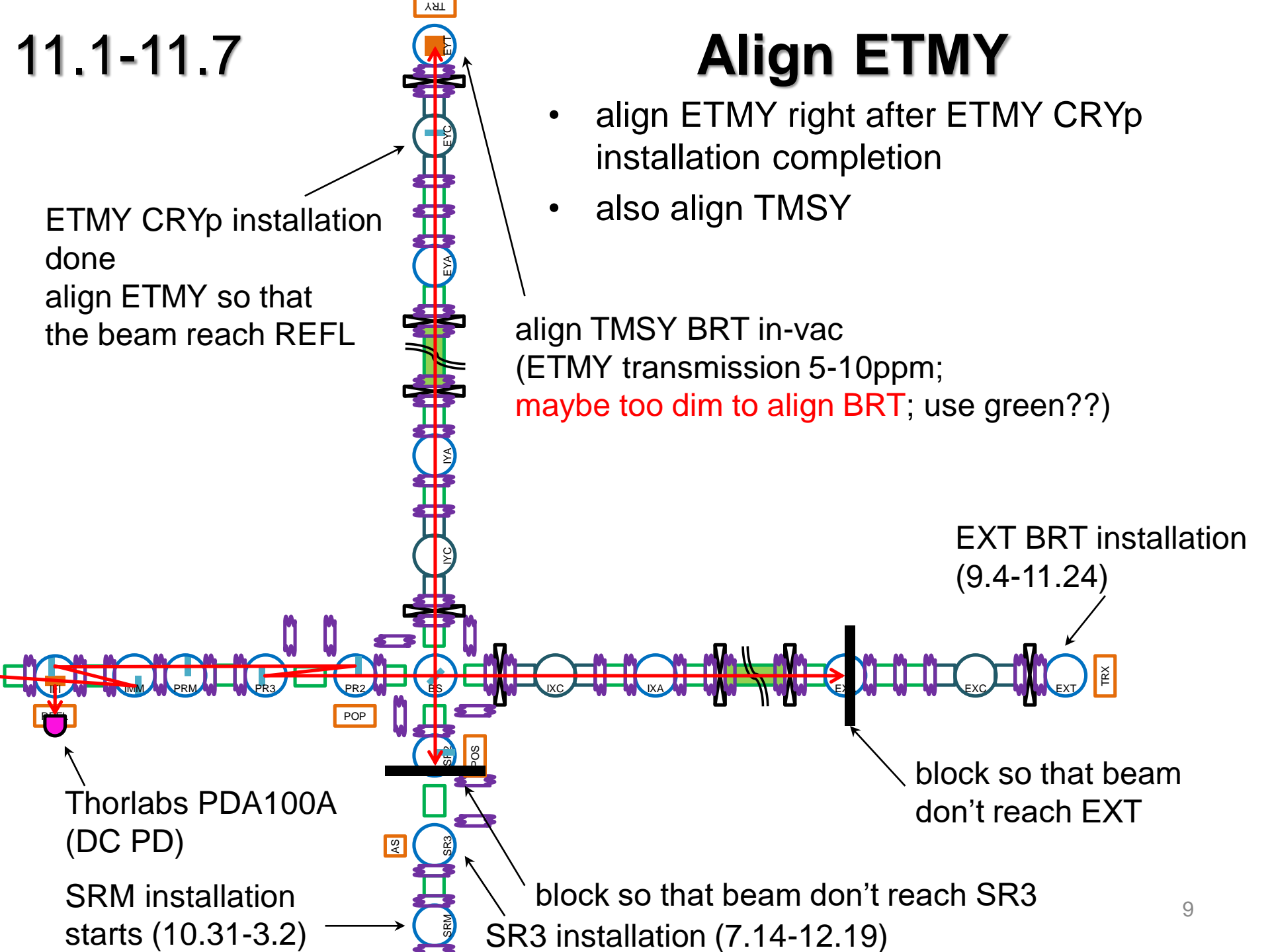
EXT BRT installation
(9.4-11.24)

block so that beam don't reach EXT

Thorlabs PDA100A
(DC PD)

SRM installation starts
(10.31-3.2)

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)

align POP in-vac optics

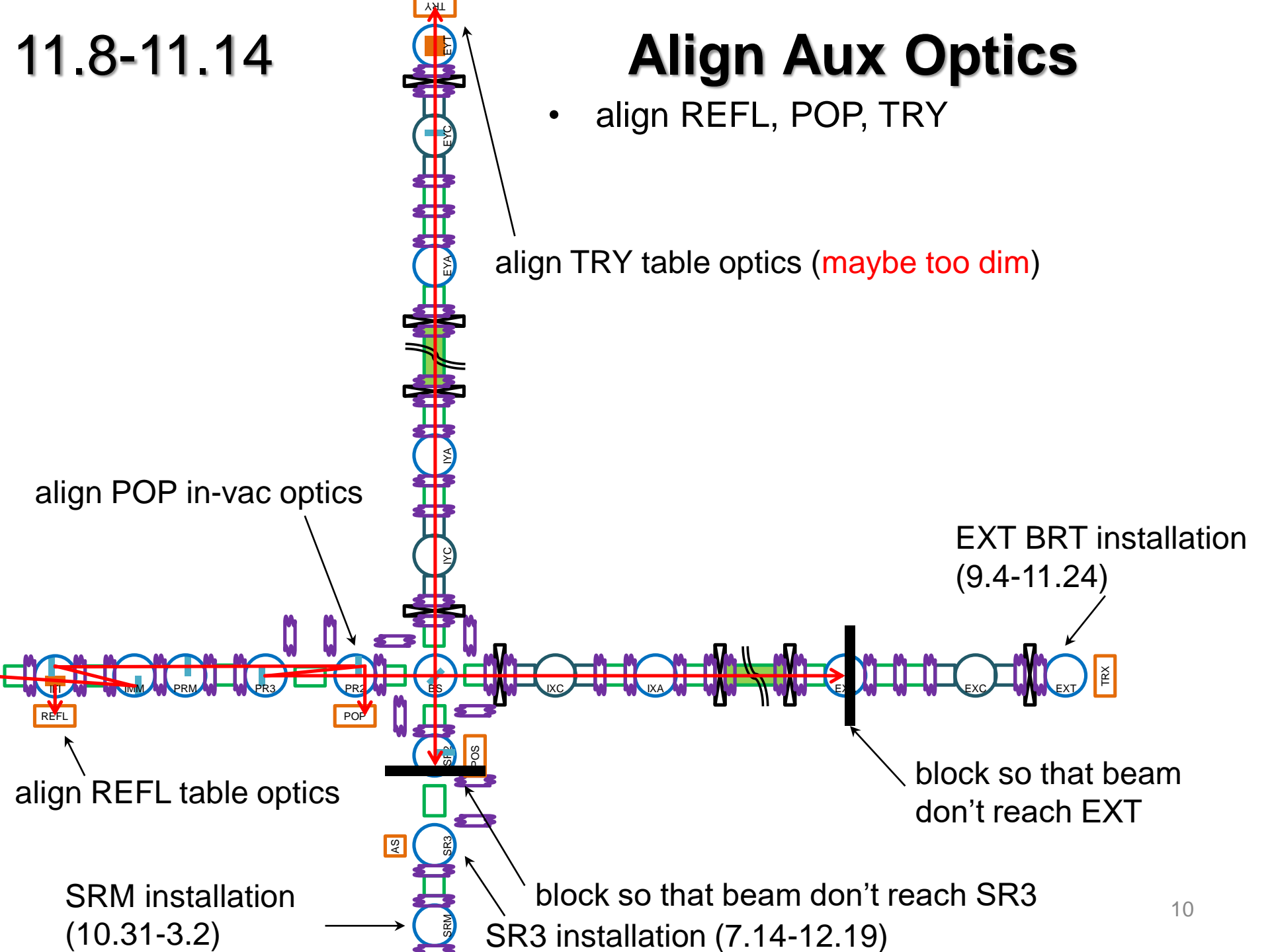
EXT BRT installation (9.4-11.24)

align REFL table optics

block so that beam don't reach EXT

SRM installation (10.31-3.2)

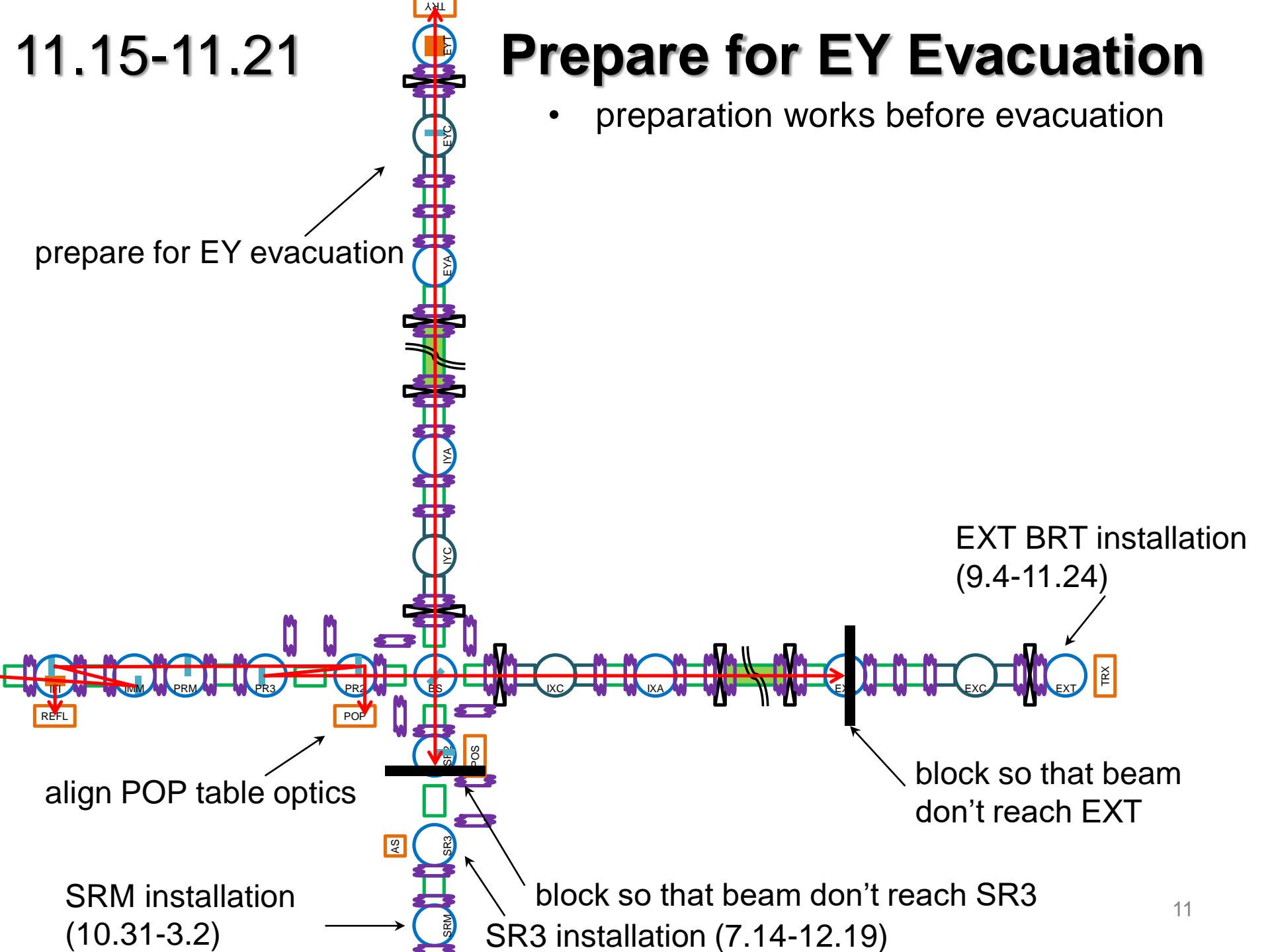
block so that beam don't reach SR3
SR3 installation (7.14-12.19)



11.15-11.21

Prepare for EY Evacuation

- preparation works before evacuation



prepare for EY evacuation

EXT BRT installation
(9.4-11.24)

align POP table optics

block so that beam
don't reach EXT

SRM installation
(10.31-3.2)

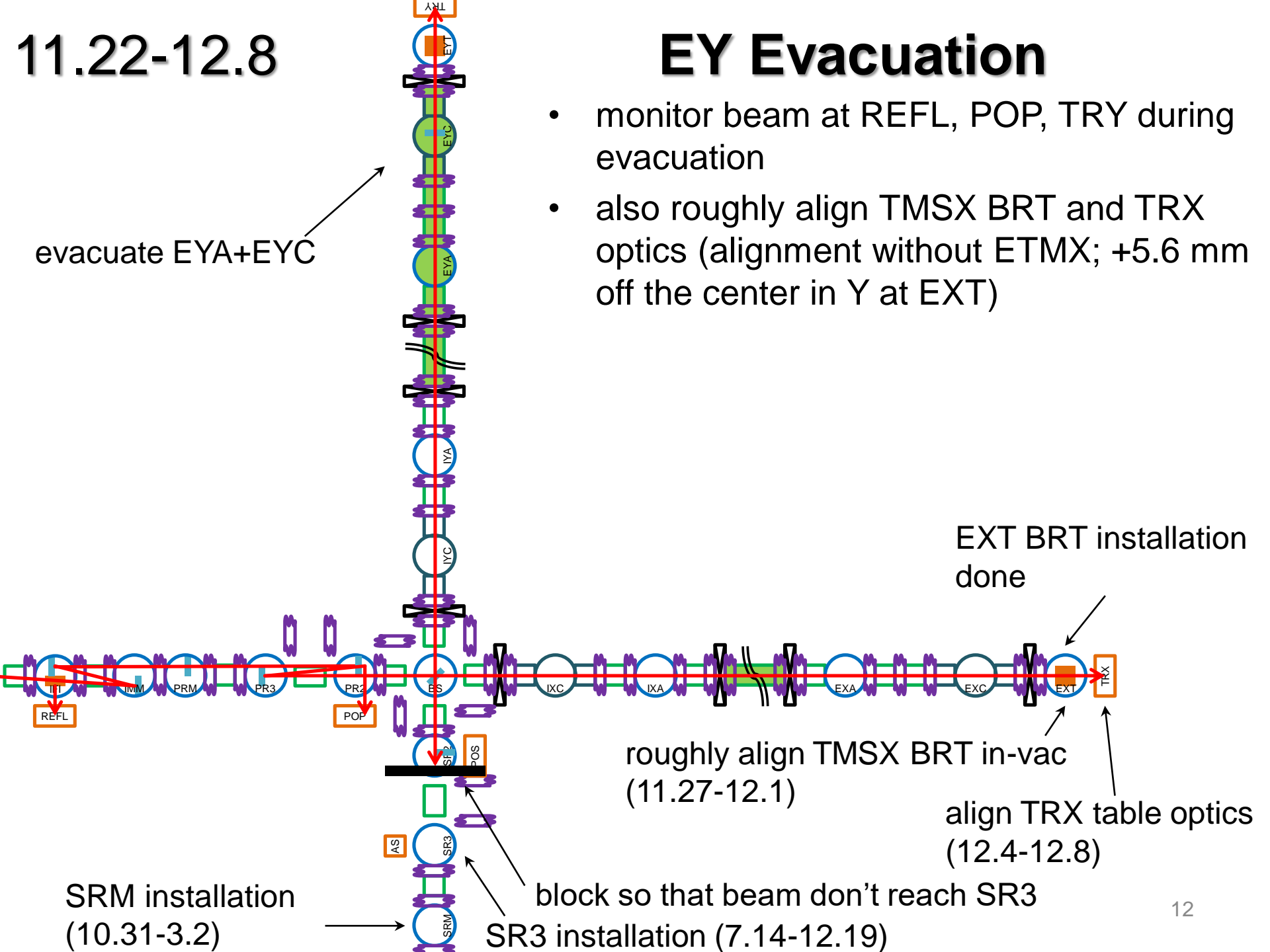
block so that beam don't reach SR3
SR3 installation (7.14-12.19)

11.22-12.8

EY Evacuation

- monitor beam at REFL, POP, TRY during evacuation
- also roughly align TMSX BRT and TRX optics (alignment without ETMX; +5.6 mm off the center in Y at EXT)

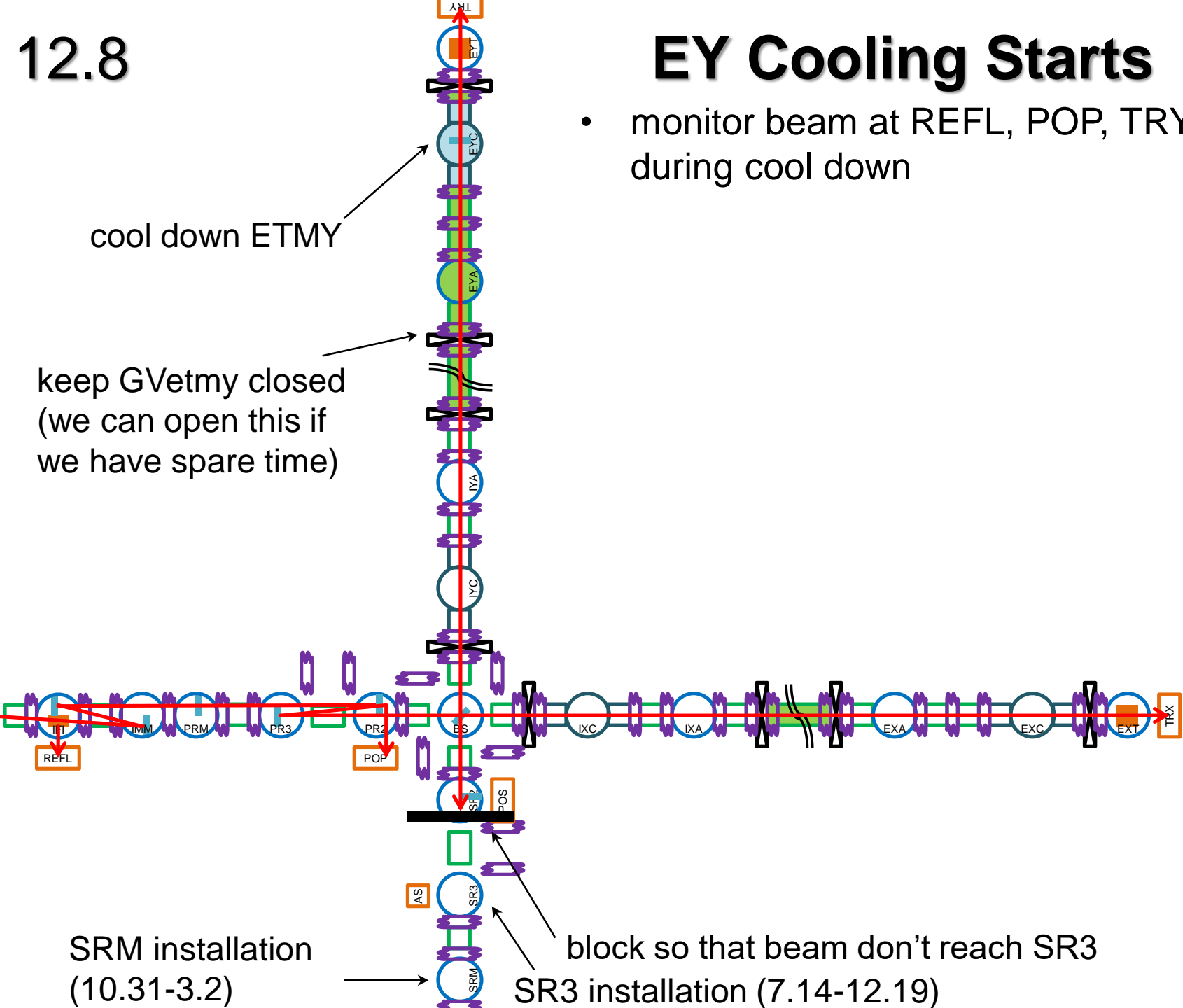
evacuate EYA+EYC



12.8

EY Cooling Starts

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

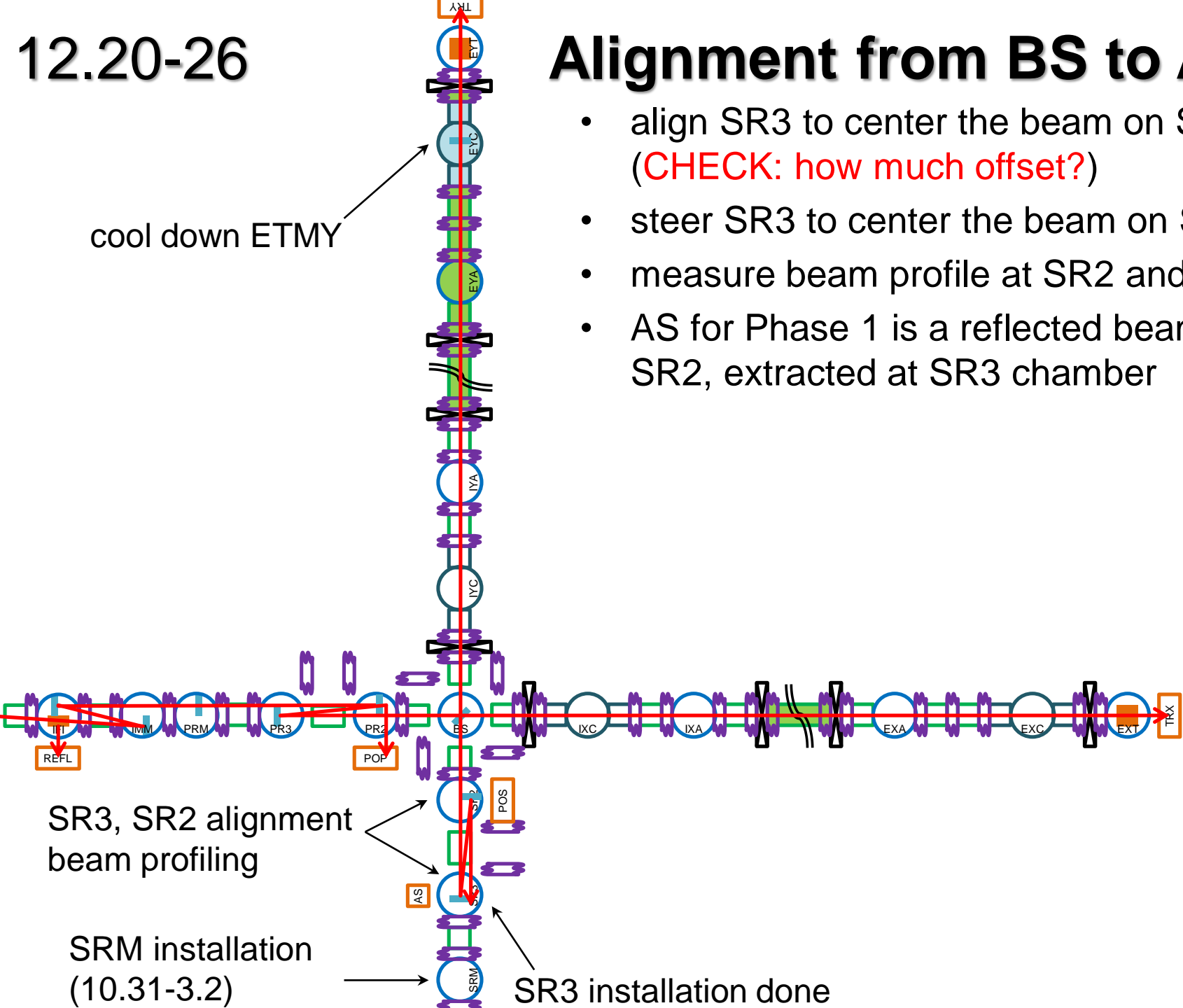


12.20-26

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

cool down ETMY



SR3, SR2 alignment
beam profiling

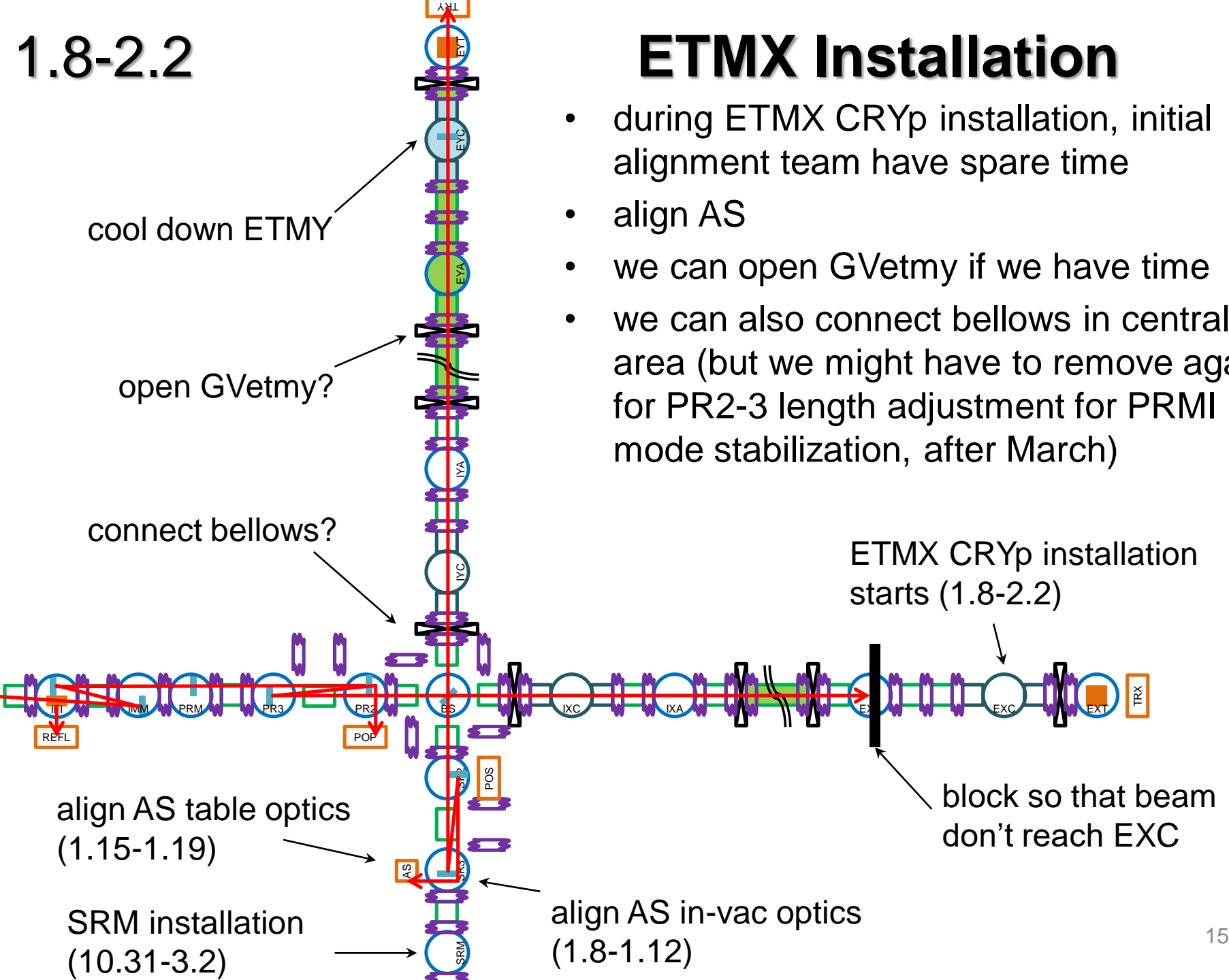
SRM installation
(10.31-3.2)

SR3 installation done

1.8-2.2

ETMX Installation

- during ETMX CRYp installation, initial alignment team have spare time
- align AS
- 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)

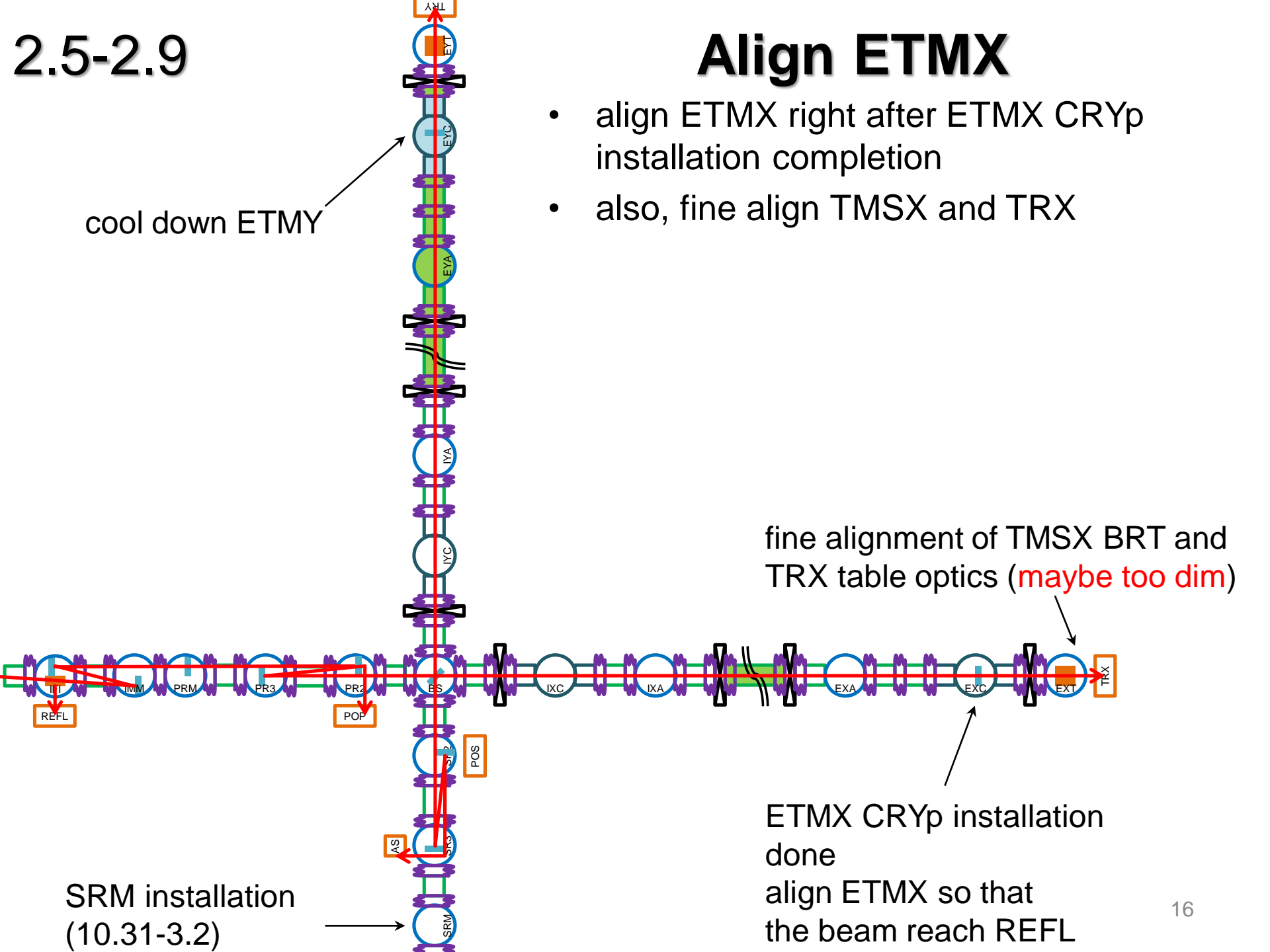


2.5-2.9

Align ETMX

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

cool down ETMY



fine alignment of TMSX BRT and TRX table optics (maybe too dim)

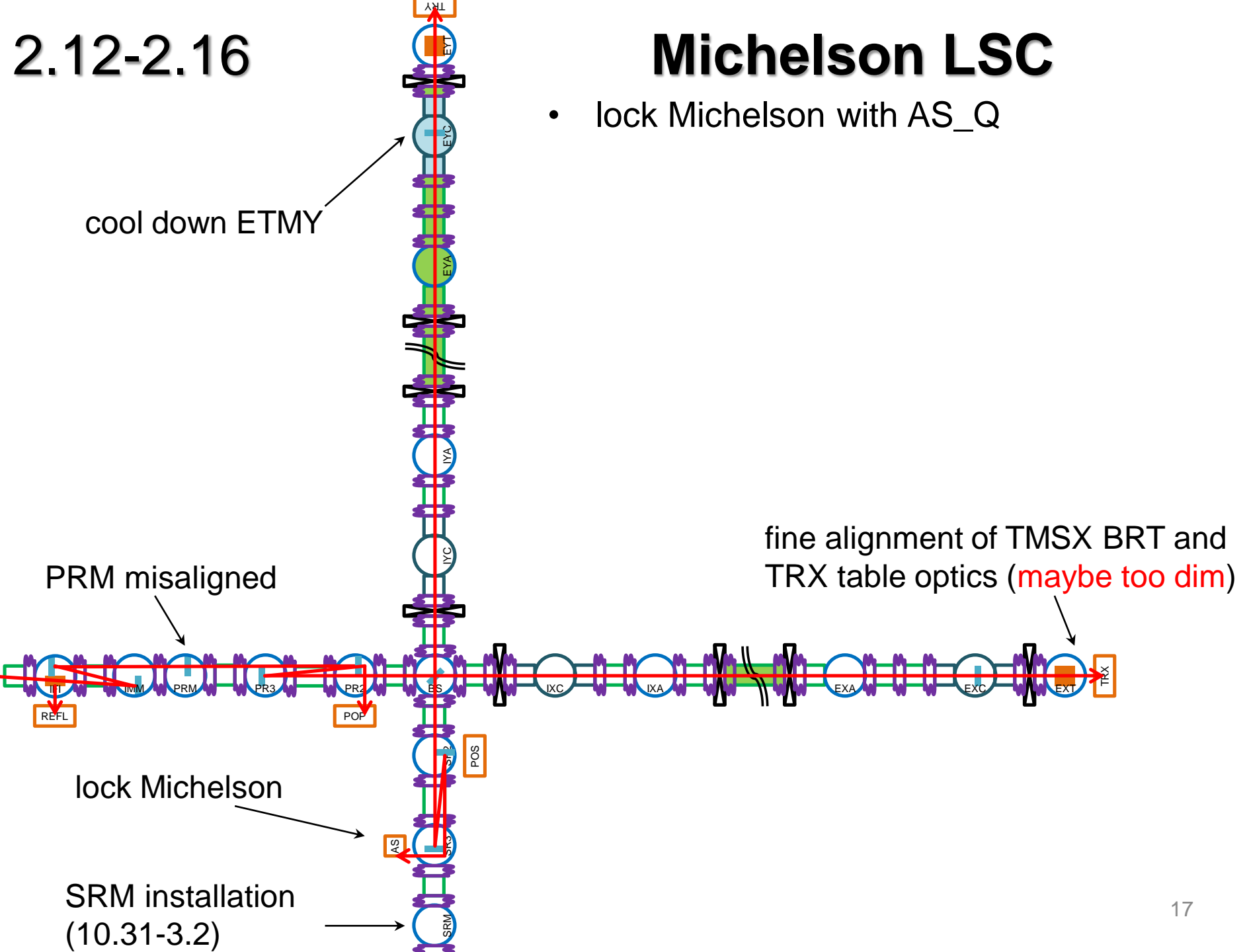
SRM installation (10.31-3.2)

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

2.12-2.16

Michelson LSC

- lock Michelson with AS_Q



2.19-2.23

Prepare for EX Evacuation

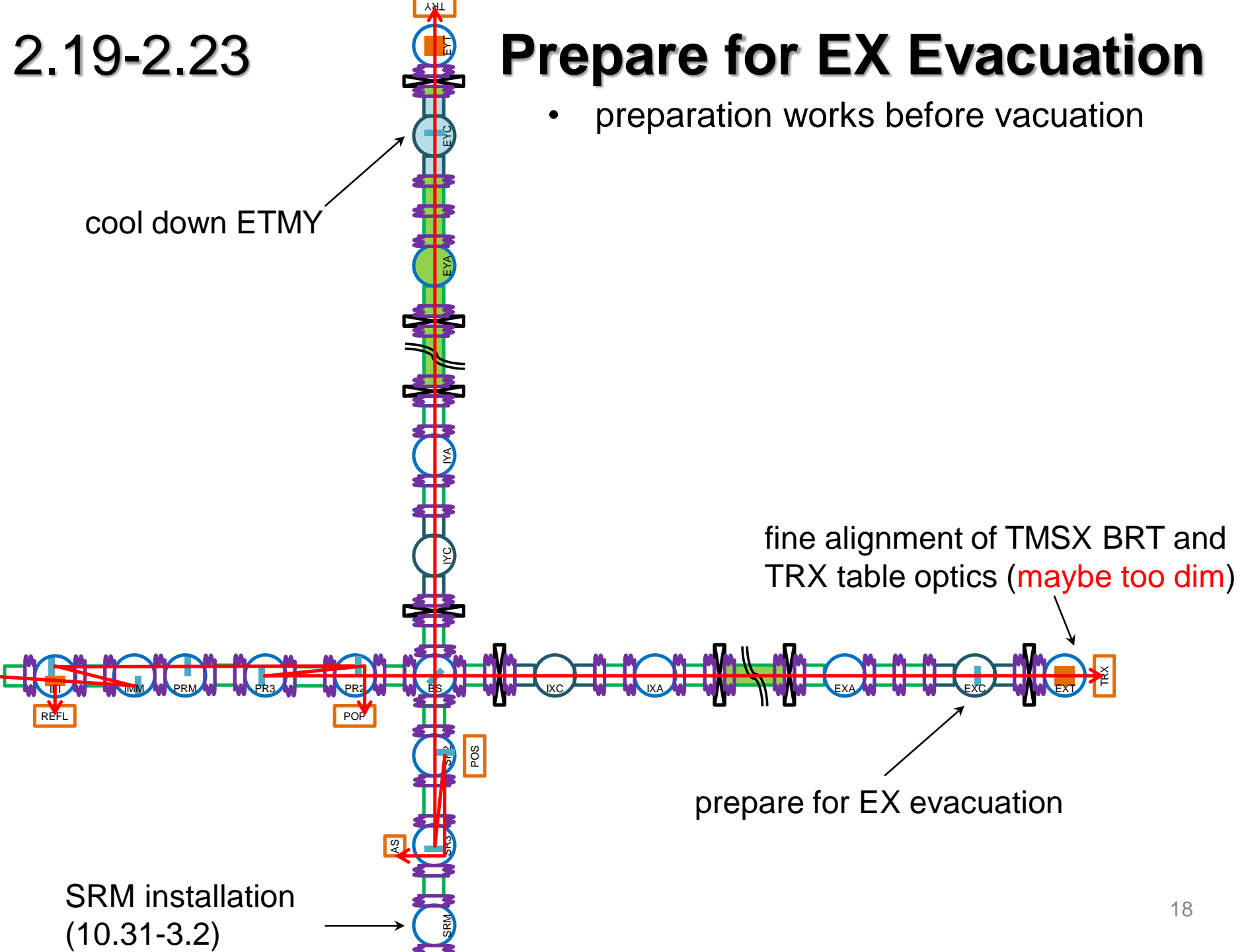
- preparation works before vacuation

cool down ETMY

fine alignment of TMSX BRT and TRX table optics (maybe too dim)

prepare for EX evacuation

SRM installation (10.31-3.2)



2.23-3.2

EX Evacuation

- monitor beam at REFL, POP, TRY, TRX, AS during evacuation

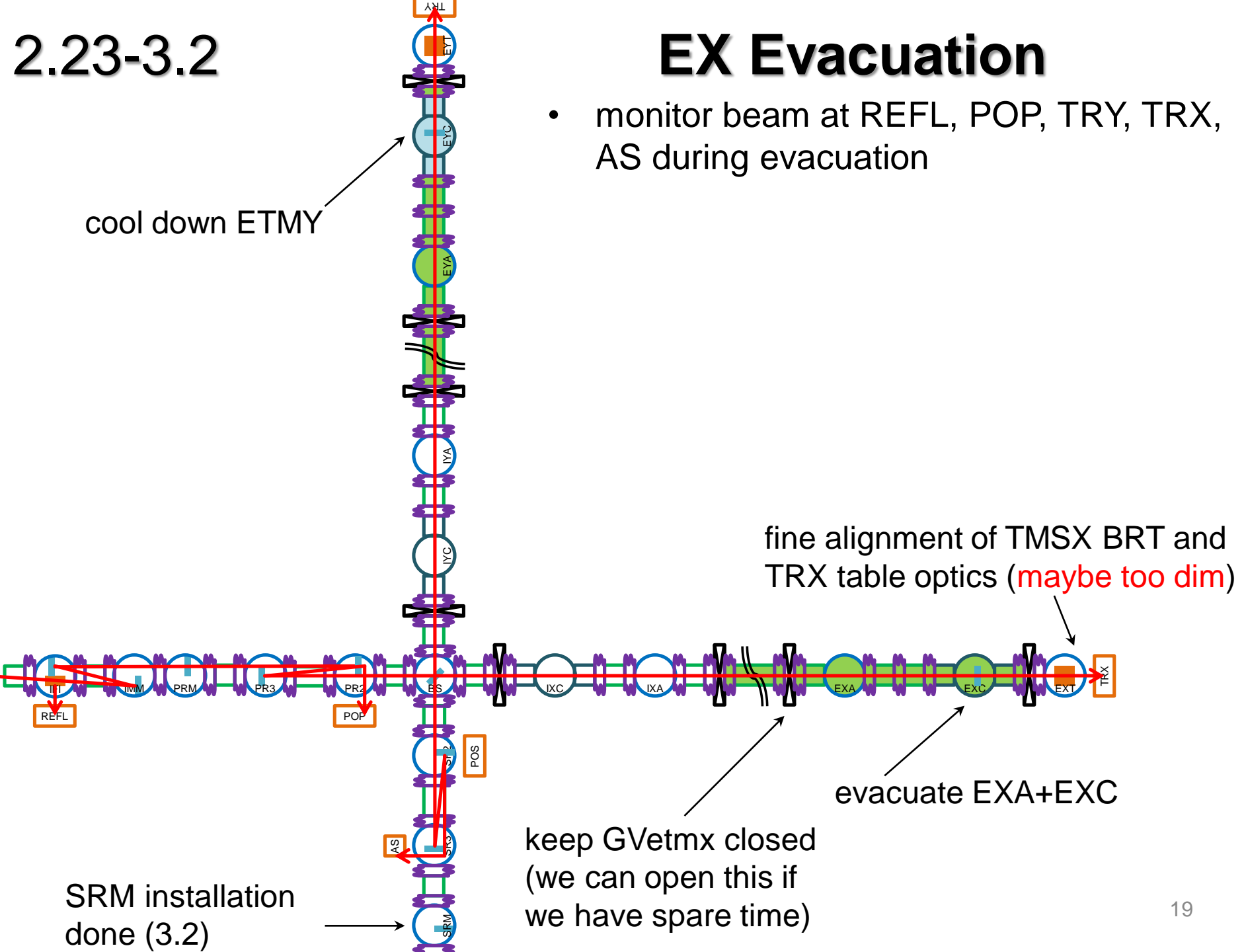
cool down ETMY

fine alignment of TMSX BRT and TRX table optics (maybe too dim)

evacuate EXA+EXC

keep GVetmx closed (we can open this if we have spare time)

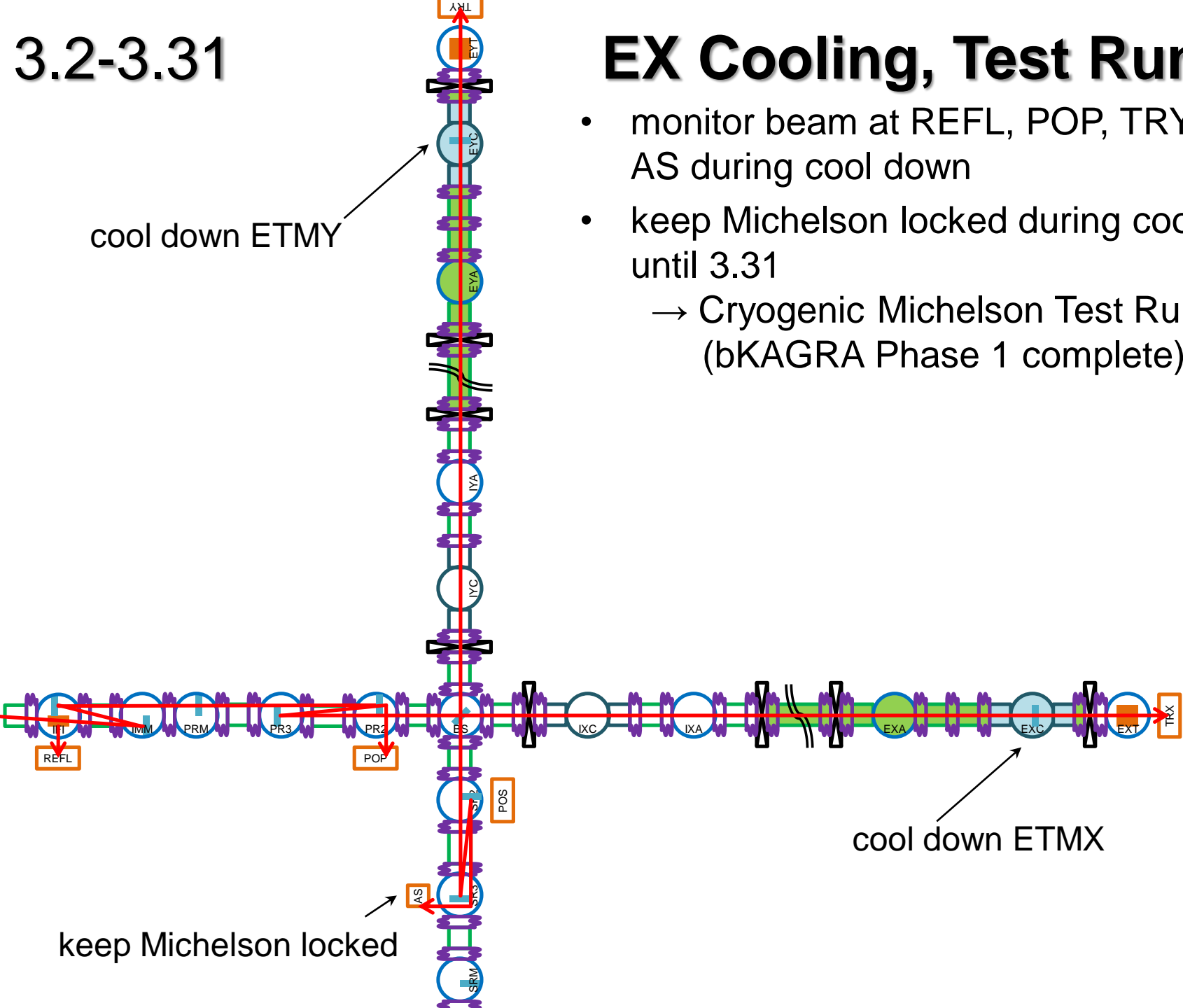
SRM installation done (3.2)



3.2-3.31

EX Cooling, Test Run

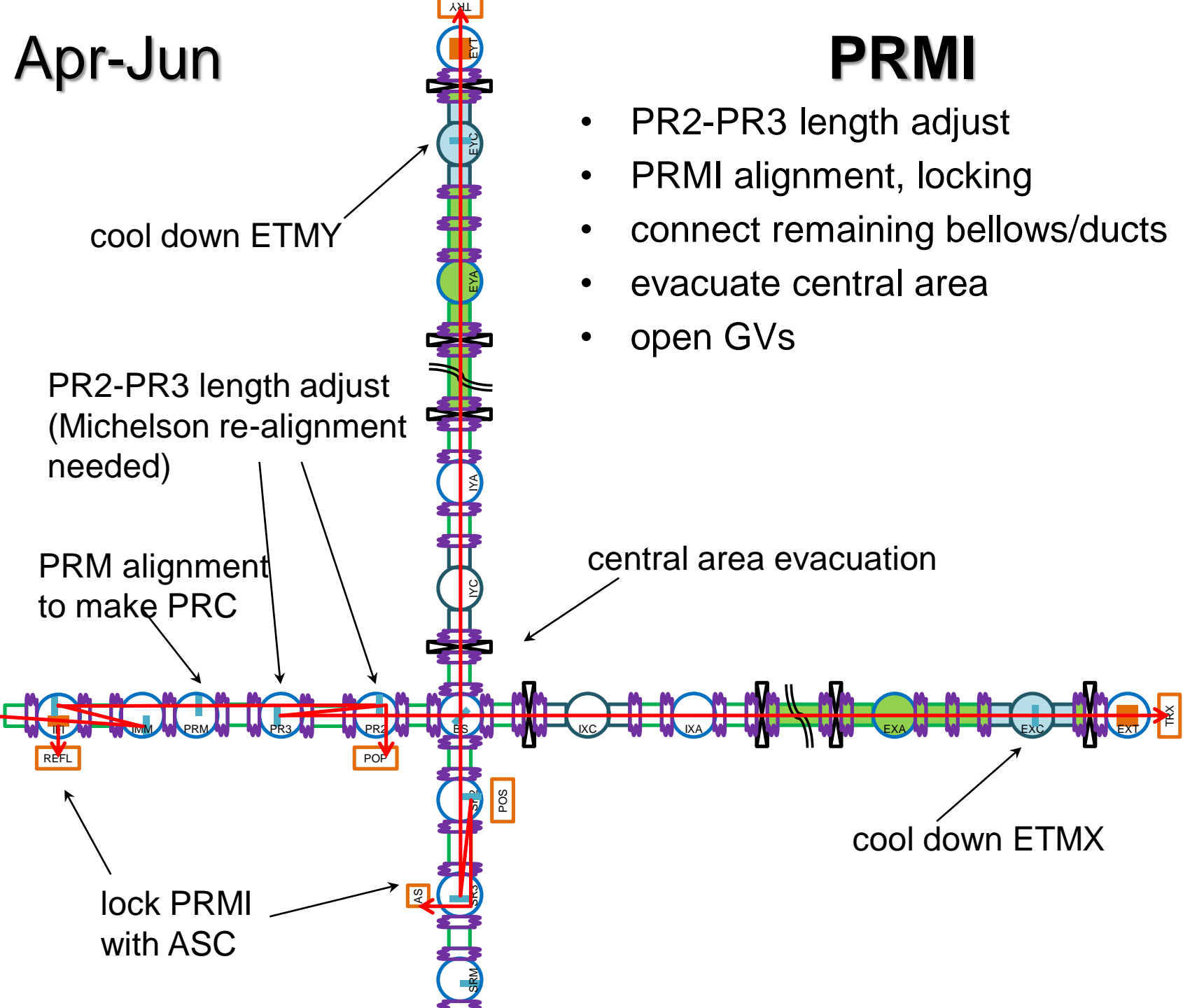
- monitor beam at REFL, POP, TRY, TRX, AS during cool down
- keep Michelson locked during cool down until 3.31
 - Cryogenic Michelson Test Run (bKAGRA Phase 1 complete)



Apr-Jun

PRMI

- PR2-PR3 length adjust
- PRMI alignment, locking
- connect remaining bellows/ducts
- evacuate central area
- open GV's



cool down ETMY

PR2-PR3 length adjust
(Michelson re-alignment needed)

PRM alignment to make PRC

central area evacuation

cool down ETMX

lock PRMI with ASC