

# Commissioning Procedure for bKAGRA Phase 1 (2017.9-2018.3)

Yuta Michimura






Department of Physics, University of Tokyo

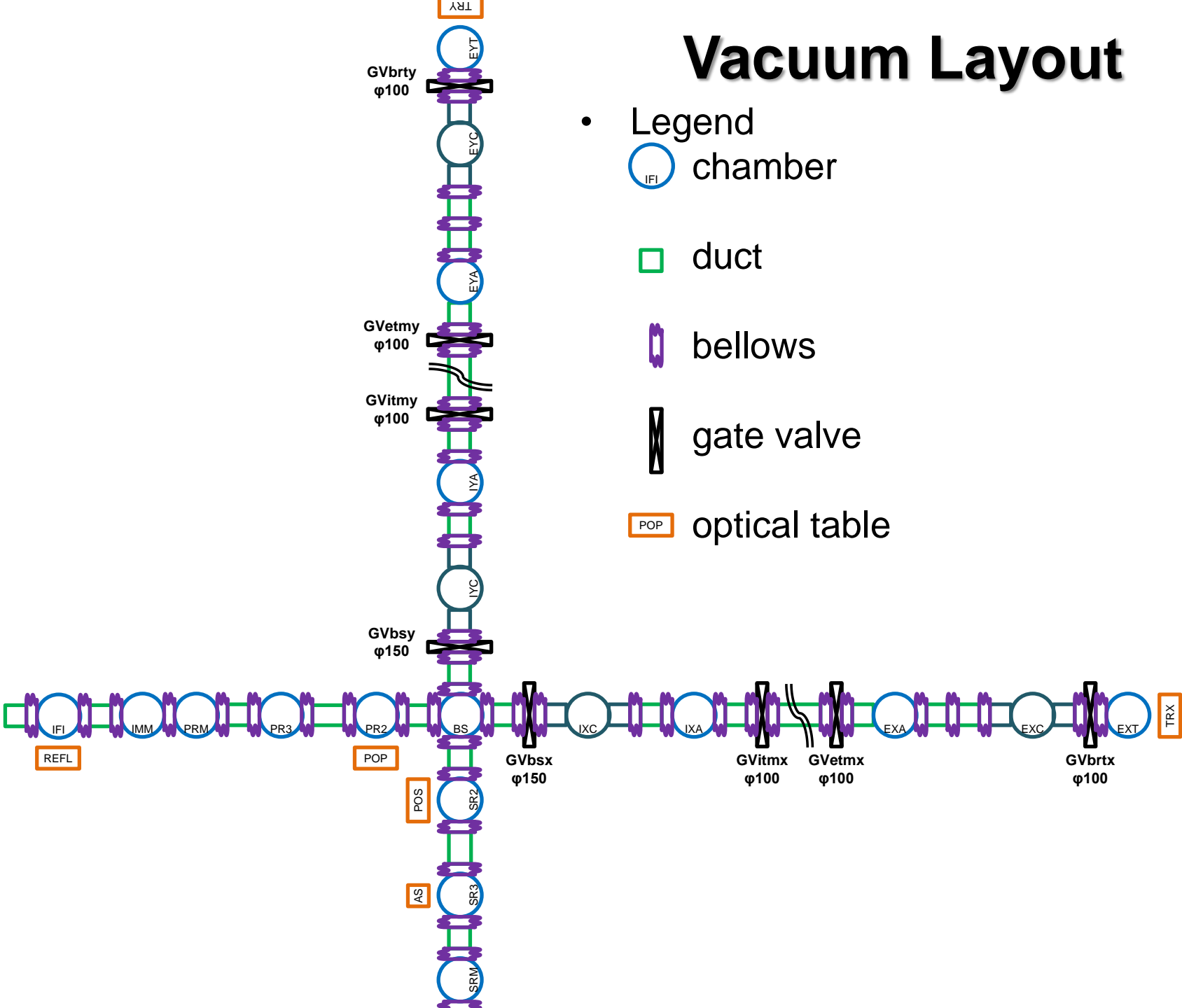
see, also, [JGW-T1605595](#)  
for interferometer design and commissioning schedule

# Major Updates

- v20170612
  - X and Y CRYp installation almost at the same time  
(much earlier X installation)
  - MICH lock at room temp. before cooling down  
(instead of cooling ETMY first)
  - AS cannot be used when room temp. lock since SR3 is not ready
  - SR2 won't be ready by Phase 1 deadline

# Vacuum Layout

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



8.31

9.7

EYT BRT installation (7.11-10.2)

Yarm evacuated

PR3-2 not connected

GV closed

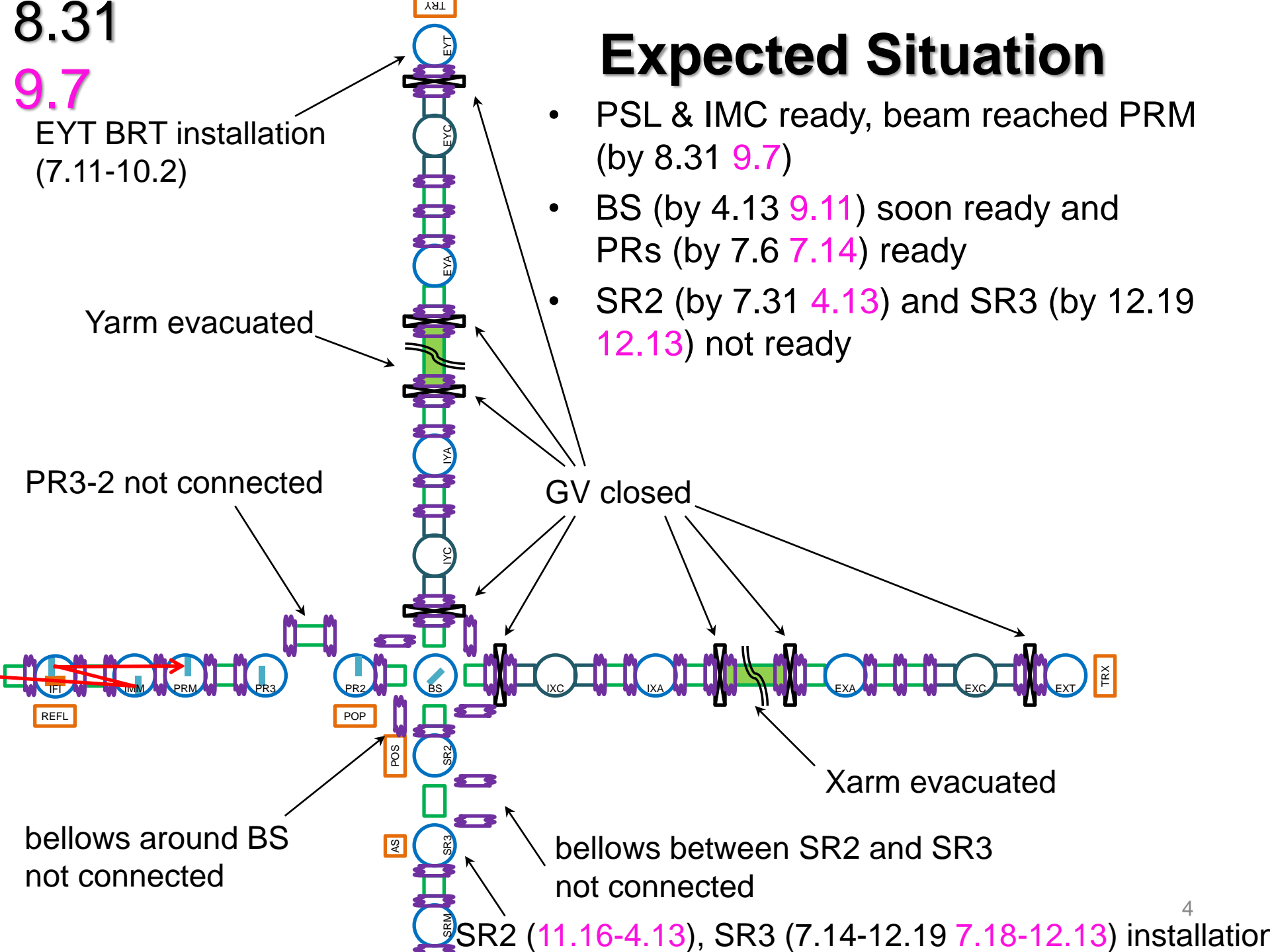
bellows around BS not connected

bellows between SR2 and SR3 not connected

SR2 (11.16-4.13), SR3 (7.14-12.19 7.18-12.13) installation

# Expected Situation

- PSL & IMC ready, beam reached PRM (by 8.31 9.7)
- BS (by 4.13 9.11) soon ready and PRs (by 7.6 7.14) ready
- SR2 (by 7.31 4.13) and SR3 (by 12.19 12.13) not ready



9.1-9.8

9.22

EYT BRT installation  
(7.11-10.2)

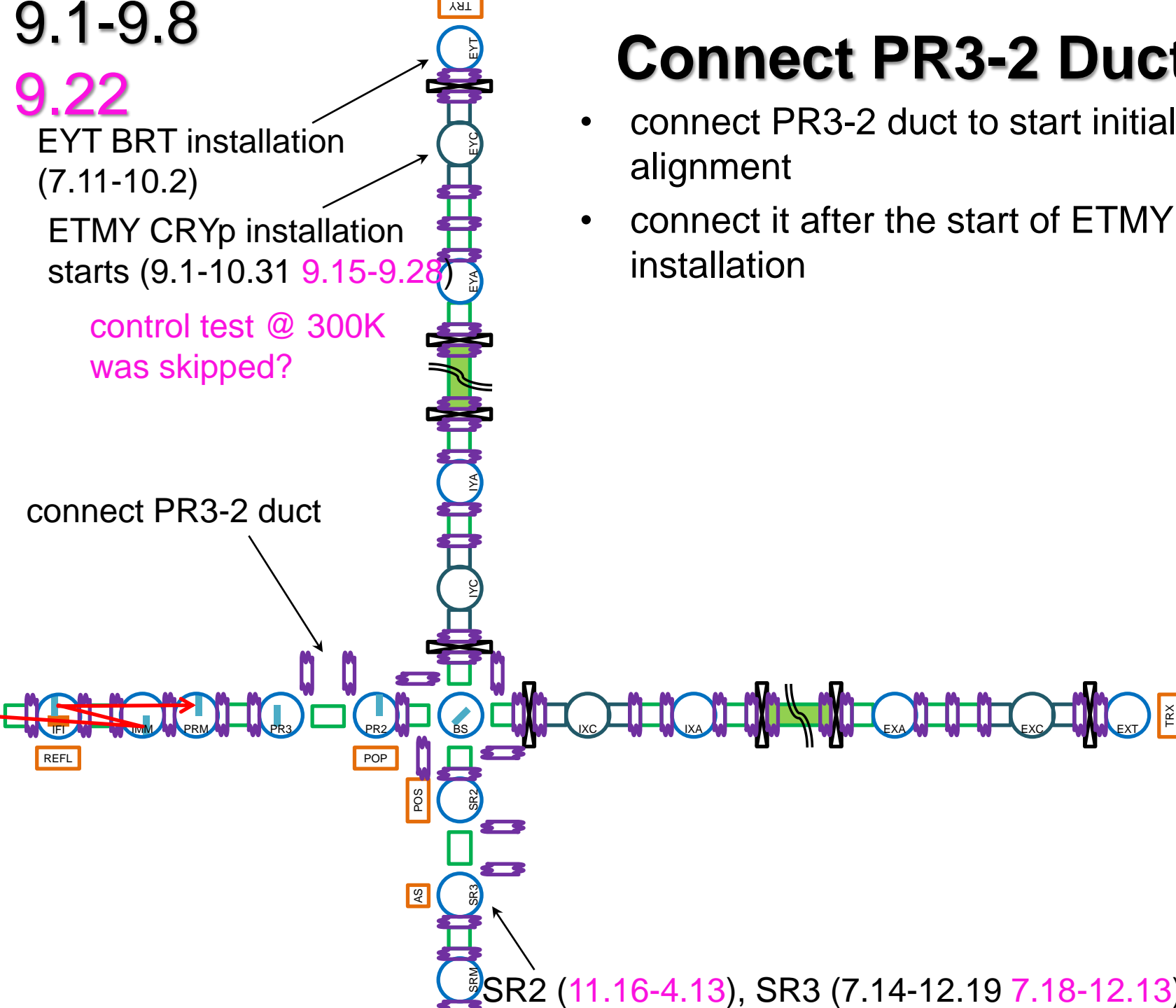
ETMY CRYp installation  
starts (9.1-10.31 9.15-9.28)

control test @ 300K  
was skipped?

# Connect PR3-2 Duct

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

connect PR3-2 duct



SR2 (11.16-4.13), SR3 (7.14-12.19 7.18-12.13) installation

9.11-9.15

9.25-9.29

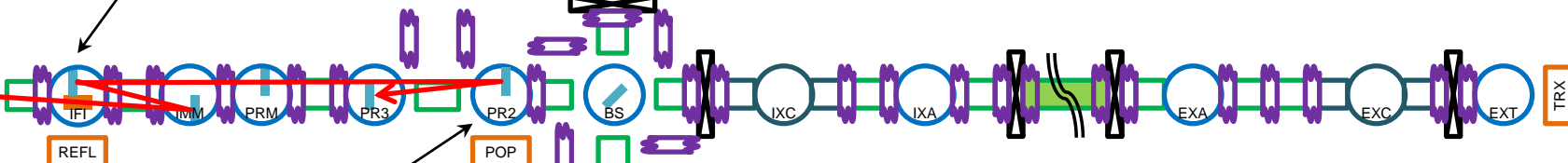
EYT BRT installation  
(7.11-10.2)

ETMY CRYp done  
(9.1-10.31 9.15-9.28)

# 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

steer IMMT2 to center the beam on PRM and PR2



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

POP

POS

AS

SR2 (11.16-4.13), SR3 (7.14-12.19 7.18-12.13) installation

9.18-9.22

10.2-10.6

EYT BRT installation done

EYA NAB installation starts (10.3-11.27)

# Alignment from PR3 to Xend

- need to calculate the beam position on GV windows

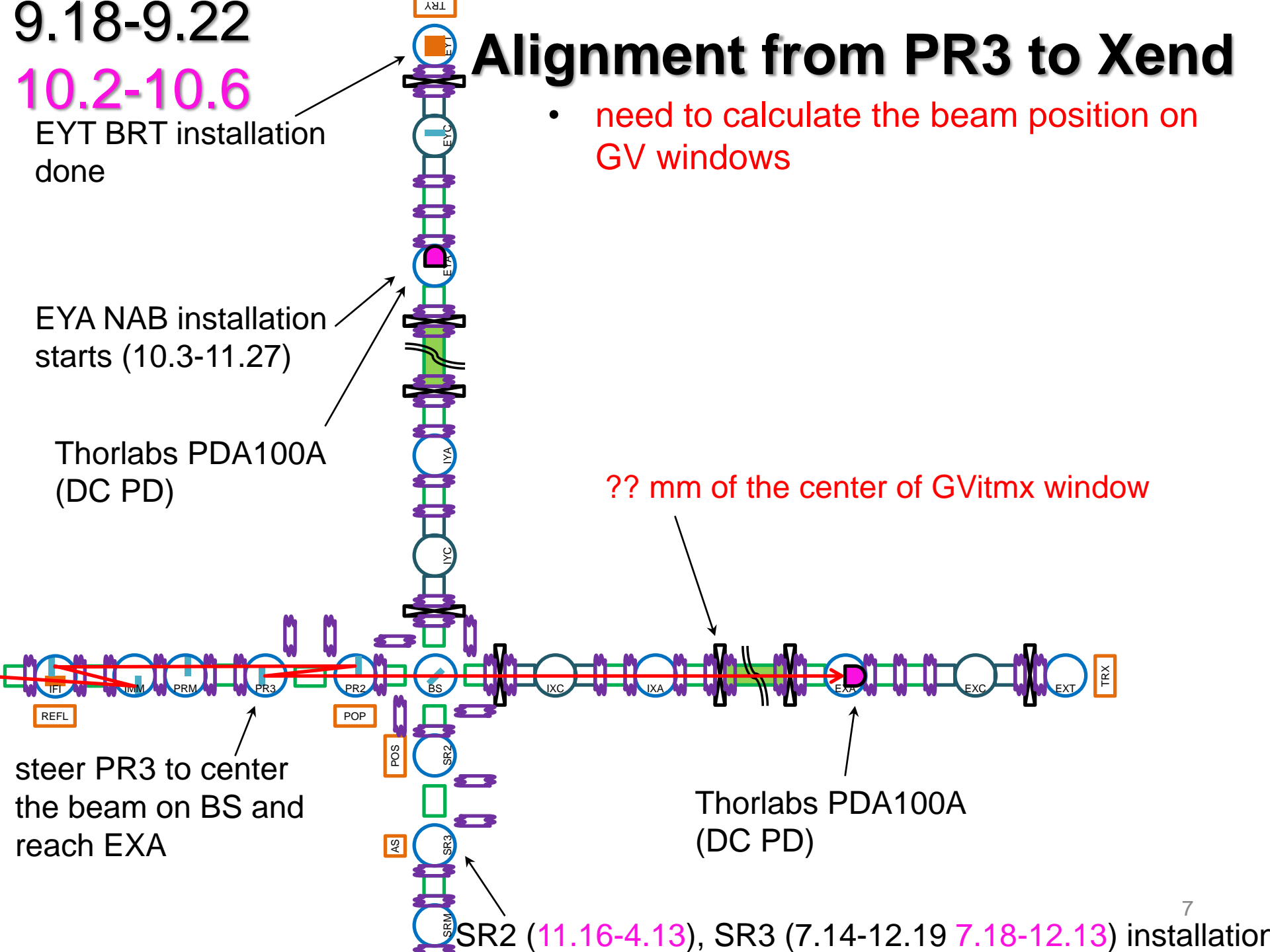
Thorlabs PDA100A (DC PD)

?? mm of the center of GVitmx window

steer PR3 to center the beam on BS and reach EXA

Thorlabs PDA100A (DC PD)

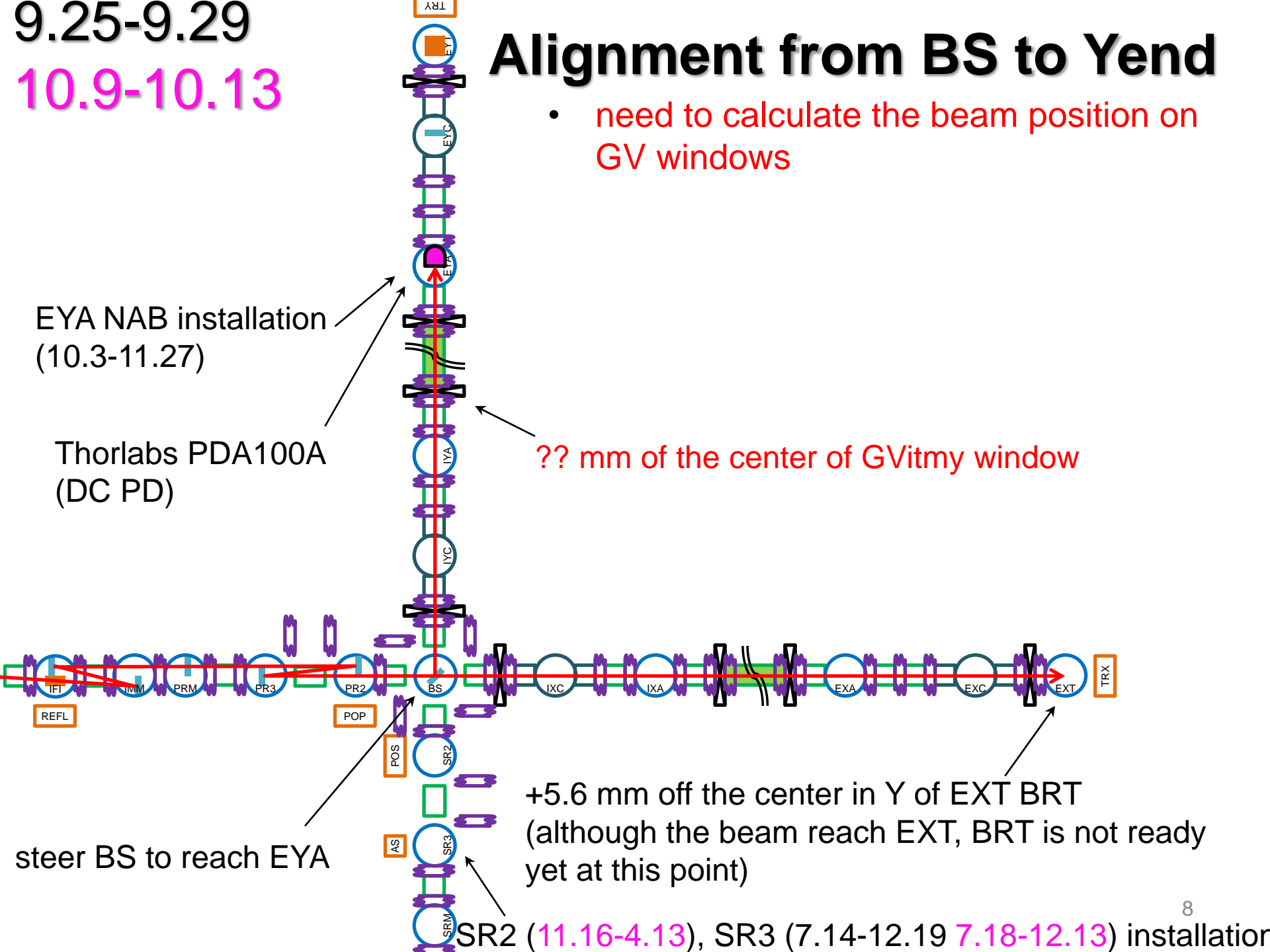
SR2 (11.16-4.13), SR3 (7.14-12.19 7.18-12.13) installation



9.25-9.29  
10.9-10.13

# Alignment from BS to Yend

- need to calculate the beam position on GV windows





10.2-10.27

10.16-11.10

alignment of TMSY BRT  
And TRY table optics

(maybe too dim)

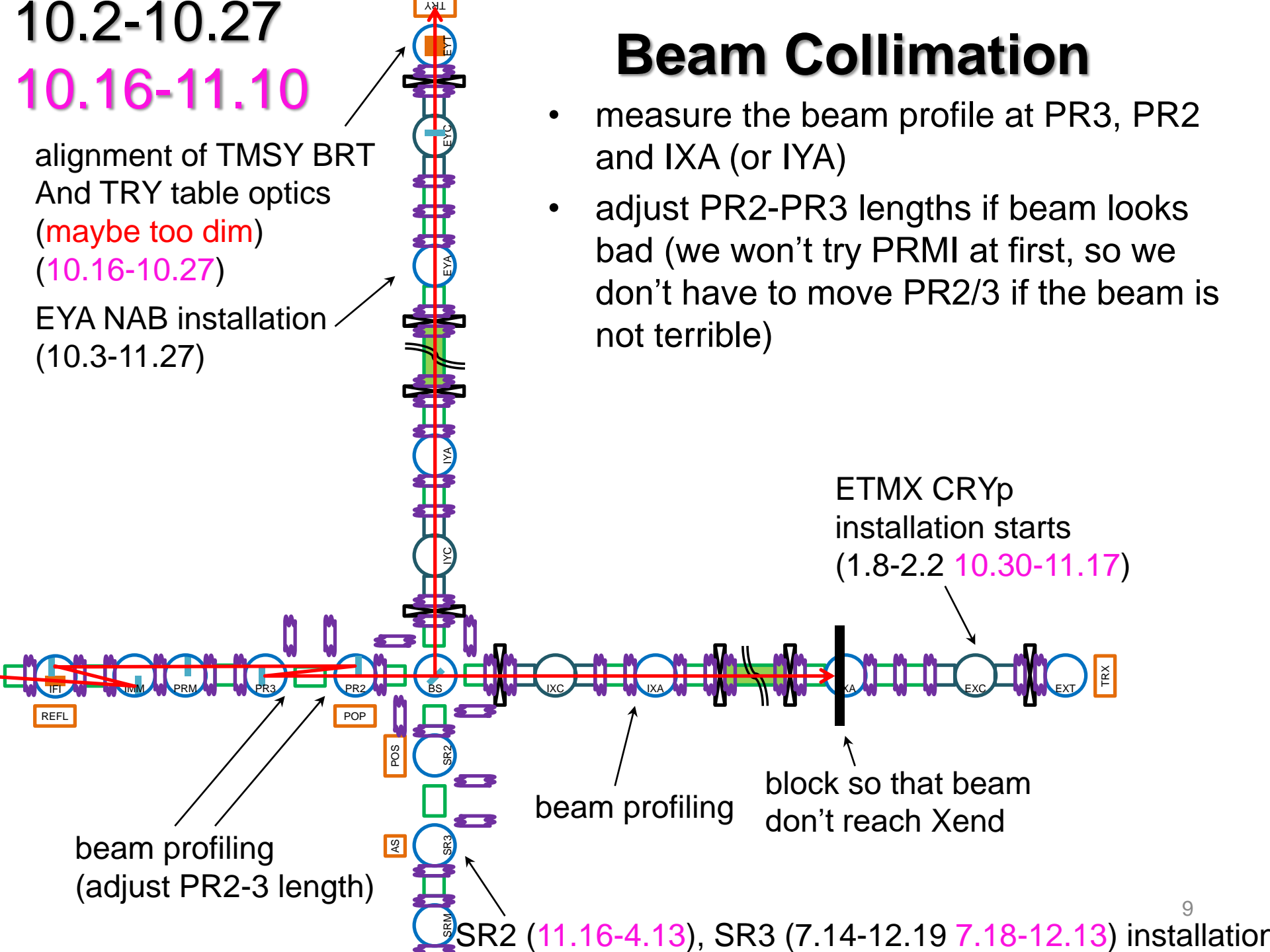
(10.16-10.27)

EYA NAB installation

(10.3-11.27)

# 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)



beam profiling  
(adjust PR2-3 length)

beam profiling

block so that beam  
don't reach Xend

ETMX CRYp  
installation starts  
(1.8-2.2 10.30-11.17)

SR2 (11.16-4.13), SR3 (7.14-12.19 7.18-12.13) installation

11.1-11.7

11.13-11.17

# Align ETMY

- align ETMY ~1.5 month after ETMY CRYp installation completion
- also align TMSY

align ETMY so that the beam reach REFL

EYA NAB installation (10.3-11.27)

slit at EYA for ETMY alignment

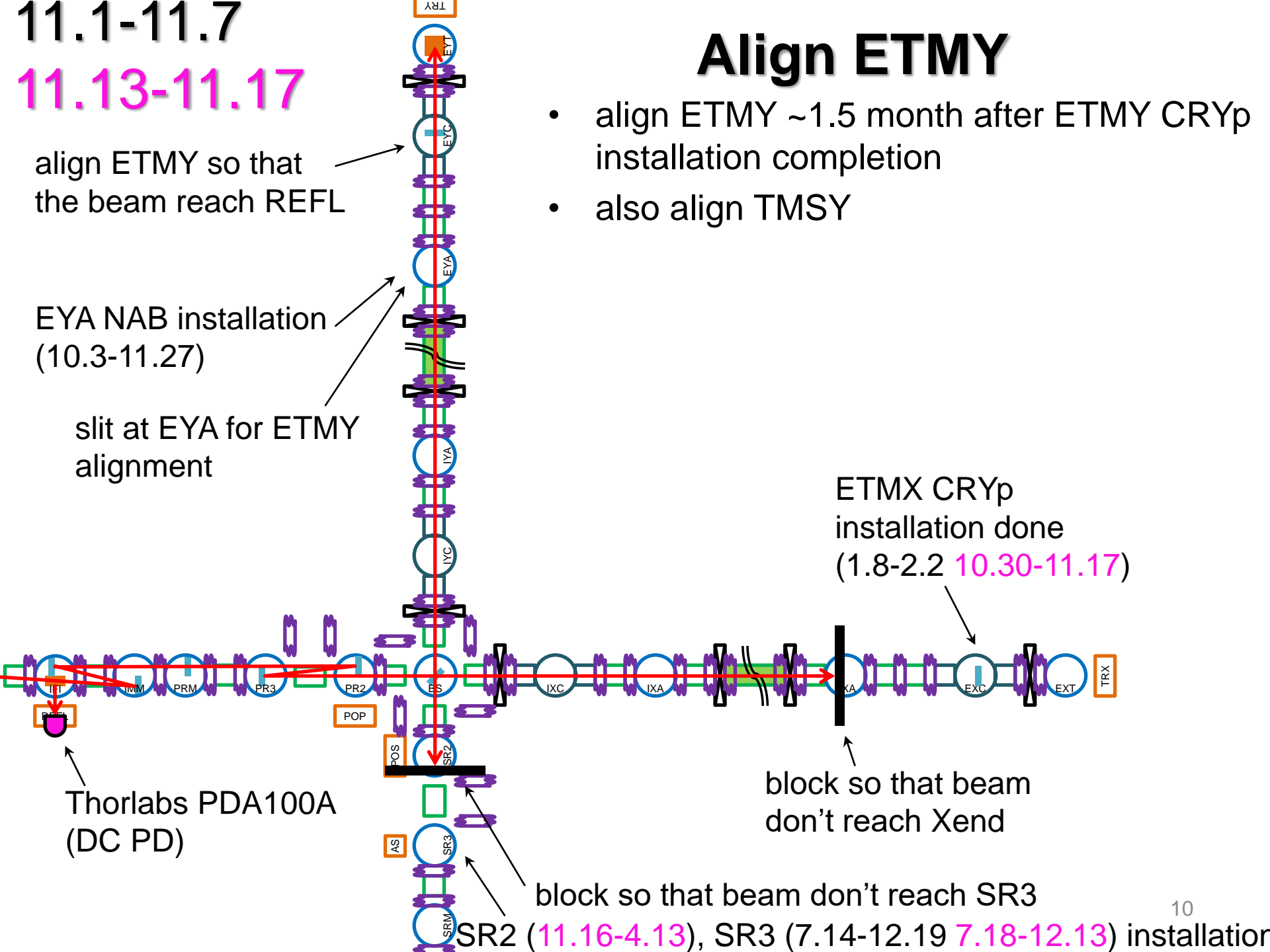
ETMX CRYp installation done (1.8-2.2 10.30-11.17)

Thorlabs PDA100A (DC PD)

block so that beam don't reach Xend

block so that beam don't reach SR3

SR2 (11.16-4.13), SR3 (7.14-12.19 7.18-12.13) installation

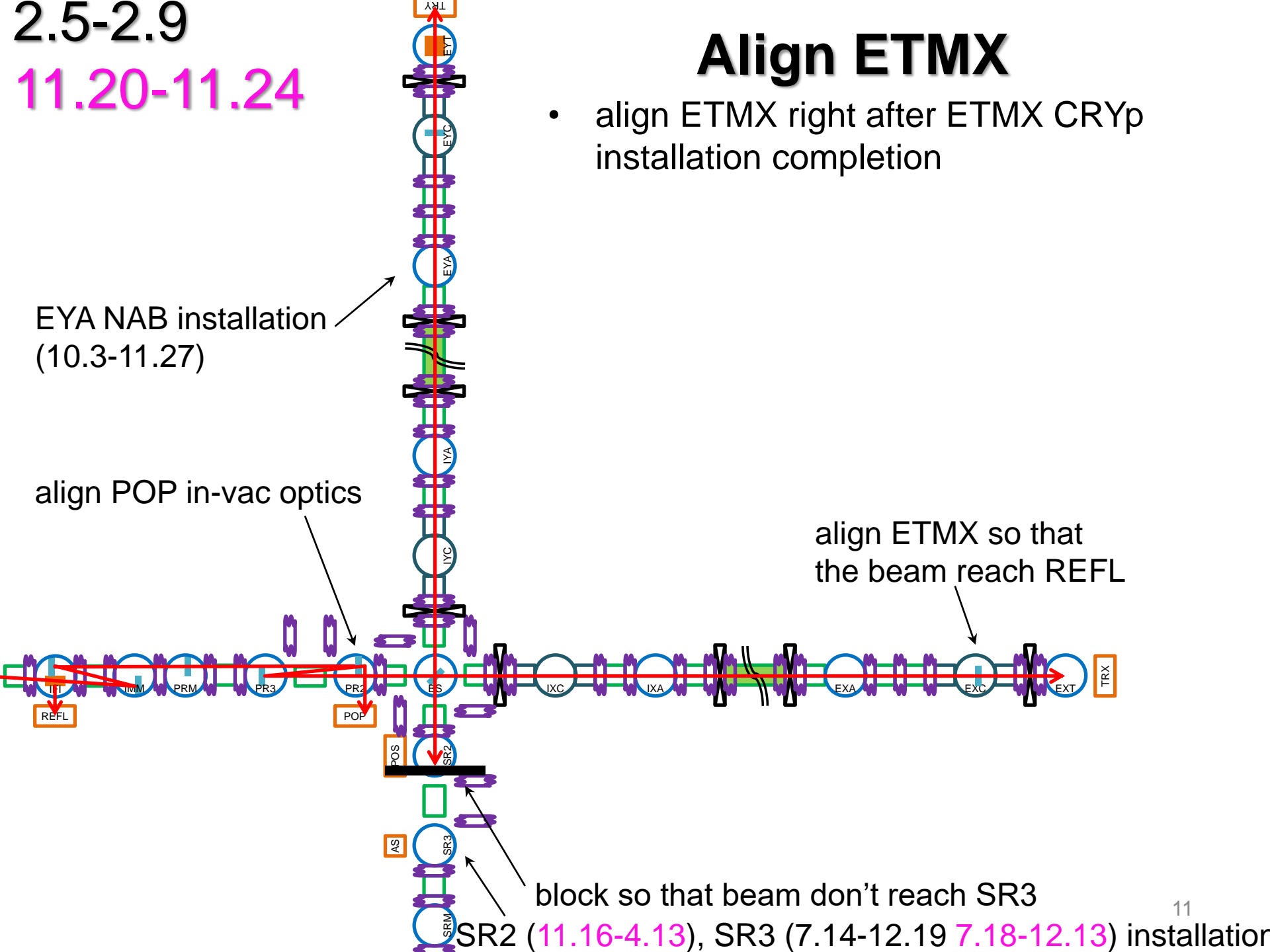


2.5-2.9

11.20-11.24

# Align ETMX

- align ETMX right after ETMX CRYp installation completion



EYA NAB installation  
(10.3-11.27)

align POP in-vac optics

align ETMX so that  
the beam reach REFL

block so that beam don't reach SR3

SR2 (11.16-4.13), SR3 (7.14-12.19 7.18-12.13) installation

11.8-11.14  
11.20-11.24

# Align Aux Optics

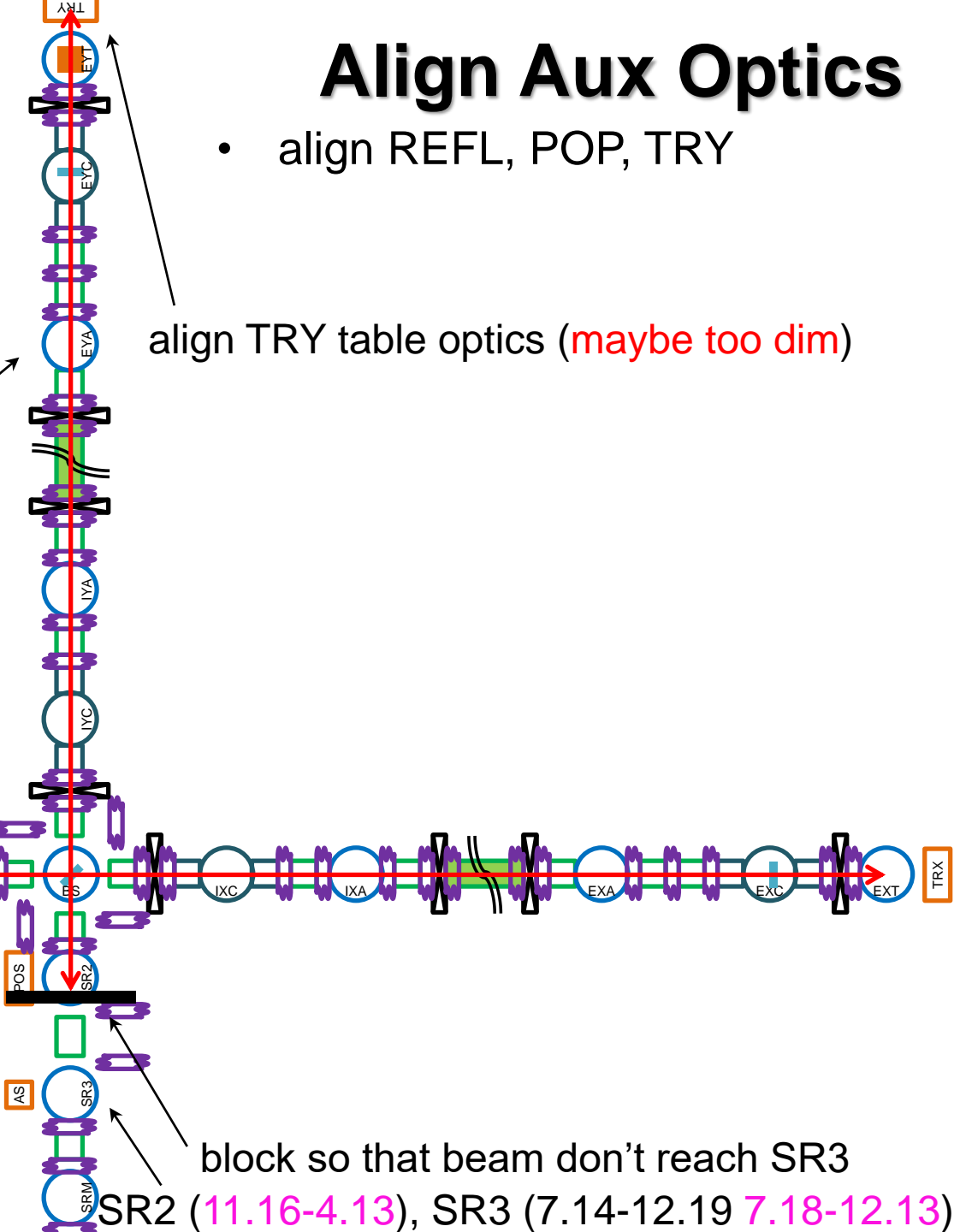
- align REFL, POP, TRY

align TRY table optics (maybe too dim)

EYA NAB installation  
(10.3-11.27)

align POP in-vac optics

align REFL table optics



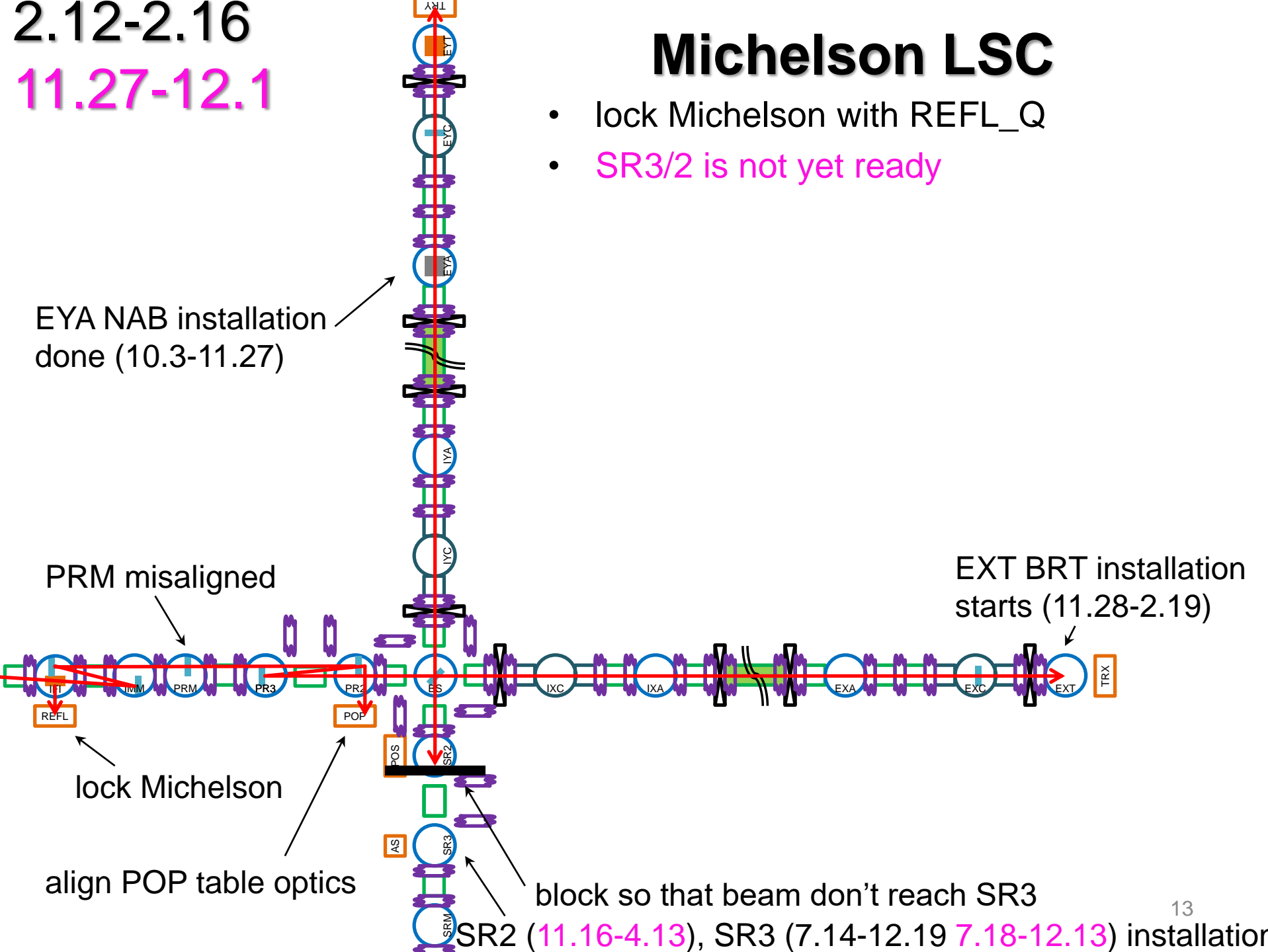
block so that beam don't reach SR3

SR2 (11.16-4.13), SR3 (7.14-12.19 7.18-12.13) installation

2.12-2.16  
11.27-12.1

# Michelson LSC

- lock Michelson with REFL\_Q
- SR3/2 is not yet ready



11.15-11.21

12.4-12.8

# Prepare for EY Evacuation

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

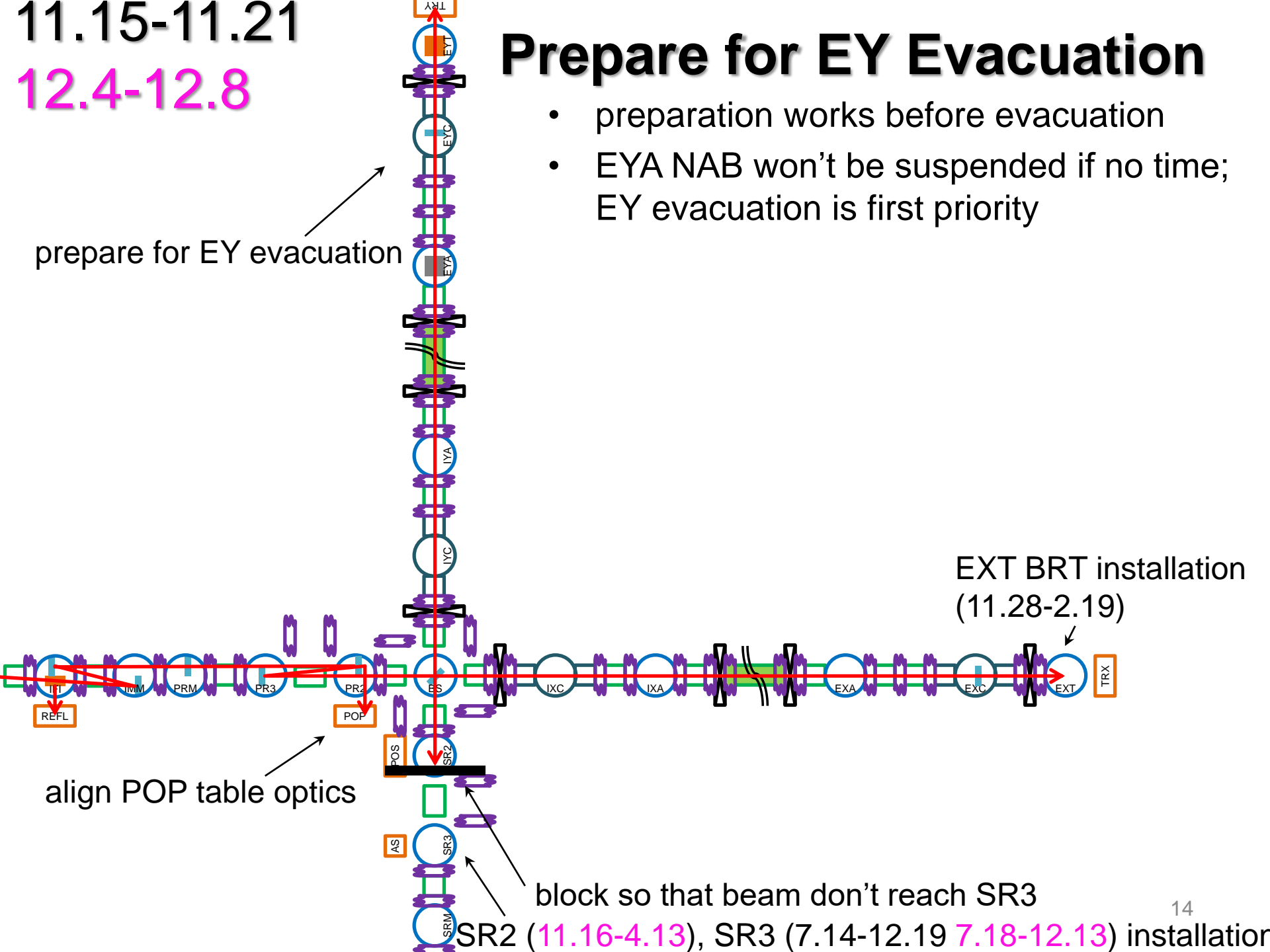
prepare for EY evacuation

EXT BRT installation (11.28-2.19)

align POP table optics

block so that beam don't reach SR3

SR2 (11.16-4.13), SR3 (7.14-12.19 7.18-12.13) installation



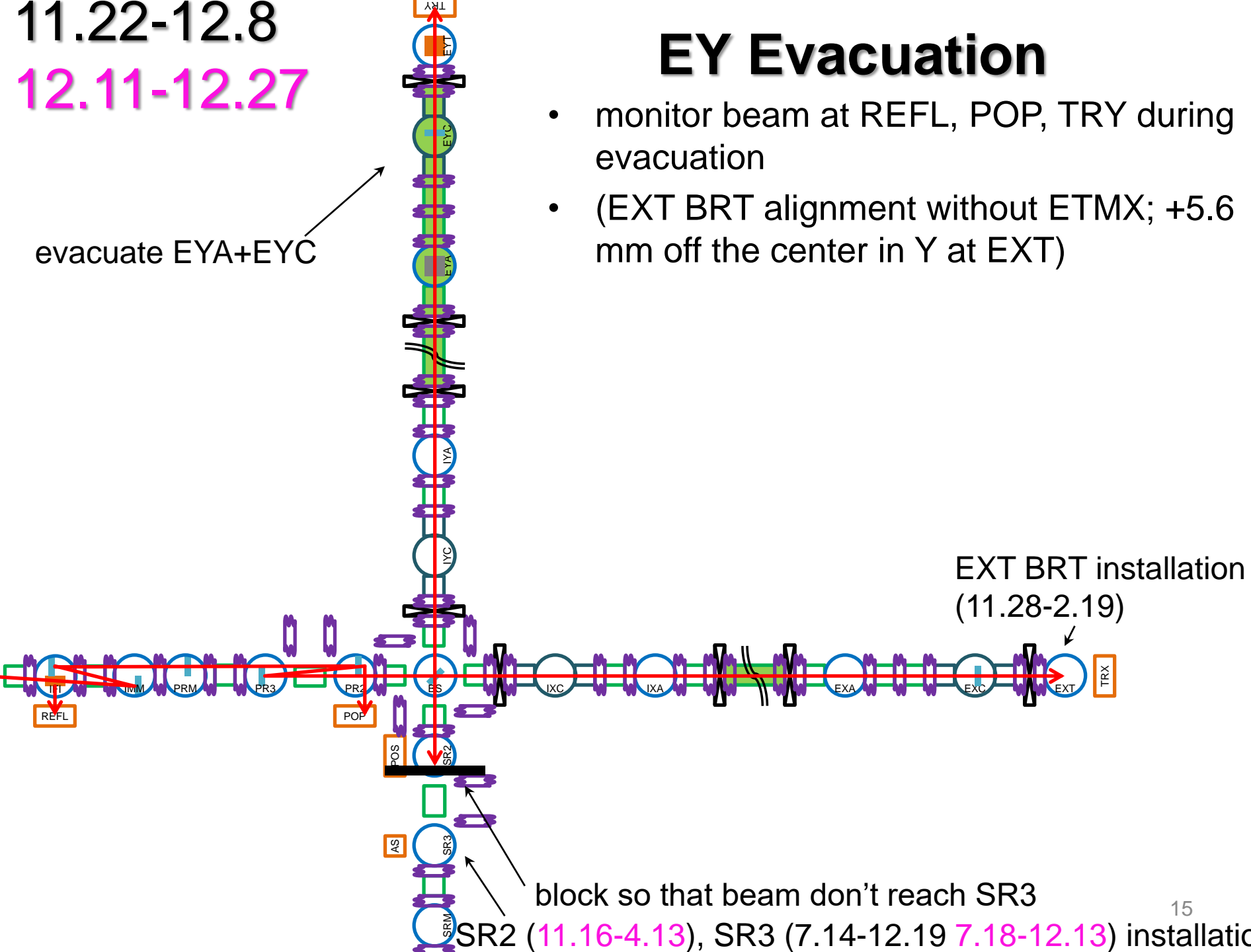
11.22-12.8

12.11-12.27

# 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)

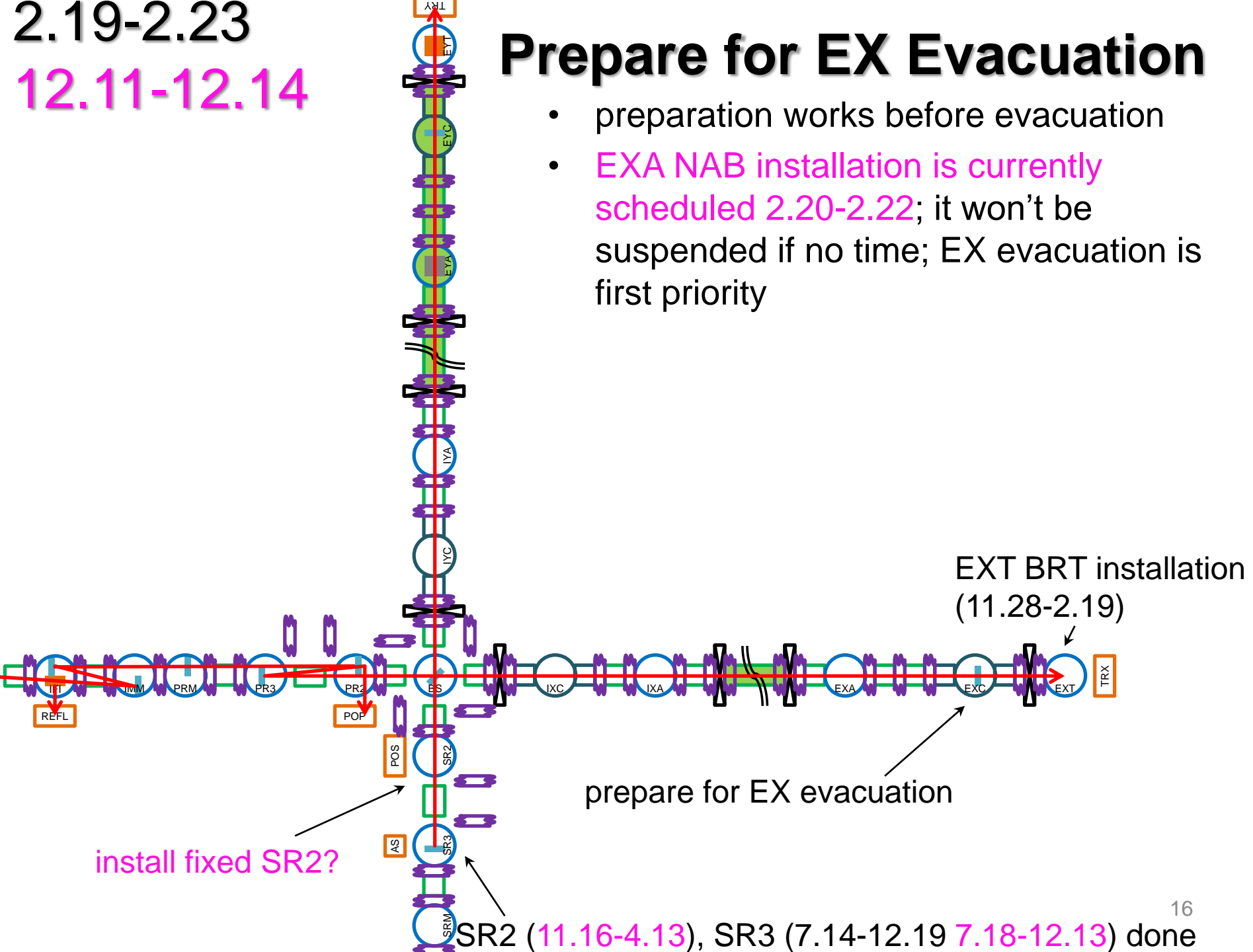
evacuate EYA+EYC



2.19-2.23  
12.11-12.14

# Prepare for EX Evacuation

- preparation works before evacuation
- EXA NAB installation is currently scheduled 2.20-2.22; it won't be suspended if no time; EX evacuation is first priority



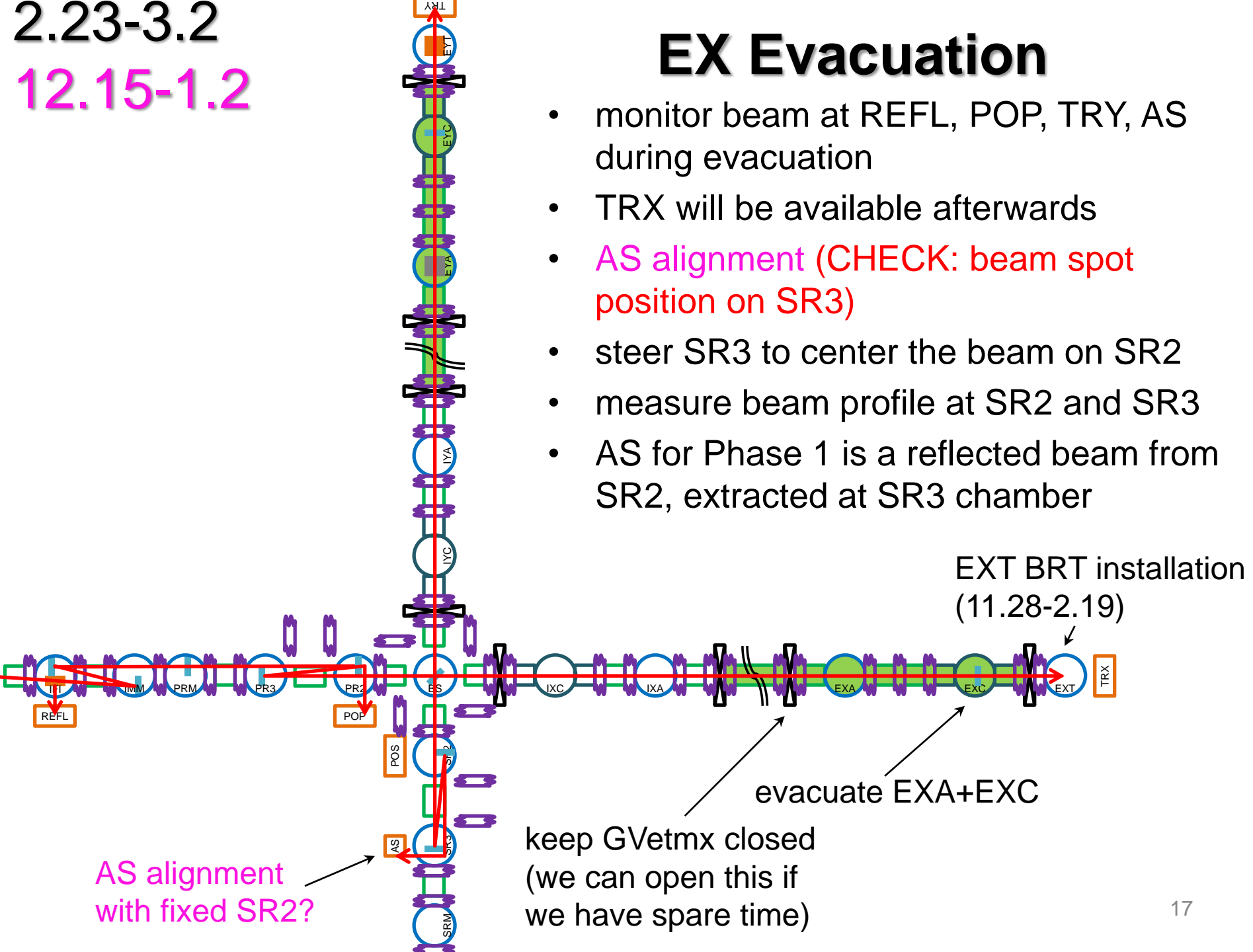


2.23-3.2

12.15-1.2

# EX Evacuation

- monitor beam at REFL, POP, TRY, AS during evacuation
- TRX will be available afterwards
- AS alignment (CHECK: beam spot position on SR3)
- 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



12.8  
12.27

# EY Cooling Starts

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

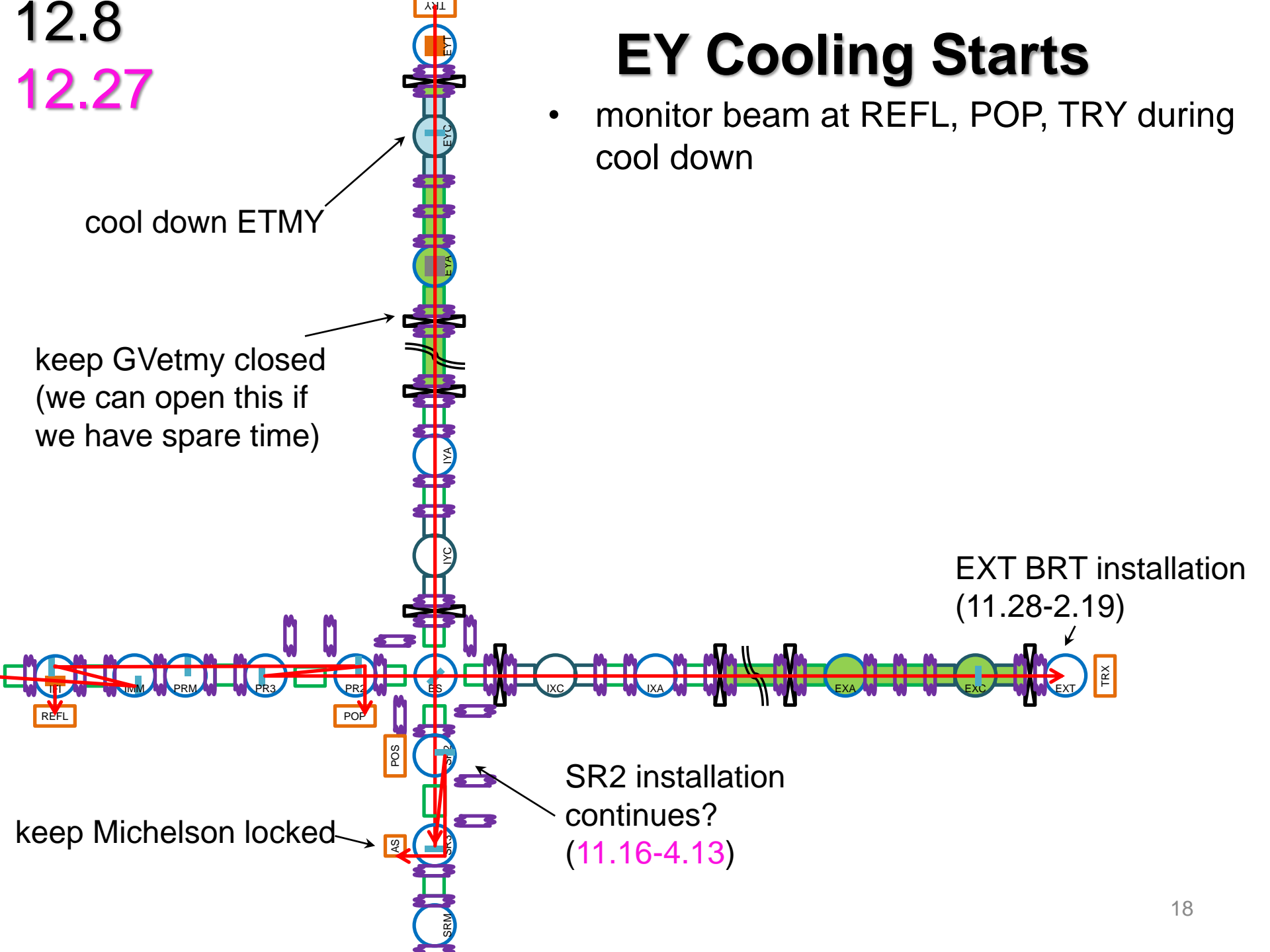
cool down ETMY

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

EXT BRT installation  
(11.28-2.19)

SR2 installation  
continues?  
(11.16-4.13)

keep Michelson locked

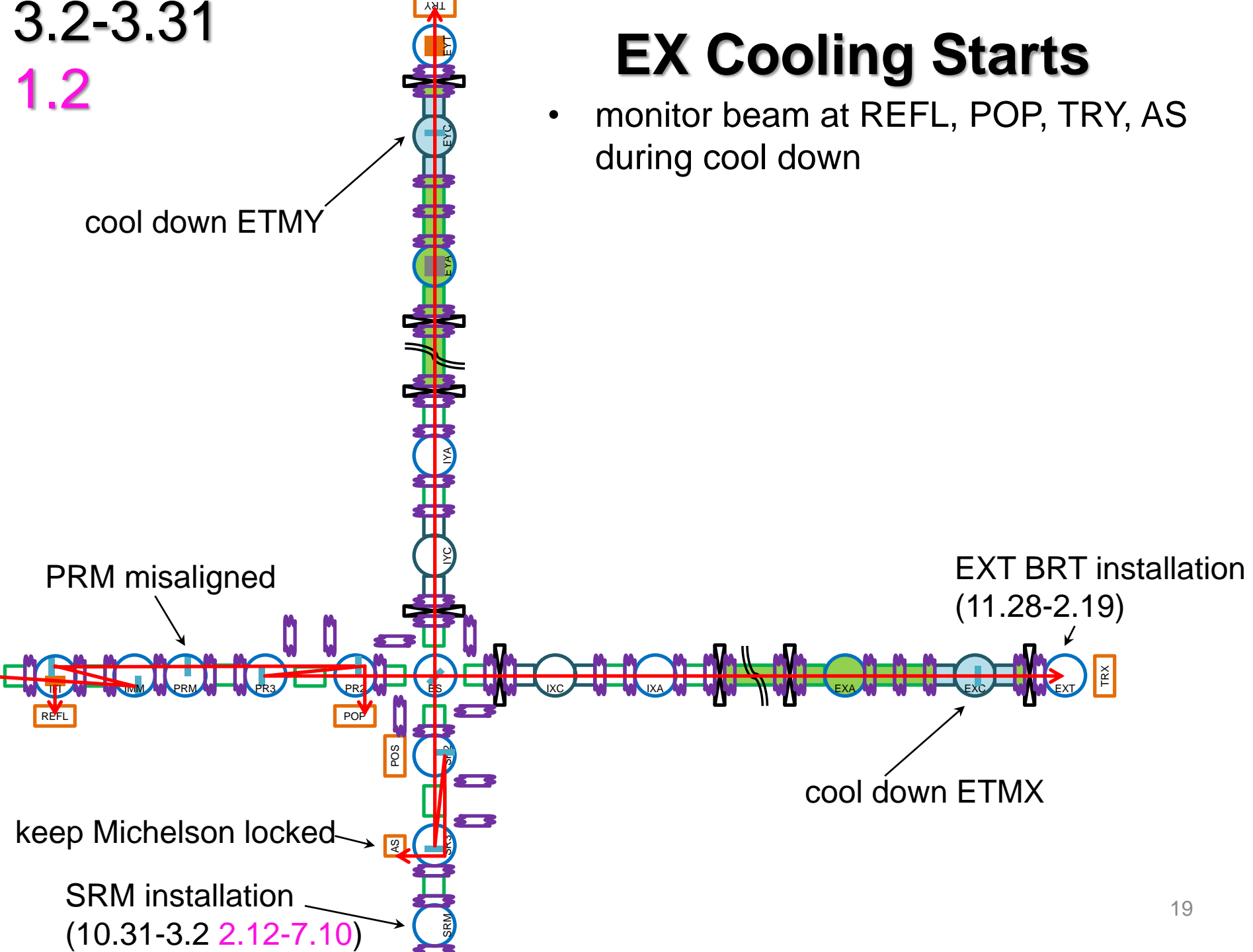


3.2-3.31

1.2

# EX Cooling Starts

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

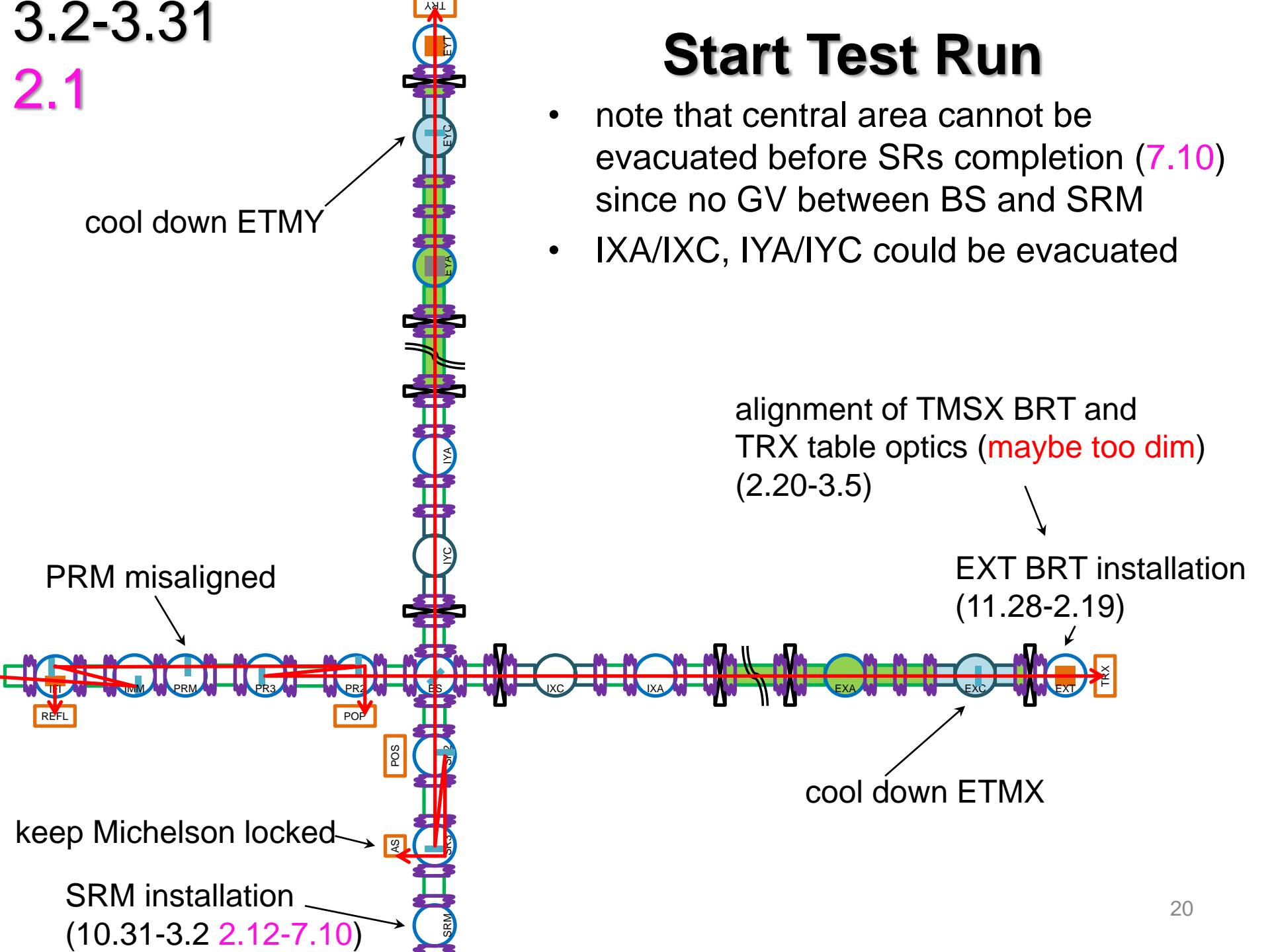


3.2-3.31

2.1

# Start Test Run

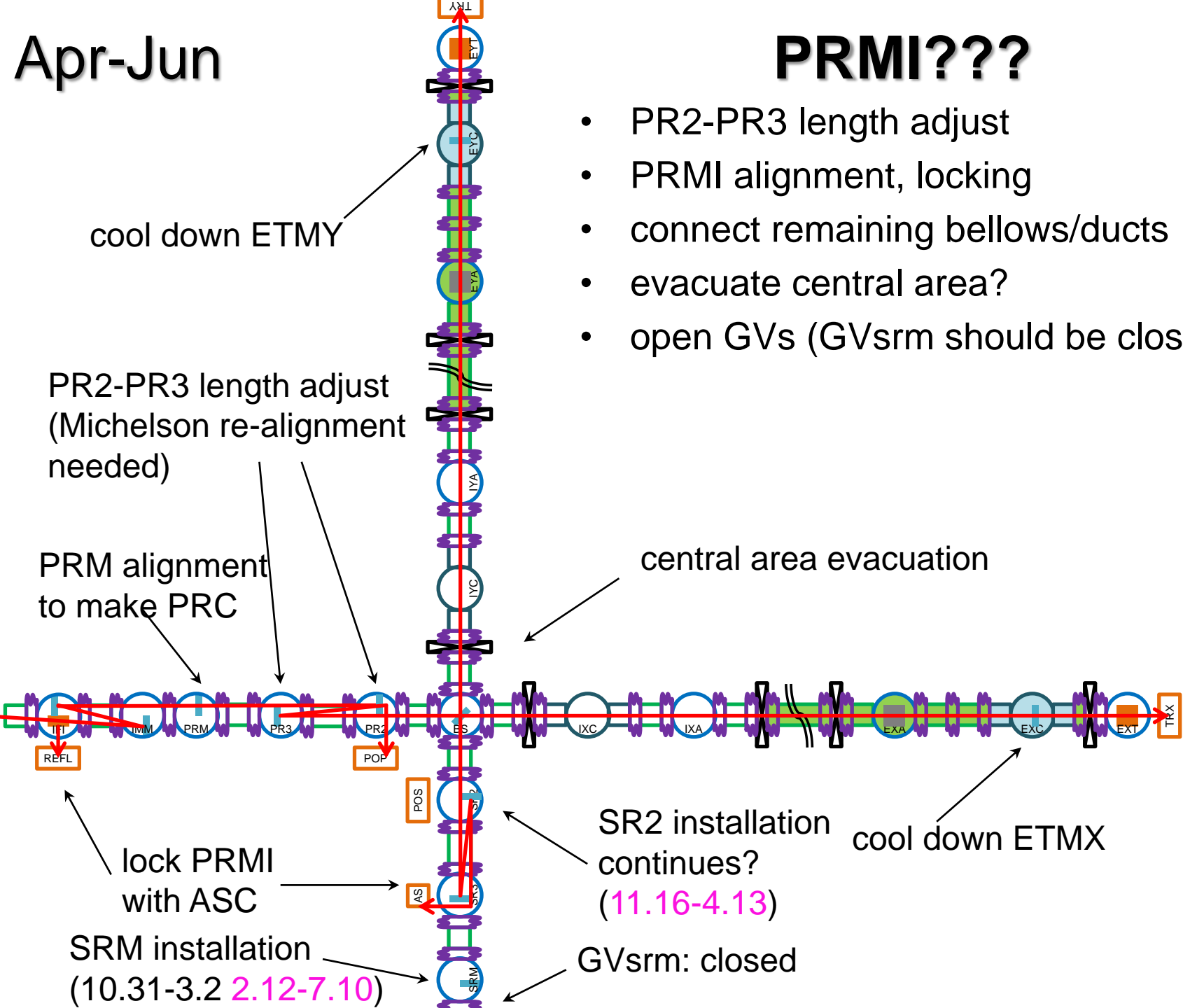
- note that central area cannot be evacuated before SRs completion (7.10) since no GV between BS and SRM
- IXA/IXC, IYA/IYC could be evacuated



Apr-Jun

# PRMI???

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



cool down ETMY

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

PRM alignment to make PRC

central area evacuation

lock PRMI with ASC

SR2 installation continues?  
(11.16-4.13)

cool down ETMX

SRM installation  
(10.31-3.2 2.12-7.10)

GVsrm: closed

# Some Notes

- Update NAB installation schedule?
- Confirm beam spot positions at GVs