

MIF Schedule Estimate for bKAGRA Phase 2

Yuta Michimura

Department of Physics, University of Tokyo

Installation Schedule

- 2017.9 BS and PRs ready
- 2017.11 ETMs ready
- By 2018.3 bKAGRA Phase 1 complete
- 2018.7 Green ready
- 2018.8 ITMX ready (Y first?)
- 2018.9 SRs ready
- 2018.11 ITMY ready

bKAGRA Phase 2 Goal

- Achieve full lock of the cryogenic RSE
- No sensitivity goal
- Open questions (my opinion):
 - lock stretch? ~1 hr?
 - laser power?
 - prototype OMC? DC or RF readout?
 - no SRC detuning?
 - moderate/no reflectivity SRM for better sensitivity with low power?
 - vacuum?
 - ASC?
 - ETM swap?
 - ETM swap comes after Phase 2. Swap takes 2.5 month. If quality is too bad for RSE, we will swap during Phase 2.
- When to cool down the mirror? ITM cooling test? Cooling down takes ~1 month, warm up takes ~< 1 month.

Steps for Full lock

- X-arm (IR and green)
GreenX, TMSX, PR mirrors, REFL optics
- Y-arm (IR and green)
GreenY, TMSY, SR mirrors, REFL optics
- FPMI (IR and green)
X-arm, Y-arm, AS optics
- DRMI
f3 AM modulation, POP optics
- Full locking
(prototype) OMC
- Cool down ITM/ETMs

- Things necessary are written below each step

Timeline Estimation

- Case1: Follow aLIGO experience as a steady case scenario
- Case2: Learn from AdV experience as a quick case scenario (no ALS, no SRC)
- Case3: Learn from iKAGRA experience as a superman scenario roughly break down into tasks (no OMC, no ASC)

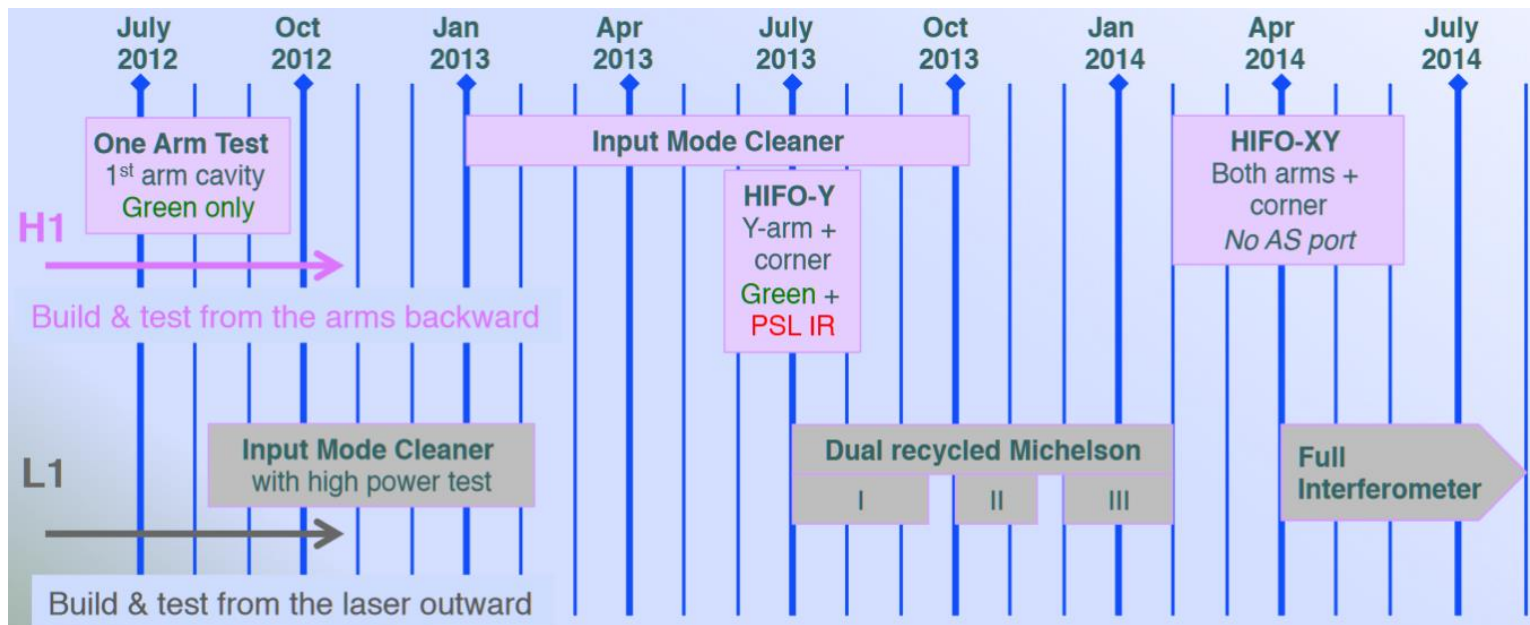
aLIGO Experience

- X-arm (2 months at LHO)
- Y-arm (2 months at LHO)
- FPMI (2 months at LHO)
- DRMI (7 months at LLO, 1.5 months at LHO)
- Full locking (1.5 months + 1.5 months for OMC readout)
- Stable lock to obs. (7 months at LHO, 5 months at AdV)

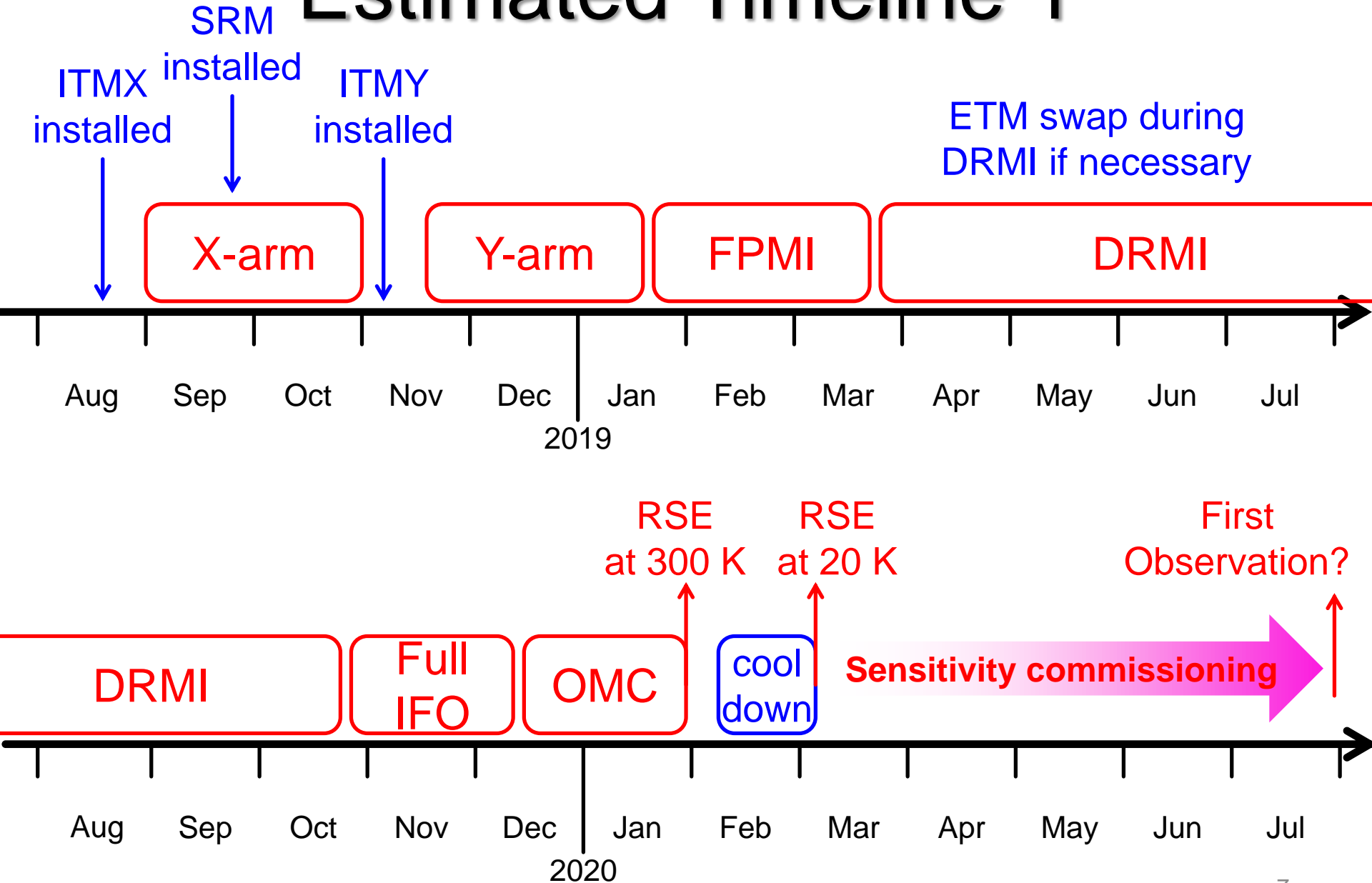
M. Laundry, [LIGO-G1300759](#)

K. Izumi, [LIGO-G1400529](#)

P. Fritschel, [LIGO-G1401078](#)



Estimated Timeline 1



AdV Experience

- 2016.4 PR-NI (=PRX) locking work
- 2016.5.6-5.24 North cavity flash-locked [Virgo log 33758, 33868]
- 2016.6.14-9.16 CITF (=PRMI) fringe-locked [Virgo log 34769]
- 2016.8 Installation finished
- 2016.8.30 Both arm locked
- 2016.11 Wire replaced with steel, started full commissioning
- 2016.12.30 First lock of PRITF (=PRFPMI)
- 2017.1.4 First lock of SSFS
(SSFS = Second Stage of Frequency Stabilization = CARM lock)
- 2017.1.30 First lock with RF readout
- 2017.2.30 First lock with DC readout
- 2017.3.20 First stable lock (~1hr)
- 2017.4.7 Angular control implemented G. Losurdo, [LIGO-G1601346](#)
- 2017.5.9 Both OMCs locked G. Losurdo, [LIGO-G1601797](#)
- 2017.8.1 Joined O2 A. Rocchi, [LIGO-G1700828](#)
A. Rocchi, VIR-0418A-17

Estimate from AdV Experience

- Arm locking takes 2.5 weeks from flash
- FPMI takes 2 weeks?
- PRMI takes 3 months from fringe
- PRFPMI takes 1 months?
- Stable lock takes 3 months
 - > Full IFO takes ~4 months
- ASC takes 2.5 week?
- OMC lock takes 1 month
- Stable lock to obs. 5 months

Estimated Timeline 2

dummy SRM

ITMX installed

installed

ITMY installed

ETM swap not compatible with this timeline

X-arm

Y-arm

FP
MI

PRMI

Full IFO

Aug Sep Oct Nov Dec 2019 Jan Feb Mar Apr May Jun Jul

RSE at 300 K

RSE at 20 K

First Observation without SRC?

ASCOMC

COMC

cool down

Sensitivity commissioning

Aug Sep Oct Nov Dec 2020 Jan Feb Mar Apr May Jun Jul

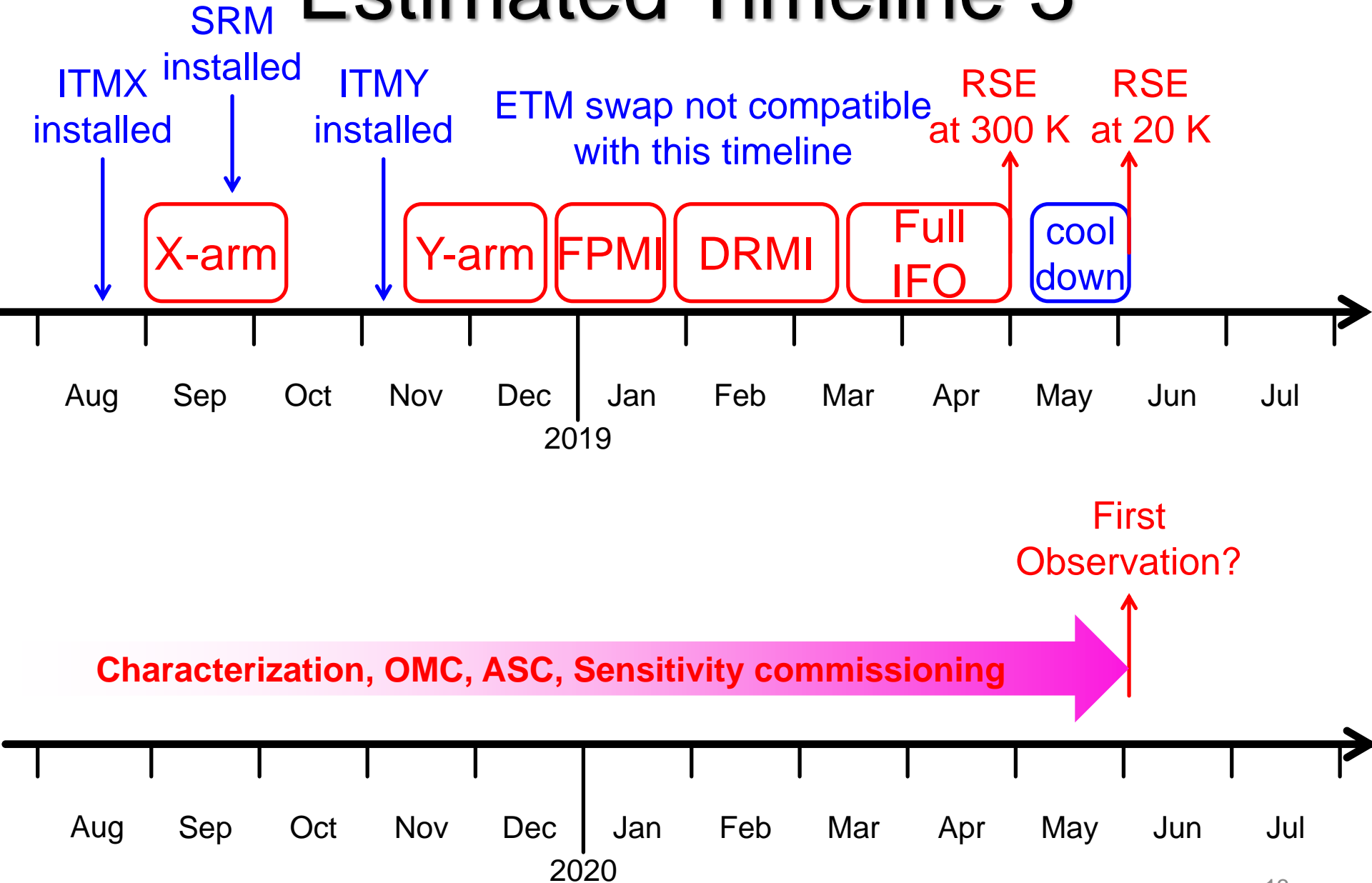
iKAGRA Experience

- IMC experience
 - 2015.12.02 Installation done (including oplevs) [klog 414]
 - 2015.12.12 Alignment done [klog 470]
 - 2015.12.27 Locked [klog 559]
 - 2016.01.21 Locked with high finesse [klog 636]
- Michelson experience
 - 2016.02.25 All mirrors installed
 - 2016.03.17 Alignment done [klog 1058]
 - 2016.03.18 Locked [klog 1080]
- Roughly 1 week for one-way alignment, 2 weeks for locking 1 DOF (without ASC)
- Detection optics setup, electronics cabling was done simultaneously with alignment and locking work

Estimate from iKAGRA Experience

- X-arm (1.25 months)
1w for alignment, 2w for locking, 1w for green to IR hand-off, 1w for characterization
- Y-arm (1.25 months)
same as X-arm
- FPMI (1 months)
1w for alignment, 2w for locking, 1w for characterization
- DRMI (1.5 months)
2w for alignment, 1w for sensing matrix measurement, 2w for locking, 1w for characterization
- Full locking (1.5 months)
1w for alignment, 1w for green to IR, 1w for sensing matrix measurement, 2w for locking, 1w for characterization
- Time to observation (~ 1 year?)

Estimated Timeline 3



General To Do List before Phase 2

- RF PD/QPD characterization
- DC QPD holder
- Detection table optics design
- Electronics and cabling (outsource?)
- RT model, MEDM screens, guardian scripts
- LSC/ASC modeling for ALS and intermediate steps
- NoiseBudget
- RF generation scheme, RF AM generation scheme
- AS optics design (OMC, OFI, OMMT)
- Initial alignment planning
- In-vacuum optics/electronics design