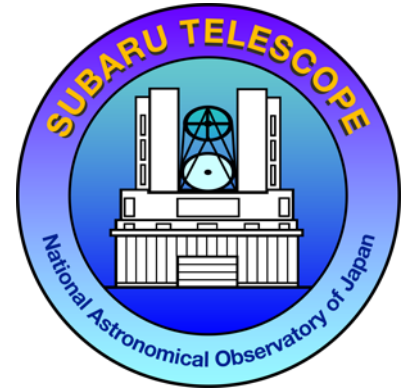


Subaru Users' Meeting FY 2016
NAOJ Mitaka Campus
Jan.10-12, 2017



Telescope Status Report

Hirofumi Okita

Telescope Engineering Division

Subaru Telescope

okita14@naoj.org



Summary

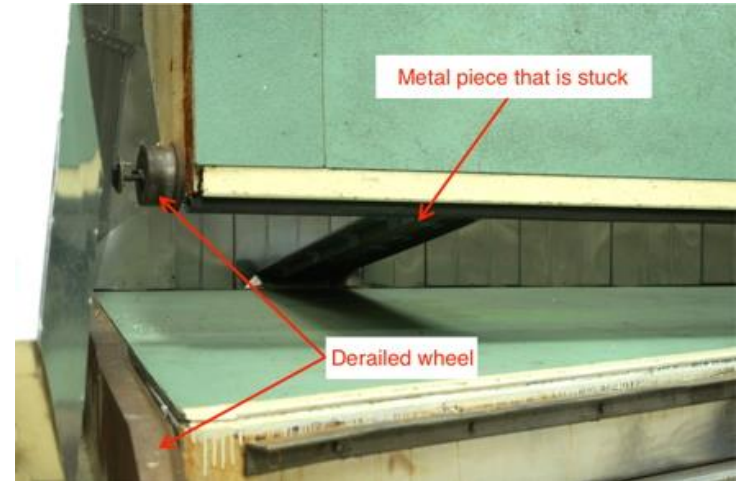
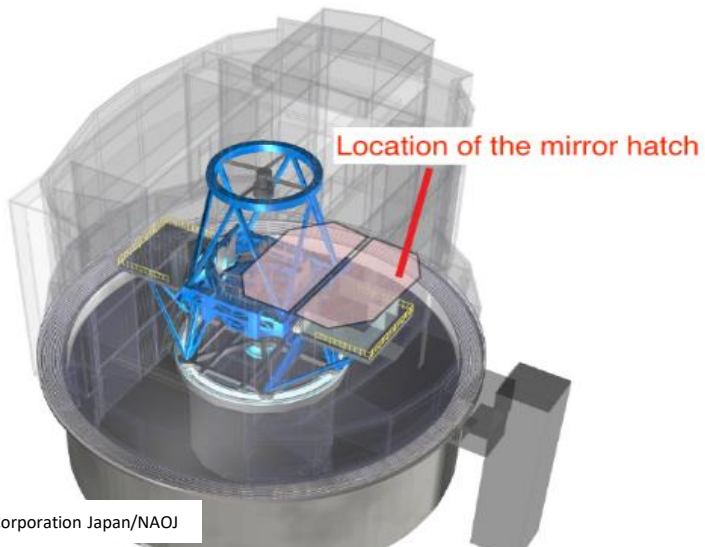
- Mirror Hatch Incident was happened on Feb. 22.
- 18 nights (22 nights, effectively) were lost due to telescope trouble in 2016.
- Aging is a major cause of telescope trouble.
- Large number of downtime are required for repair Mirror Hatch and recoat Primary Mirror in 2017.
(11~15 weeks expected)



Mirror Hatch Incident

- During the scheduled maintenance work of the telescope and the enclosure, on Feb. 22, 2016 (HST), a mirror hatch stopped working when a metal piece was caught while being opened for testing. It was found that the wheel of the mirror hatch derailed and there are damages to the mirror hatch.
- The direct cause of the incident was putting a metal piece at a location which interferes with the hatch during the opening/closing. The telescope engineering division carried out the analysis of the root causes using the methods such as Variation Tree Analysis, and identified the following root causes:
 1. The principle that any objects should not be placed around moving objects was not followed.
 2. Insufficient recognition of the increase of the risk with 4M changes (4M: Man, Machine, Method, Material)
 3. Detailed operation manual of the hatch was not prepared.
 4. Insufficient system to define the summit work rules for safety.

Mirror Hatch Incident



Mirror Hatch Mechanism



Mirror Hatch Incident





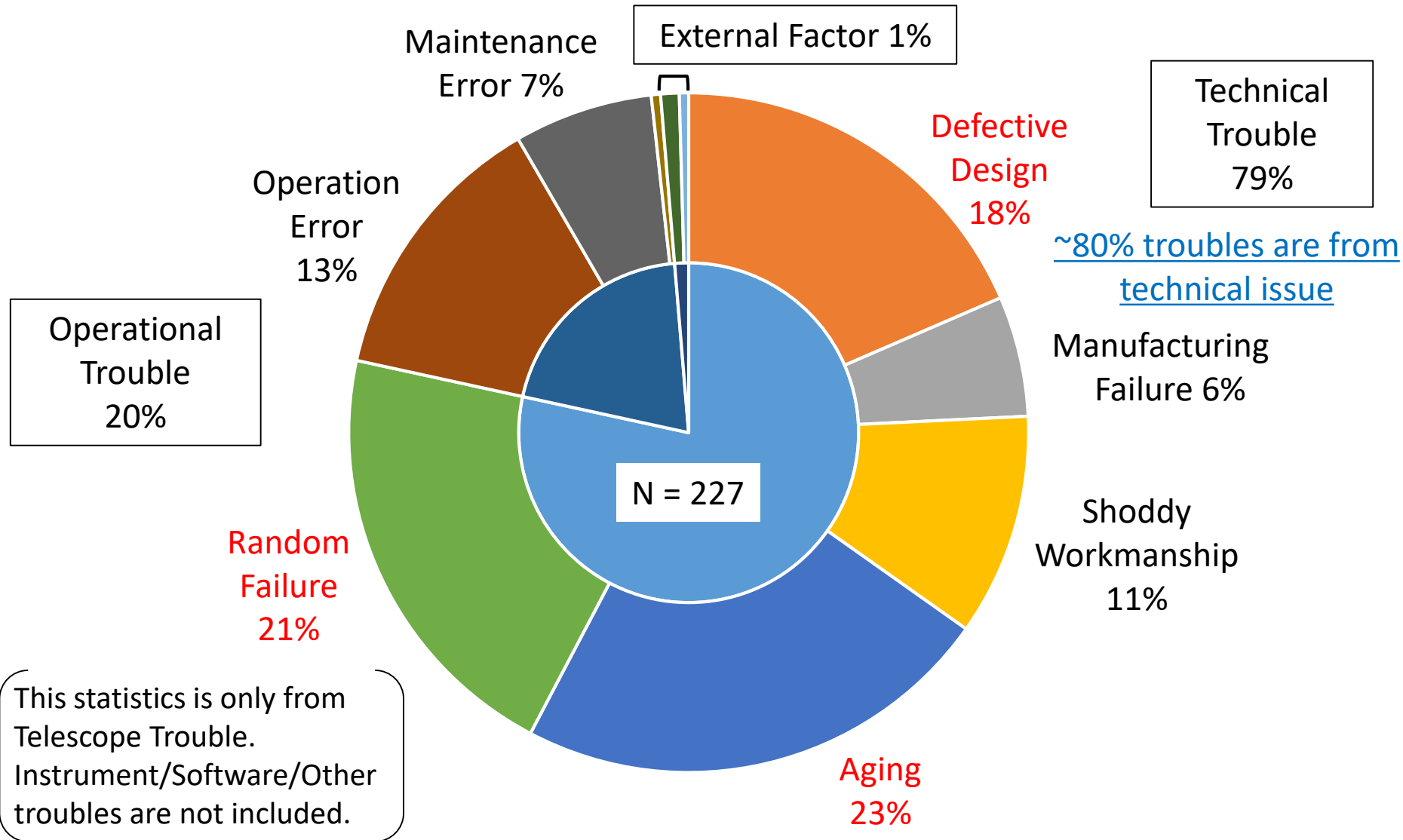
Telescope Trouble Downtimes

- | | |
|--|-----------------------|
| • UPS2 Failure (Aging): | 1 day |
| • Mirror Hatch (Maintenance Error): | 7 days |
| • PIR install (Maintenance Error): | 1 day |
| • FRPU(PF) (Manufacturing Failure): | 1 day |
| • POpt Hexa-pod (Random Failure): | 1 day |
| • Man-basket PLC (Aging): | (1 day, effectively) |
| • CP1 Barcode value (Operational Error): | 1 day |
| • TUE Gripr2 (Aging): | 1 day |
| • Tip-tilt cabling (Shoddy workmanship): | 1 day |
| • Slip-Ring (Shoddy workmanship): | (3 day, effectively) |
| • EL Cable Wrapper (Defective design): | 1 day |
| • AZ Cable Wrapper (Aging): | 1 day |
| • IR Main Shutter (Defective design): | 1 day |
| • Safety Switch 15 (Maintenance error): | 1 day |

Cancel nights due to Telescope Troubles are only listed. Instrument/Software/Other troubles are not included.

→ **Total 18 nights**
(effectively 22 night) lost
by telescope trouble

Number-based Trouble Statistics



Time-based Trouble Statistics

External Factor 0%

Defective
Design 9%

Technical
Trouble
45%

Manufacturing
Failure 6%

Shoddy
Workmanship
8%

Aging
16%

Random
Failure 6%

Operation Error 8%

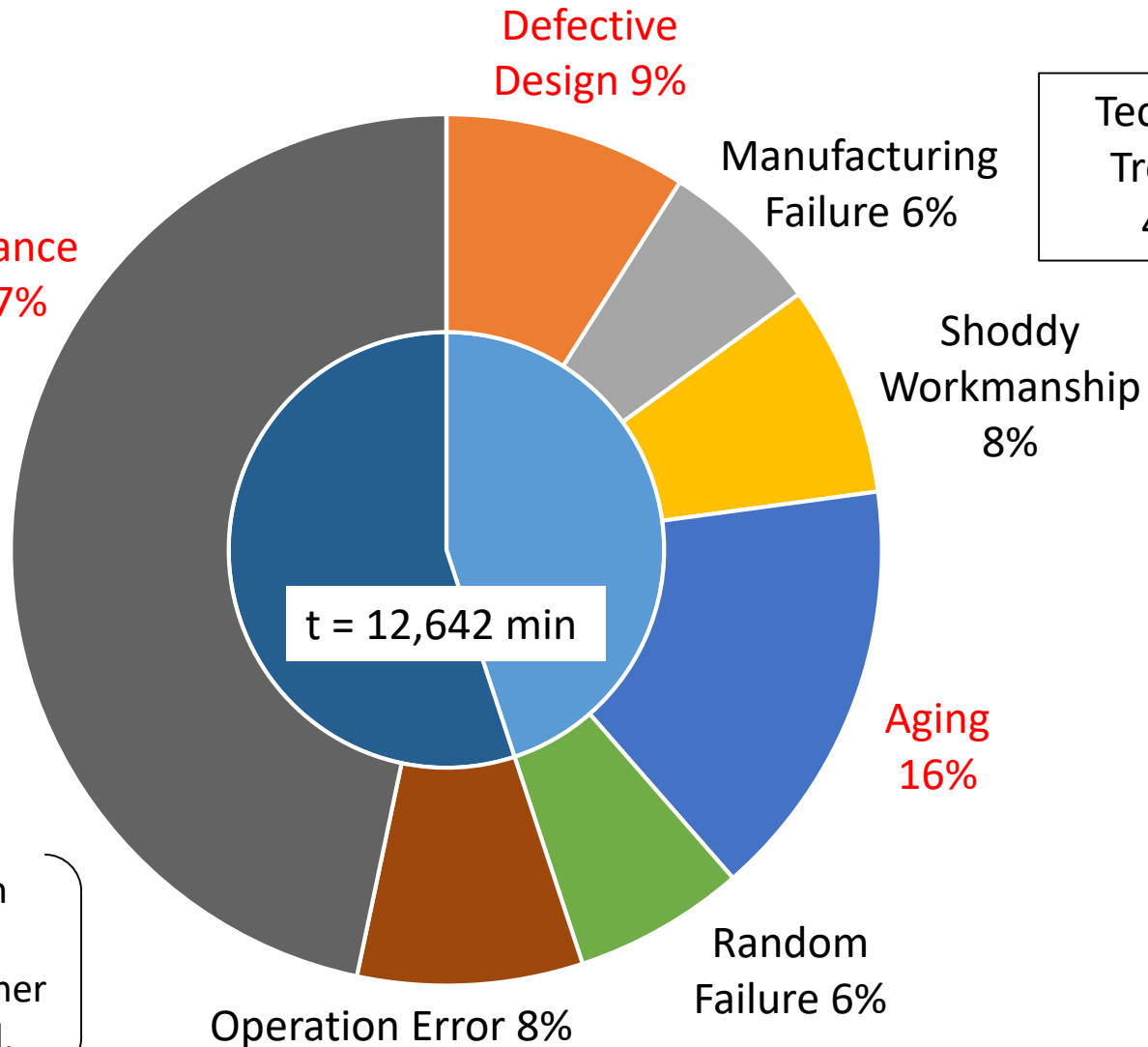
Maintenance
Error 47%

Operational
Trouble
55%

t = 12,642 min

Maintenance error may
make huge downtime

This statistics is only from
Telescope Trouble.
Instrument/Software/Other
troubles are not included.



Time-based Trouble Statistics

External Factor 0%

Mirror Hatch
Incident 36%

Operational
Trouble
55%

That Critical Error
made huge downtime

Defective
Design 9%

Manufacturing
Failure 6%

Technical
Trouble
45%

Shoddy
Workmanship
8%

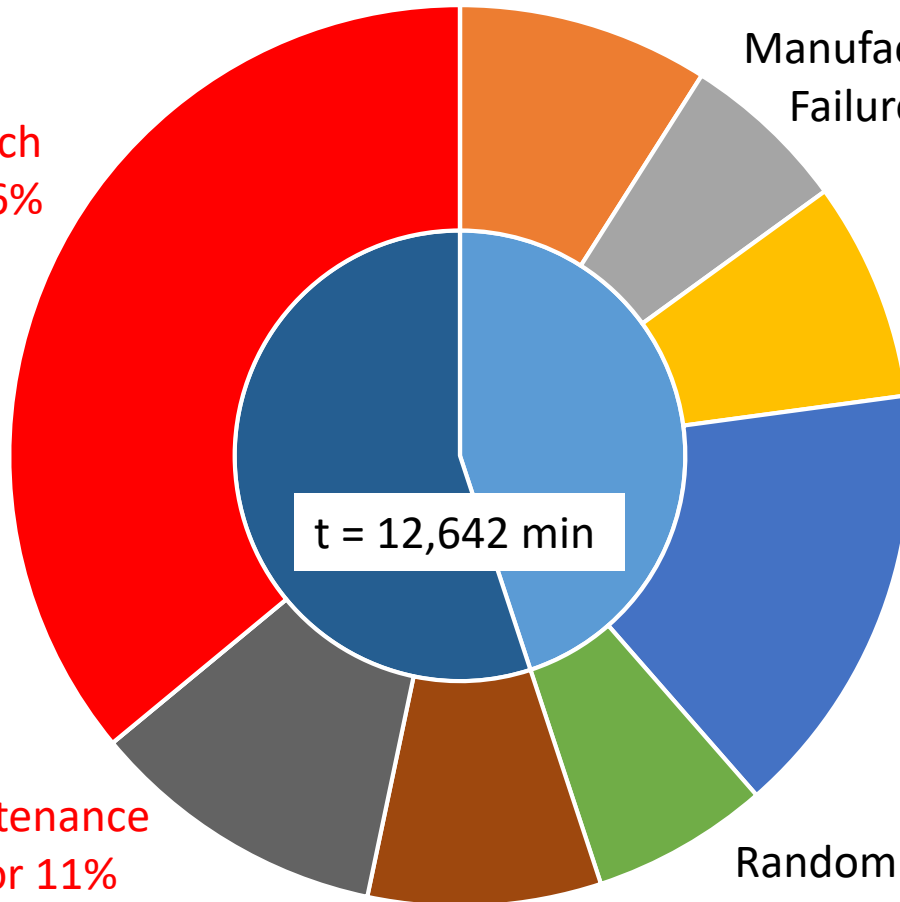
Aging
16%

Random
Failure 6%

Operation Error 8%

Maintenance
Error 11%

t = 12,642 min



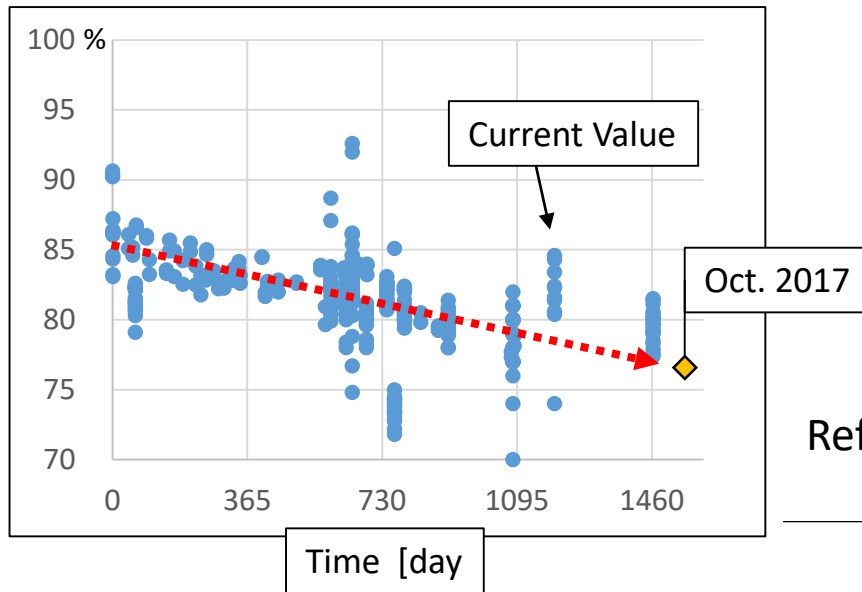


Major Concerns in 2016

1. Telescope UPS2 malfunction
2. Mirror Hatch Incident
3. Spark on Slip Ring
4. Twisted dome rail due to welding
5. Collision between telescope and dome
6. Bad workmanship on Tip-tilt wire
7. Reflectivity degradation especially at short wavelength
8. Crack-like mark on Main shutter structure (Aging)
9. Main shutter limit issue
10. Misalignment on IR-side Main-shutter
11. Dome LGR wire disconnection
12. Ventilation shutter malfunction (Aging)
13. PLC Alarms on DP1 (Aging)
14. Man-basket Sequencer malfunction (Aging)
15. TUE Gripper2 motor failure (Aging)
16. EL Cable Wrapper stuck
17. Az Cable wrapper trouble (Aging)

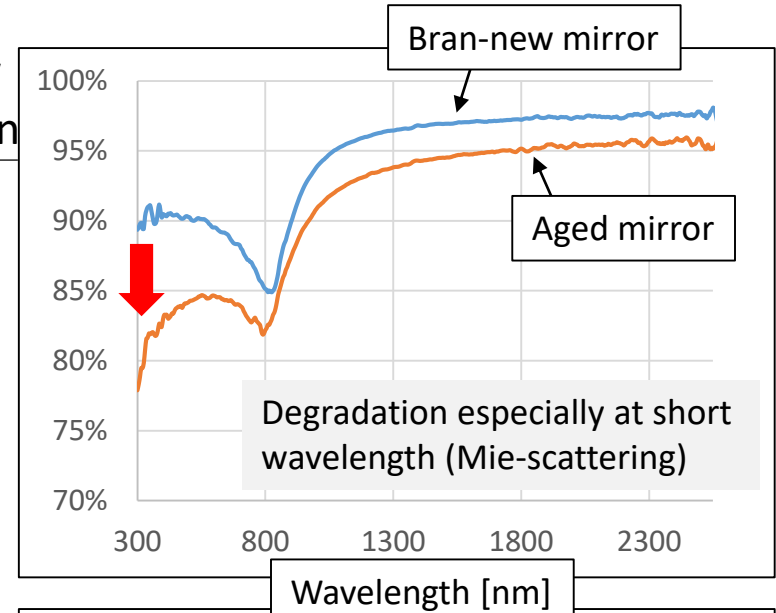
Reflectivity Degradation

Primary Mirror Reflectivity degradation curve at 670nm

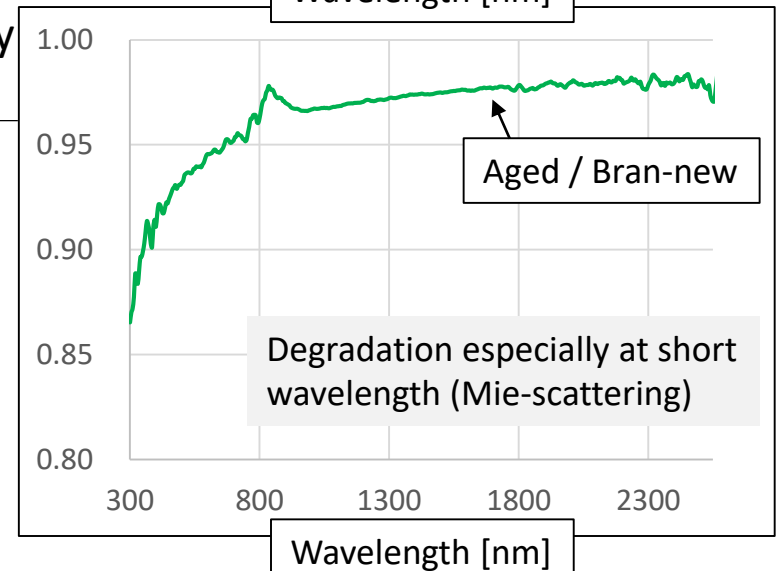


- HDS data also shows reflectivity degradation at short wavelength.
- Observation at short wavelength should be avoided before Primary Mirror recoating in Oct., 2017.

Reflectivity Comparison



Reflectivity Ratio





(Major Activities in 2016)

1. Preparation for Primary Mirror recoating
2. AG/SH Shutter CEU replacement
3. Tip-Tilt DPA replacement
4. M1 washing facility maintenance (w/ Hitz)
5. M1 transporter maintenance (w/Hitz)
6. TWS renewal (by Melco)
7. Drawing up long term maintenance plan
8. Observation for Hitomi satellite
9. Dome barcode tape renewal
10. Dome bogie rubber spring replacement
11. BLCU renewal (by Melco)
12. TMCU renewal (by Melco)
13. PMA CPU card experiment (w/ Melco)
14. Welding repair on dome bogie rail
15. LOCOMOCO system development



Scheduled Works in 2017

- Jun: Mirror hatch repair (Welding)
 - 2 weeks downtime
- July: Mirror hatch repair (Ball-screw replacement)
 - 2 weeks downtime
- Oct-Dec: Primary Mirror Recoating
 - 7 weeks downtime
- Nov: CO₂ Cleaner Maintenance
 - Additional 4 weeks downtime in M1 recoating work
 - (It depends on budgetary situation)

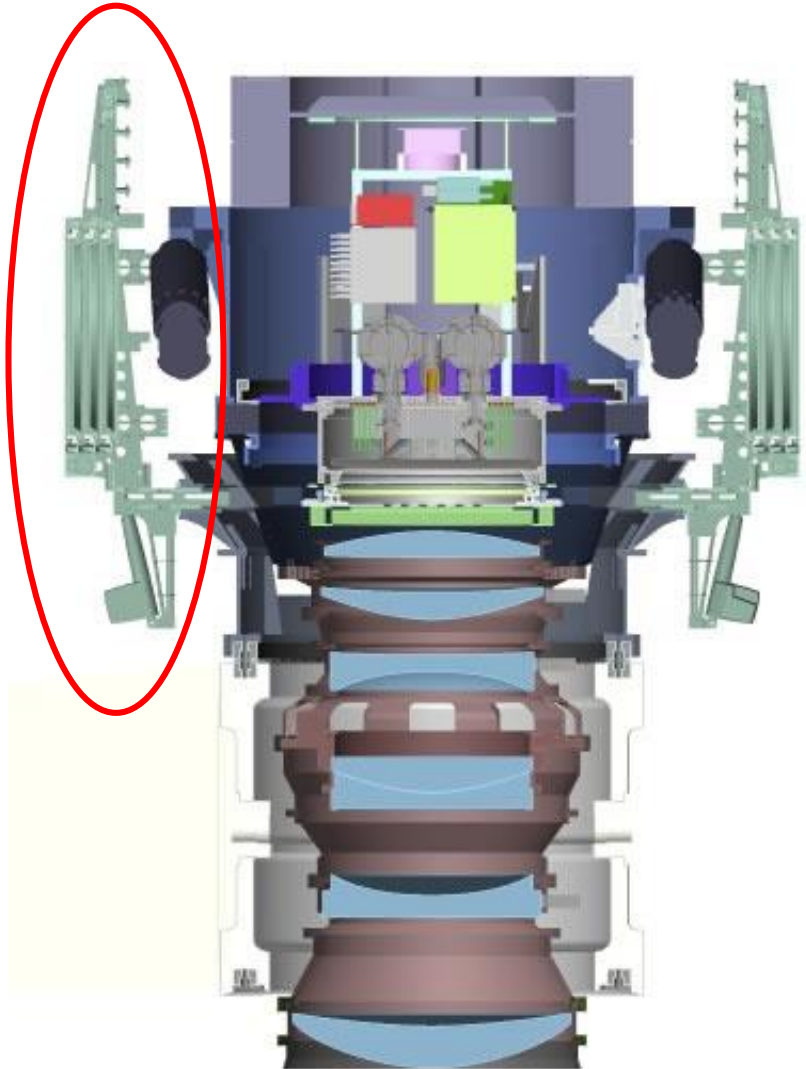


(Other Plans in 2017)

1. Mechanical maintenance (by Melco)
2. TUE upgrade for Only Opt-side FEU exchange (w/ MHI)
3. PMA CPU card mass-producing (by Melco)
4. Interface device (SPU) renewal (by Melco)
5. TCS (tsc) renewal (By Melco)
6. Coolant bottleneck modification (w/ Melco)
7. Telescope UPS renewal study (w/ Melco)
8. Revise remote maintenance contract (w/ Melco)
9. Revise mechanical maintenance contract (w/ Melco)
10. Revise CIAX maintenance (w/ Craft)
11. Execute electrical maintenance
12. Execute Preventive Maintenance with LOCOMOCO System
13. Learn PLC technique
14. Learn how to apply FEM
15. Measure dome rail flatness
16. V-Lan hardware upgrade from FDDI to RJ45

TUE Upgrade: Only Opt-side FEU Exchange

- We will add a new sequence on TUE. After this upgrade, 3 filters in Opt-side FEU will be exchangeable in one day. This allow you to use up to 9 filters in one HSC observing run. (Not in one night)





Summary

- Mirror Hatch Incident was happened on Feb. 22.
- 18 nights (22 nights, effectively) were lost due to telescope trouble in 2016.
- Aging is a major cause of telescope trouble.
- Large number of downtime are required for repair Mirror Hatch and recoat Primary Mirror in 2017.
(11~15 weeks expected)