

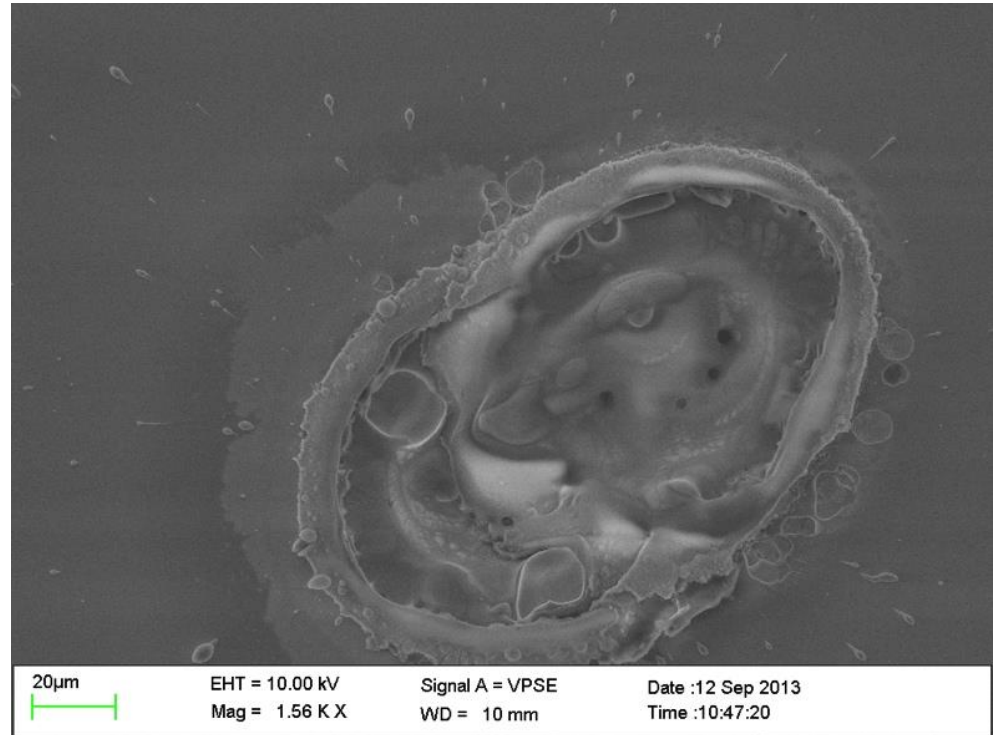
Hanford Contamination Control Update 2

Back to Basics

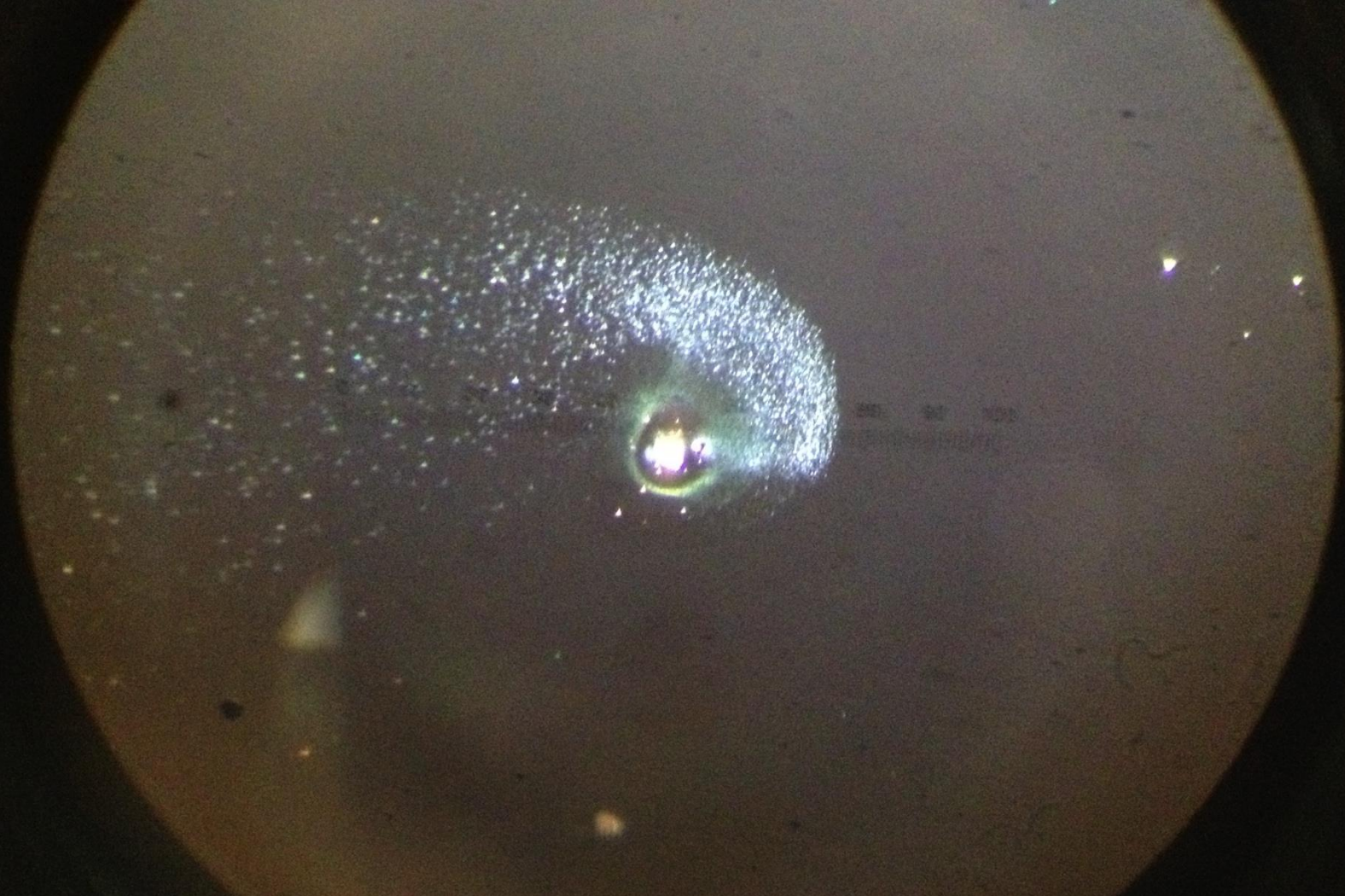


Why do we care?

- Sensitivity loss
- Absorption
- Scatter
- Damage



➤ *Contamination will limit performance.*



Laser Induced Damage due to Particulate Contamination

Billingsley, Gushwa, Phelps, Torrie, Zhang
LVC meeting March 2014

LIGO G1400209

Contamination Control Working Group:



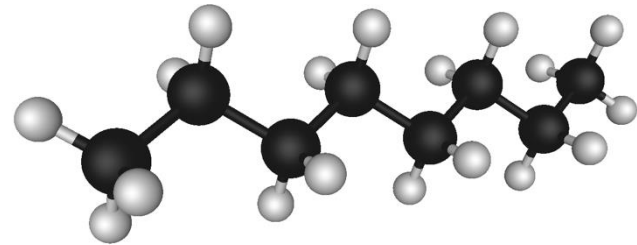
Analyze and mitigate contamination

Contamination

▪



Metals



Complex mix of hydrocarbons



Fibers



Biological



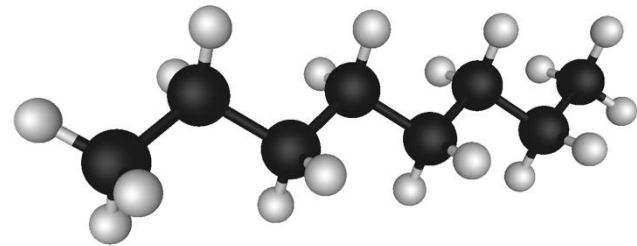
Mixed silicates (soil)

Contamination

➤ *Contamination comes from us and everything we do.*



Metals



Complex mix of hydrocarbons



Fibers

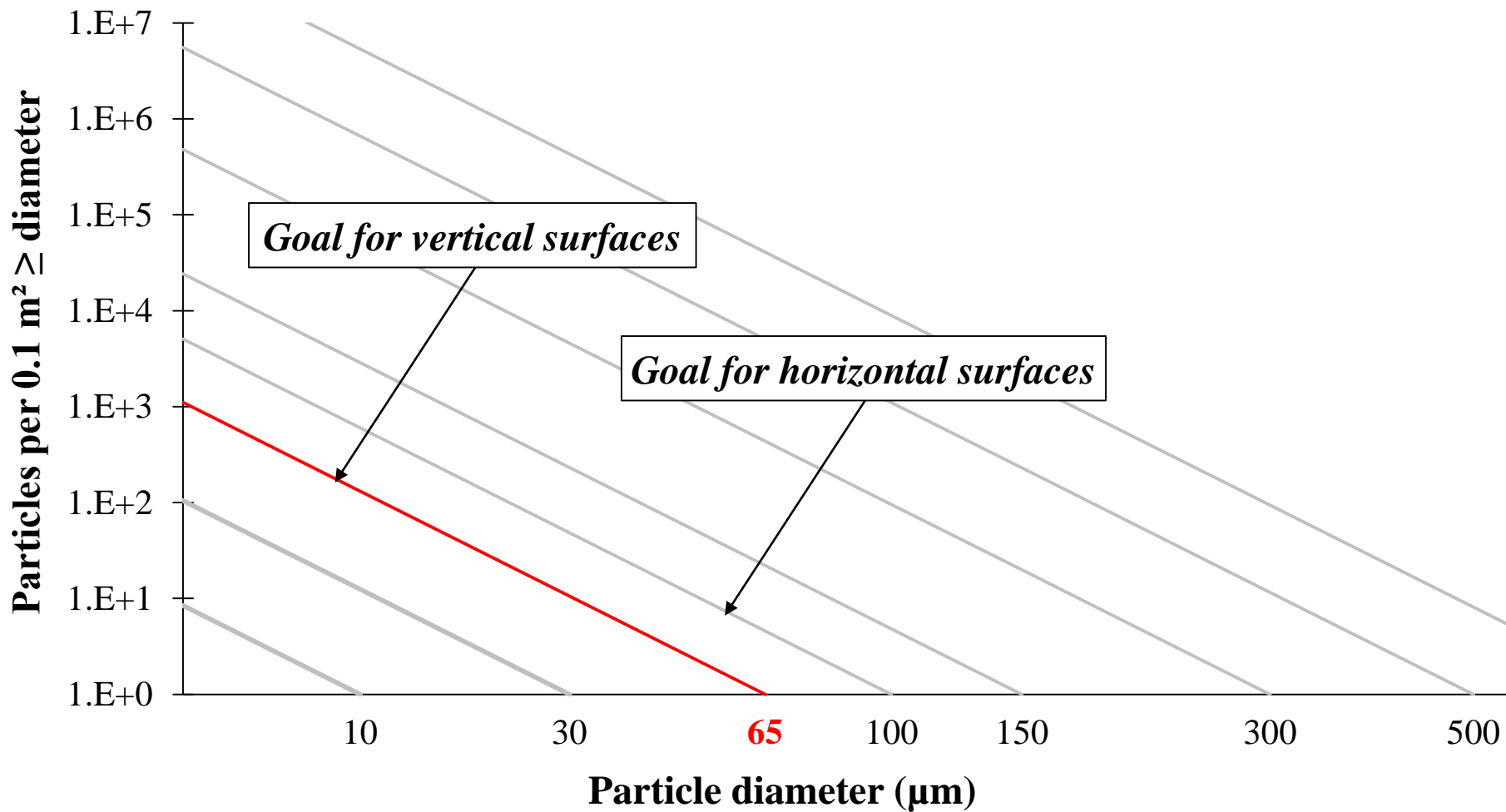


Biological

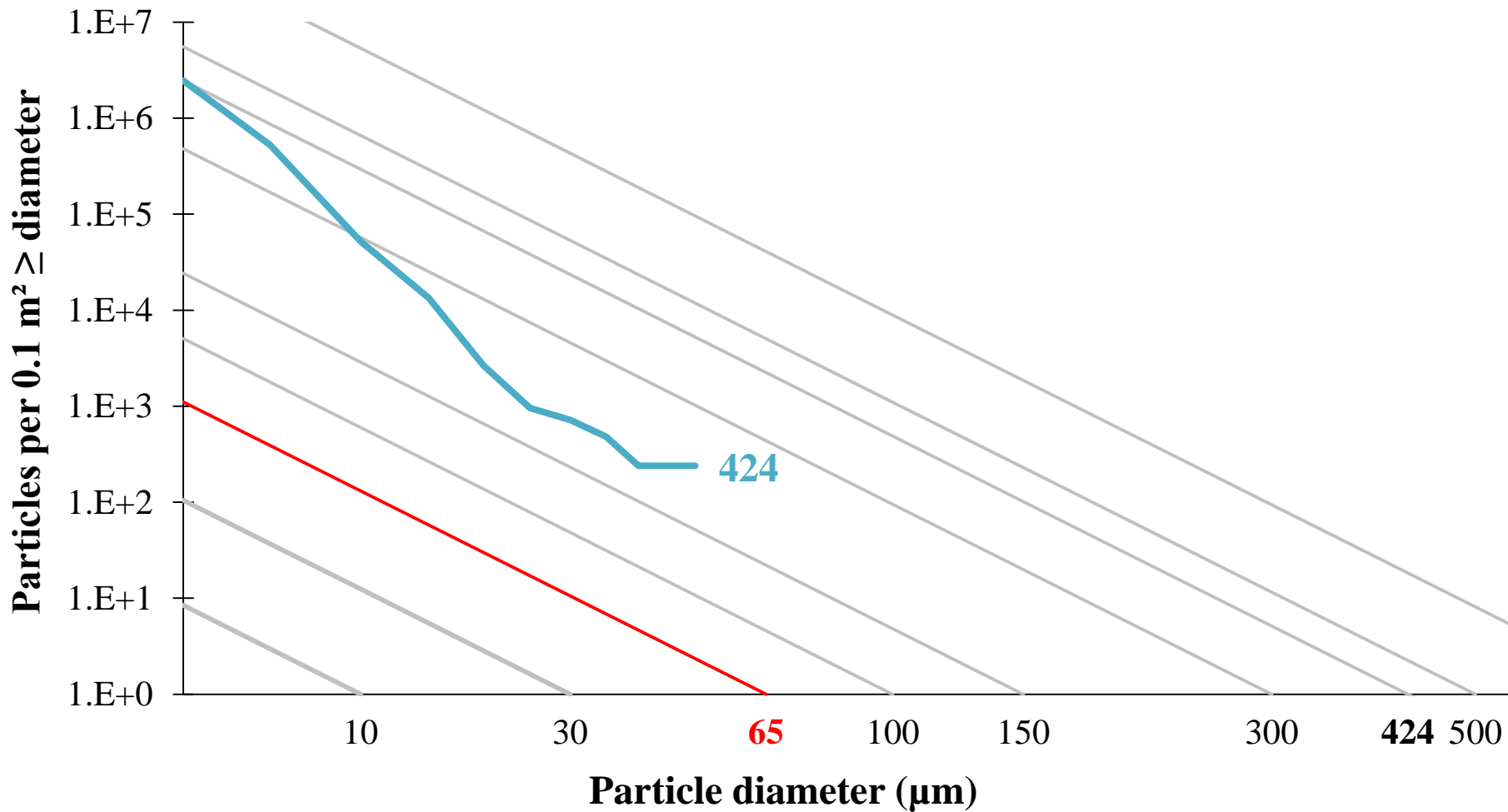


Mixed silicates (soil)

- log vs. log² graph

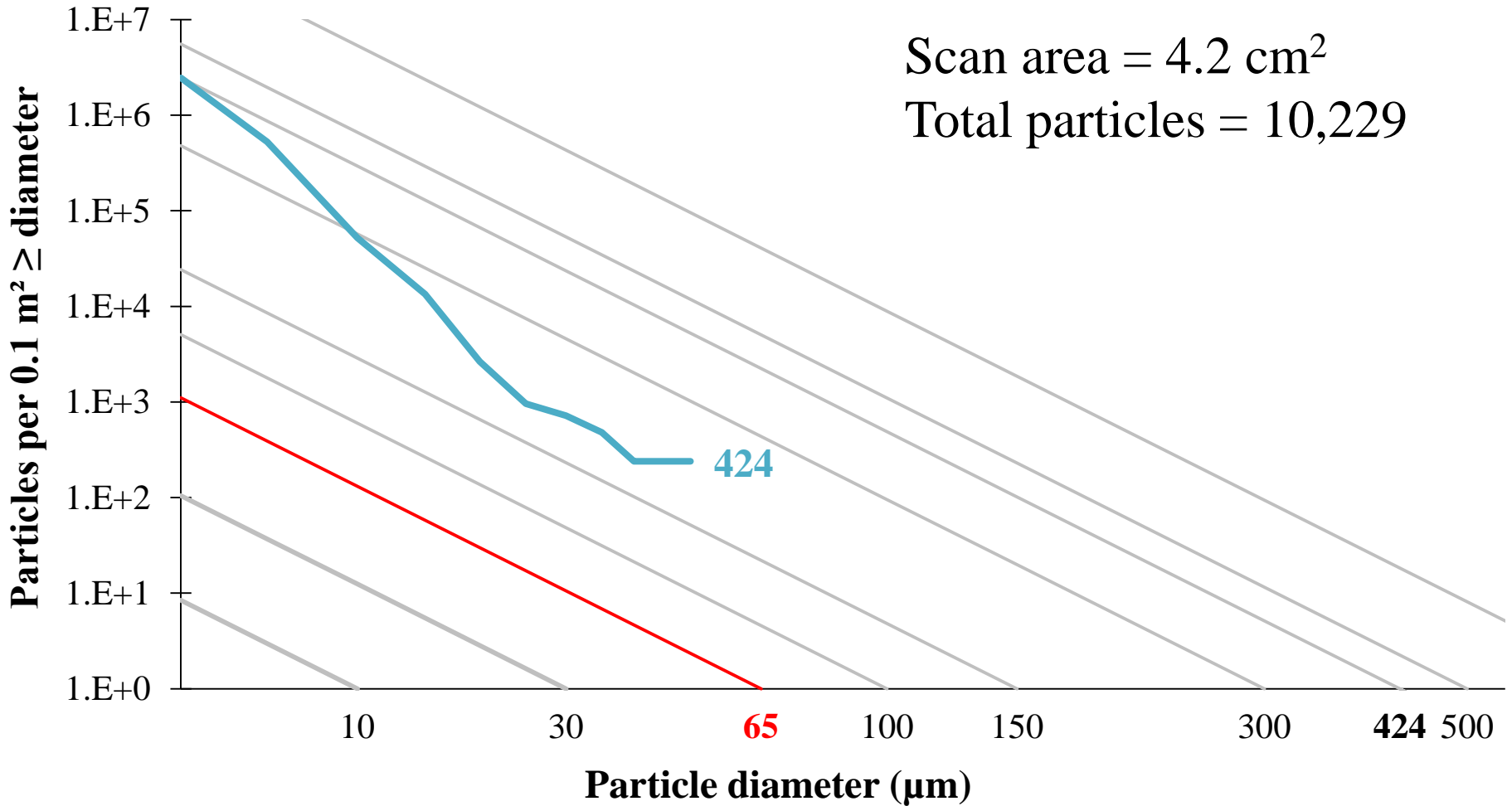


- log vs. log² graph

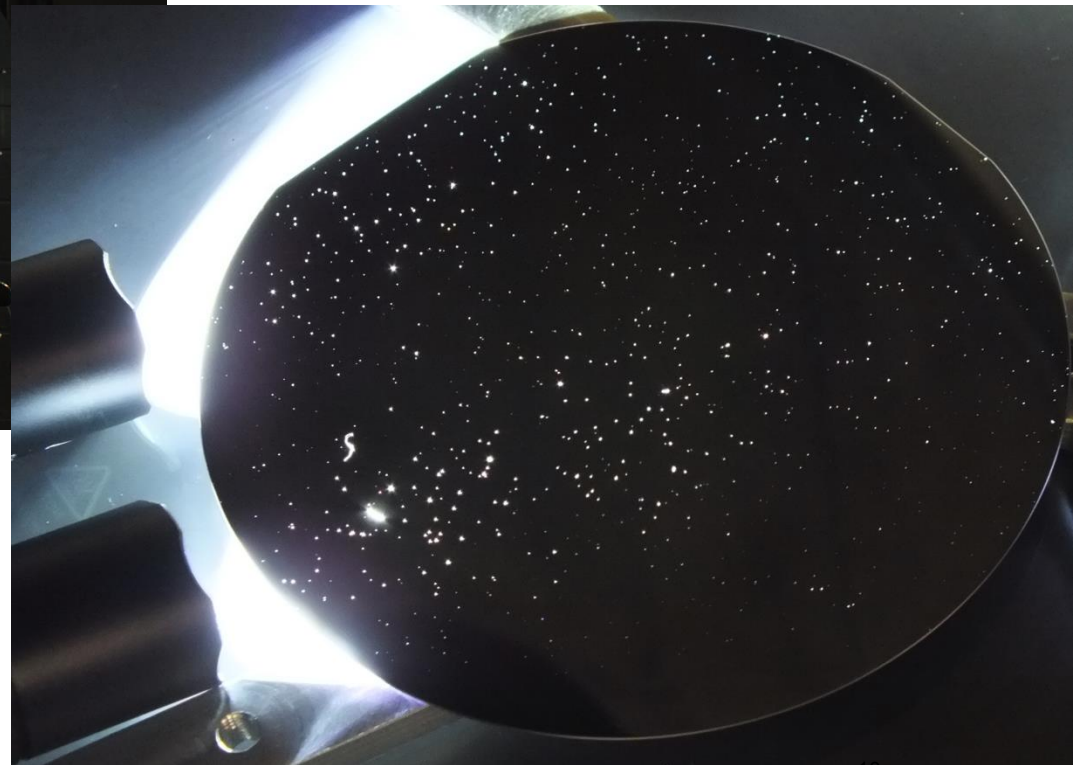
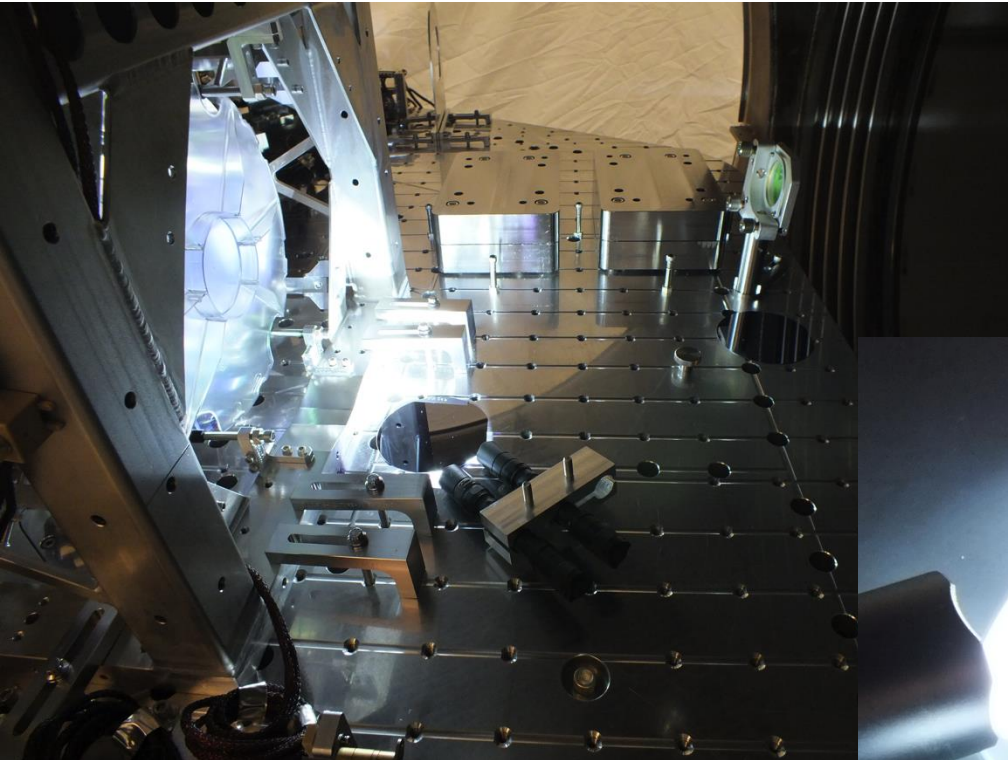


Understanding PCLs

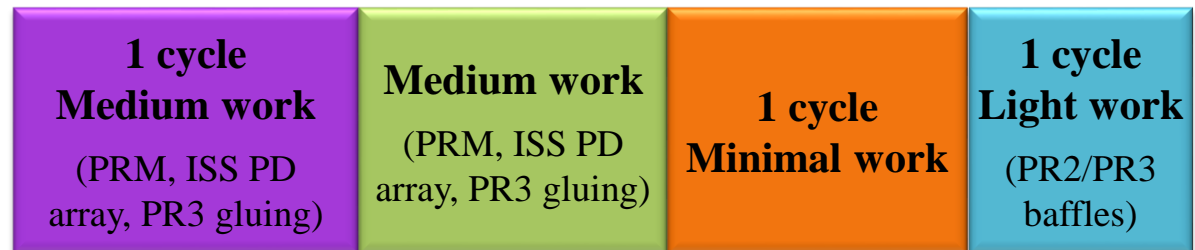
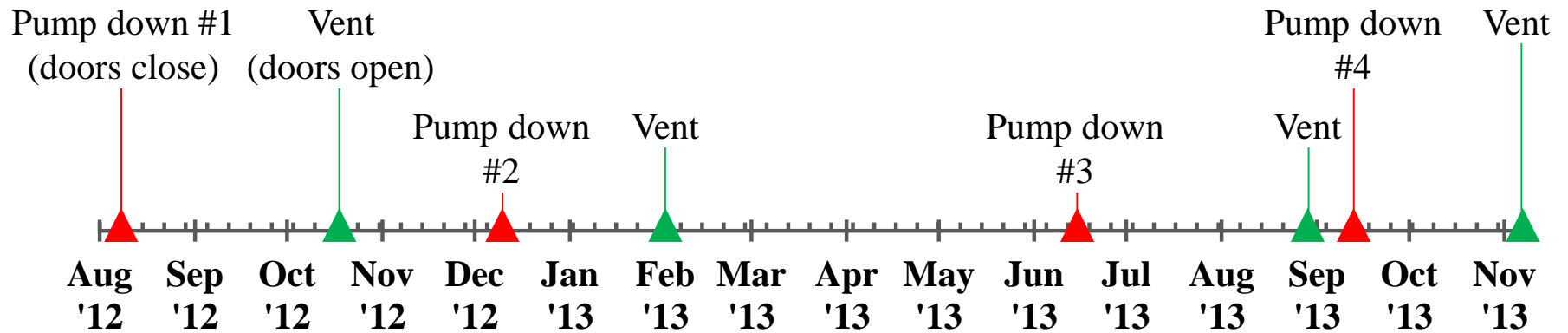
- log vs. log² graph



Telling a story...



LLO HAM2 History



LLO HAM2 History

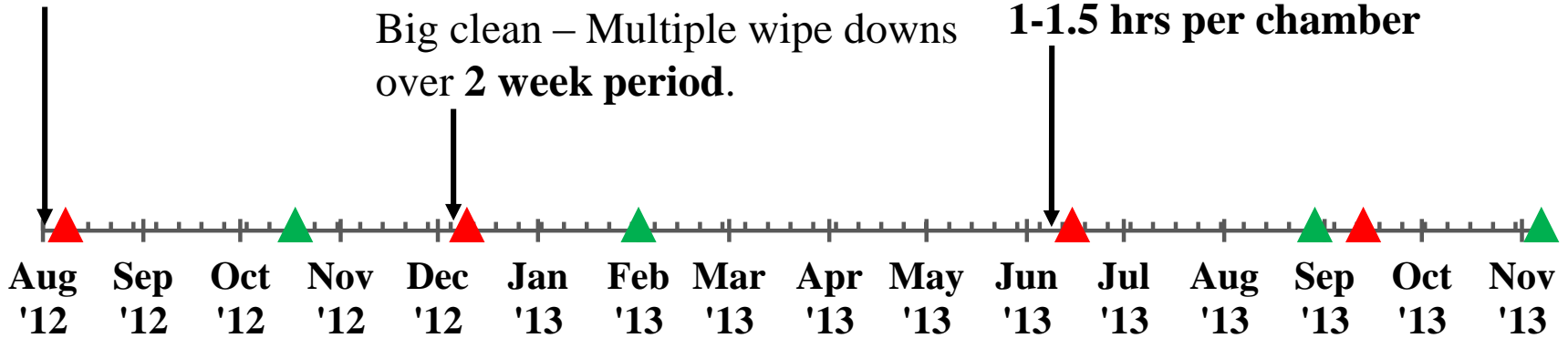
First clean – Basic wipe down.

~ 1 hour total

Big clean – Multiple wipe downs
over **2 week period.**

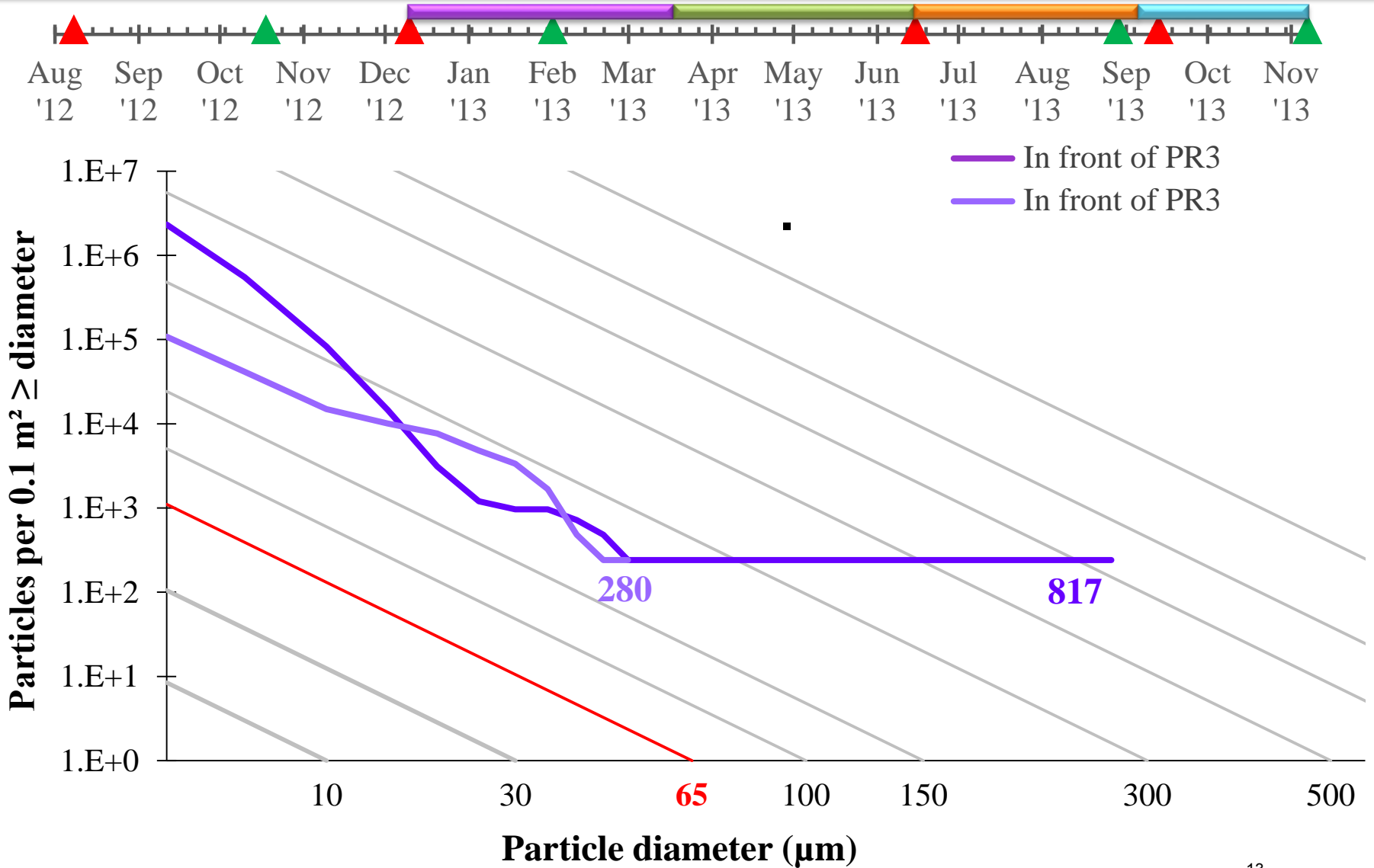
Big clean – Wiped horizontal &
vertical surfaces, inside of ISI,
underneath support tubes, etc.

1-1.5 hrs per chamber

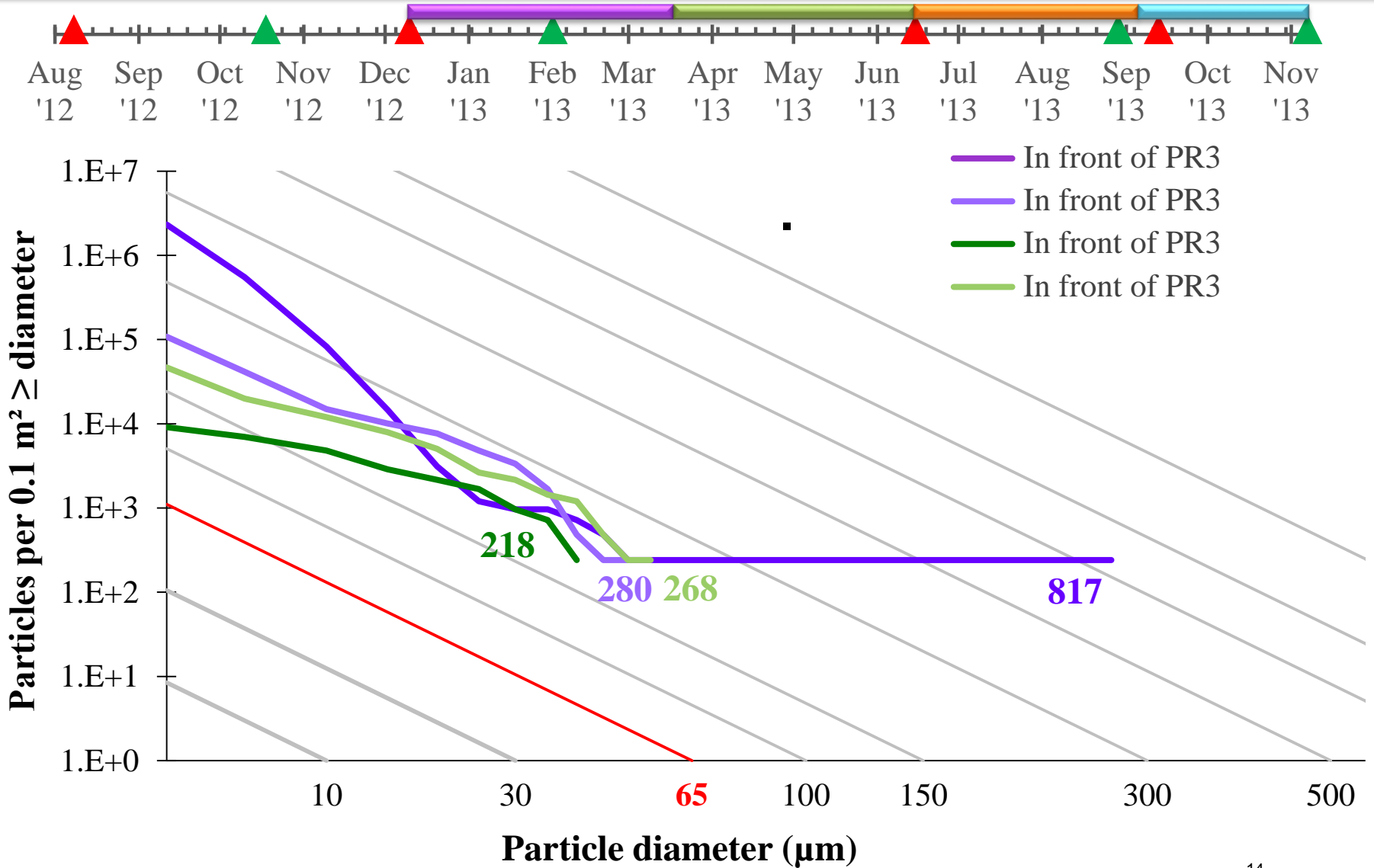


<p>1 cycle Medium work (PRM, ISS PD array, PR3 gluing)</p>	<p>Medium work (PRM, ISS PD array, PR3 gluing)</p>	<p>1 cycle Minimal work</p>	<p>1 cycle Light work (PR2/PR3 baffles)</p>
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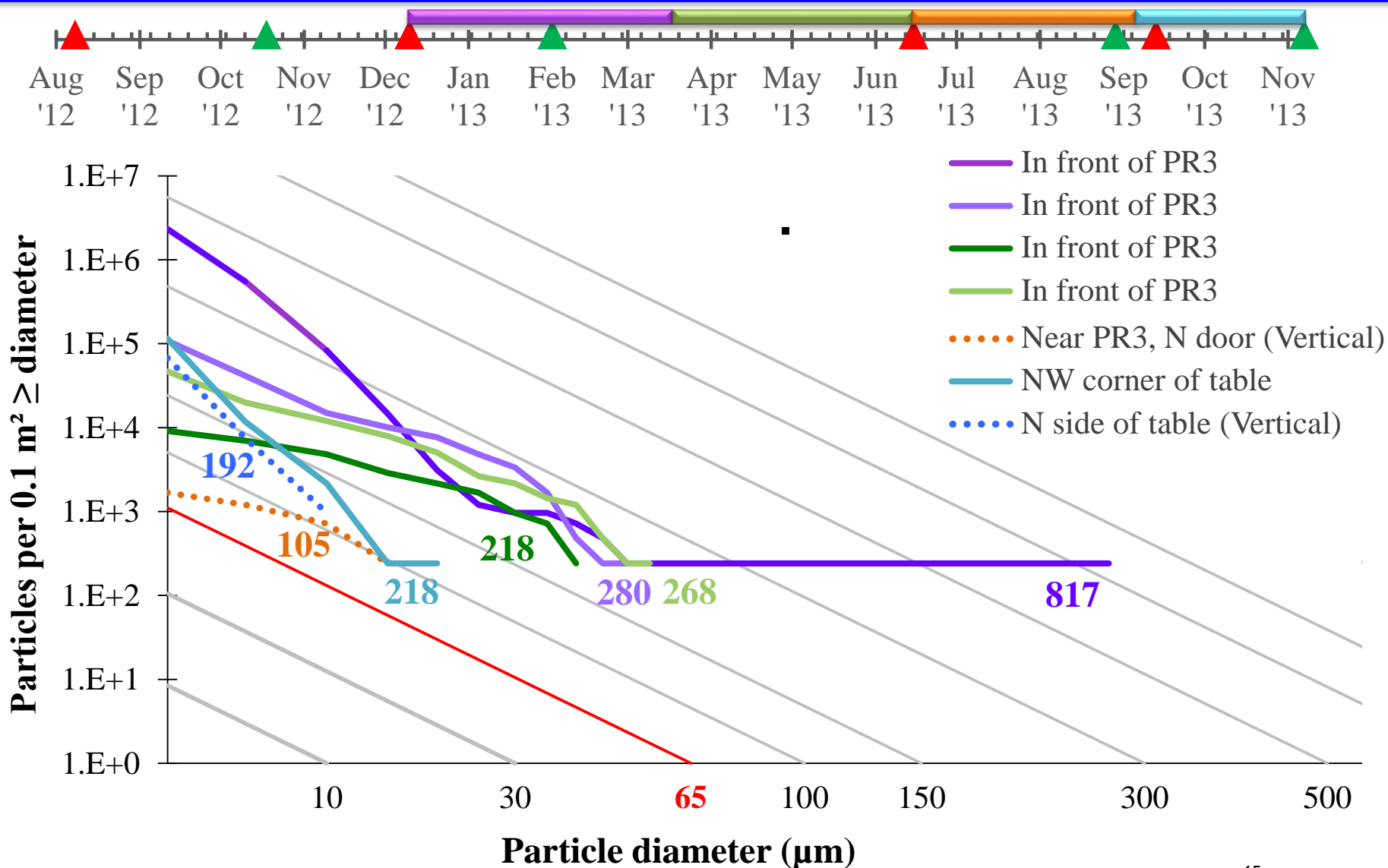
LLO HAM2 Story



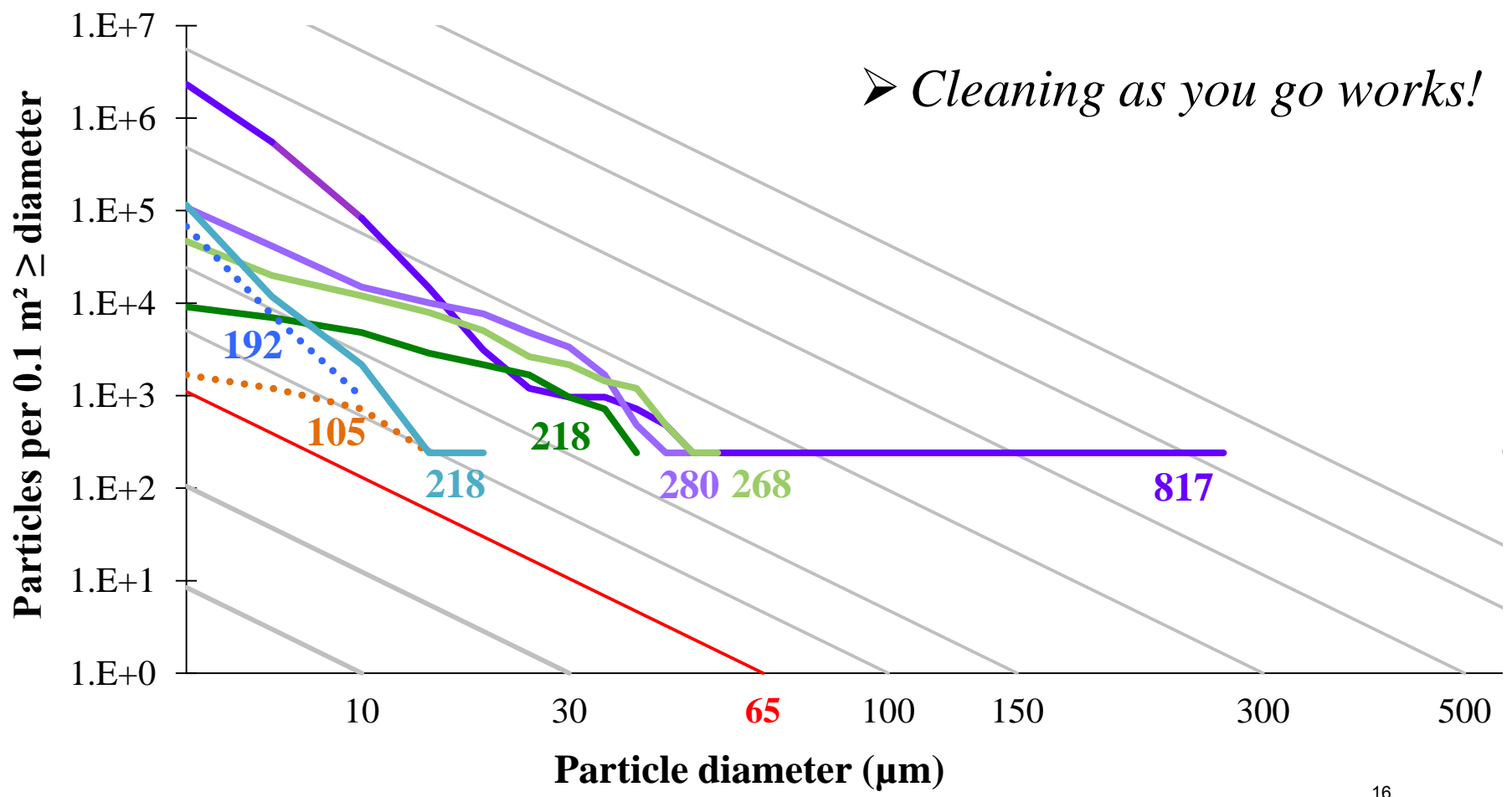
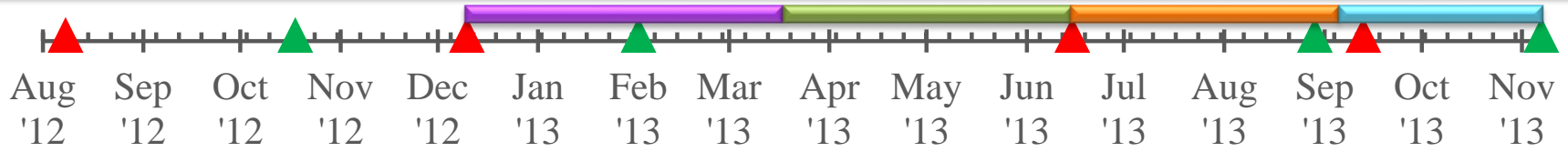
LLO HAM2 Story



LLO HAM2 Story



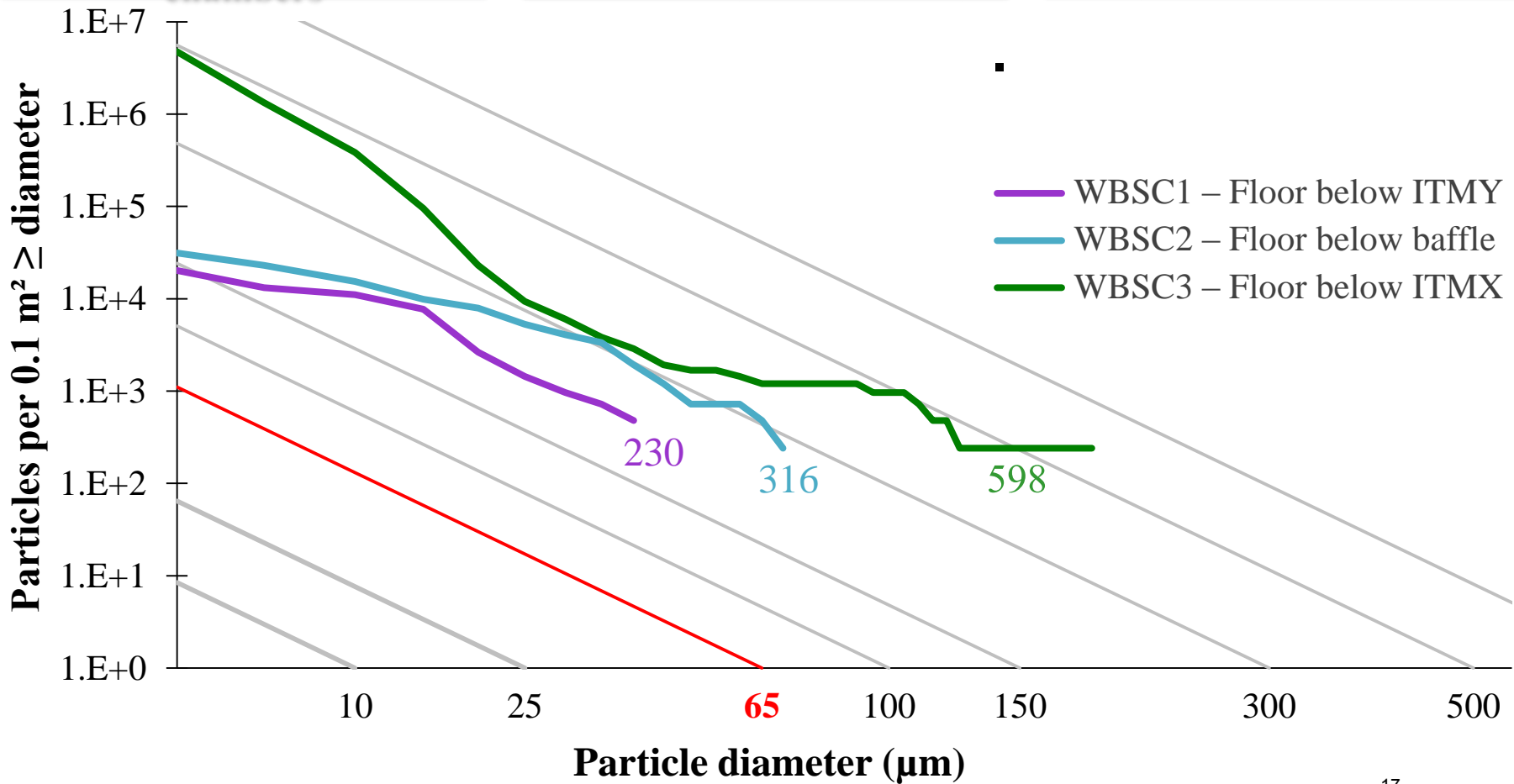
LLO HAM2 Story



Feb – Oct 2013
1 cycle
Work in adjacent chambers

April – Oct 2013
1 cycle
Heavy work over wafer

Oct – Nov 2013
1 cycle
No work?

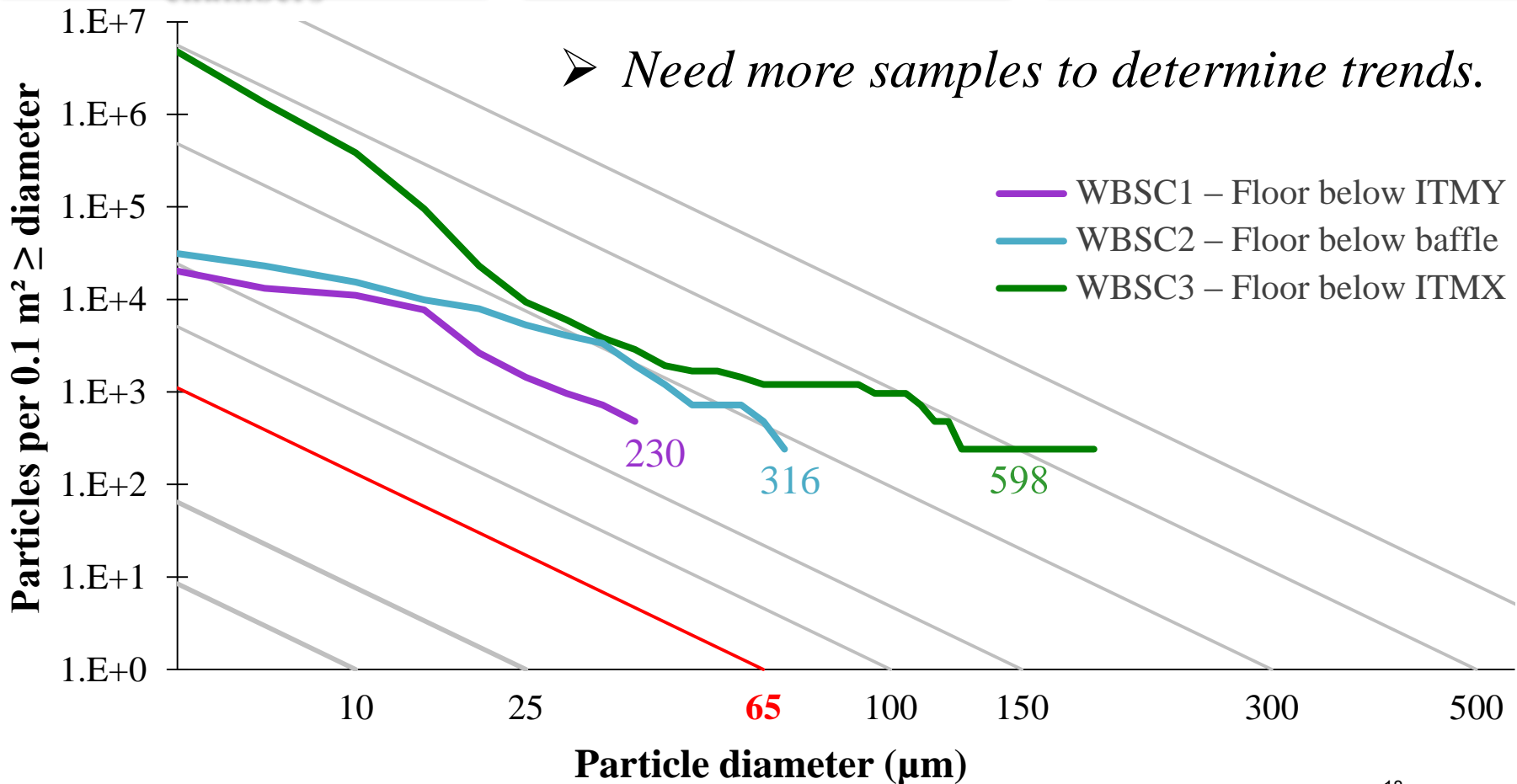


LHO BSC Stories

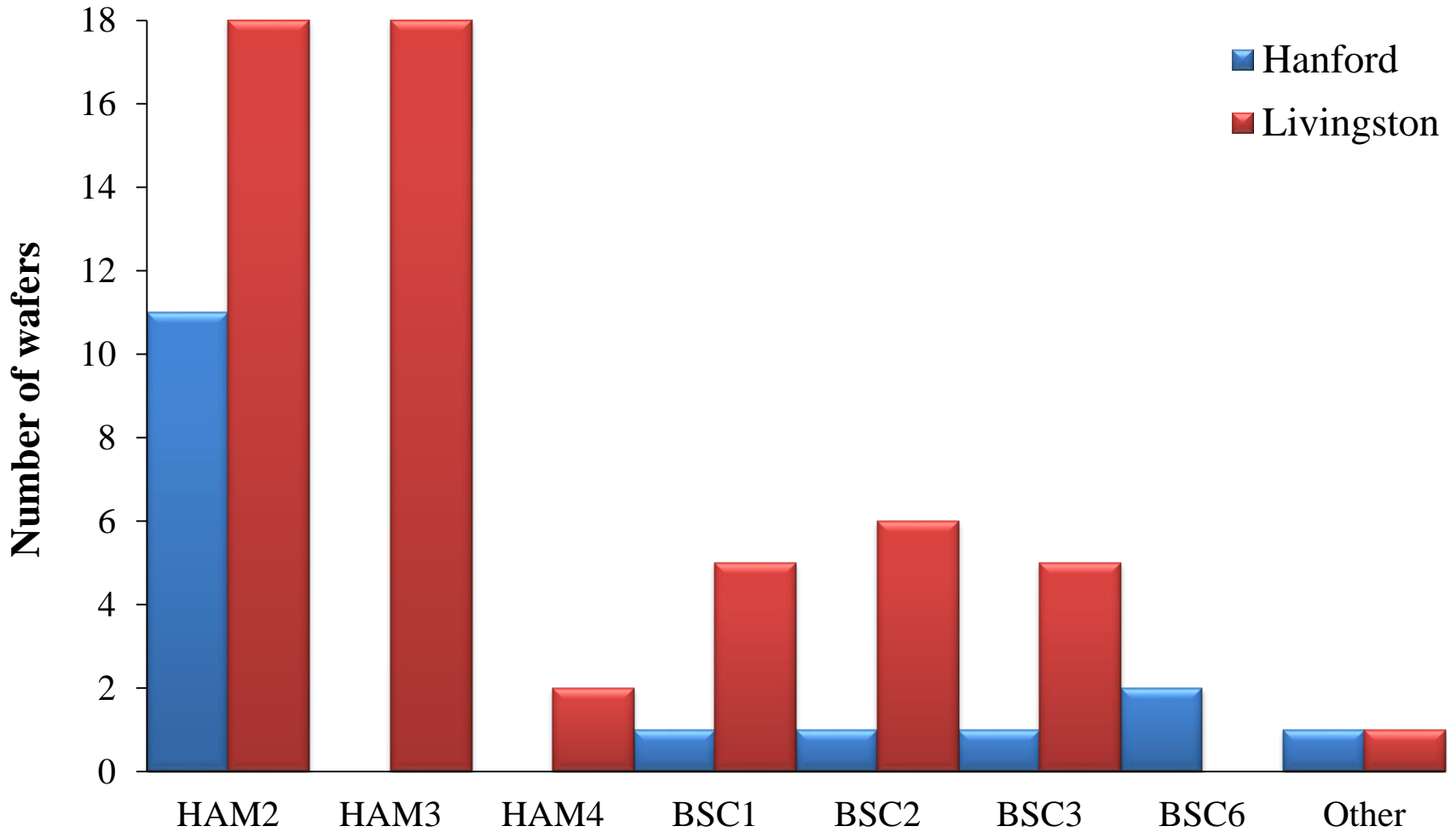
Feb – Oct 2013
1 cycle
Work in adjacent chambers

April – Oct 2013
1 cycle
Heavy work over wafer

Oct – Nov 2013
1 cycle
No work?

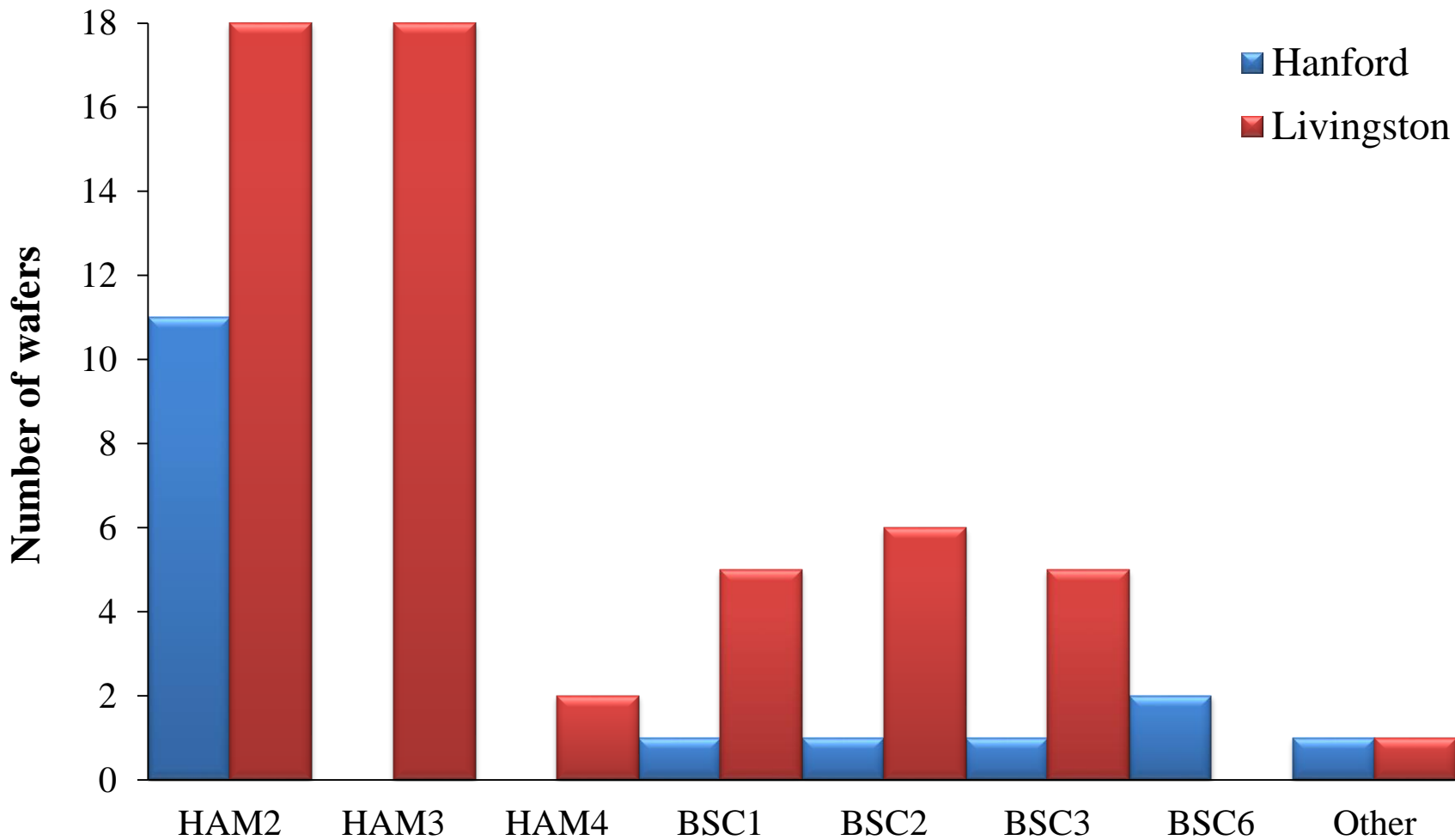


Total Wafers Collected



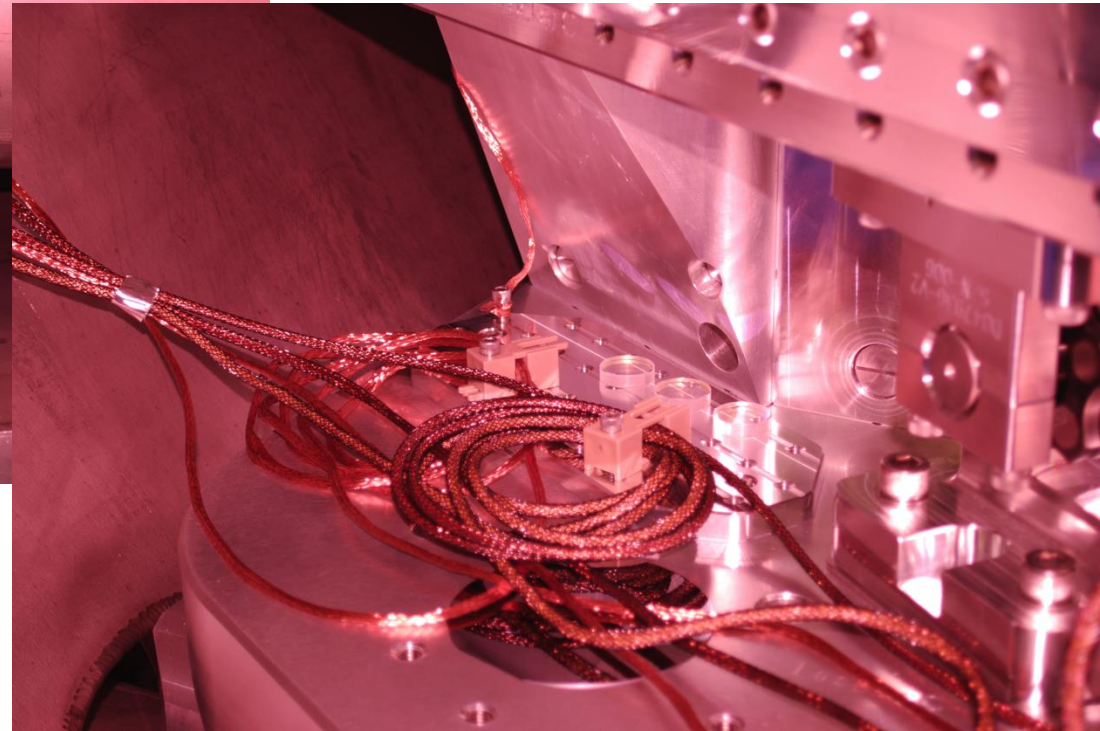
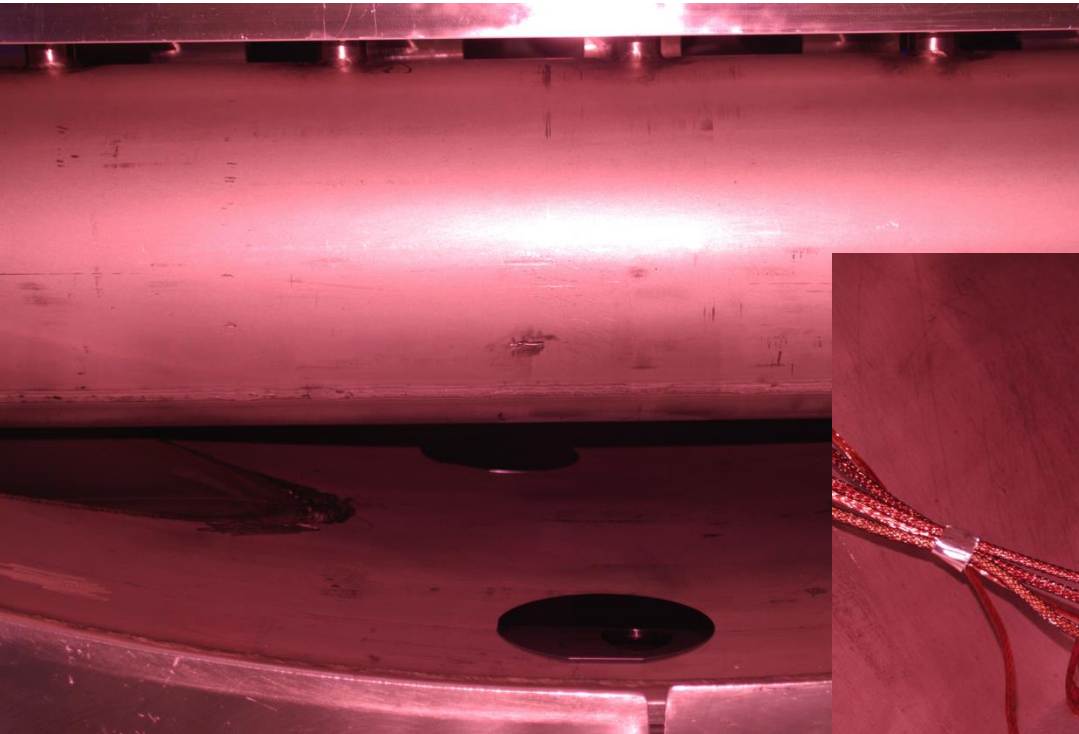
Total Wafers Collected

➤ *Need more samples from Hanford.*



Total Wafers Collected

➤ *Need more samples from Hanford.*



[LIGO-T1300014](#): Aligo, BSC
Flooring + HAM ISI, Witness
Sample Placement Requirements





Contamination Control 101



- Why:
 - At least $\frac{1}{2}$ class improvement

Scrubs



- Why:
 - At least $\frac{1}{2}$ class improvement
- How:
 - Wear instead of street clothes
 - No special laundering requirements
 - Tailor if needed

Scrubs



- Why:
 - At least $\frac{1}{2}$ class improvement
- How:
 - Wear instead of street clothes
 - No special laundering requirements
 - Tailor if needed
- When:
 - Required for all cleanroom work
 - Strongly encouraged for VEA work

Scrubs



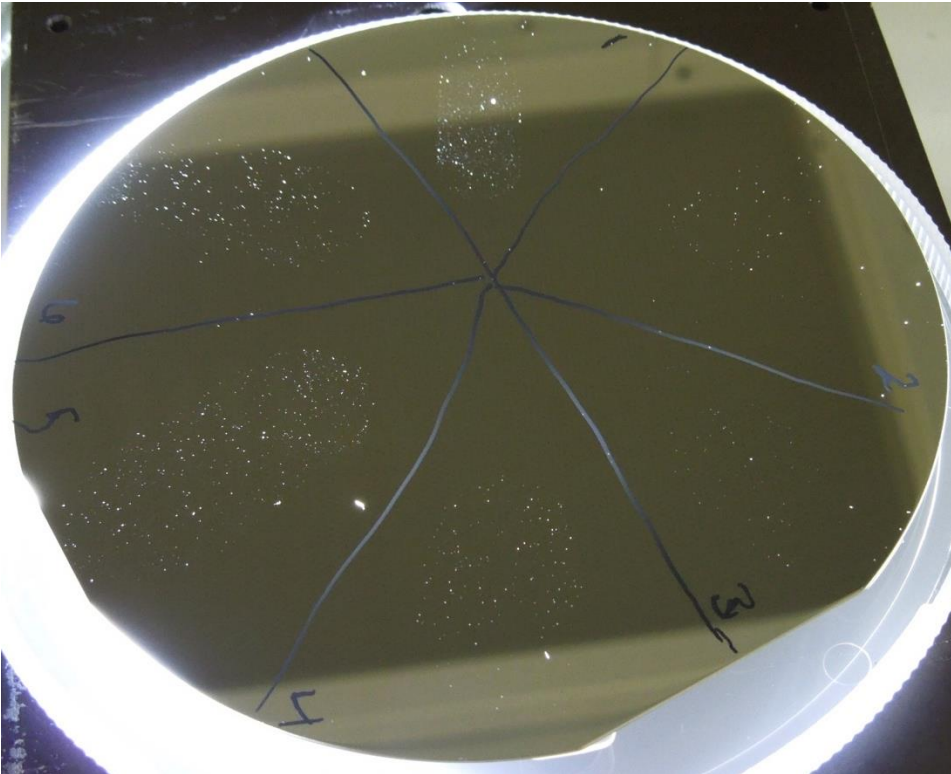
- Why:
 - At least ½ class improvement
- How:
 - Wear instead of street clothes
 - No special laundering requirements
 - Tailor if needed
- When:
 - Required for all cleanroom work
 - Strongly encouraged for VEA work

** NOT a magical barrier against contamination!*

**Refer to [LIGO-E0900047](#) aLIGO Contamination Control Plan*

Glove Washing

- Why:
 - Covered in particulates



Glove Washing

- Why:
 - Covered in particulates
- How:
 - High purity IPA + wipe



OR



Glove Washing

- Why:
 - Covered in particulates
- How:
 - High purity IPA + wipe
 - Think peanut butter hands



Glove Washing

- Why:
 - Covered in particulates
- How:
 - High purity IPA + wipe
 - Think peanut butter hands
- When*:
 - After donning
 - If dirty

* *Change if ripped or excessively dirty*





**KEEP
CALM
AND
CLEAN
AS YOU GO**

Clean as you go policy

- Why:
 - Everyone contributes to problem
 - Everyone **MUST** contribute to solution

Clean as you go policy

- Why:
 - Everyone contributes to problem
 - Everyone **MUST** contribute to solution
- How (basic):
 - Inspect
 - Wipe
 - Vacuum

GROSS



CHAMBER



LIGO G1400378-v2



Advanced LIGO



Clean as you go policy

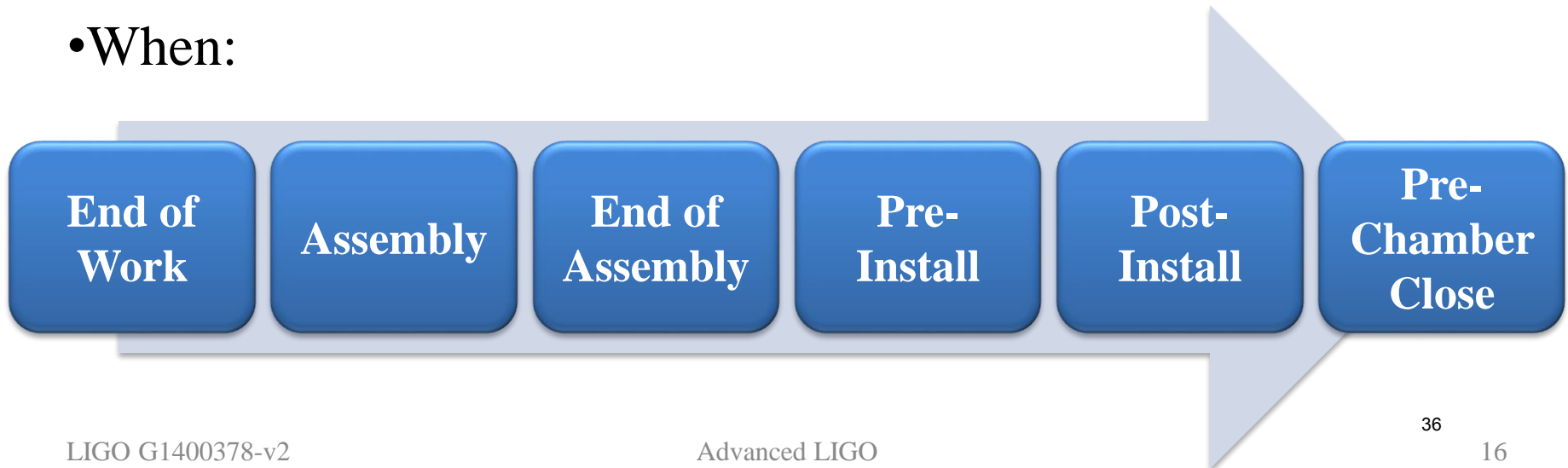
- Why:
 - Everyone contributes to problem
 - Everyone **MUST** contribute to solution
- How (basic):
 - Inspect
 - Wipe
 - Vacuum
- When:



**End of
Work**

Clean as you go policy

- Why:
 - Everyone contributes to problem
 - Everyone MUST contribute to solution
- How (basic):
 - Inspect
 - Wipe
 - Vacuum
- When:




Contamination Control Supplies





NOTICE

Please
**EXCUSE OUR
APPEARANCE
WE ARE
REMODELING**



Common mistakes



What's wrong with these pictures...
Advanced LIGO







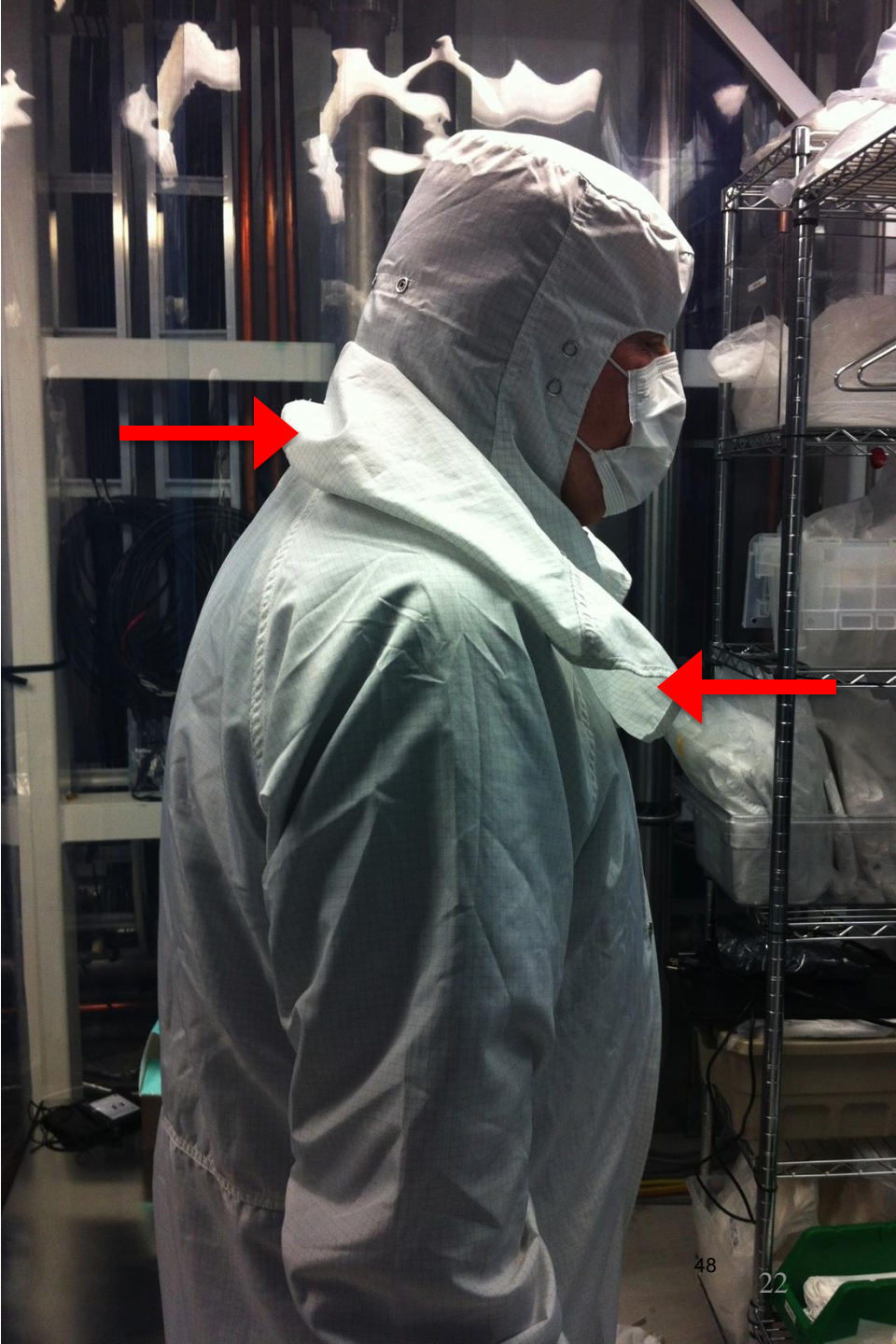




- As shown ready for door removal.
- If in to e.g. "clean" or other then skinny bunny okay but only when door or door cover is on.





















- Local CC Czar:
 - Jeff Bartlett

- Caltech:
 - Calum Torrie
 - Kate Gushwa

References

Contamination Control on the DCC and Wiki

- [LIGO-E1300953](#) aLIGO, Particulate Contamination
- https://dcc.ligo.org/wiki/index.php/Engineering_for_LIGO/ContaminationControlWorkingGroup

Requirements

- [LIGO-T1300511](#) Some thoughts regarding Particulate Contamination Requirements

Talks

- [LIGO-G1301249](#) Hanford and Livingston Contamination Control Update Dec 2013-Jan2014
- LIGO-G1400142: [Summary of 4" Wafer Data](#)
- [LIGO-G1300777](#) Contamination Control Requirements – Gloves, Cleaning on the Go and The Plan

Key Documents

- [LIGO-E0900047](#) aLIGO Contamination Control Plan
- [LIGO-E1201035](#) aLIGO Chamber Entry & Exit Procedures.
- [LIGO-E1201096](#) Contamination Sample Handling – How to receive, use, send, buy and store samples.
- [LIGO-T1300014](#): Aligo, BSC Flooring + HAM ISI, Witness Sample Placement Requirements
- [LIGO-L1300086](#) Contamination Control Guidance on Cleanroom Scrubs



Backup slides

Defining Clean

Cleanroom Class

Particles per: Volume of air
Requirement: ISO 5 (Class 100)

Tool:



Defining Clean

Cleanroom Class

Particles per:
Requirement: Volume of air
ISO 5 (Class 100)

Particulate Cleanliness Level (PCL)

Area of surface
Level 65 (optics at full power)
Level 100 (chambers)

Tool:

