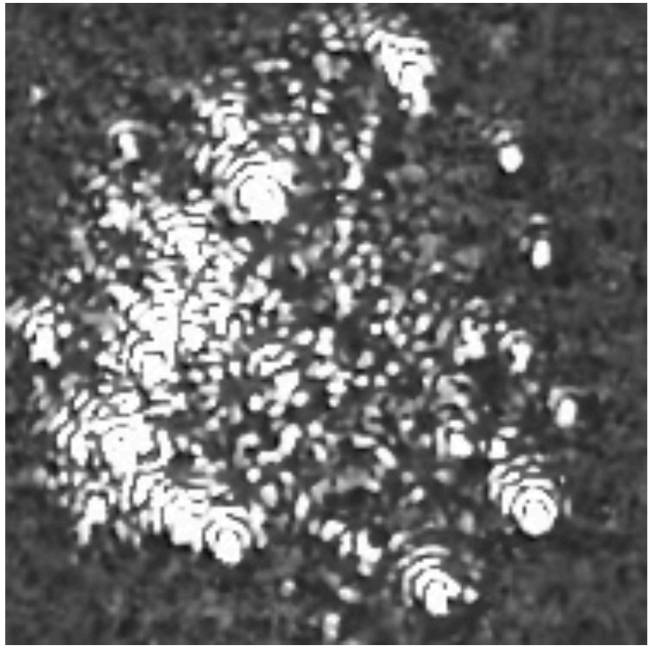
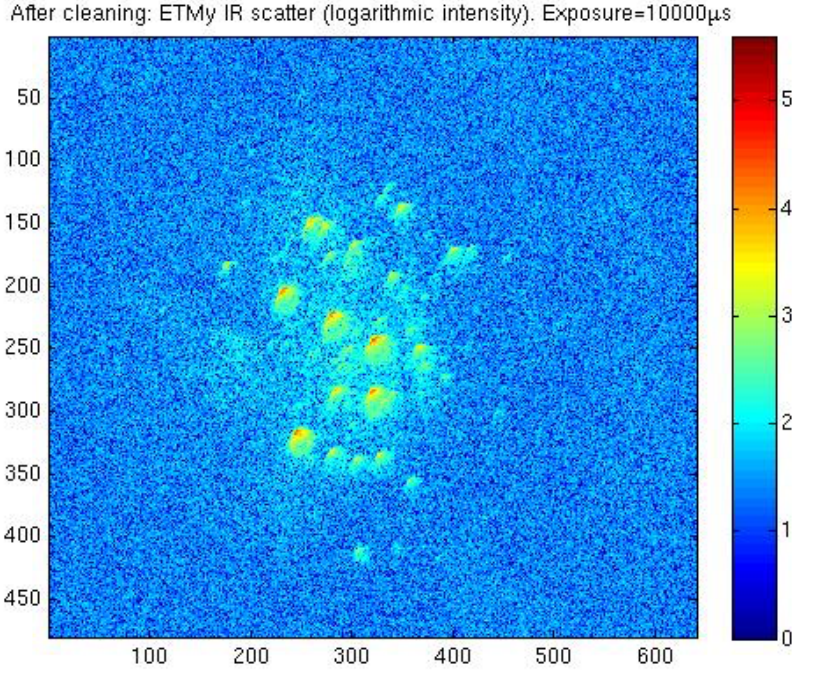
Beam centering onto test masses

H1 ITMX infrared GigE view
(when fully locked)



Credit: C. Vorvick, LHO log 35304

H1 ETMY infrared GigE view
(when fully locked)



Credit: E.King, LHO log 15879

Kiwamu Izumi for
KAGRA commissioning and MIF teams

Beam positioning is essential

- **No alignment, no interferometer locking.**
- **This had been a hot topic in LIGO as well.**

  https://dcc.ligo.org/LIGO-G1401257/public

  https://dcc.ligo.org/LIGO-G1400193/public

- **Very critical even for the 3km Michelson.**
- **Perhaps, this is a good opportunity to think through the alignment process (for now and future).**
- **In particular, beam positioning (or centering) onto the ETMs are the most critical for the upcoming 3km Michelson.**

In other words

- **How do we make sure that the beam is at the center of ETMs during the 3km Michelson run?**

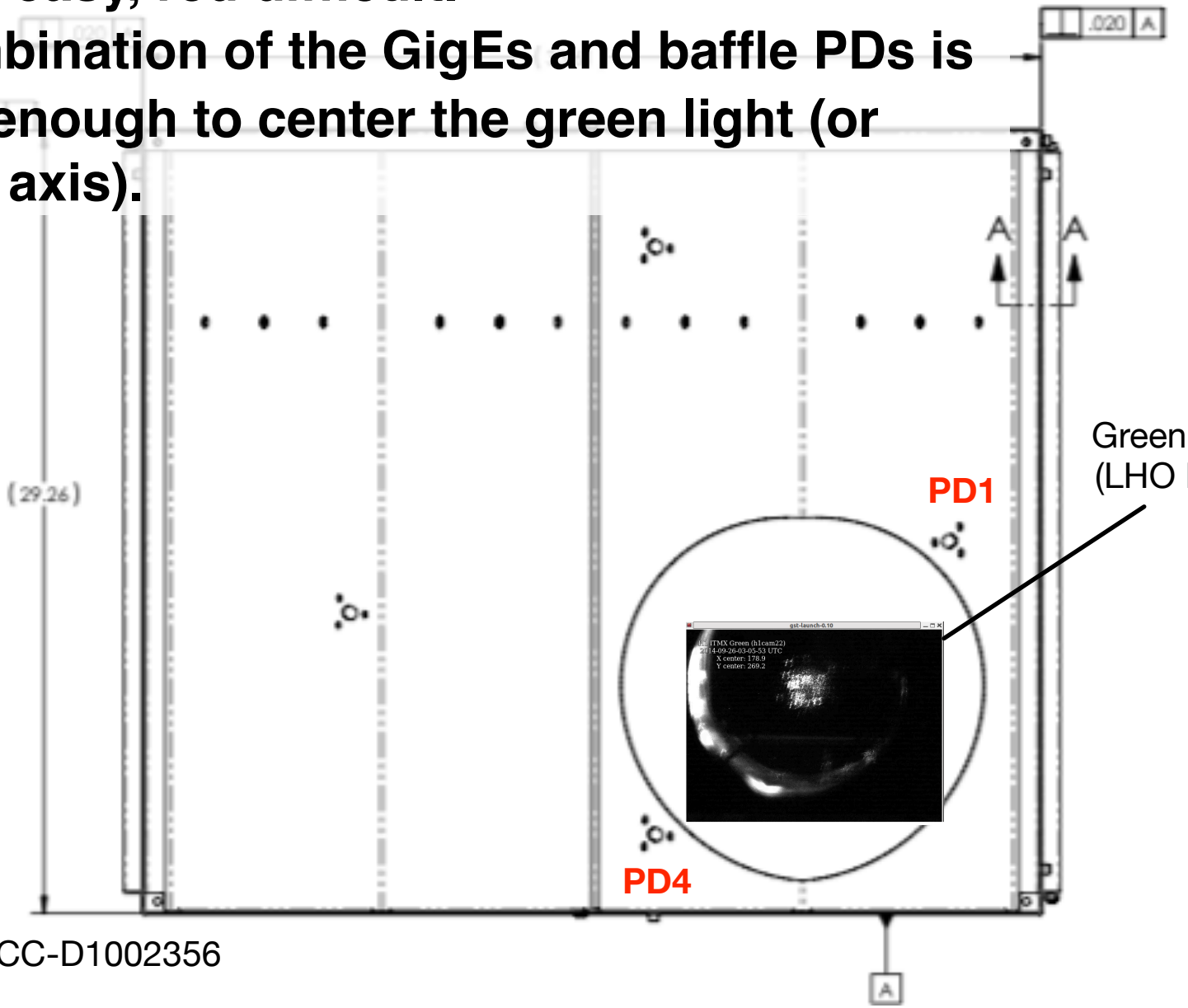
- **The worst scenario would be something like:**

  We completely lost a good alignment of PR3 and now have to perform the initial alignment without opening the ETM chambers.

- **What do we do then?**

Consensus (among LIGO people)

- **Green easy, red difficult.**
- **A combination of the GigEs and baffle PDs is good enough to center the green light (or cavity axis).**

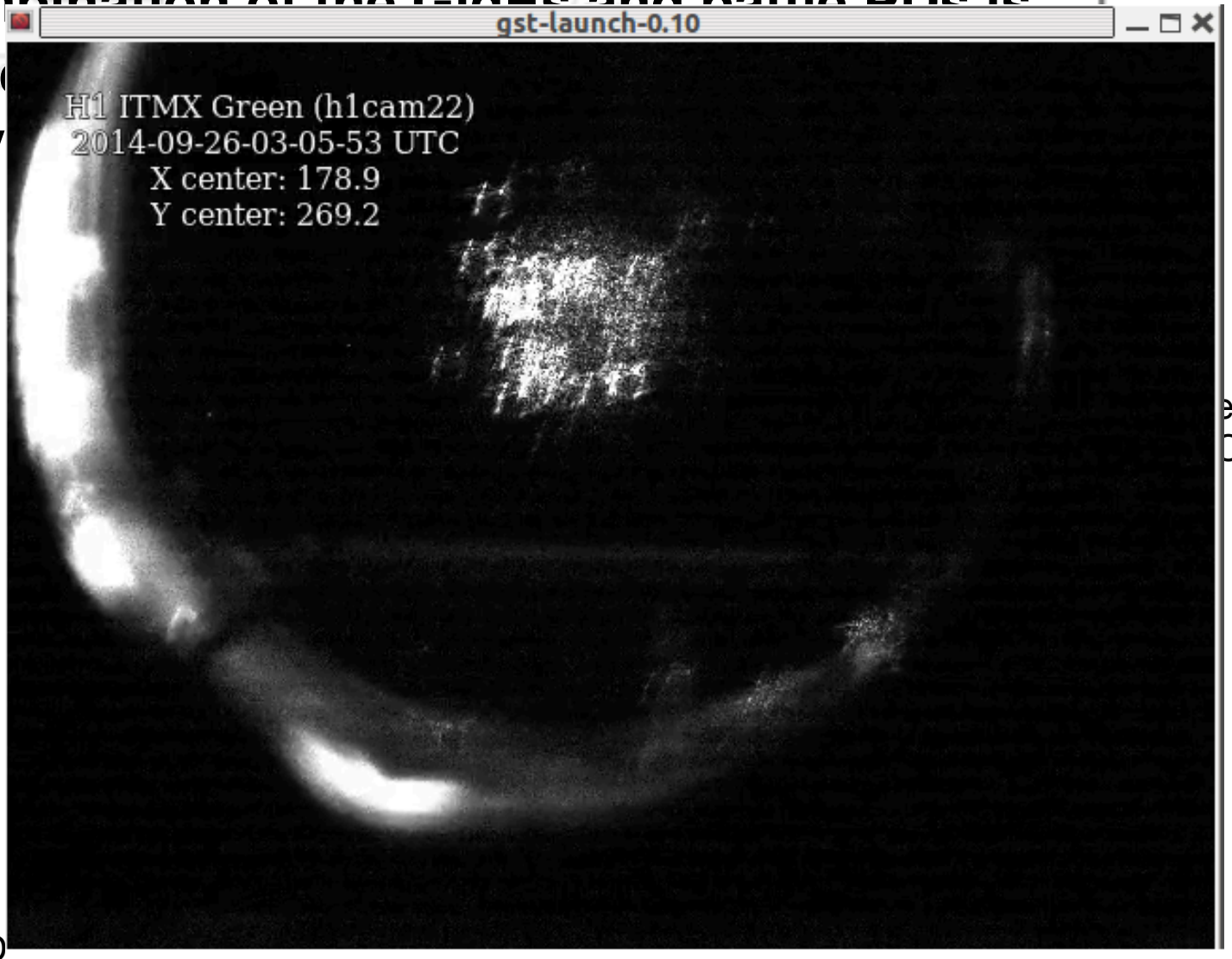


Green GigE view
(LHO log 14160)

LIGO-DCC-D1002356

Consensus (among LIGO people)

- **Green easy, red difficult.**
- **A com[illegible] good [illegible] cavity**



[illegible]en GigE view
[illegible]O log 14160)

Here are our problems

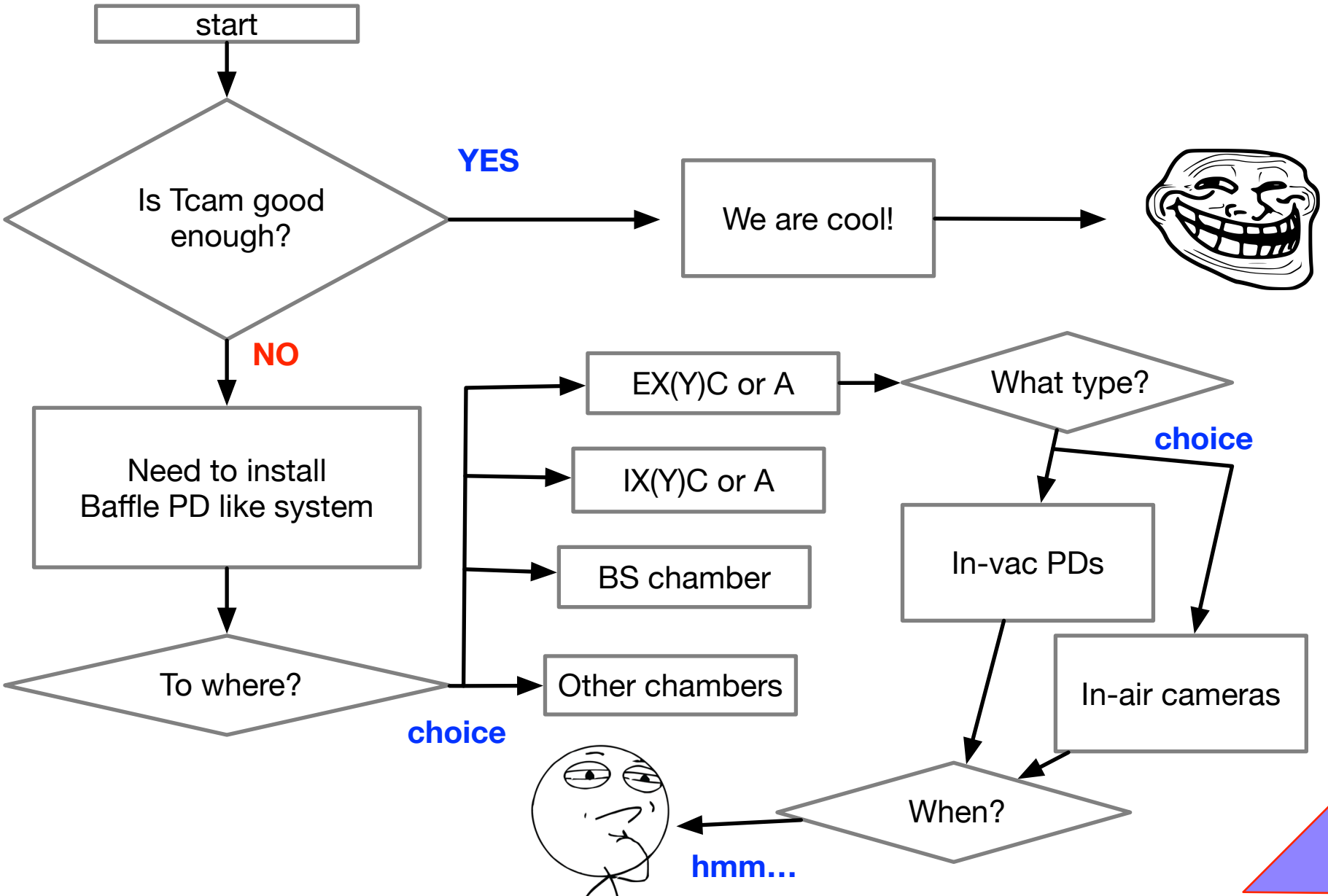
- **NAB(narrow angle baffle) won't be installed in time.**
  => no baffle PD technique.

- **3km Michelson doesn't have an arm cavity**
  => no way to resonate green or IR light anyway.
  => hard to directly monitor the spot position w.r.t. the mirrors by cameras.

- **The planned GigEs for ETMs don't have a large enough field of view.**
  => they only see a part of the mirror surfaces.

- **Is Tcam the only way?**
  => but needs to intentionally misalign the beam onto the recoil mass cage to make it bright enough.

Questions we have to answer



Optimistic Scenario

- **The suspended mirrors are stable over months.**
- **Once the initial alignment is done manually, the beam won't miss any mirrors.**

But, we already know that this is not the case!

Added on v2.

~~**(iKAGRA followed this scenario though)**~~

Correction:iKAGRA lost the beam once, which was subsequently recovered by using the trans PD (the ETMs were not high reflective).

http://klog.icrr.u-tokyo.ac.jp/osl/?r=1368

Summary of discussion

Added on v2.

Main resolutions:

- Plan A: Use of Tcam, looking for scattering from the recoil mass cage or the screw heads.
- Plan B: Use of Tcam with the addition of a shiny post installed in the EYC chamber.

Required actions:

- Experimentally check the brightness of the scattered light hitting the recoil mass cage, as seen by Tcam.
- Schedule and organize the Tcam experiment (the week of Jan. 9th nominally) -> Kiwamu
- Prepare a post or two for Plan B. -> Osamu

An incomplete minutes

Added on v2.

- EYC chamber has a remote-controllable illuminator.

- The inner diameter of WAB is 254 mm, marginally big enough for Tcam to see some parts of the recoil mass cage. (WAB won't be in during the 3km Michelson run).

- With the illuminators on, a 1 sec exposure seems good enough to visually see the test mass location.

- Tcam software will need some additional functionalities for us to be able to perform the Lissajous beam survey e.g., processing a number of images and spitting out pixel sums as a function of time and recording the significant images which exceeded a certain threshold for the pixel sum.

- The synchronization of the Tcam workstation and the KAGRA digital system need to be checked. Even if the synchronization turned out to be bad or unknown, one can slowly do the Lissajous survey.

- Alternative to plan A, one can place a ring type reflective object in front of the mirror.
  => does this need to be a ring shape?
  => No.
  => Then we could just put a post or some kind.
  => plan B

An incomplete minutes

Added on v2.

- **The view port for Tcam is coated such that it actually attenuates the IR. Nevertheless, if a reflective plate (made of Al) is in place, Tcam was able to see the beam shape beautifully with an exposure time of 15 sec. The exposure can be reduced to a smaller number as far as the scattered light is concerned.**

- **The beam height at EYC w.r.t. the optical table is 350-400mm. If we install a reflective object additionally, it has to be as tall as this.**

Minutes

Added on v2.

- **When a plate of aluminum is placed at EYC, Tcam was able to see the IR scattered light.** Klog 3619