ITM03; LHO ITMx
Post O2 inspection

The Hanford ITMx exhibited high absorption. The optic was examined and cleaned in-chamber, May 2017.

The absorption persisted, the optic was removed after O2

A feature was found at the location predicted by TCS. This feature is highly absorbing. A feature at this location was present in the scatter scans of the optic as received from the coater. Several other post-coating absorbers over 20 ppm were found in the center 60 mm of the optic.

G. Billingsley, L. Zhang

LIGO-G1800345-v1

Experimental process

- Scatter measurement -
  The map before installation: measured after First Contact cleaning with ion gun.
  The map after O2: measured as-returned from LHO, no cleaning

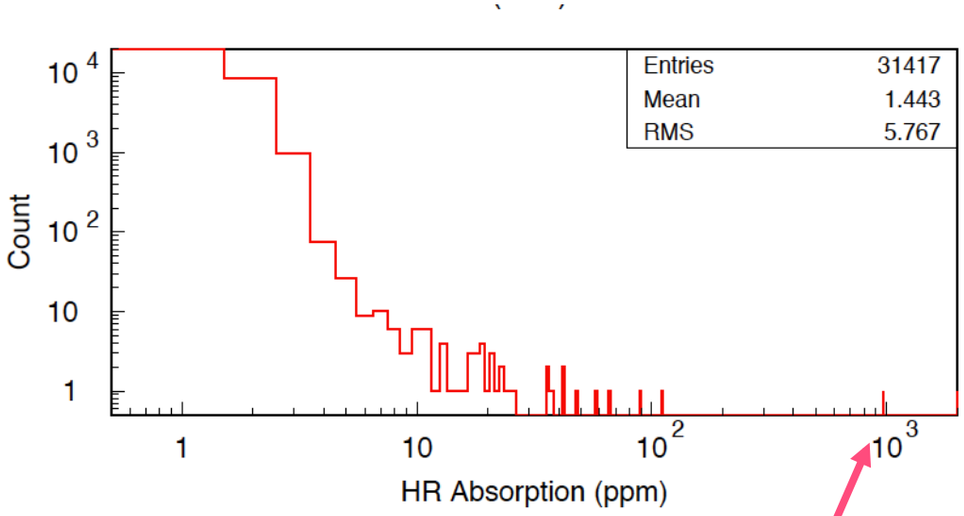
- Cleaning with ion gun because there was some dust visible when checking with a flash light.

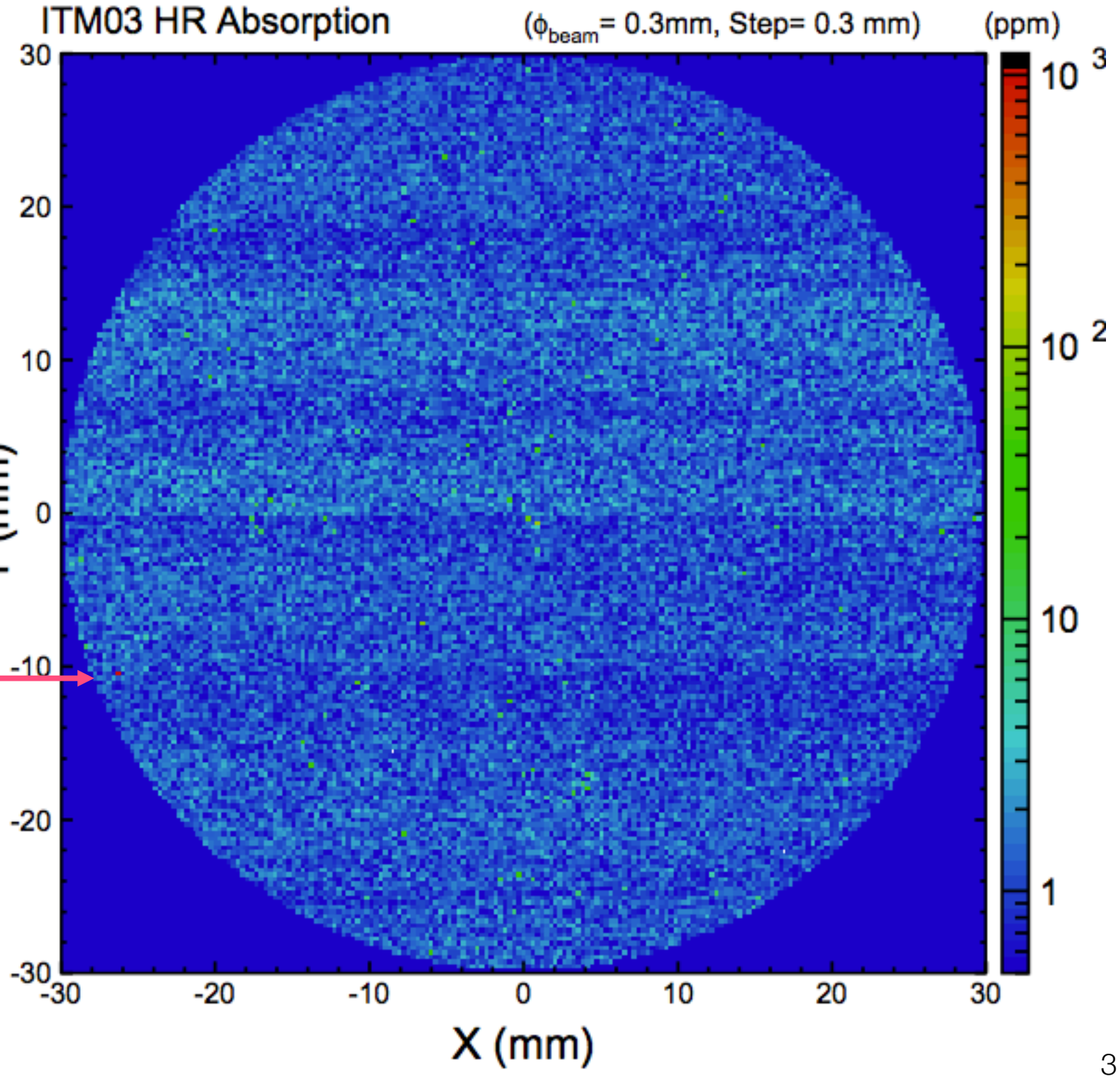
- Gentle absorption: the measurement was carried out with a beam of 0.3mm in diameter and 0.9W, i.e. 12.7W/mm^2. The lower limit of sensitivity for this scan was about 20ppm.

- High resolution probe of the high absorption spot.
  The measurement was done with a beam of 60 um in diameter at 25 mW, i.e. 8.8 W/mm^2.

- All scatter and absorption data are referenced from LIGO-E1000766

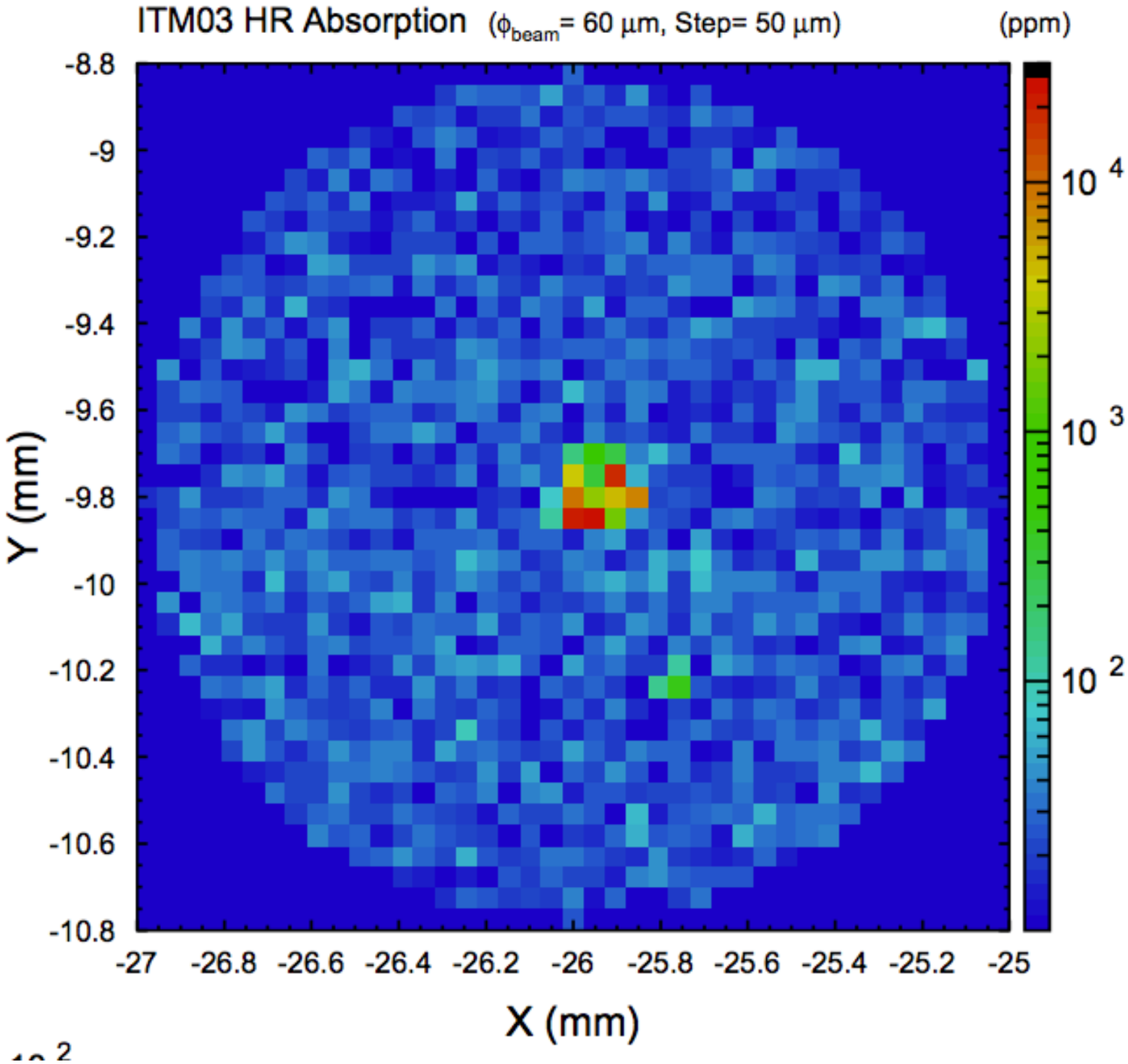
“Gentle” Absorption Scan



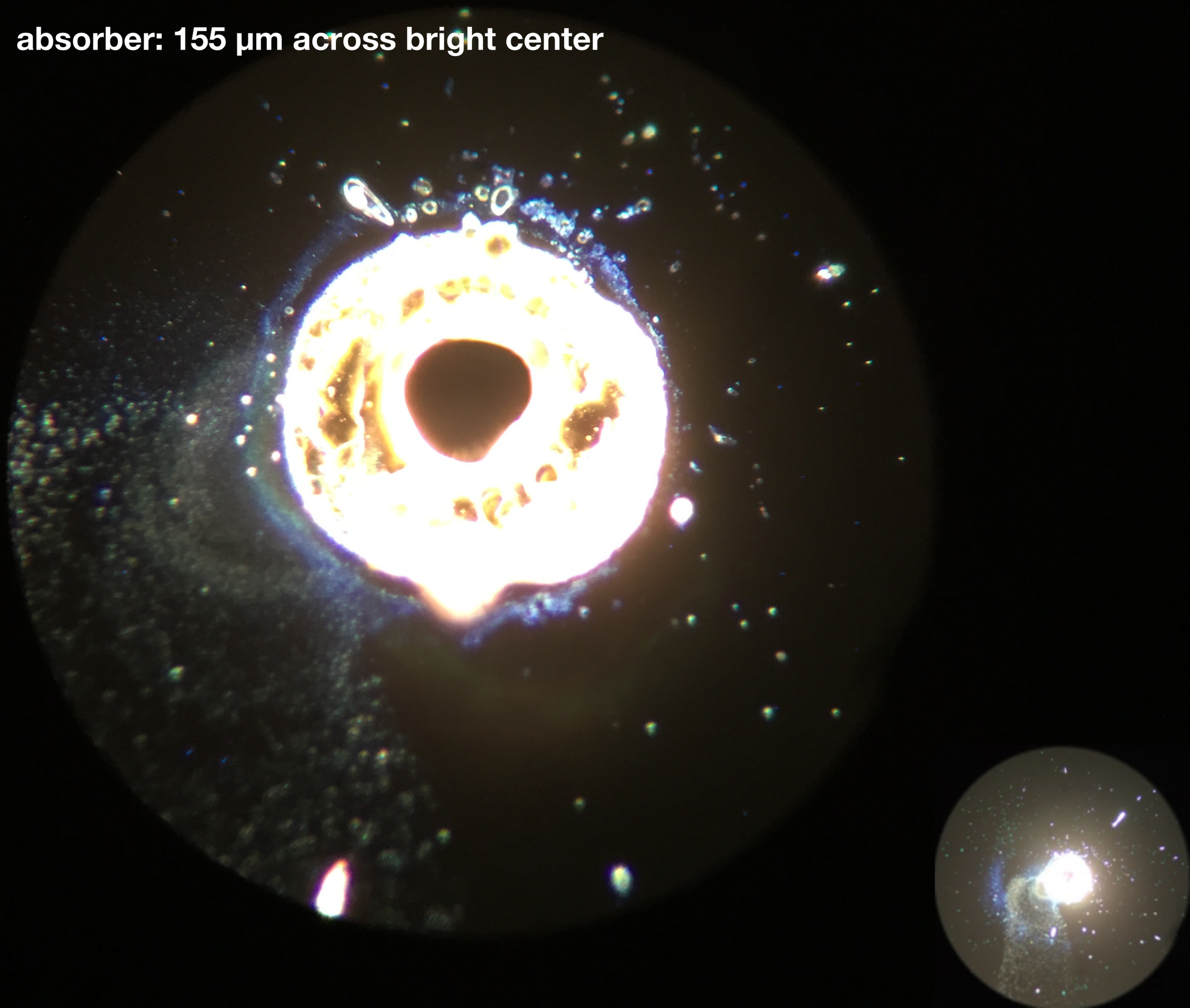


- Absorber found!
- Lower power and larger beam than the usual absorption scan: Noise floor ~20 ppm

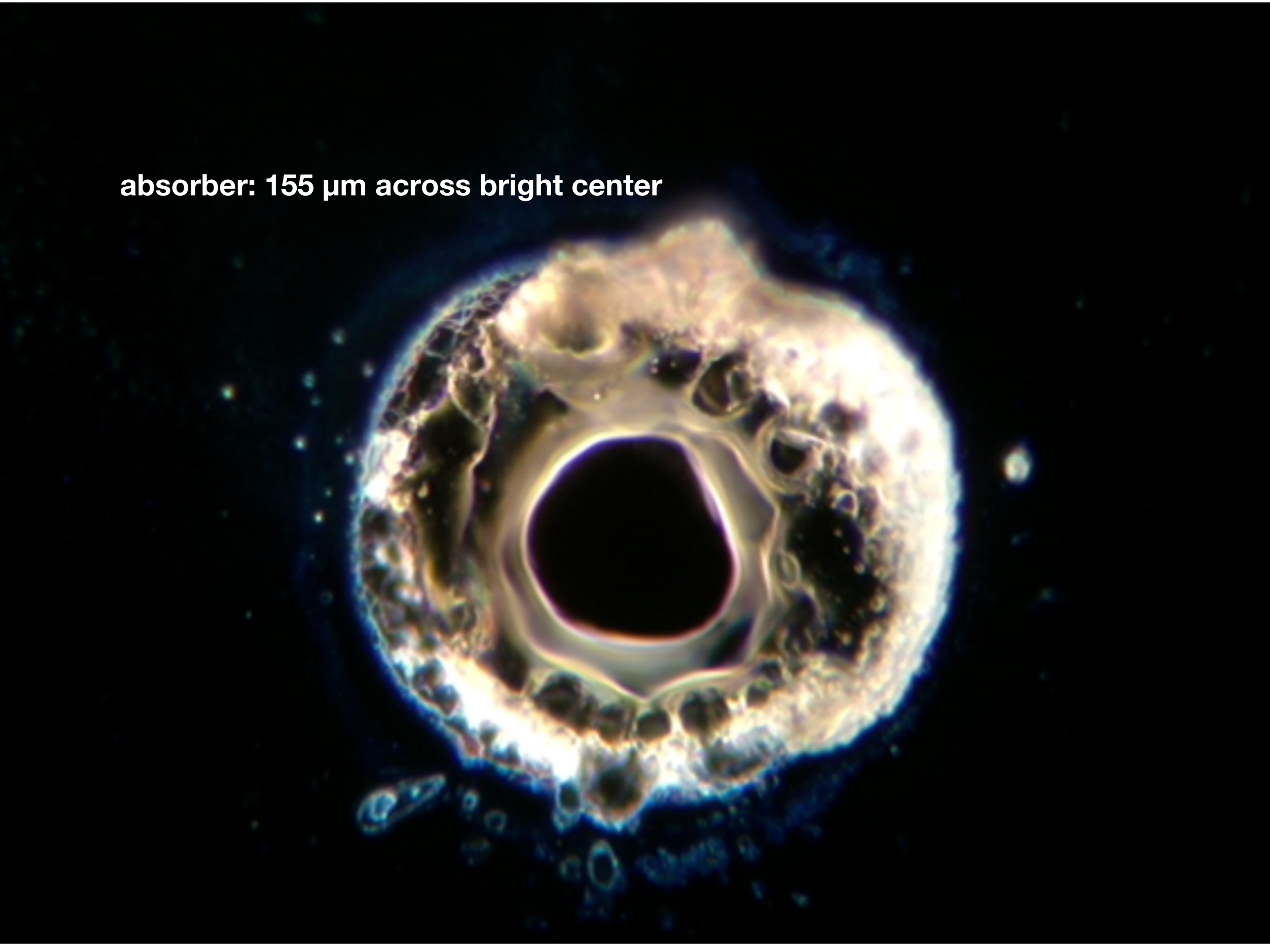
LIGO Probe absorption with smaller beam



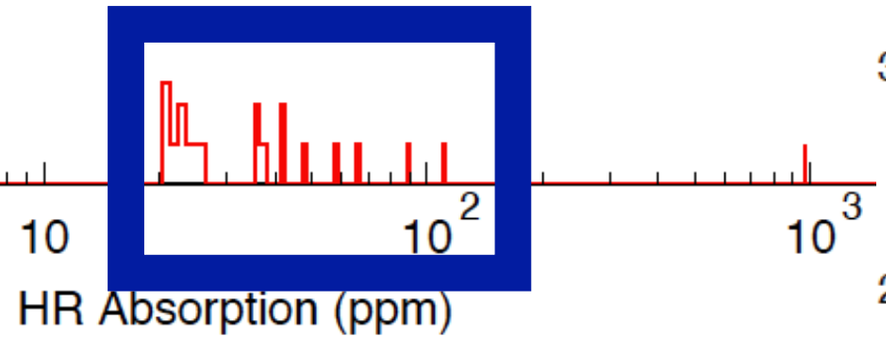
absorber: 155 μm across bright center



absorber: 155 μm across bright center

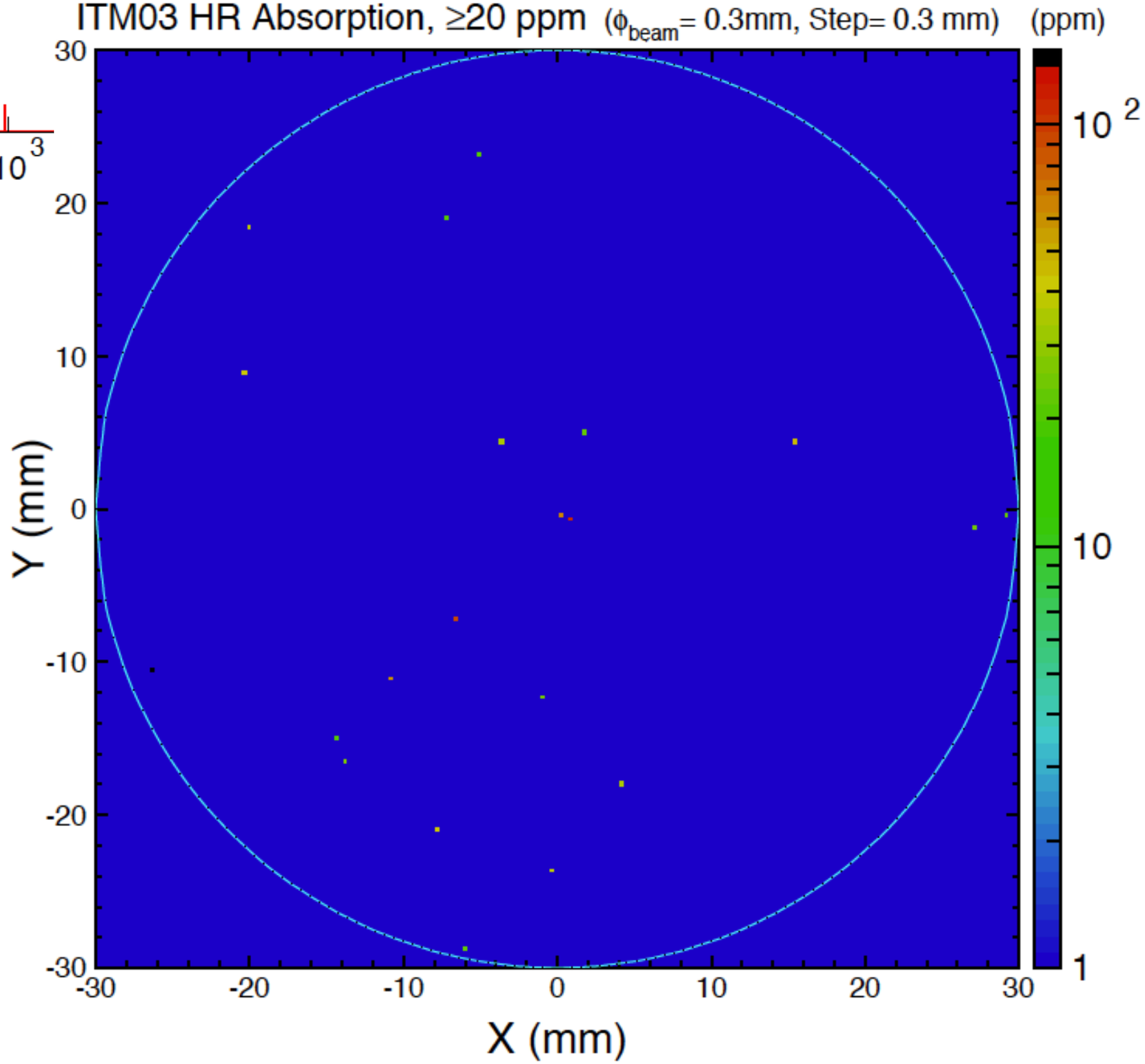


LIGO “Gentle” Absorption Scan with bottom noise chopped off



Note there was no first contact cleaning before this scan.

Possible dust added during chamber removal or installation on absorption test stand

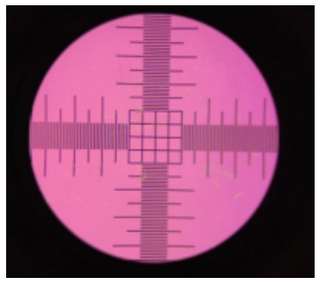


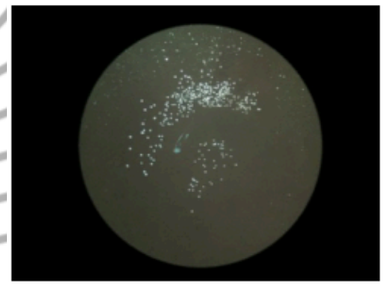
Dark Field Microscopy

Features found within a radius of ~60 mm of center.

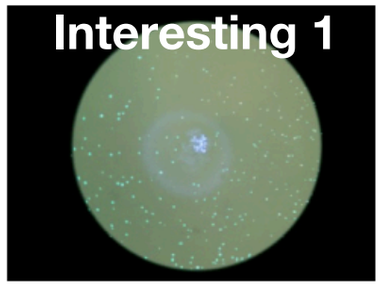
1 mm ∅ field

Center scale squares are 50 µm

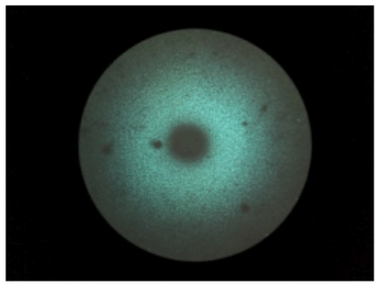




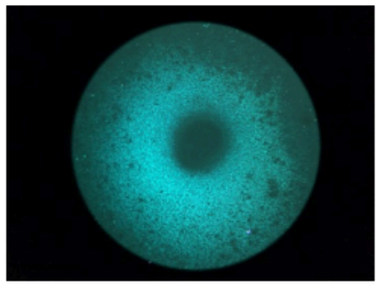
(-23, -27)



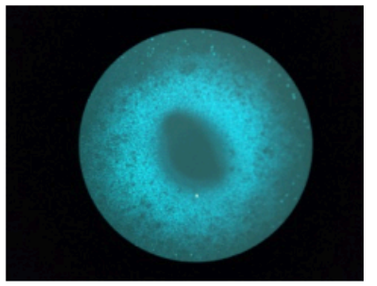
(5, -27)



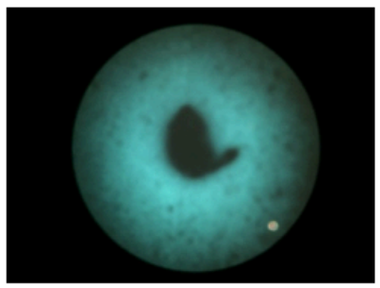
(27, -47)



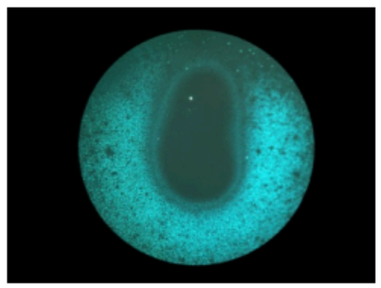
(-1.4, -62)



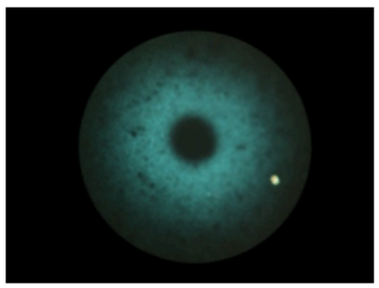
(8, -30)



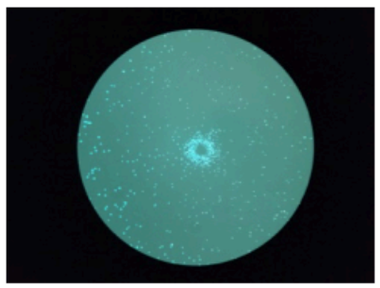
(-2, 23)



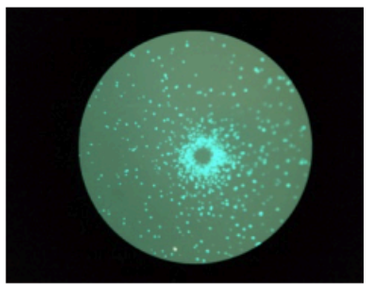
(-60, -43)



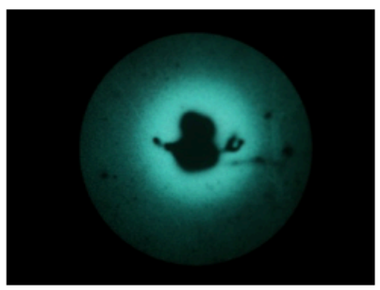
(15, -41)



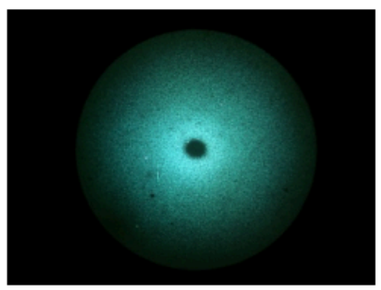
(11, -61)



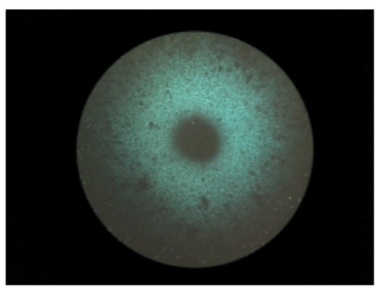
(-3, -33)



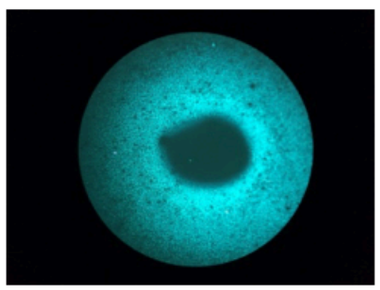
(11, 21)



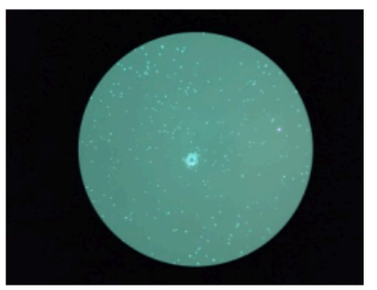
(11, -26)



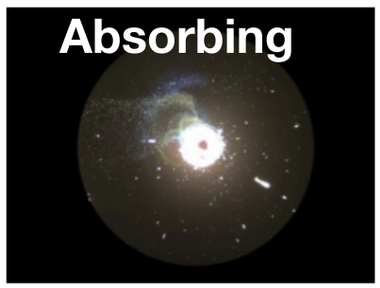
(-2, -50)



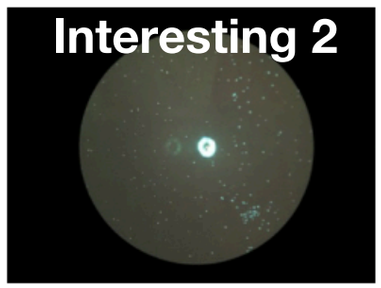
(32, -59)



(1, -44)



(-21, -13)



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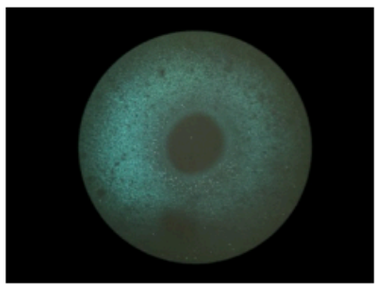
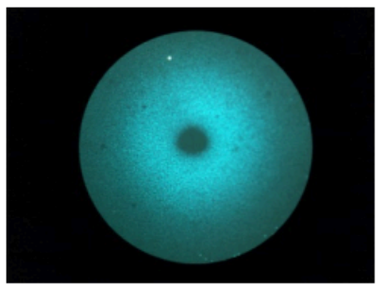
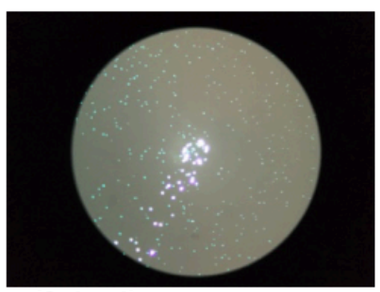


(-4, -43)

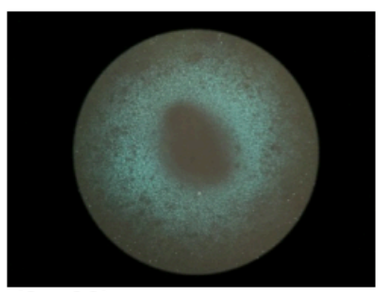


(40, -56)

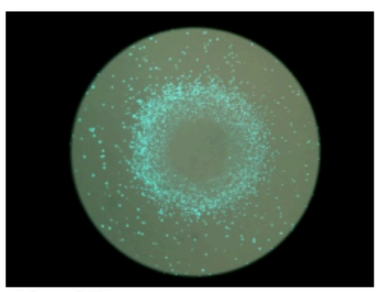
(-41, -52)



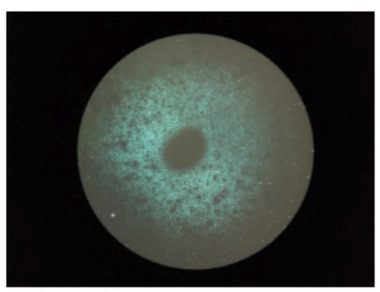
(0.4, -4)



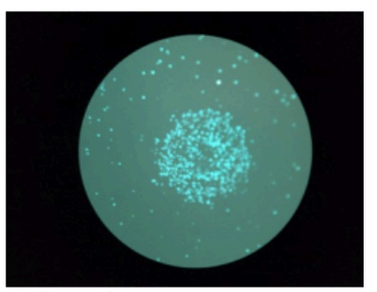
(8, -30)



(6, -27)



(-2, -46)

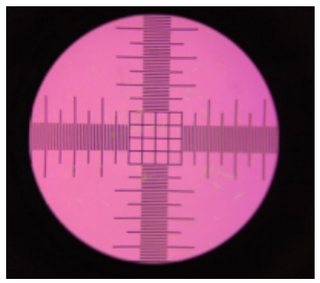


(47, -43)

Features found within a radius of ~60 mm of center.

1 mm ∅ field

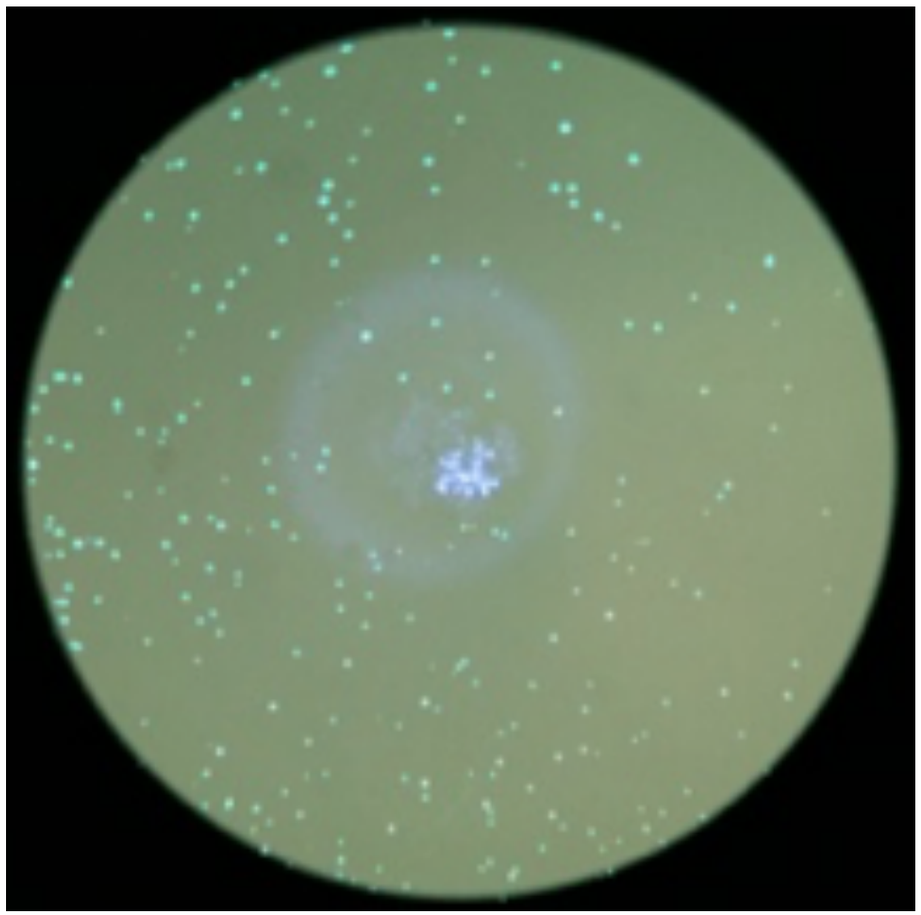
Center scale squares are 50 µm

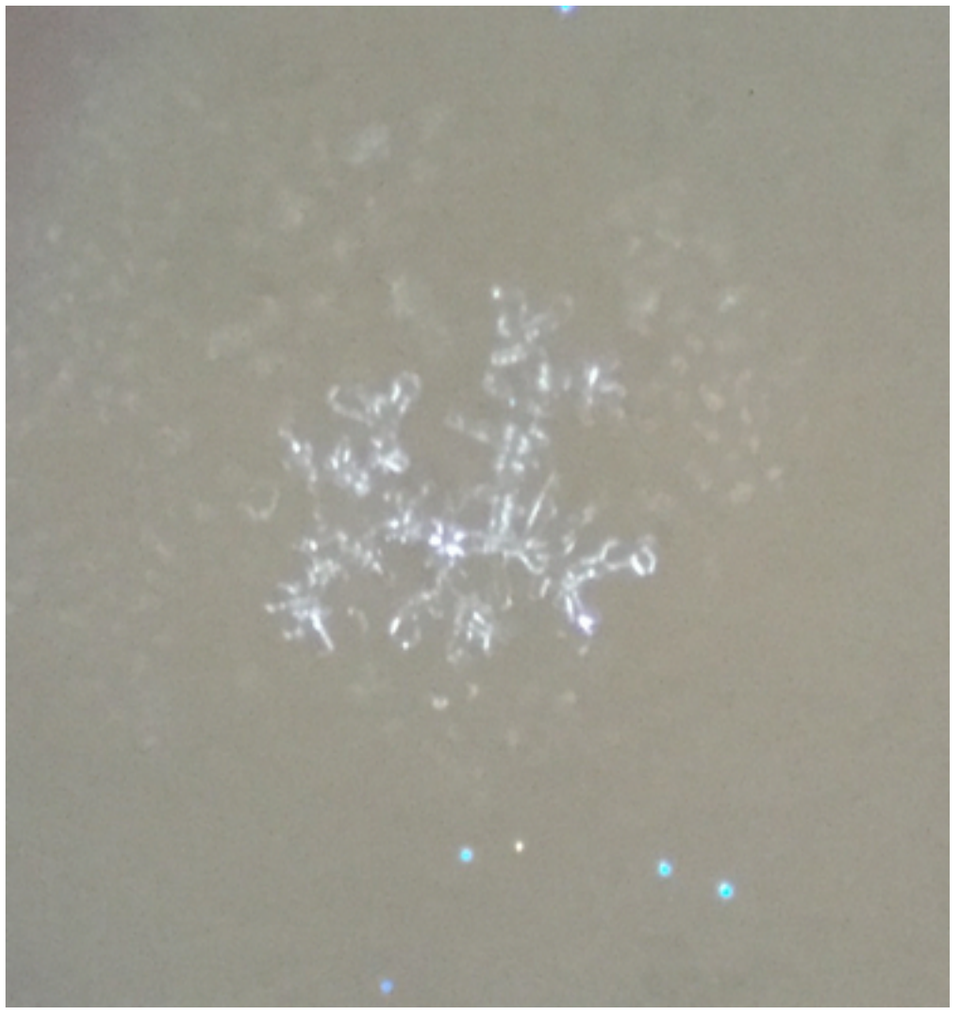


LIGO

Interesting 1 (5, -27)

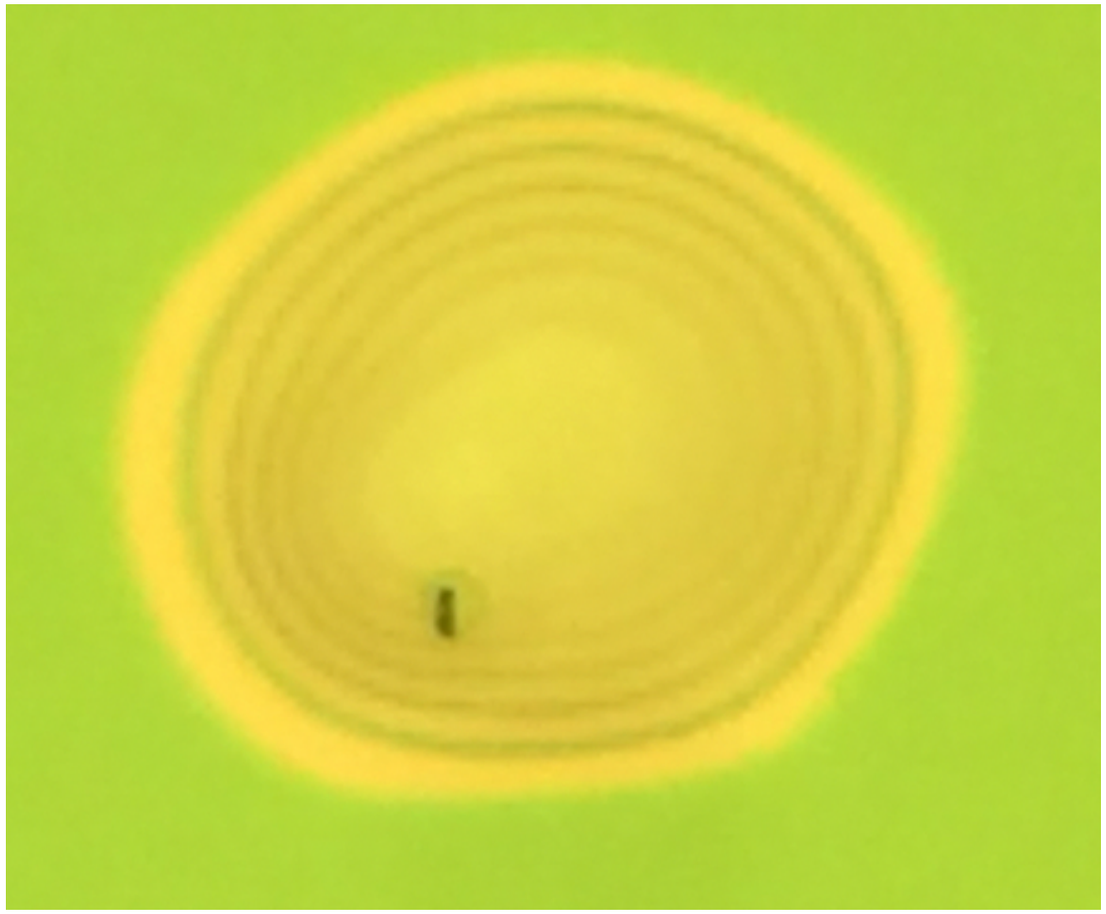
- Branch-like center structure

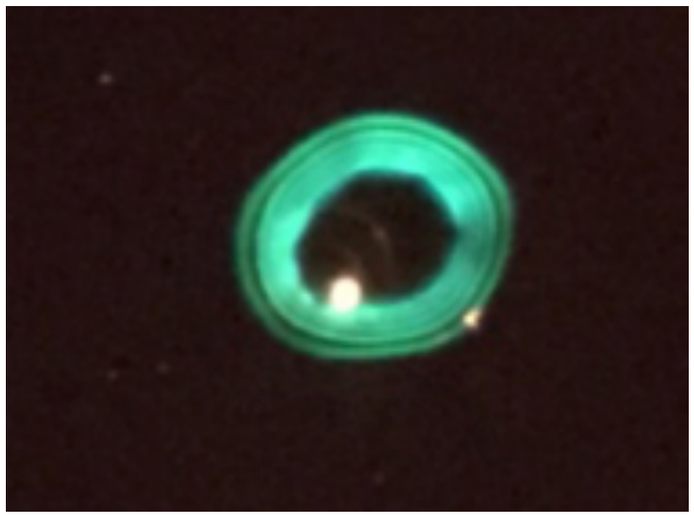




Interesting 2 (-8, -39)

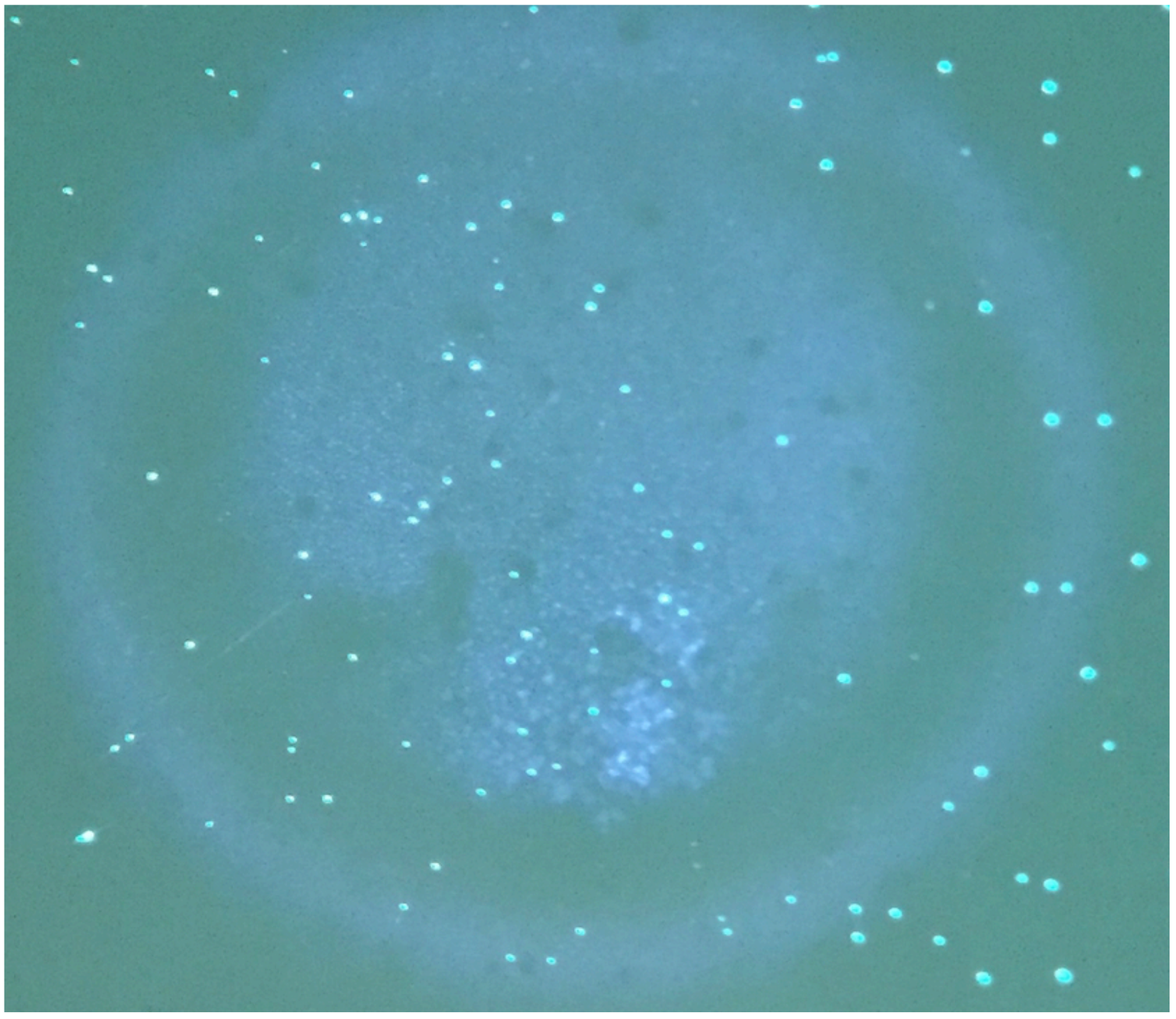
- Shown in bright field
- ~80 µm in diameter





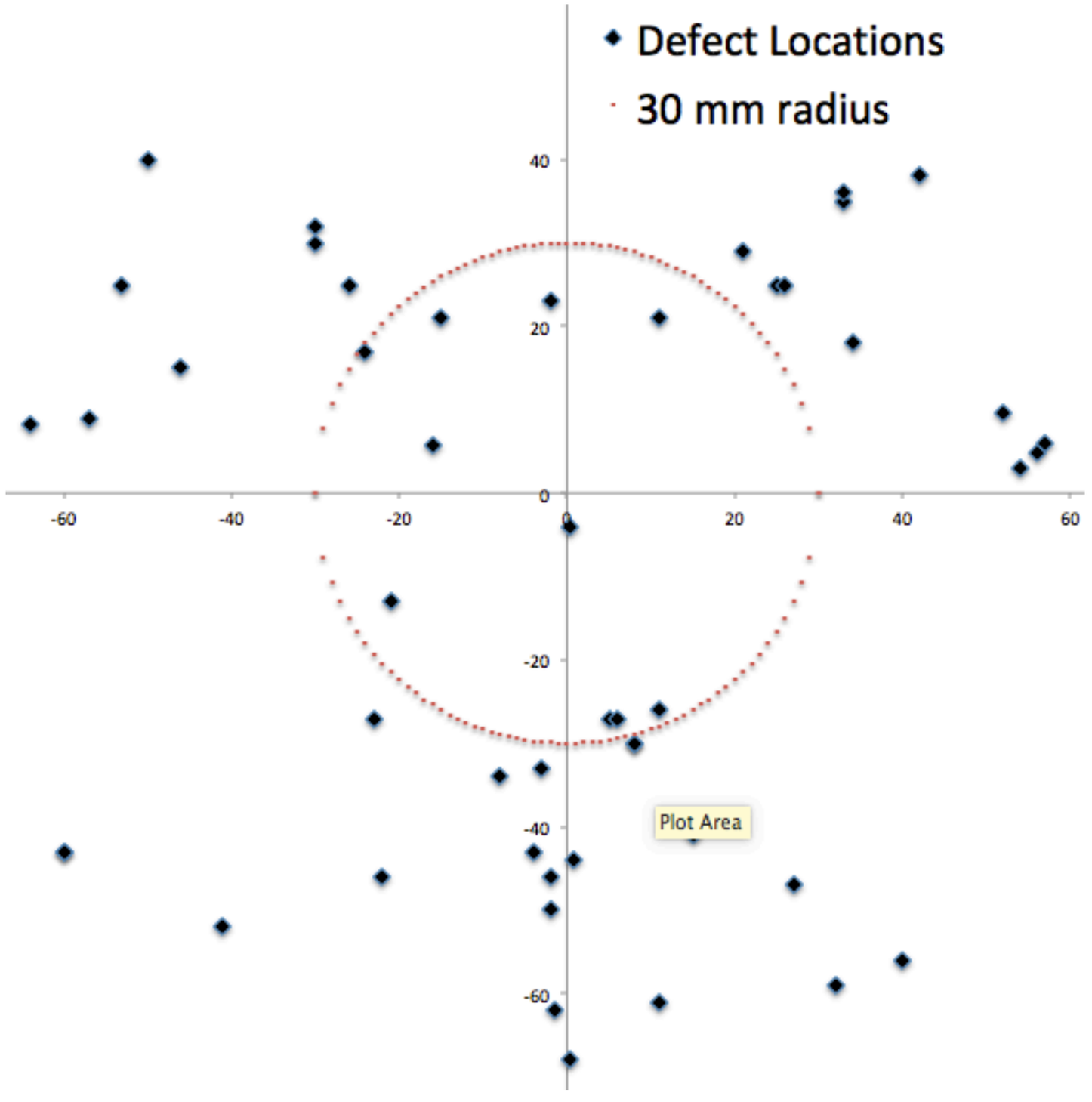
Interesting 3 (-60, -43)

- Center is filled



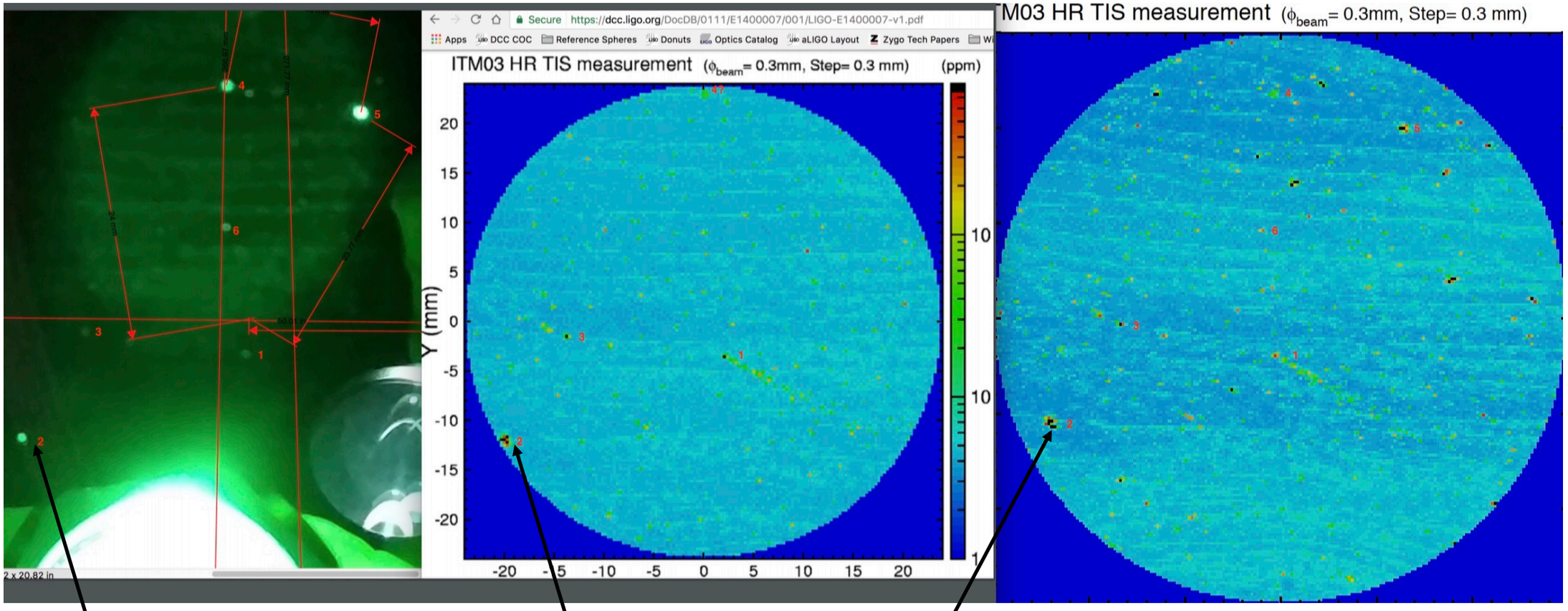
LIGO

Distribution



ITM03 scatter

In chamber view, before install, after removal



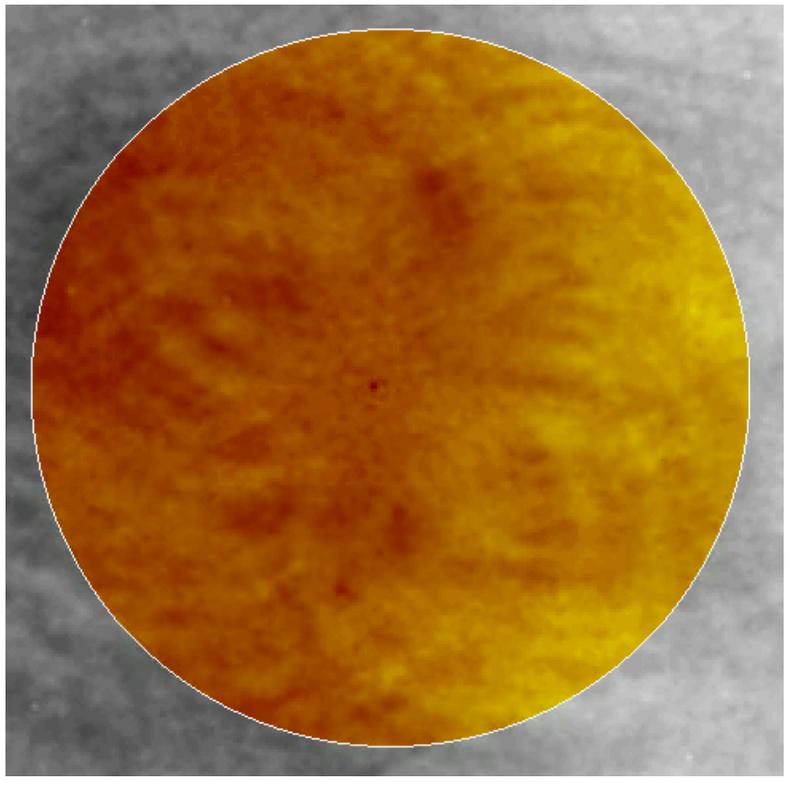
Spot # 2 found to be the high absorber,
Present in “before” and “after” scatter scans

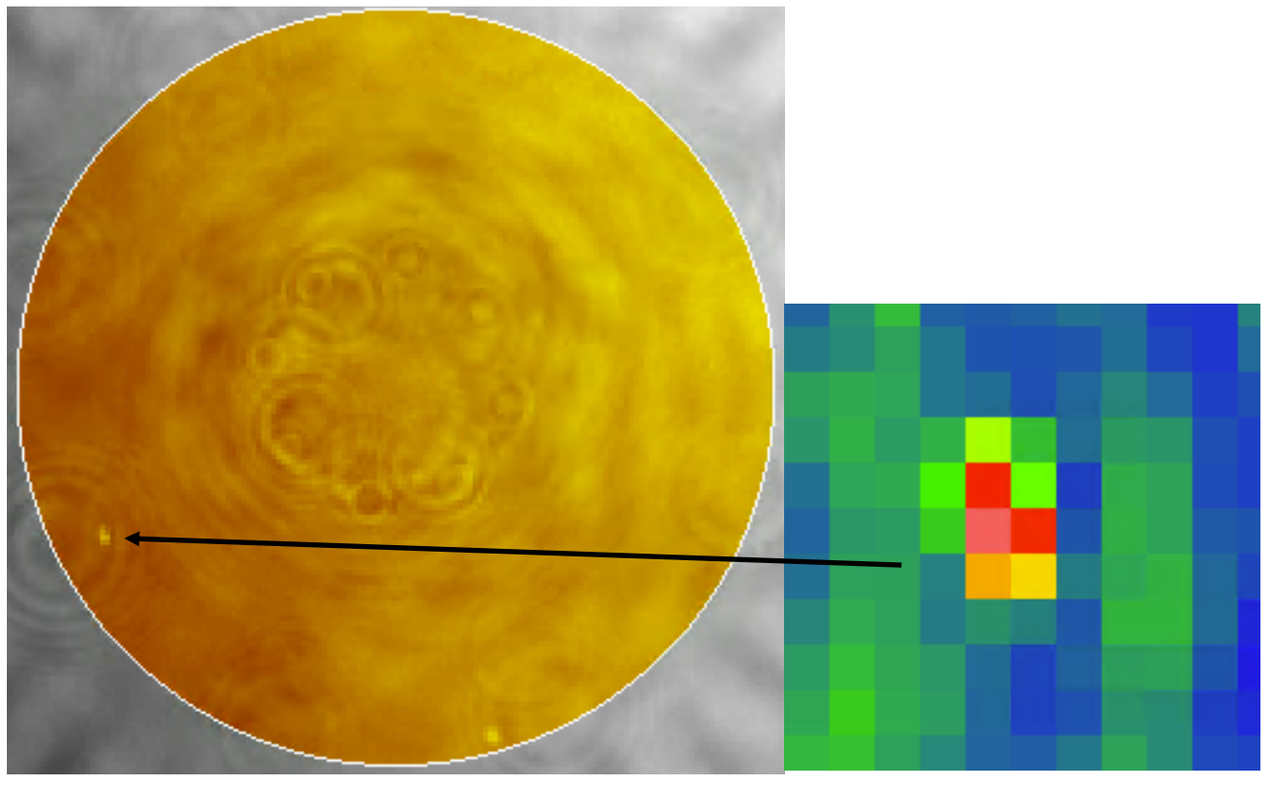
Scatter before installation: 5.6 ppm. Scatter after installation 6.3 ppm

Absorption spot seen in figure data? Or dust?

- Polished and coated data, 60 mm mask (orange circle)
  0.06 nm rms polished, PV 0.49 nm
  0.08 nm rms coated, PV 1.06 nm - 1 pixel = 400 µm

- "Interesting point" #1 (page 10) is in a similar, though not exact location to the point seen low right.





Next

- Scanning available ITM spares to screen for possible high absorption spots using the “gentle” absorption method.

- See E1000766 for ITM03 Characterization data

- See T1700193 for the in-chamber inspection at LHO