FC Peeling & Charging Tests

Common:

- 3" diameter mirror, same used over.
- Left on RTS stage in cleanroom, in-situ, not moved after scans or during cleaning.
- Sprayable FC (conductive or non-conductive indicated).
- Applied in 2 sublayers until visibly thick. 4 hour wait between sublayers. Overnight cure.
- Peel without gloves using peel strips.
- HR side.
- Measure scatter over a square 16 mm on a side.

Part 1 is a 3" REO Mirror – Leaving sample in cleanroom now for serial tests.

#1 – 5/3/09

- No treatment at all, sample left in dirty room over weekend, exposed HR, also uncleaned since storage.
- Result: 37.9 ppm.

#2 – 5/6/09

- Peeled with nc-FC
- Charge measured at -25 kV/in (actually field at about 2.5 mm from surface).
- Result: 3 ppm.

Note – peeling without discharging the FC very clearly attracts a large amount of dust to the surface!

#3 – 5/8/09

- Peeled nc-FC while simultaneously blowing interface with N2 ionizer gun.
- Charge / Field confirmed to be zero.
- Result: 3 ppm.

#4 – 5/11/09

- Drag wiped with methanol (was charge measured?).
- Result: 3 ppm.

We conclude N2 ionizer surely removes charge, and inside the cleanroon, does not impact the scatter measurement. FC→DW cleaning does not improve scatter.
Part 2 is the 1st (of three) new 3"LMA Mirrors

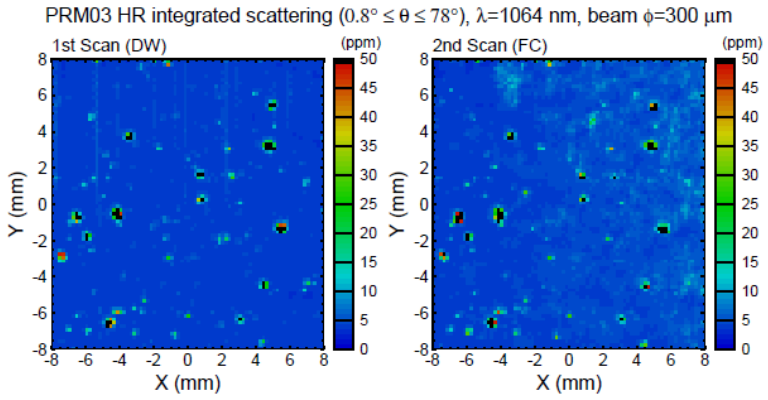
#1 – 5/13/09

- Drag wiped with methanol (was charge measured?).
- Result: 5.5 ppm.

#2 – 5/15/09

- Peeled with nc-FC while simultaneously blowing interface with N2 ionizer gun.
- Charge/Field confirmed to be zero.
- Result 6.4 ppm.

This part was taken off the RTS but left in the cleanroom to examine with a microscope to see if any first contact got left on it. It does appear from the RTS scan there is something left on it, "**first contact residue"**, based on the lighter contrast in the figure below. Noting the three repeats of 3 ppm on the first part, the difference is not noise. On the third LMA Mirror, we will repeat the DW→FC also, to see if the order has something to do with it.



Part 3 is the 2nd (of three) new 3"LMA Mirrors

We are repeating part of treatment of the REO Mirror on this second LMA Mirror.

#1 – 5/19/09

- No treatment at all, sample removed from container and scanned.
- Result: 6.2 ppm.

This part had not been previously cleaned by us. Why is this part so clean to begin with?

#2 – 5/21/09

- Peeled nc-FC while simultaneously blowing interface with N2 ionizer gun.
- Charge / Field confirmed to be zero.
- Result: 5.9 ppm.

We got in the bar lights, and this light was taken into the cleanroom to examine this part after #1. The cleanroom is not dust free, and some dust could be seen on the surface of the part, and much more dust could be see on the test mass next to it (it had been in there a long time). Blowing on the surfaces with the N2 ionizer gun removed only a small portion of the dust.

Next, when the part was peeled with nc-FC while blowing the surface of the N2 ionizer gun for #2, the bar light allowed me to see that almost all of the dust was removed, though two small particles of some kind where still visible.

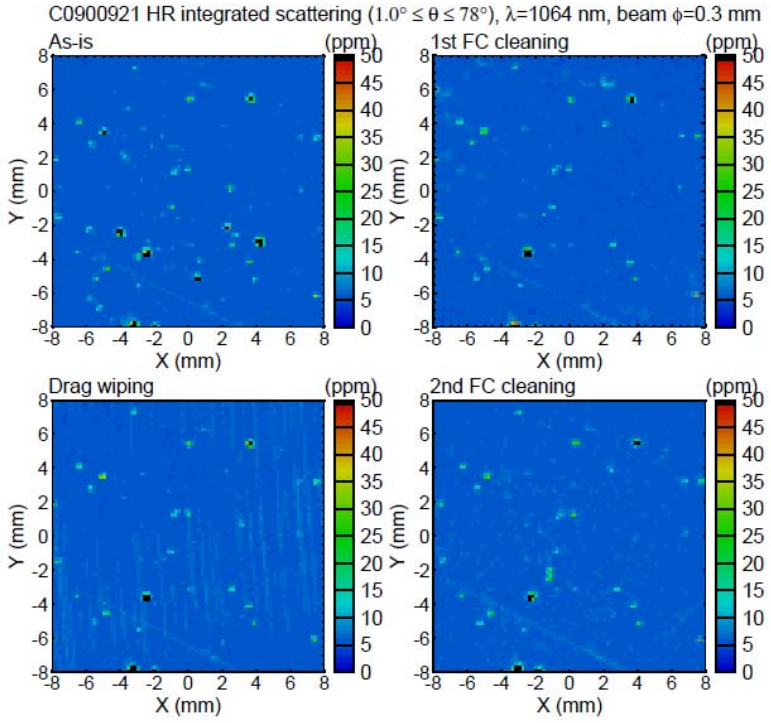
#3 – 5/27/09

- Drag wiped.
- Charge / Field confirmed to be zero.
- Result: 6.17 ppm.

The drag wiping made things worse. This could be seen as “smear”, directional contrast, in the RTS scattering areal scattering plot. Inspection of the part kept in-situ in the cleanroom on the RTS showed a very dust-free surface, in stark contrast to the parts stored out of the cleanroom that showed hundreds of particles accumulated in a day.

#4 – 5/27/09

- Brushed on thickest / oldest version of nc-FC with a Nylon Brush. Did a single application (not multiple layers). Overnight cure. Peel with N2 ionizer gun.
- Charge / Field confirmed to be zero.
- Result: 6.4 ppm.



Return to 1st LMA Mirror and REO Mirror for cnt-I-FC

The 1st LMA Mirror sat out of the cleanroom for 3 days, and the REO Mirror for about a week. The bar light showed there was more dust on the latter than the former.

A conductive version of the cnt-I-FC (we have versions I, II, III that vary in concentration, though I asked Jim H. to clarify) was sprayed, unthinned, on both parts.

Without using the ionizer gun, one will be peeled normally, and the other will be peeled when grounded, and in both cases, the electrostatic surface field will be measured.

The conductive version I is applied in two coats, and allowed an overnight cure. After the first coat dried, I attempted to measure the resistance of the cnt-I-FC with an ohmmeter, but the

reading across the 3" diameter was off-scale, > 40 MOhms. After the second coat, the reading read >40 MOhms regardless of the location of the probe tips (close or far).

5/22/09

- Peel of 1st LMA Mirror **without grounding** or N2 ionizer gun resulted in typical charging field of -31.5 kV/in.

- Peel of REO Mirror **grounded** and without N2 ionizer gun resulted in typical charging field of -29.4 kV/in. Grounding was accomplished with Al tape on the FC and one end of an alligator-banana plug into the ground of a wall outlet. Resistance between the Al tape and the metal cover on the outlet was 18 Ohms.

Return to 1st LMA Mirror and REO Mirror for cnt-III-FC

Conductive versions of cnt-III-FC was sprayed onto these two mirrors, unthinned, into two applications, then allowed to cure over the long weekend. The results are basically indentical with cnt_I-FC. The resistance of the polymer >40 MOhms no matter where the leads a replaced.

5/26/09

- Peel of 1st LMA Mirror **without grounding** or N2 ionizer gun resulted in typical charging field of -31.2 kV/in.

- Peel of REO Mirror **grounded** and without N2 ionizer gun resulted in typical charging field of -31.5 kV/in. Grounding was accomplished with Al tape on the FC and one end of an alligator-banana plug into the ground of a wall outlet. Resistance between the Al tape and the metal cover on the outlet was 2.3 Ohms.

- Using the bar light showed that the surface was covered with dozens of dust particles in a matter of seconds on both samples.

Notes on Rolling, Brushing, Spraying of FC

5/27/09

- I have now rolled, brushed, and sprayed FC onto horizontal and vertical surfaces.

- Vertical surface is an iLIGO TM illuminated on the side with a bar light that helps you see dust, and whether the FC was applied where it was needed.

- Rolling on FC, using the most viscous material onto a vertical surface, creates large drippings, and a kind of "spider-web" fibrous form of the material that gets airborne and floats all over the surround and sides. You also get alot of superthin material on the bevel that will be hard to get off. Rolling is bad.

- Spraying is messy, getting small droplets everywhere, and difficult to control the polymer (not getting it on the bevel). When it gets under the mask you are using to delineate it, it does not come off until you apply another thicker layer, and you must do this by brush. "Mist" material does not come off unless you apply more.

- The best results were obtained by the most low-brow of application methods: brushing on the polymer in the most viscous concentration, with a 1" wide 100% Nylon bristle paintbrush (the maker is Purdy, bought from Home Depot). We get the most control, least drip / run, least material on the bevel, and possibly the thickest layers of material that will help peel away anything that gets on the bevel & barrel, with brushing. We will need to do scattering measurements to make sure that the Nylon brush does not cause any damage (and this is being done right now on the 2nd LMA Mirror, test #4), and we expect a good result.

- The application by brush takes practice on a vertical optic.

    - You will need the FC, Pyrex beaker or aluminum tray for the FC, a 1" 100% Nylon bristle brush by Purdy, the Electrostatics charge/field probe, the Terra Universal N2 Ionizer gun and its gas source, Ultra High Purity N2 with the regulator set at 40 lbs, and the gun plugged into a 120 V outlet. To see what you are doing, you will need the bar light form FSI, 250 W lamp with the bar level with the plane of the optic, and 1-2 inches from the barrel edge.

    - You need to wear rubber gloves that you de-charge with the N2 ionizer gun, or gloves of lint-free cloth. The rubber glove (yellowish material) will charge up after awhile to about -4 kV/in, so must be de-charged every 10 minutes or so. Just shoot your hands with the N2 ionizer for 15 second each time.

    - Position yourself so your face and elbow are about 1 foot from the optic face.

    - Only use new brushes, each time. The brush can be cleaned in the FC thinner, but becomes "bushy" and this makes little droplets of the material shoot out sometimes.

    - Put about ½ inch of nc-FC, non-sprayable, most viscous version into an aluminum tray or a Pyrex beaker.

    - The brush is dipped in the fluid about an inch and fully saturated.

    - Pull the brush out of the fluid, but, stroke the brush against the insides of the container to get excess off the brush that would drip.

    - On the optic face, start at 5 o'clock. Apply the FC in 1-2 inch strokes at the EDGE of the face, stroking in a CIRCUMFERENTIAL direction. After each 1-2 inches, re-dip your brush and get off the excess. If the FC runs down, stop it with an upward stroke from the brush. Work your way around, counter-clockwise to 7 o'clock.

- Between 5 – 7 o'clock at the bottom of the optic is where the FC is most likely to run onto the bevel, so here, in about 1" spacings, brush in a RADIAL direction, upwards only.

- You have now made the first of three layers of the "pizza crust" around the edge of the optic.

- For the inside of the pizza, start at the top of the pie, filling in the whole area in 1-2" strokes, left to right, catching what runs. This is the first of 3 layers of the pizza.

- Wait 10 minutes for the layer to gel. Repeat the whole thing two more times, doing the crust of the pizza, and the inside of the pizza.

- Allow the sum of the three applications of FC to cure overnight.

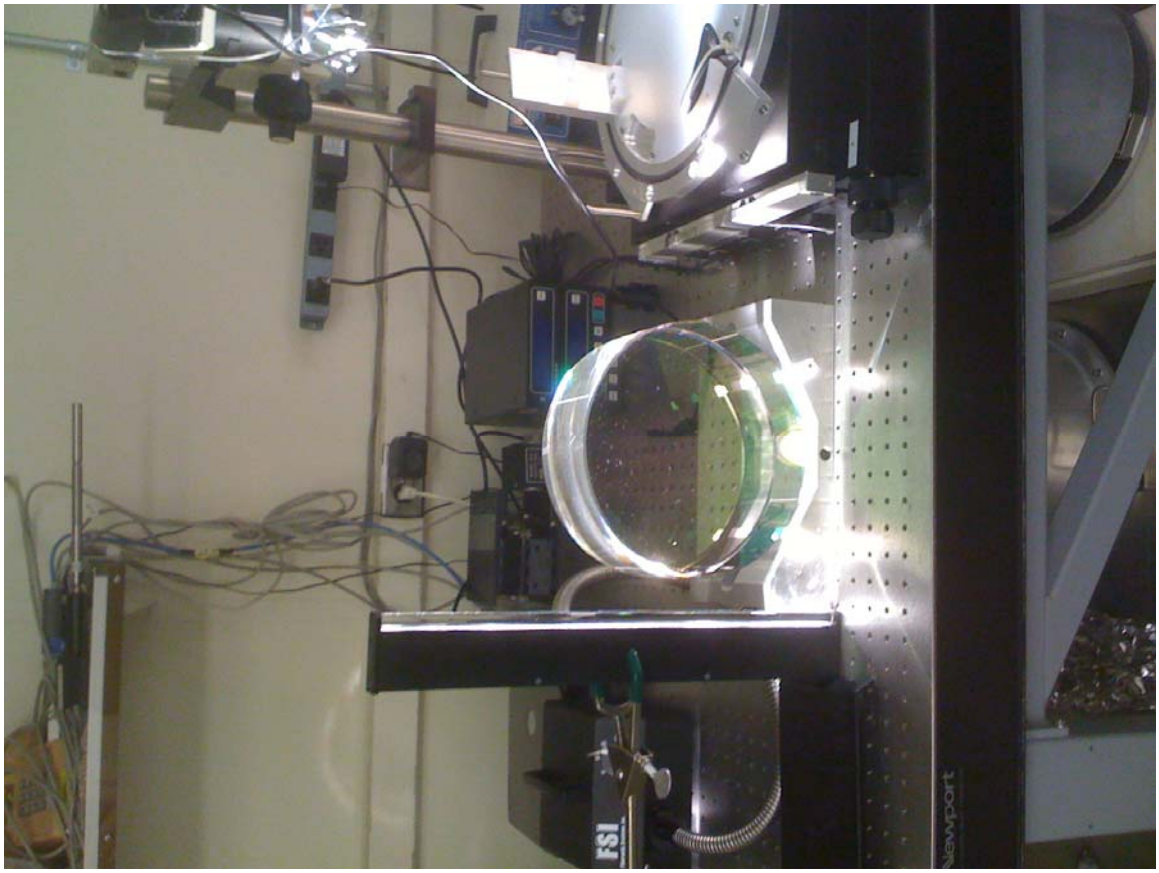
- Apply the peel strips in a pattern like in the attached image, running all around the edge, and inside, and at the top, place a tab to initiate the peel. How the peel initiates varies, but I have had the best results with a hard-jerk motion to get it going. Be ready with the ionizer gun. Initiate the peel but only go about 1 inch.

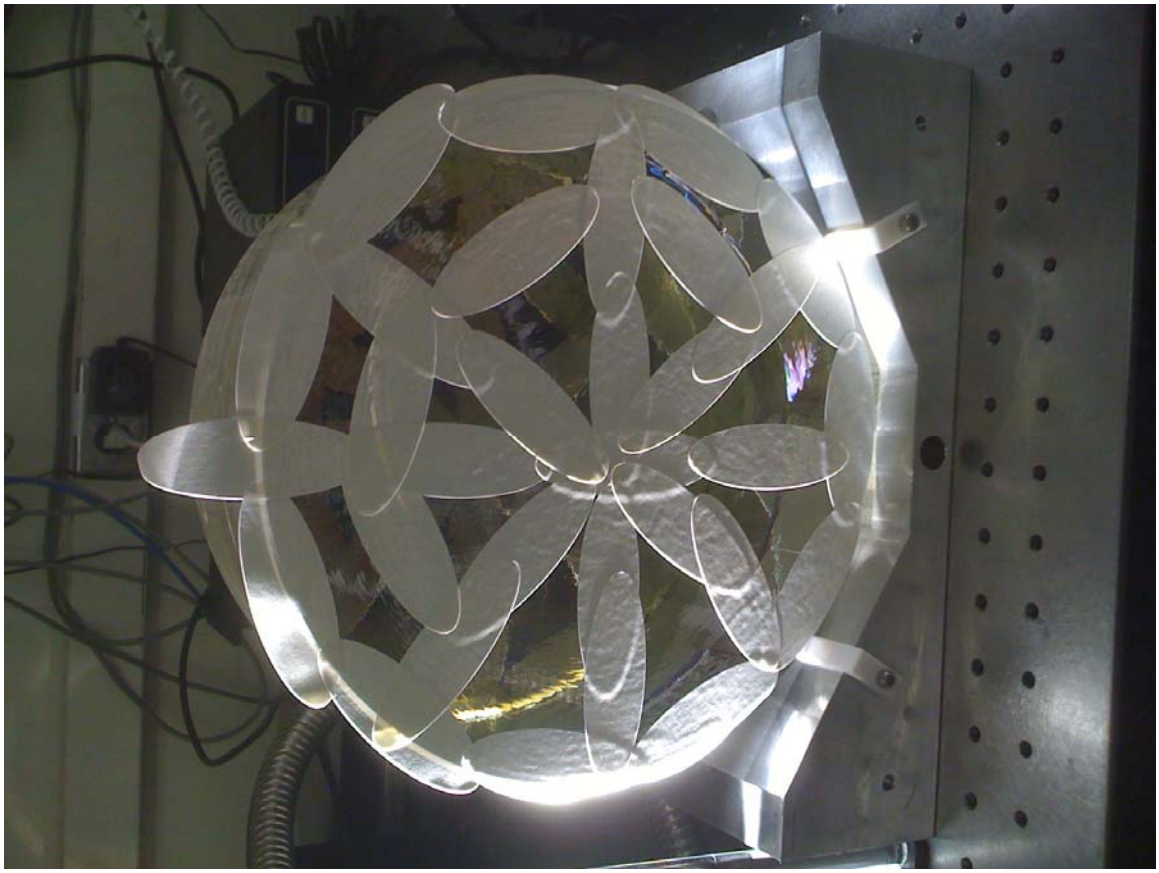
- Make sure the N2 ionizer gun is plugged in and all the gas valves are opened. Shoot the N2 ioner gun at the interface of the FC film and the substrate as it peels off, peeling at about 1" per second.

- Continue with the N2 ionizer gun for about 30 seconds after the film has been removed.

- Use the Electrostatics field meter to determine if you have removed the charge. To use the meter, you need to ground yourself, without gloves, touching a wall outlet or something else metallic you know to be grounded, while holding the meter, also ungloved, zeroing it. If the optic has been de-charged, the meter will read about 0.00 to +0.03 kV/in about 2.5 mm from the optic surface. If the optic has not been discharged at all, it can read as high as -31.5 kV/in. Keep spraying for 30 seconds and remeasuring until the optic is no longer charged. Note – in air, the charge can last up to 15 hours if the N2 ionizer gun is not used.

- Look around near the bevel and edges. This is where FC usually remains if it has not come off. Take a peel strip and a de-charged but gloved had, and tap around the edges where polymer film is still visible to remove it.


FSI
Newport



- Thick material that gets on the bevel / barrel is removed by repeated "tapping" tape application around the bevel and barrel. We will need to make sure we have access when it is mounted to those areas closest to the active face.

- I did verify that the solvent does not attack the Nylon brush, foam on the roller and foam brushes that were purchased, or the horse hair bristle brush material. Nylon brush is the best.

Observation on Dust Collection

6/5/09

- I had an iLIGO TM just sitting with the HR side open, exposed to the air, the AR side was down, but supported a few millimeters from the bottom can surface by Teflon. It was there for several weeks. When I flipped it onto its side to try vertical application of FC, viewing with the bar light, the "upside" was really dusty compared to the "downside". It seems just covering the surface can help prevent dust accumulation.

- I had 3 1" diameter mirrors, two sitting on a table out of the cleanroom, one sitting in the cleanroom exposed to the environments for 24 hours. Viewing with the bar light, one

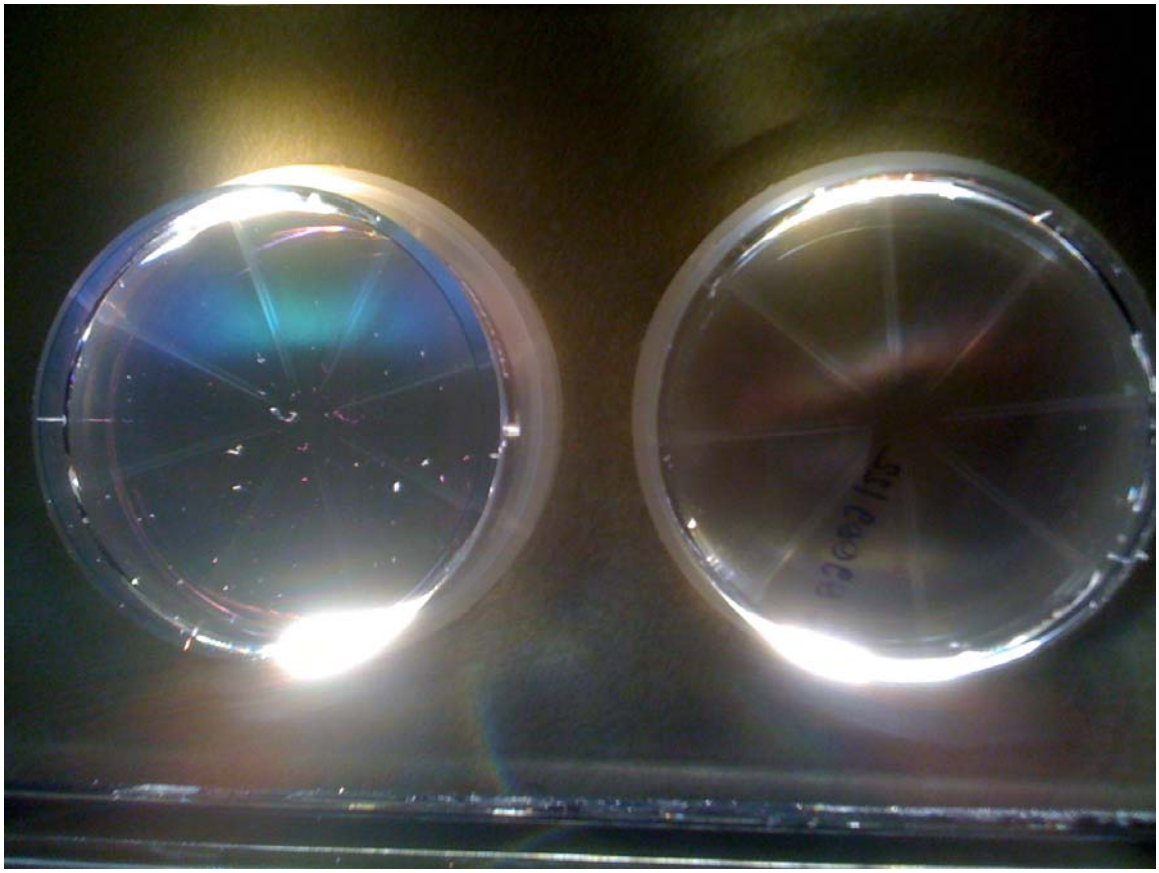
could see hundreds of dust particles on the ones in the dirty room, and almost nothing on the one in the cleanroom. While it is no surprise, it certainly does emphasize the quality of the environment on dust accumulation – we should measure one of these dirty room parts (that had been cleaned well with FC only a short time ago) to get a handle on the impact of big dust particles on the scatter number.

- A measurement of the REO mirror after sitting exposed in the dirty part of the lab gave 35 ppm of scatter, that fell to 3 ppm and stayed there after FC and DW treatments, serially. A measurement of the 2nd LMA mirror right out of the packaging (no room exposure) was about 6 ppm and the same for all following DW & FC treatments, and the 1st LMA mirror, immediately DW, with serial FC stayed about about 6 ppm also. This means the environment the optic sees, and also how it is stored, count for a lot, and that dust is the main culprit.

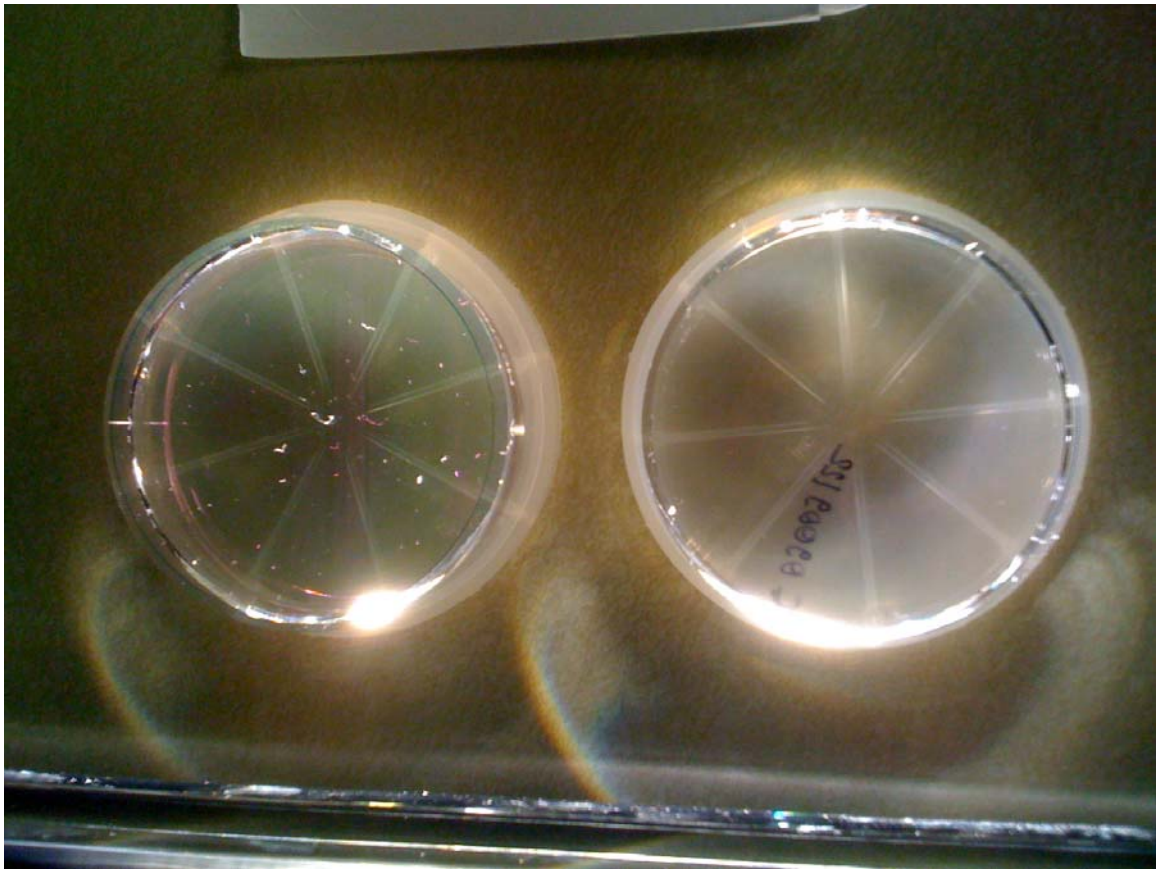
- An experiment is going on right now where I cleaned two 3" parts with FC right next to each other, and shot them with the N2 ionizer while peeling (2 coats brushed on nc-FC non-sprayable). I put a dust cover (de-charged) on one immediately, and left the other one uncovered. I am timing it, and will take pictures comparing the rate of dust collection, covered versus uncovered. The photos below show that dust covers really do slow down the accumulation of dust!

Both cleaned with nc-FC brushed + N2 Ionizer. One immediately covered, other left exposed. Time = 0.

Time = Two hours later, the cover is removed, photographed, immediately replaced. No particles are visible on the surface of the one that was covered (right).



Time = 4 hours. Right side had the dust cover.



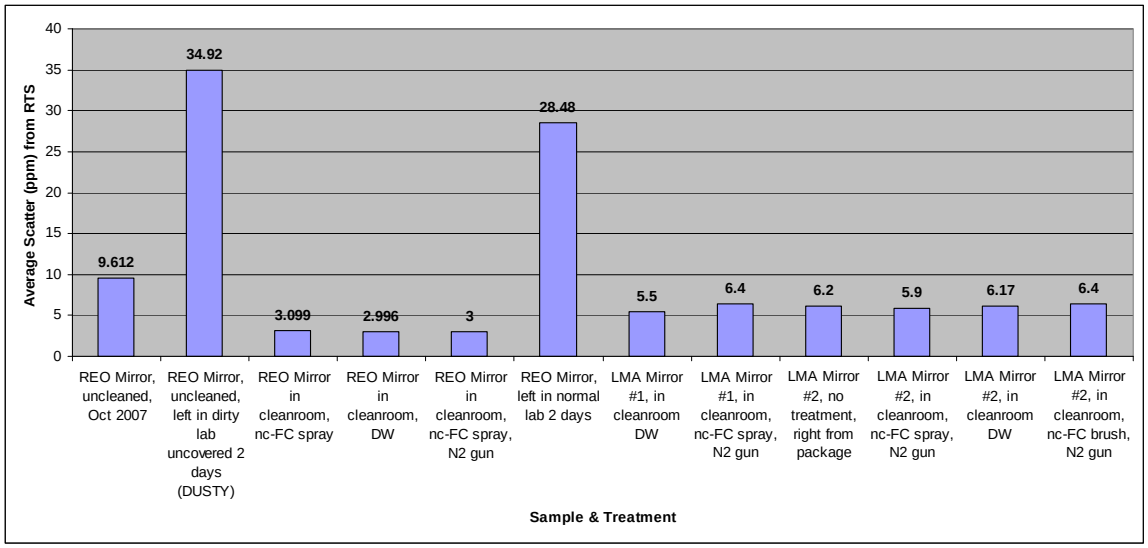
Time = 6 hours. Right side had the dust cover.

Time = 24 hours. Right side had the dust cover.

Time = 48 hours. Right side had the dust cover.

Time = 72 hours. Right side had the dust cover.

RTS Scatter Result Summary Chart Showing Importance of Dust



It appears, in as far as scatter, that the most important factor is the elimination of dust from getting to the optic surface, and that DW with methanol and FC application (whether by spraying or brushing) removes the dust almost equally well.

Note – we do not have scatter data on the impact of 2 – 24 hours of dust collection in the lab (non-cleanroom). This would be very relevant to the situation in the IFO where the optic has been cleaned by FC and/or DW, and is exposed when work is going on around it, for example, unlocking the mirror in the suspension. The mirror must be cleaned with the mirror locked, and unlocked with the surface exposed. AS of 6-23-09 we have this data, 28 ppm in a 5.6E-5 particle-m^{-3} in two days.

The lower limit of the average scatter is a function of either the polish or the optical coating, and FC and or DW basically reduces the scatter to that limit. However, in two cases, a FC treatment increased the amount of scatter relative to a DW treatment: LMA Mirror #1 increased from 5.5 to 6.4 ppm, and LMA Mirror #2 increased it from 6.17 to 6.4 ppm on the second treatment.

Particle Counting in the areas where work was performed

6/10/09

1 MIN SAMPLE TIME	WORK DONE	0.3 UM	0.5 UM
Lab 37 area right near entrance	3" and iLIGO FC "ex-situ" peels, dust cover work.	15463 15851 15950 Ave ~ 16000 **5.6E6 $m^{-3}min^{-1}$**	1706 1690 1722 Ave ~ 1600 **5.6E5 $m^{-3}min^{-1}$**
In RTS cleanroom	None.	47, 50, 23, 7, 42,24 & 54, 17, 19 Ave ~ 50 **1.75E4 $m^{-3}min^{-1}$**	19, 31, 10, 5,25, 11 & 23,5,19 Ave ~ 25 **8.75E3 $m^{-3}min^{-1}$** **Close to class 10K**
In RTS clean room in RTS box	3" serial FC and DW scatter maps.	0,0,0,0	0,0,0,0
My Office	Nothing	101851 100370 Ave ~ 100,000 **3.5E7 $m^{-3}min^{-1}$**	13461 12280 Ave ~ 10,000 **3.5E6 $m^{-3}min^{-1}$**

Note: 227B has a 0.1 cubic foot / min motor. Multiply 1 minute measurement by 350.3 to get to particles/(m^3 min) and 1 min sample gives particles m^3, which for >=0.5 micron particles is the "cleanroom class".

Notes on Glove Type Worn

- The "accepted" non-residue gloves, that are yellowish in color, tend to charge up as they are worked with, to fields measured with the ES meter I have of ~ -5 kV/in. For comparison, a FC peel results in a -31 kV/in peel, and plastic rubbed vigorously against a shirt get up to -12 kV/in.

- The nitrile gloves, purplish in color, do not charge up, even with vigorous rubbing against a shirt.

- The cotton gloves do not charge, but generate huge amounts of dust.

First Contact Vacuum Compatibility Tests

6/11/09

Four samples types, two duplicates of each on standard microscope slides cleaned by Bob Taylor with acetone, were prepared and will be tested in the vacuum chamber with the RGA next week.

1. Residue from peel tape strips that come with FC. A residue could be seen at oblique incidence.

2. Residue from "approved" Kapton tape. A residue could also be seen from the adhesive, as chunks of material remaining on the slide.

3. FC brush applied in two coats of the standard viscous, non-sprayable, no CNT variety that will not be peeled off at all.

4. FC brush applied in two coats of the standard viscous, non-sprayable, no CNT variety that will be peeled off WITHOUT using tape, with clean tweezers, manually picking off the remainder. 24 hour cure in air prior to peeling. This is a test of FC "residue".

The two slides of each type will be run at the same time. The testing will take the whole week. They will not be pre-baked at 200 C.

- First Contact (thick films) was given a preliminary vacuum compatibility test by Bob Taylor at 40 C, and it passed the RGA criterion, that the sum of critical hydrocarbon masses be less than 1E-11 mTorr partial pressure.

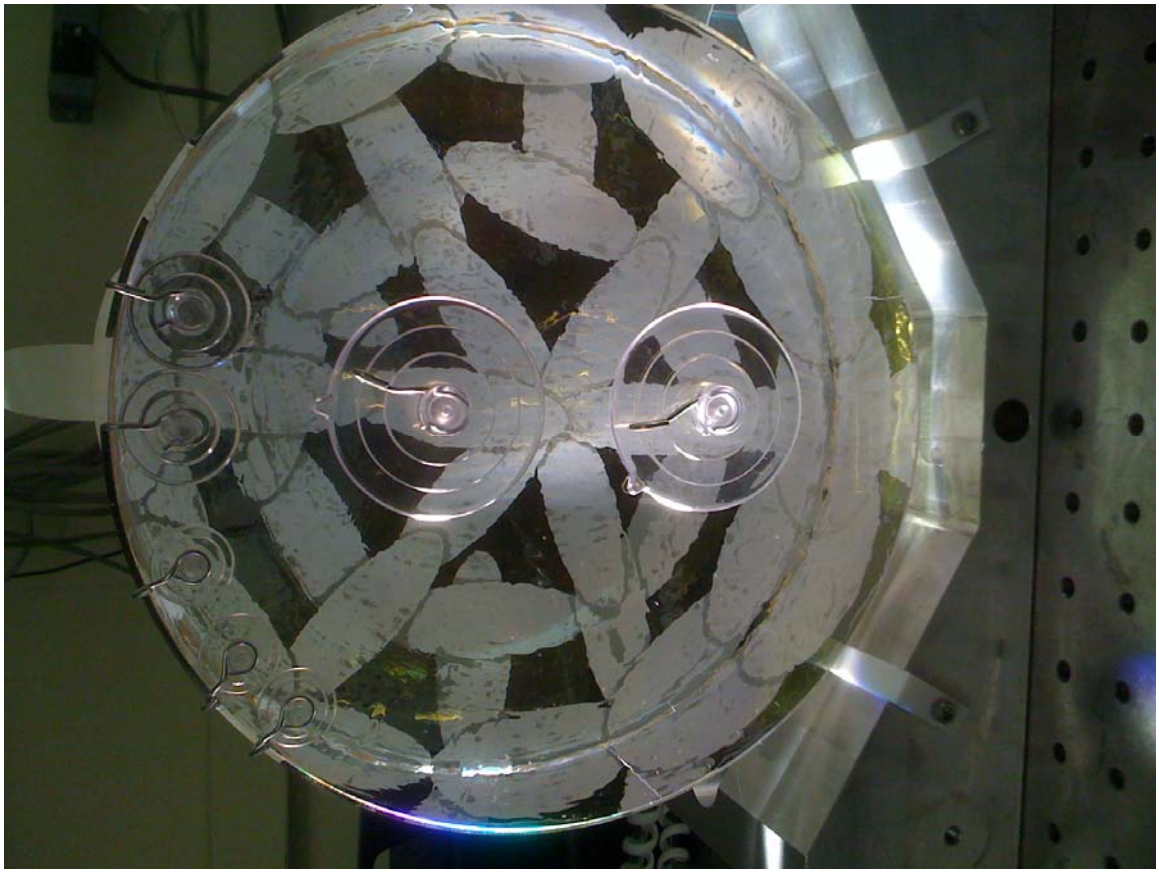
First Contact Solvent-compatible polymers

Early June '09.

- Teflon, Nylon, Polyethylene, Polypropylene.
- Teflon mesh has been ordered to attempt to replace the peel tape with.

Attempt to Initiate First Contact Peel with Suction Cups

6/11/09



- Medium and large suction cups stuck well, small poorly.
- Can pull very hard, but does not start to peel, cups eventually pull off.
- Maybe peel needs to be initiated with a plastic implement.

Weird Things with Women's Underwear

6/12/09

- Here, I embedded "B Nude Sheer Toe Legg's Everyday Regular Pantyhose" bought in a 4 pack between layers of FC.

- Three layers of non-spray formula nc-FC were applied by the usual brush-on pizza pie method described above and allowed to cure overnight. Then the hose were stretched over the optic (rear-end area over the face of interest), and three more layers painted on, with another overnight cure.

- It peeled right off.

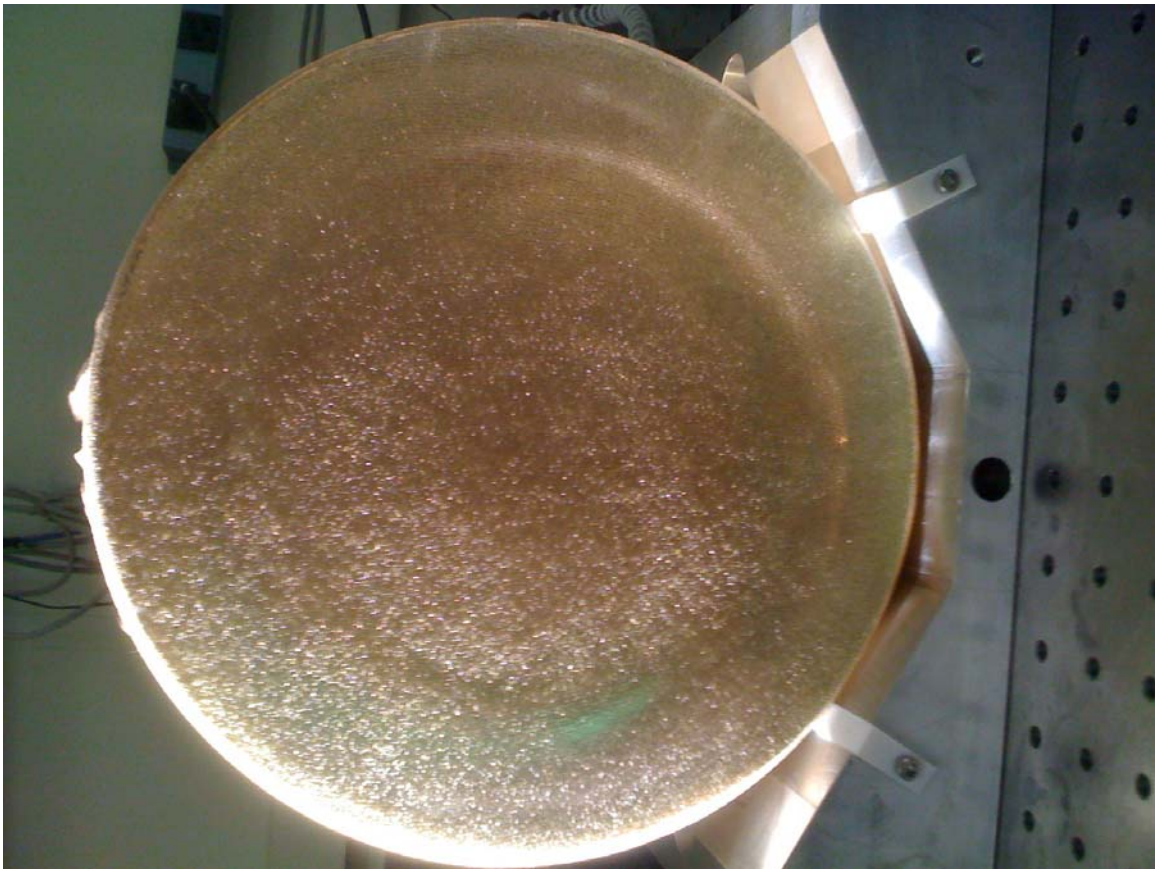
- It also got 99% of the stuff that usually sticks to the bevel off, and what was left I could remove with plastic tweezers.

- It was all Riccardo Desalvo's idea.

- Lots of off-color jokes came of it, the most offensive of which were Gari's.

- I did not shoot the surface with ionized N2 when I peeled it. Must dust was attracted to the surface. I do not know if the dust came from the hose.

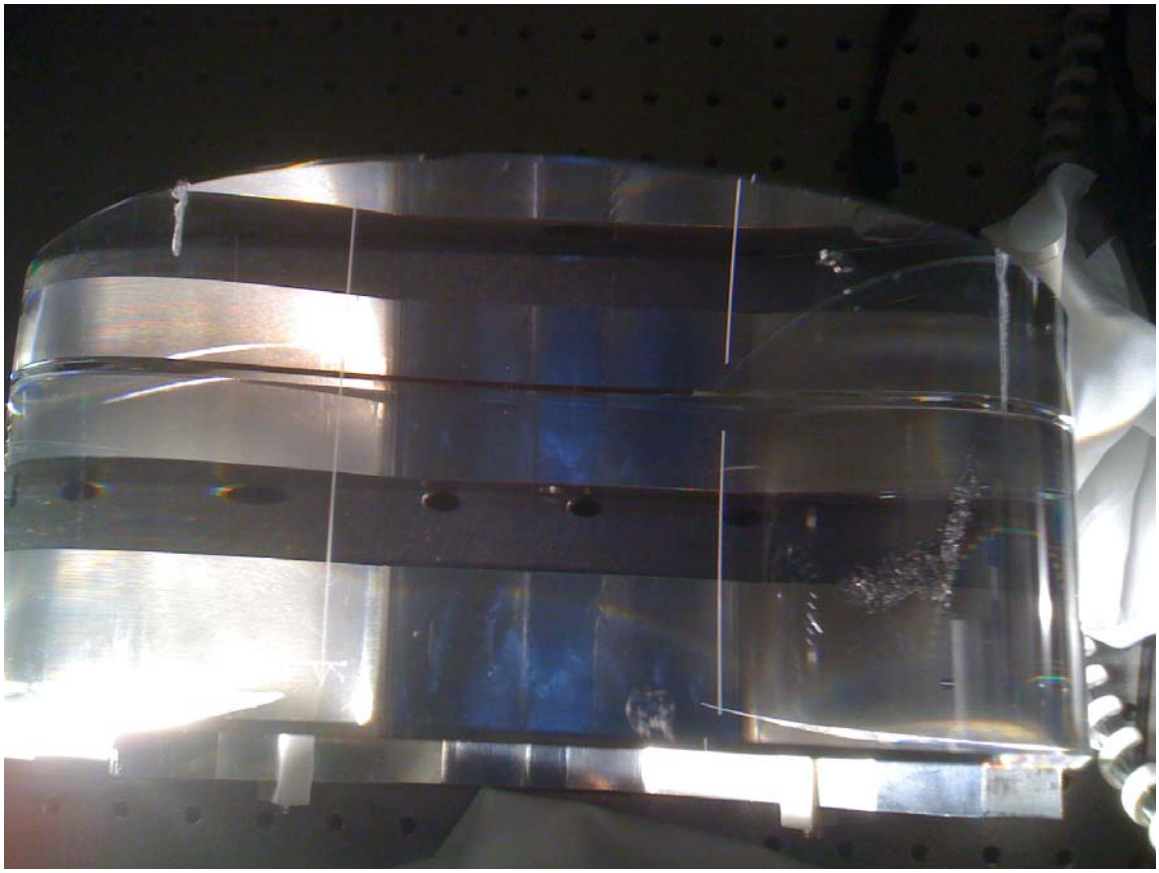

4 PAIR
B NUDE SHEER TOE
REGULAR PANTY
Leggs everyday
REGULAR
PANTYHOSE



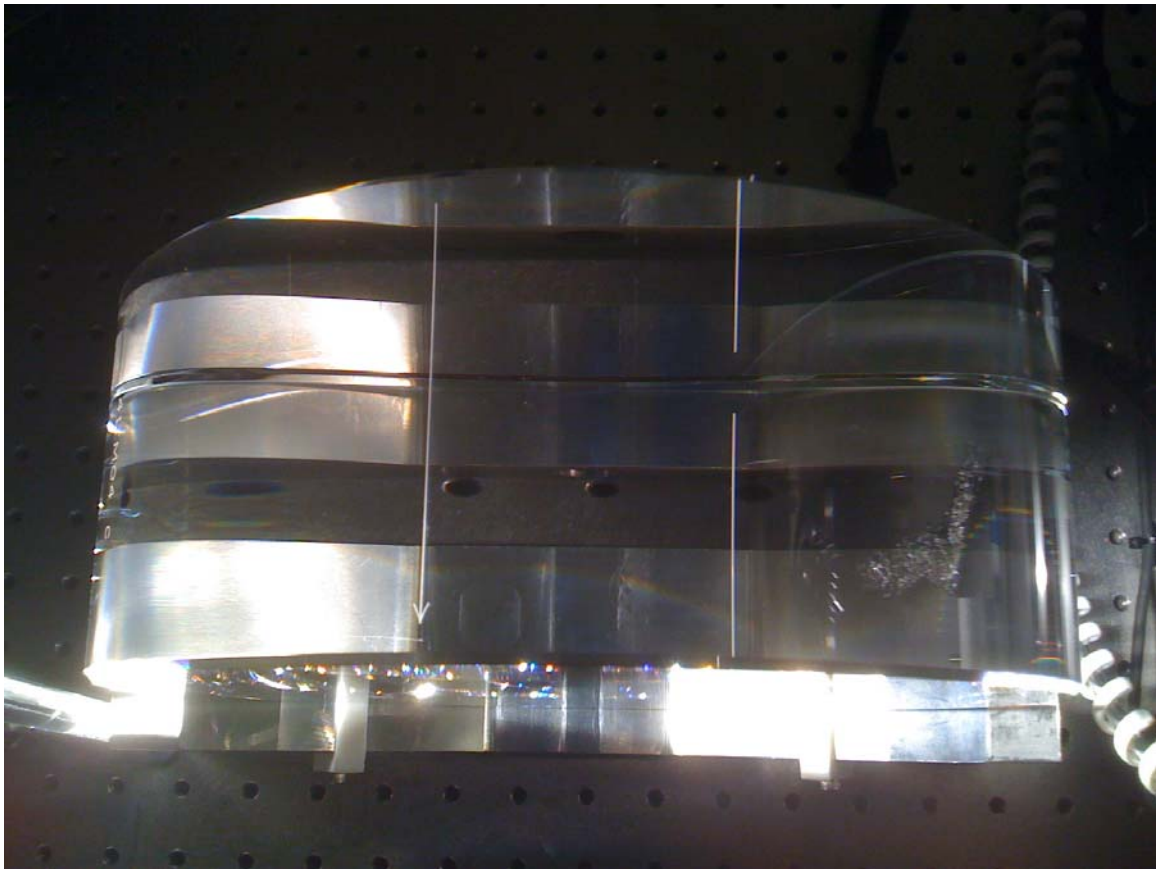
Wiping off FC Droplets & Runs from the Barrel

6/12/09

It seems possible to wipe off the excess with a lint free rag and METHANOL. This means we don't have to "tap-tap" with tape to get the shards, drippings, and runs off. Below are two pictures of an iLIGO barrel, covered with FC slop, before/after wipe-off and capture with a lint free rag.



Before Methanol Wipe



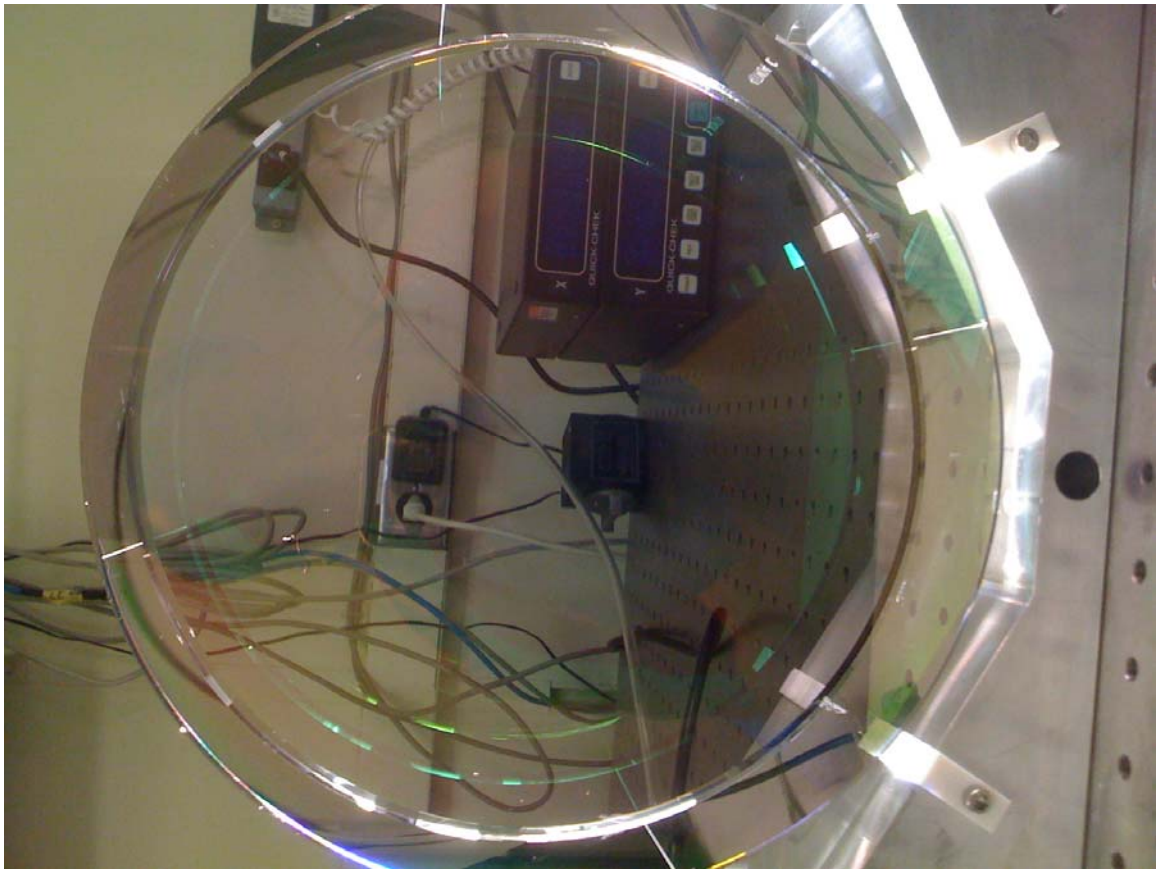
After Methanol Wipe

<u>Comparing Dust Generation of Lint Free Rag & Hose</u>

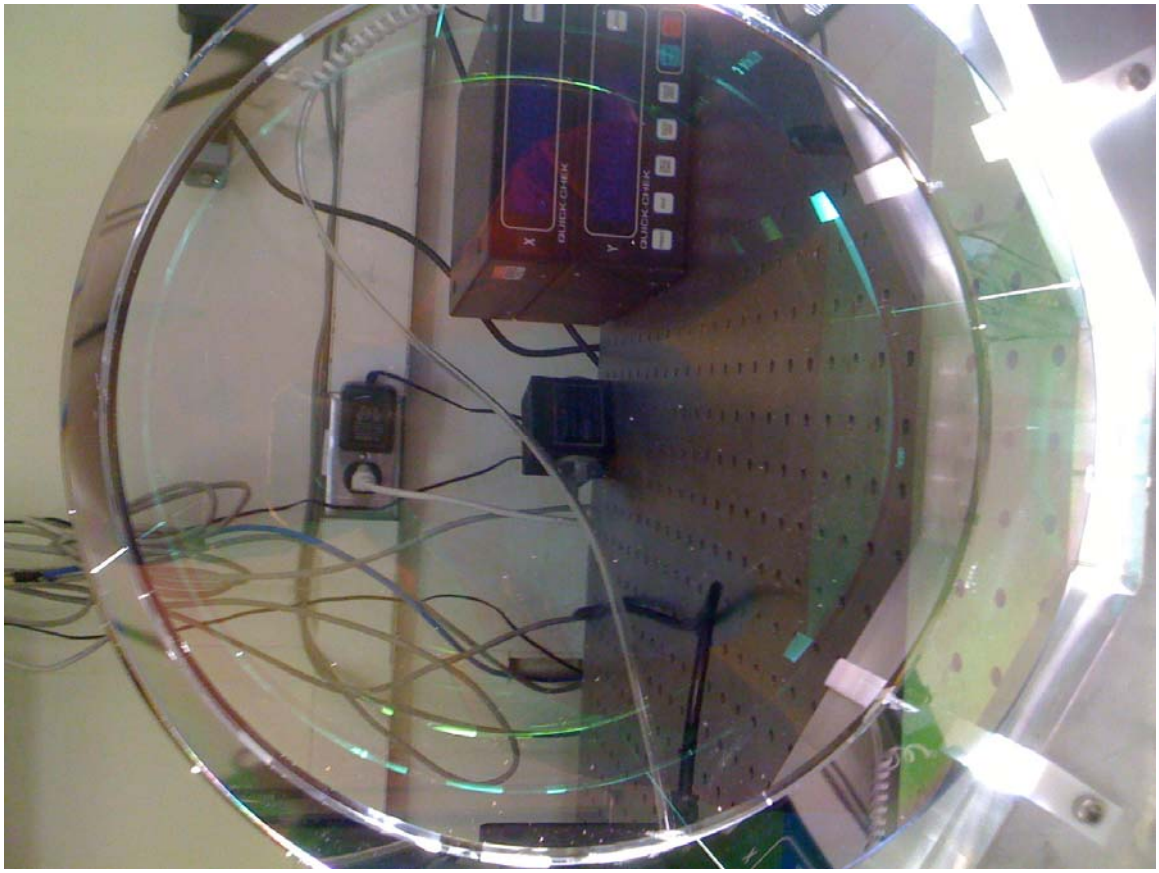
The hose are not exactly lint free. When I peeled them the first time, I did not shoot the interface with ionized N2. I did see immediately dust attracted to the surface, and confirmed, again the -31.5 kV/in field.

I shot the surface with N2 later, and wiped the dust off with methanol. I smacked the surface with a lint free rag and the hose 30 times (cleaning between with methanol) in the part of the lab not in the cleanroom where the particle count ~ 5E5 m^{-3}. One can see the hose generate much more dust.

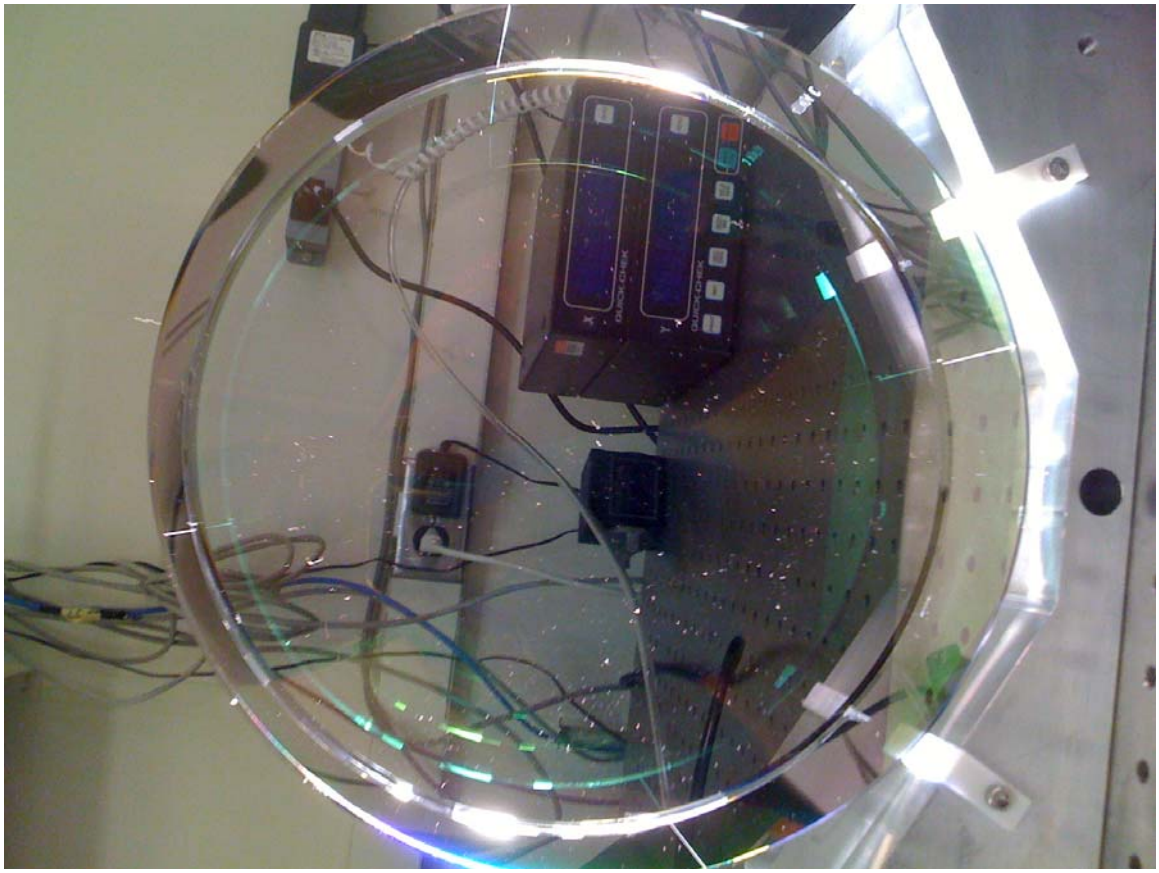
If we can find "lint free hose" that would be ideal. Here are pictures.



Clean with methanol.



30 smacks lint free rag.



30 smacks hose.

Dissolution of Cured FC with methanol and IPA

6/15/09

I put cured films of FC in beakers of IPA and Methanol. Methanol breaks down the FC very rapid, while IPA does so, but much more slowly. The films, in either case, do not entirely dissolve.

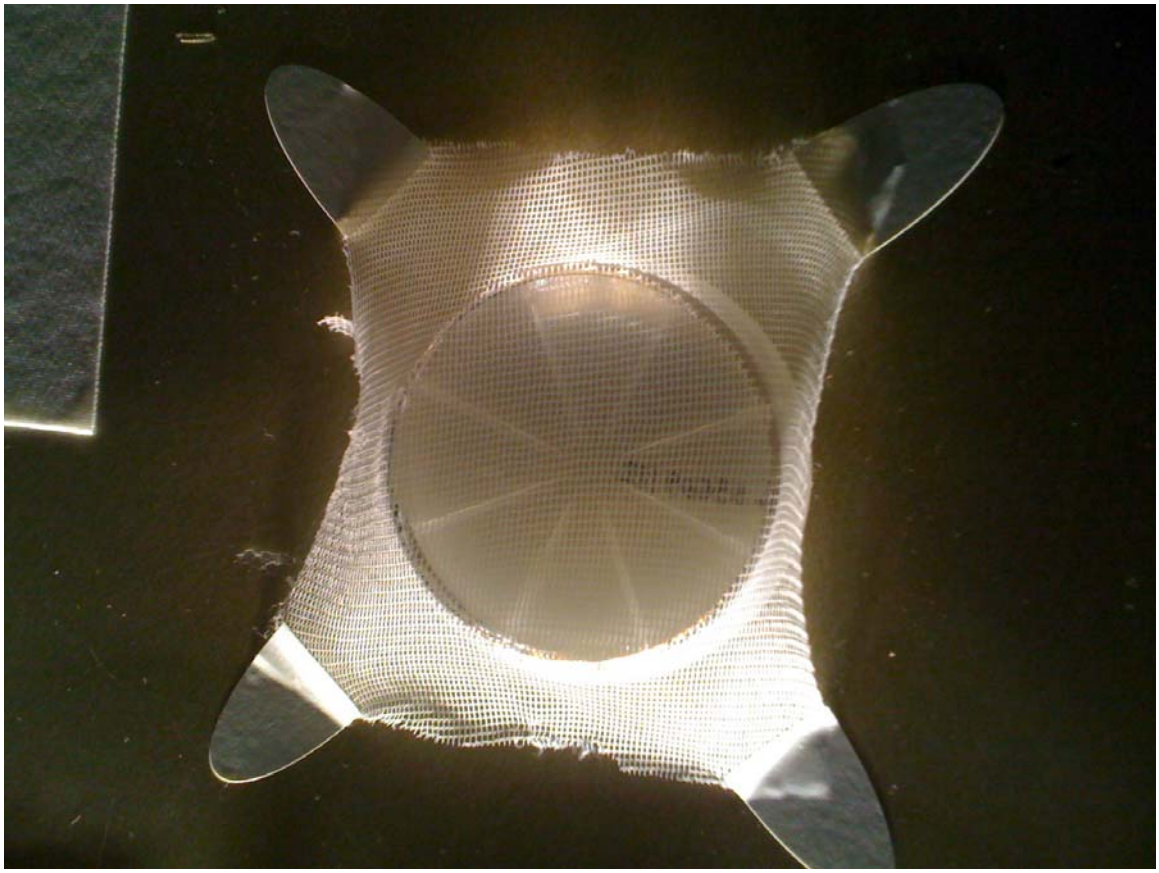
FC must be weakened/loosened by methanol and collected in the lint-free rag when wiping it.

After about 5 minutes cured FC in Methanol and IPA.

FC & Oxford Mesh

6/16/09

Worked well between two thick layers of brushed on FC.



Fixture Development for FC Application-Removal

7-2-03

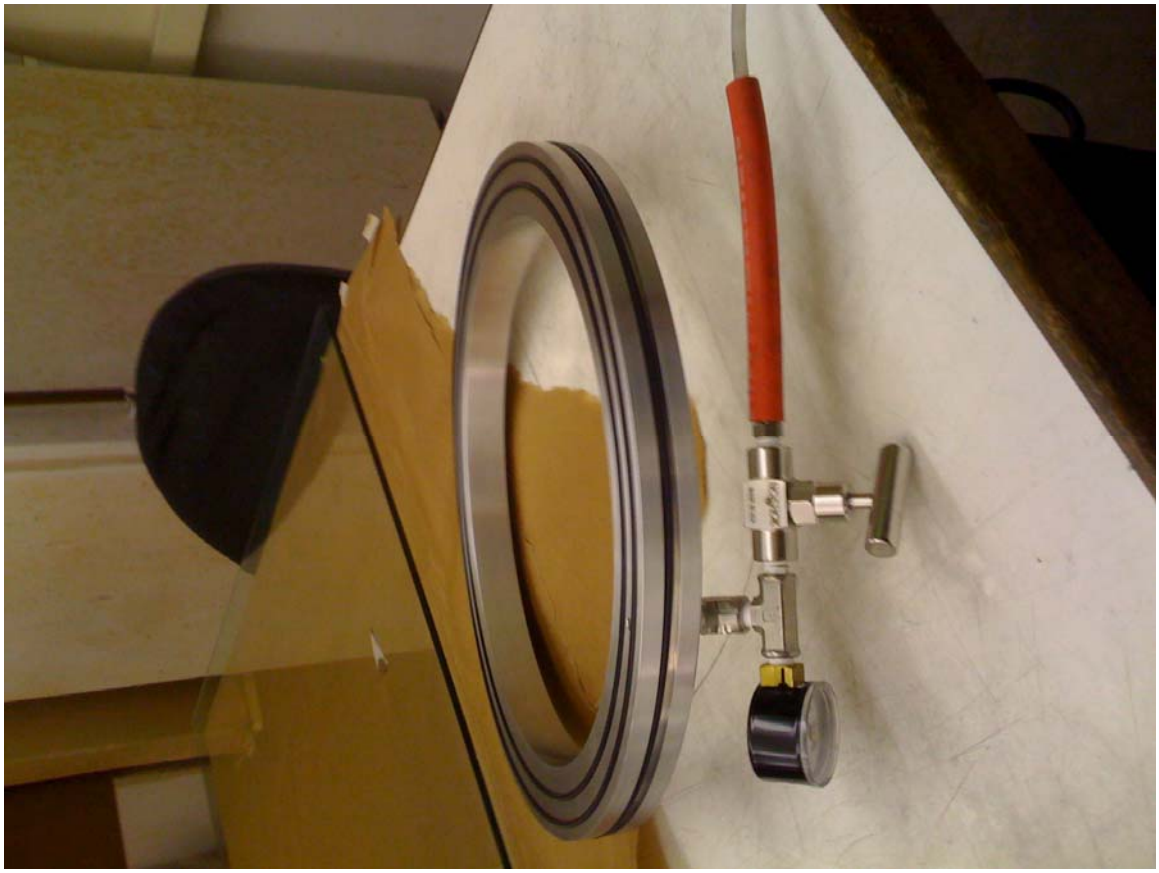
Ric in the physics machine shop produced the first prototype of the vacuum Frisbee for the FC application and removal. It has the same valve type and vacuum gauge as the ERGO arm.

Two –rings, originally PTFE coated viton, were too hard to draw a vacuum with. Non-PTFE viton glued together at the ends (made in the shop) did allow a vacuum to be drawn but it leaked away very quickly as soon as the pump was turned off.

On the next iteration, he will deepen the well between the o-rings to store more vacuum and minimize the impact of small leaks, and replace the o-rings with commercial ones not glued together at the ends.

He is also working in an inner concentric ring to allow the Oxford mesh to be stretched across a first layer of FC in order to embed the mesh (not shown).

Top view of first iteration showing intended use of mesh.



Bottom and side view showing the vacuum connection, bottom o-rings, and side-o-ring. The volume between the bottom o-ring will be increased to reduce the sensitivity to small leaks. The side o-ring is for clamping a plastic bag around the device while putting the FC on. Off to the left is the sheet glass used for test the device, for now.

Ric and his assistant trying to press down hard enough on the PTFE encapsulated viton o-rings to draw a vacuum, and failing.

Cleanroom Install 015A

7/10/09

Seems to be running. Particle counts were :

015A out of cleanroom = 3647 (0.3 um) and 388 (0.5 um) = 1.35E5 m^{-3}.

015A in cleanroom = 7 (0.3) and 0 (0.5) = very clean.

Vacuum Frisbee

7/10/09

Ric got it to suck down on glass and hold over ½ by using softer neoprene o-ring and widening the cavity. The next iteration will be:

1) Use fatter o-rings.
2) Move the out o-ring out farther, an the inner o-ring in closer, to "reasonable extremes" in both cases.
3) Core out the cavity to "reasonable extremes".

7/17/09

The Frisbee now holds vacuum on plate glass for well over a day (losing 6 inHg from 17 inHg in 1 day), but losing vacuum entirely over the weekend.

To test it, I cleaned the o-ring & glass with IPA and a lint free rag. Pump to 17 in Hg and close the valve. It takes a little pressure to grab the vacuum. 3 layer of FC were brushed on (with the Frisbee in the prone position), standard stuff, 20 minute wait.

7/20/09

Then the mesh was applied. The inner ring of plastic makes a snug fit, and without any effort or pulling, pulls the mesh taught over the surface. Then three more applications of FC are made over the mesh.

When the first 3 layers of FC were applied, they were put on without the inner ring, and FC flowed under the metal edge.

Improvements might be to put the initial FC on with the inner ring IN PLACE, and,

- Add an o-ring to or Teflon stop to the inner ring to make it safe to push against the glass when there is no FC applied yet, and to prevent any material from flowing under the metal.
- Deepen the vacuum cavity again (it could be a lot deeper).
- Fatten up the o-rings again so less pressure needs to be applied.
- Maybe (tests will tell), remove the clamps. They did not seem to be needed, as the inner ring snug fit seems to take care of getting the mesh taught.

Tomorrow on 7/21, I will peel and inspect, paying attention as to whether any FC material is not removed on the edges. Doing the application with the central ring in might help if there is an issue there.

Vacuum Frisbee with the inner o-ring not inserted. Vacuum is 17 inHg, holding for a day+ with the valve closed, pump off, but does not hold for the weekend. The substrate is just a clean piece of plateglass.

Vacuum Frisbee with the inner o-ring inserted and the mesh. The clamps did not seem to be needed since the friction & snugness of fit automatically pull the mesh taught and held it in place. This has 3 layer of FC underneath applied without the central ring. I will try it next time with the central ring.

More Vacuum Frisbee

7/21/09

- Vented the Frisbee. When I attempted to push down on the inner ring (to hold the edges of the FC area down) and pull up on the outer ring, this was very hard and painful to do. I resulted in the initiation of the peel.

- When I did get it off, the FC had already partially come off.

- I then peeled it fully. A large amount of FC remained on the edges where it had gone underneath the edges of the outer ring on the first application of the three layers (see picture below). There was also big crust chunks of the FC that got all over the inner area that was intended to be cleaned. BAD!!

- The inner ring, made of PVC plastic, was attacked by the FC solvent. FC could not be removed from it.

- It was removed from the outer metal ring by IPA wiping with a lint free rag.

- So, the fixture worked for stretching a mesh, but not for clean removal.

- I will try another iteration with:

    1. Getting the inner ring made out of Teflon so that it can contact the glass, slide out more easily, and not be attacked by solvent.

    2. Using the inner ring in place when applying the first layers of FC before embedding the mesh, and then sliding it out when it dries.

FC Goop/Crust particle mess from first test with the Vacuum Frisbee & Mesh.

Sundial Approach – Proof of Concept

7/23/09

I am now also thinking this device and procedure may be too complicated. I have in mind an alternative device and method that has the following characteristics:

- There is a Teflon ring that slides onto the barrel held by friction (no vacuum) (working around earthquake stops) *but does not touch the HR surface at all.*

- Sticking up from the sides of the device are some slits for inserting disposable plastic tabs, and there are may tabs running all around the circumference.

- After the first layers of FC are applied and have fully dried, the disposal tabs are inserted in the slits and slid onto the surface of the dried FC in such a way that the tabs bend, and only touch the surface of dried FC.

- Then more FC is painted in along all the edges over the tabs, and also allowed to dry.

- When fully dry, the whole thing is peeled off.

Plastic clips in the sundial pattern before release.

- An area about the size of an AdL optic is painted with two layers of thicker "standard" FC with a 20 minute wait in between and allowed to dry overnight.

- A "pizza crust" or rim of FC is then painted around the edge and bounded by the already dried FC.

- Plastic paper clips (about 1" in long) are immediately pressed into the wet FC with the tips just outside the wet boundary. You then wait 20 minutes for it to gel, then paint the wide end of each clip allowing FC to cover and flow into the boundary of the clip. Then allow to dry overnight.

- When dry, to release, grab the pointy ends of two clips at a time to release just a small about of the polymer film. Do not pull all the way off. Work your way around like this releasing all the clips (it would help to have a second set of hands spraying the surface with ionized N2 as you do this).

- Then, grab as much of the circumference as you can and peel the whole thing off.

- Calum made the good suggestion that once the FC is peeled off, the free-standing films might be used the way the tape was, to "dab off" remnant shards or strips of FC that did not come off when most of it was peeled.

This method did not leave a trace – now we need a fixture for it, described above!!

Clean looking area delineated by dust from the lab.

Released sundial.

iLIGO Prototype Teflon Dust Cover

7/27/09

Pictured below is a Teflon dust cover for TM's held on without vacuum, no o-ring. It is held by pressure on the barrel.

Joe Haggerty will make a ring version of it, that does not touch the surface, for holding the paper clips of the "sundial" for removing FC.

On an AdL part, both the sundial ring and the dust cover must be engineered to work around the earthquake stops and everything else, and so I will need real drawings / drafting in order to design them (Calum / Ed Chavez ?) to transfer to Joe Haggerty.

Teflon dust cover.

Duplication of Cheryl Vorvick Methanol Drag Wiping

7/28/09

At the last COC meeting, Liyuan showed some CASI data that FC improved 10 degree scattering over methanol drag wiping. Eric Gustafson pointed out that the DW though 2-5 times higher in scatter than FC also varies by a factor of 2. Drag wiping done here was not as controlled as was in Hampton per Cheryl Vorvick procedure, therefore, we will duplicate the procedure and materials for it at CIT and we will do the scatter measurements on the CASI.

Per the procedure described over the phone, she uses a "quad folded" rag with the rounded tip where the Methanol is poured. A new rag is used per wipe of a few inches at a slow speed so the methanol dries about 1" behind the rag. She also wipes horizontally starting from the top of the optic. She uses an brand new bottle of methanol each time she cleans an optic. She will write up a procedure.

On the materials for drag wiping:

Here's the materials List:
1) Sigma-Aldrich, item number 34885, Methanol, CHROMASOLV®, gradient grade, for HPLC, ≥99.9%, buy this in the 100ml bottles

2) gloves: AccuTech Ultraclean, item number 91-300C

3) tissue: Birkshire LENSX 90, 9"x9", item number LN90.0909.16

Cheryl

On bottles for storing methanol and cleaning them:

These are the glass bottles I use to hold the methanol while drag wiping. Jodi wrote up the procedure to clean them:

http://vwrlabshop.com/glass-dropping-bottles-wheaton/p/0006780/bhcd2/1248379168/

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1. Obtain glass dropping bottles (clear, 50 mL and 100 mL).

a. We use Wheaton bottles from VWR (http://vwrlabshop.com/glass-dropping-bottles-wheaton/p/0006780/bhcd2/1248379168/)

2. Clean and bake bottles according to E0960022.

a. Liquinox/DI H2O ultrasonic wash, triple DI H2O rinse

b. 24 hour air-bake

3. Wrap each individual bottle in UHV foil.

4. Place each foil-wrapped bottle into a small zip-lock Ameristat bag w/ air removed.

5. Place each small Ameristat bag into a medium zip-lock Ameristat bag w/ top folded over and stapled. (Bags are stapled to make the packaging tamper-evident.)

6. Tag outer bags appropriately (Class B clean, Size of Bottle, Date cleaned, etc.)

Place bagged bottles into a storage container close to the flammables cupboard for the Chromosolv

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Cheers,
Cheryl

Steve Vass adds:

Remove static charges by deionizer.

Acetone and Methanol in all glass containers or ss syringes (absolutely no plastics!)
http://www.emdchemicals.com/analytics/literature/011090_LCMS.pdf grade

Drag wipe with Kodak lens cleaning paper KP62647-B as described "Drop and Drag"
http://www.newfocus.com/products/?navId=3&theView=listProductGroups&productLineId=5

These technics worked so - so to 10 cm diameter at the 40m cleanliness and low power level.
The 40m is dirty compared to LIGO
Even at low power level the IFO resonant spots are scattering.

PS: remember you and your environment, gloves, clean room garment, Al foil..... etc are all shedding particles!

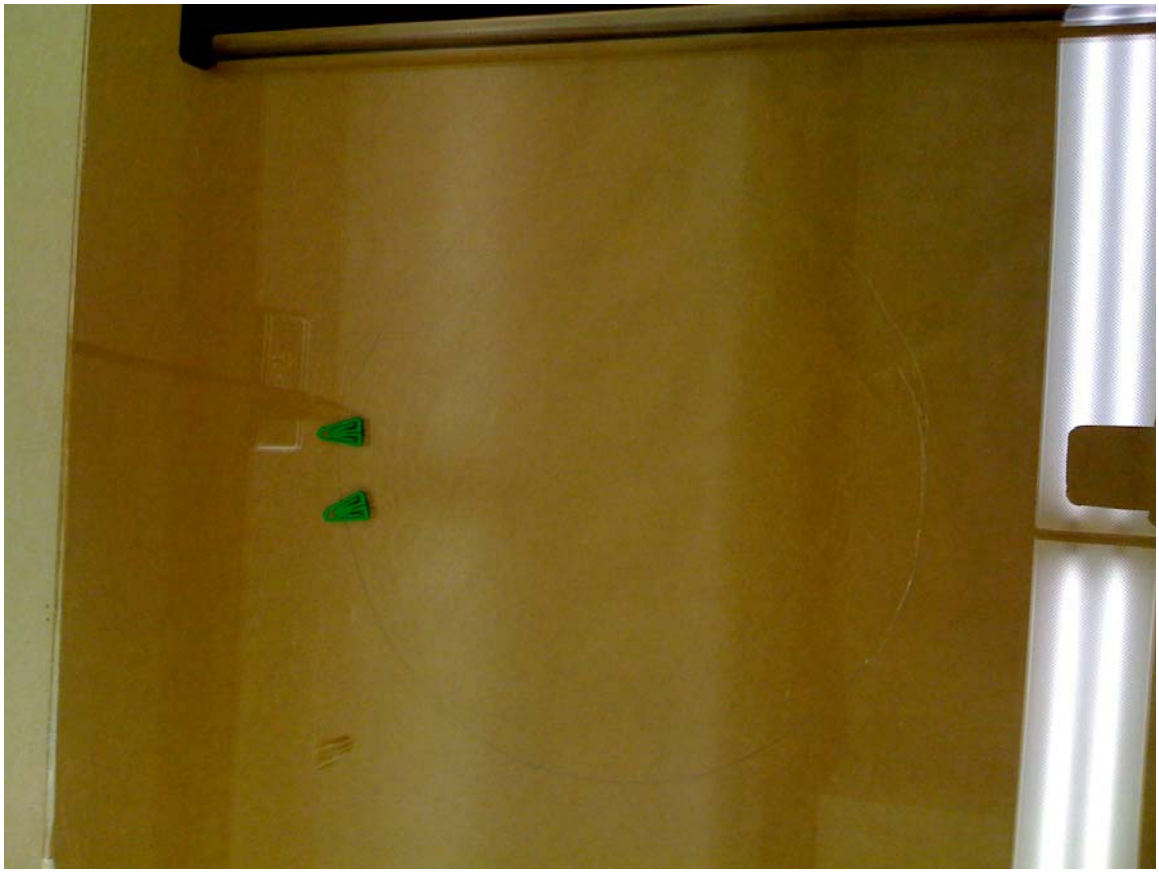
Rana may have some input into this

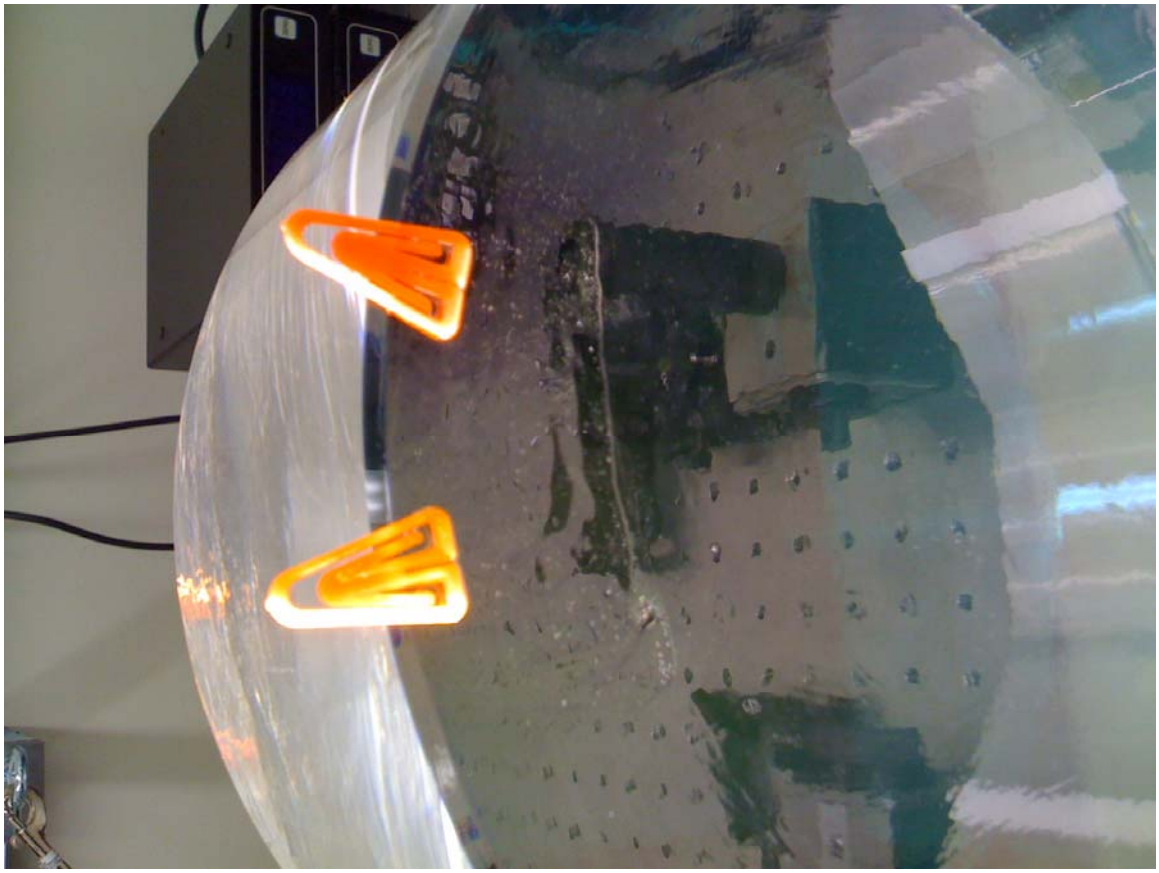
Cheers,
Steve

Minimialist Attempt at FC removal

8/ 3 & 4 / 2009

With no fixturing, we test the ability to put on 3 layers of standard FC and let it dry, then, re-wet an area near the top edge and press in the plastic paper clips. The clips adhere in a few seconds and then I let then dry for about 10. Then I paint on a layer over the clips and will let that dry overnight.





Minimalist Peel (pictured above)

8-5-09

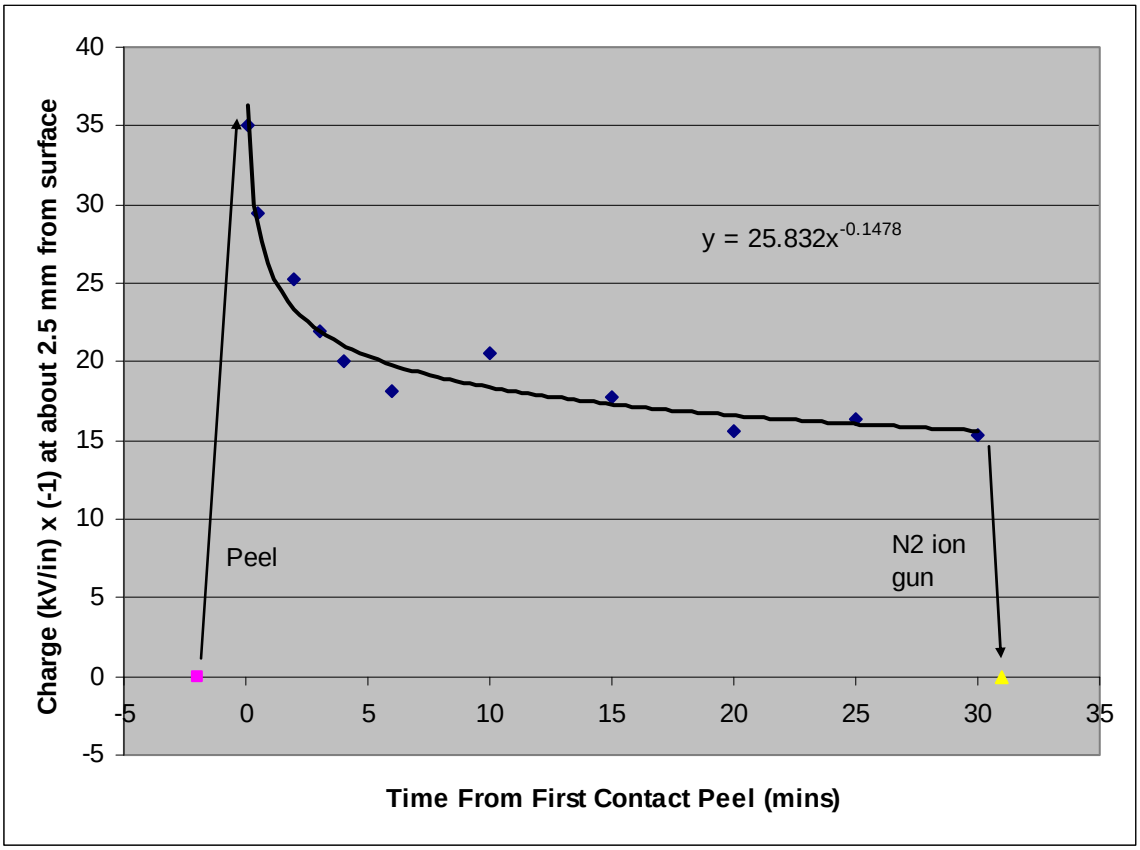
This actually works really well and is for the most part unmessy. The unwrinkled one was taken from the plate glass and left no shards (there is no bevel).

The wrinkled one left some material on the bevel & shards. I tried to use the dried FC sheet like tape to pick-off the shards, it got some of the looser ones. On the bevel there is material there you just can't get off, so I used a couple of drops of IPA on a lint free rag and my gloved finger. You have to wipe it pretty hard to get it off the bevel but it comes off.

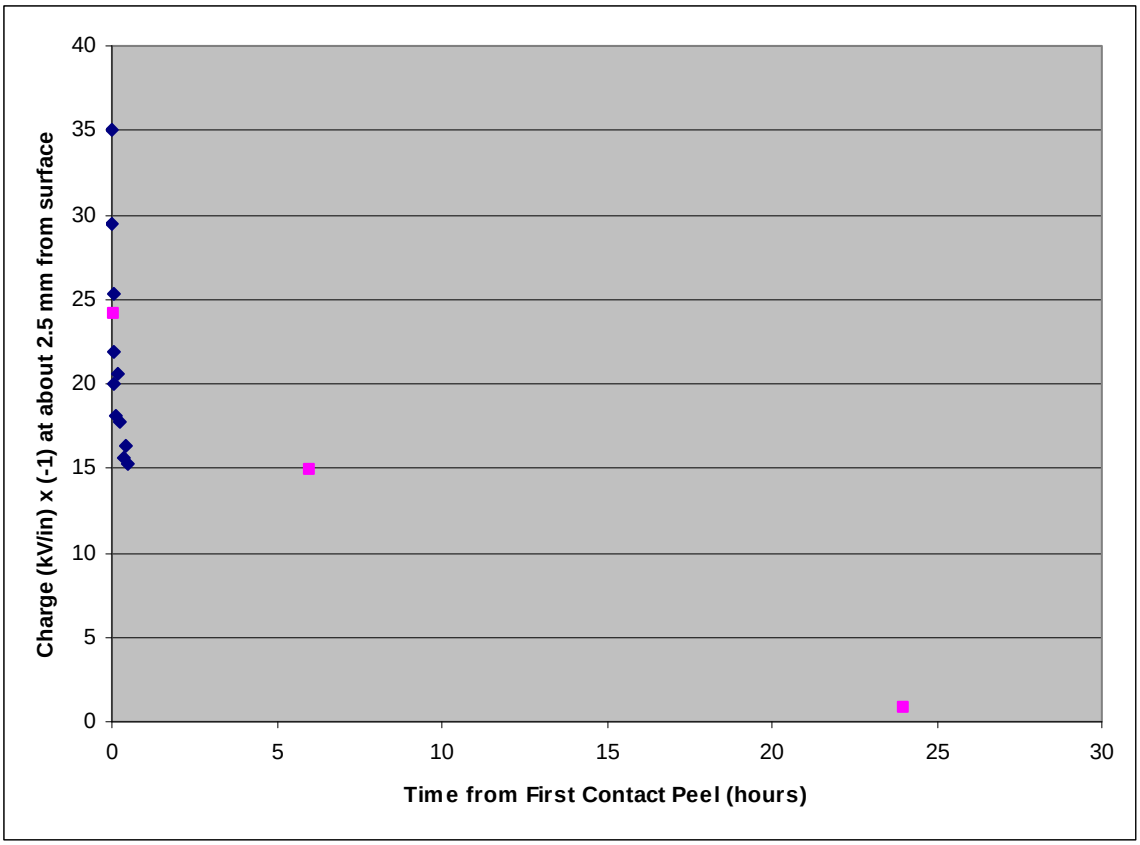
So, if its okay to wipe the bevel with IPA or Methanol (which is better), this would seem to be a good way to get it off without making a big mess, with no contraptions. The paperclip tabs can be applied at any time later that you wanted to remove the FC layers.

Charge Decay from First Contact Peel

These plots were generated awhile ago 5-6-09, peeling FC from an iLIGO optic and measuring the charge with the Electrostatic Inc. ESD probe.



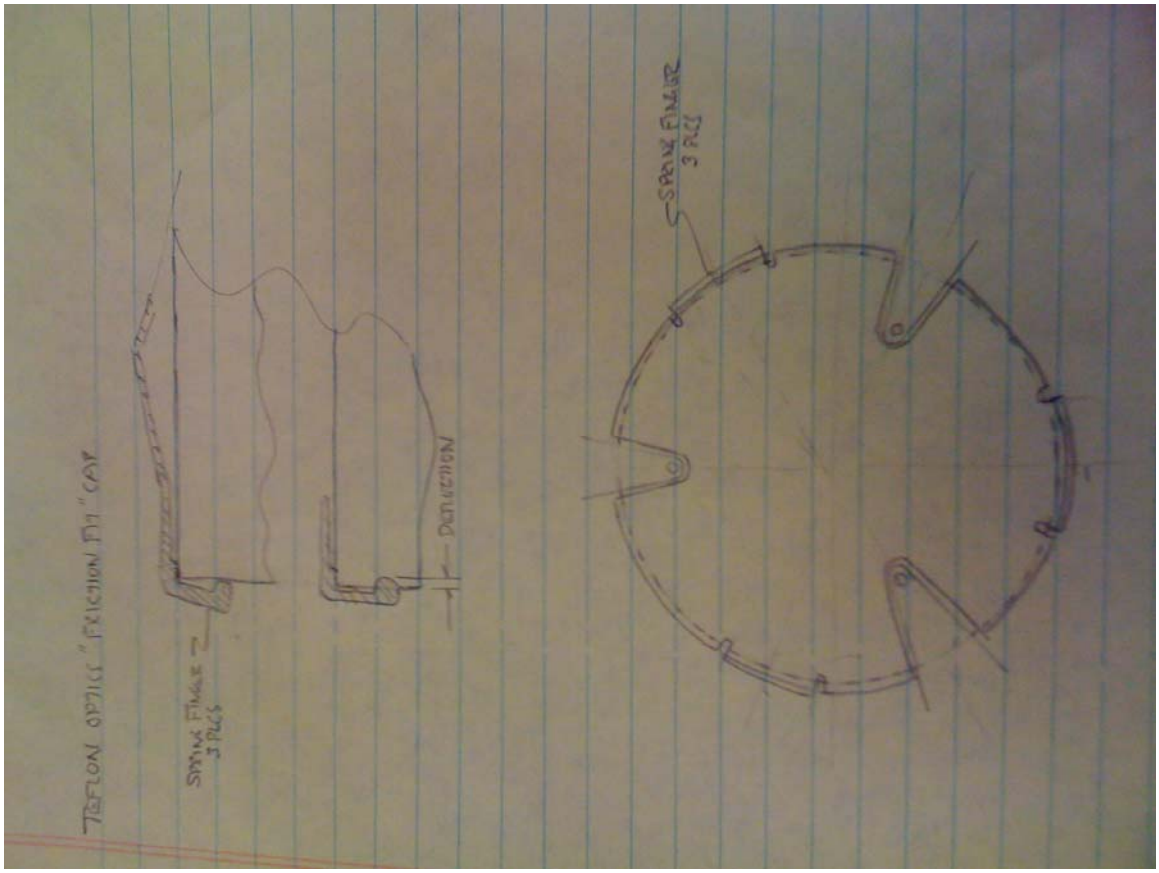
Peel #1 in which the charge was allowed to decay for 30 minutes, and discharged with the ion gun after 30 minutes.



Peel #2 (pink) overlayed on Peel #1 (blue) in which the charge was not discharged with the ion gun. There is still a measureable surface charge after 24 hours.

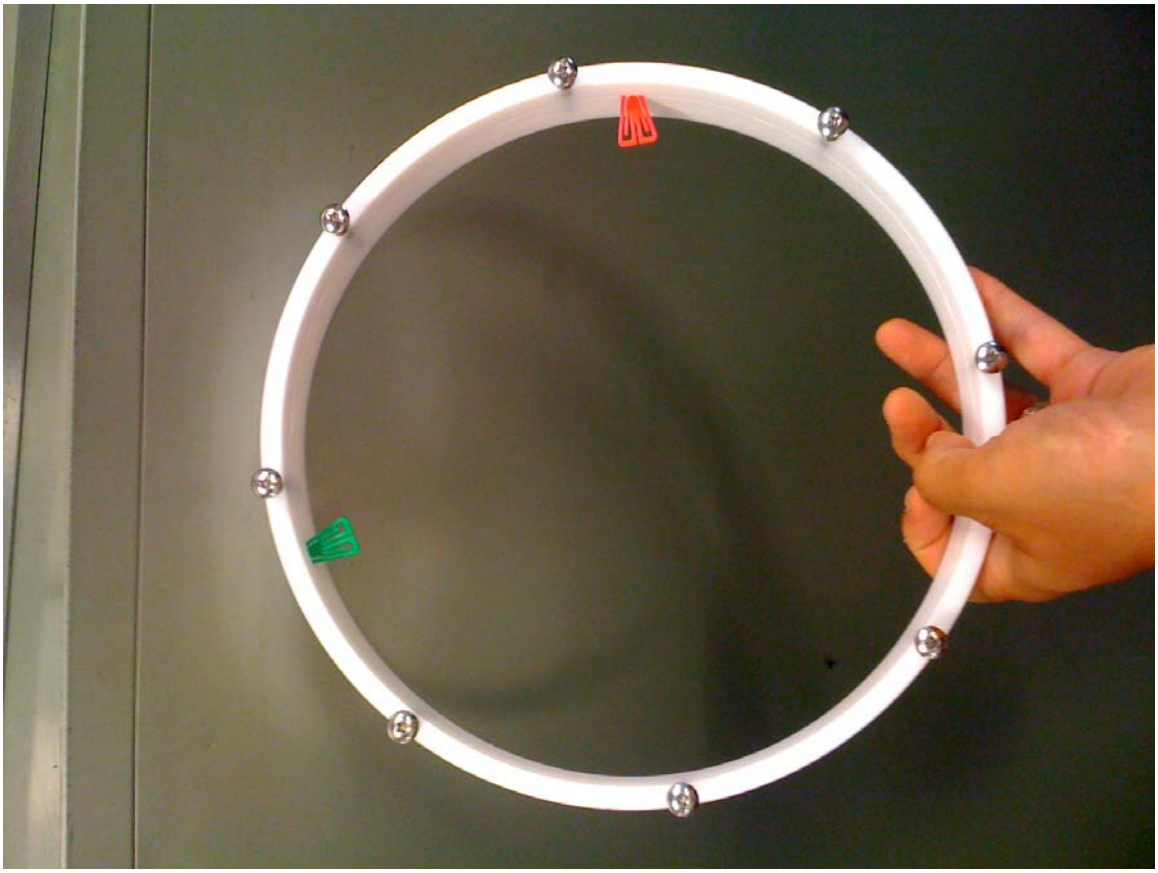
AdL Teflon Dust Cover Sketch, Teflon Outer Ring for FC removal, Metal Ring "Frisbee" with Teflon Insert, LASTI metal-vacuum cover & other updates

8-18-09



Sketch of the conception of a full sized AdL TM dust cover being drawn up by the new draftsman. It is made to be able to be put on when the earthquake stops are in place, and will be sent to LASTI.

- Above, the AdL TM Teflon dust cover sketch.
- The new Frisbee ring insert (that on page 41) made of Teflon has been released to us for test.
- A Teflon outer ring has been completed for holding multiple tabs on a vertical part on the "sundial" p. 44-46 has been completed by Joe Haggerty.



iLIGO sized ring spring-loaded doo-hickey for FC removal with clips. "Hey mister tambourine man, play that song for me…".

- A metal vacuum dust cover (a Calum Torrie endeavor, largely) is being drawn up and also fabricated by the new draftsman and will be sent to LASTI.

- *Note – FC work in lab 015A is suspended until we can solve the ventilation / safety requirements for the use of its solvent and the resultant fumes.*

- Margot Phelps has ordered and received the stuff for replication of the Vorvick drag wiping procedure. The plan is to figure out how to do it, and make scatter measurements in the RTS and CASI to see if FC is better, or not.