Coatings for stray light baffles

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Original documenthttps://dcc.ligo.org/LIGO-T1700128-v9

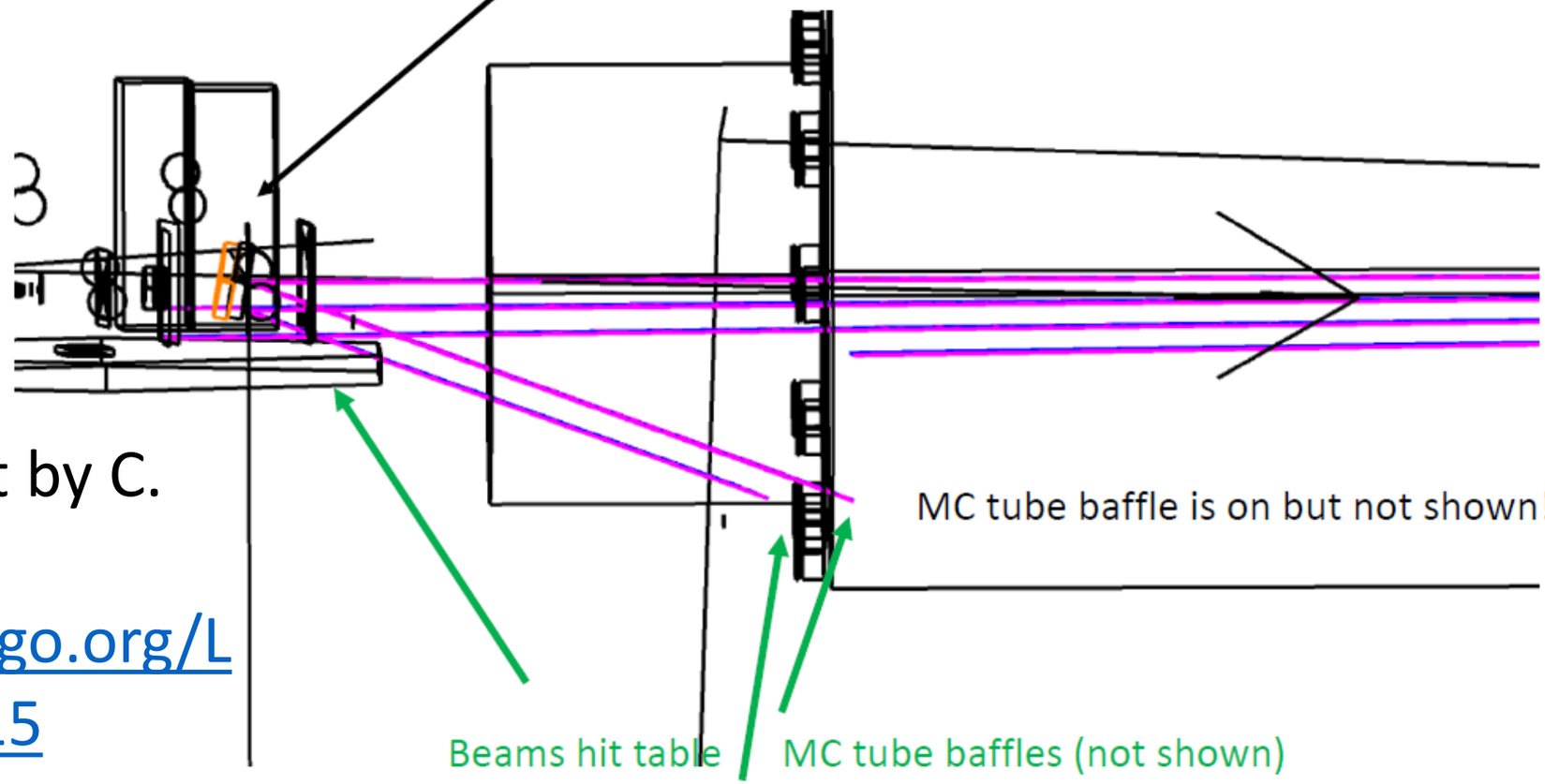
Light bouncing of a baffle

1675	Standard Lens	SR3_RADIUS	1672	0	0.000	0.000	0.000	0.000	-10.000	0.000
1676	Cylinder 2 Volume	SR3	1672	0	0.000	0.000	50.000	0.000	-10.000 P	0.000

REMEMBER I HAVE SUPPRESSED THE SR3 HR BAFFLE

SR3 (highlighted)

SR3 pitched down 10 deg as shown



Zemax layout by C. Torrie https://dcc.ligo.org/LIGO-E1700115

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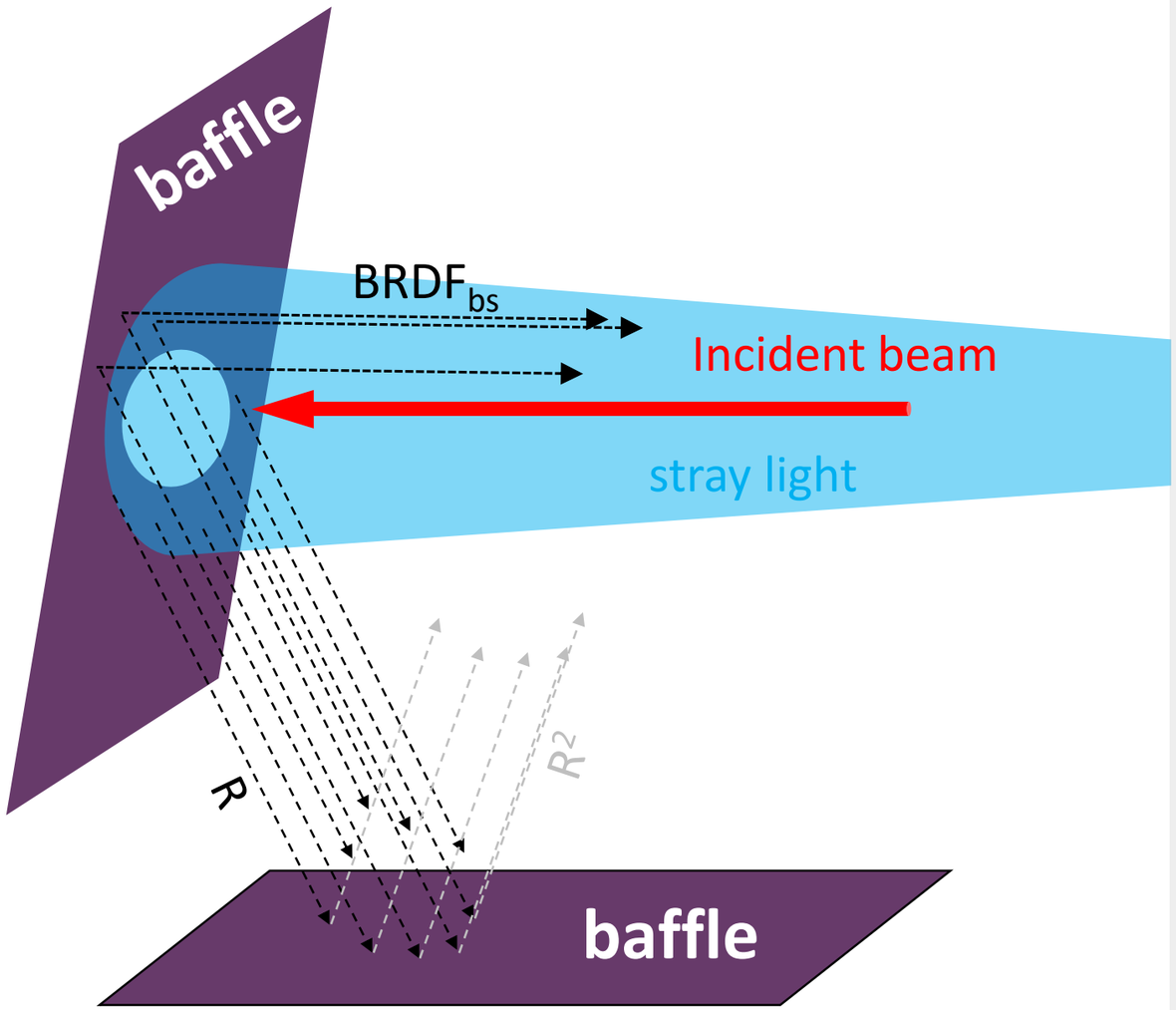
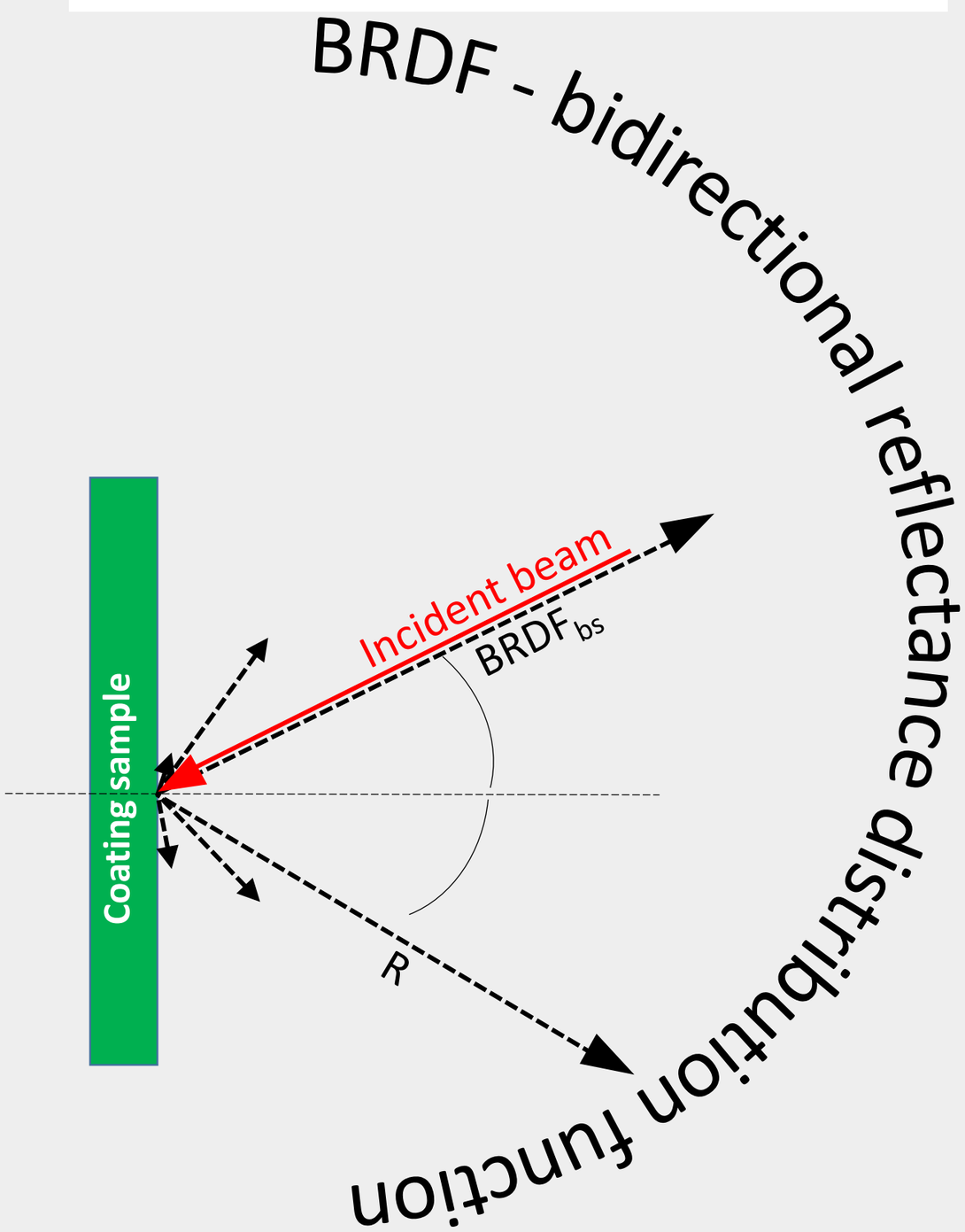
Pitched baffle against stray light

R - specular reflectance

$BRDF_{bs}$ - back scatter



Scatterometer



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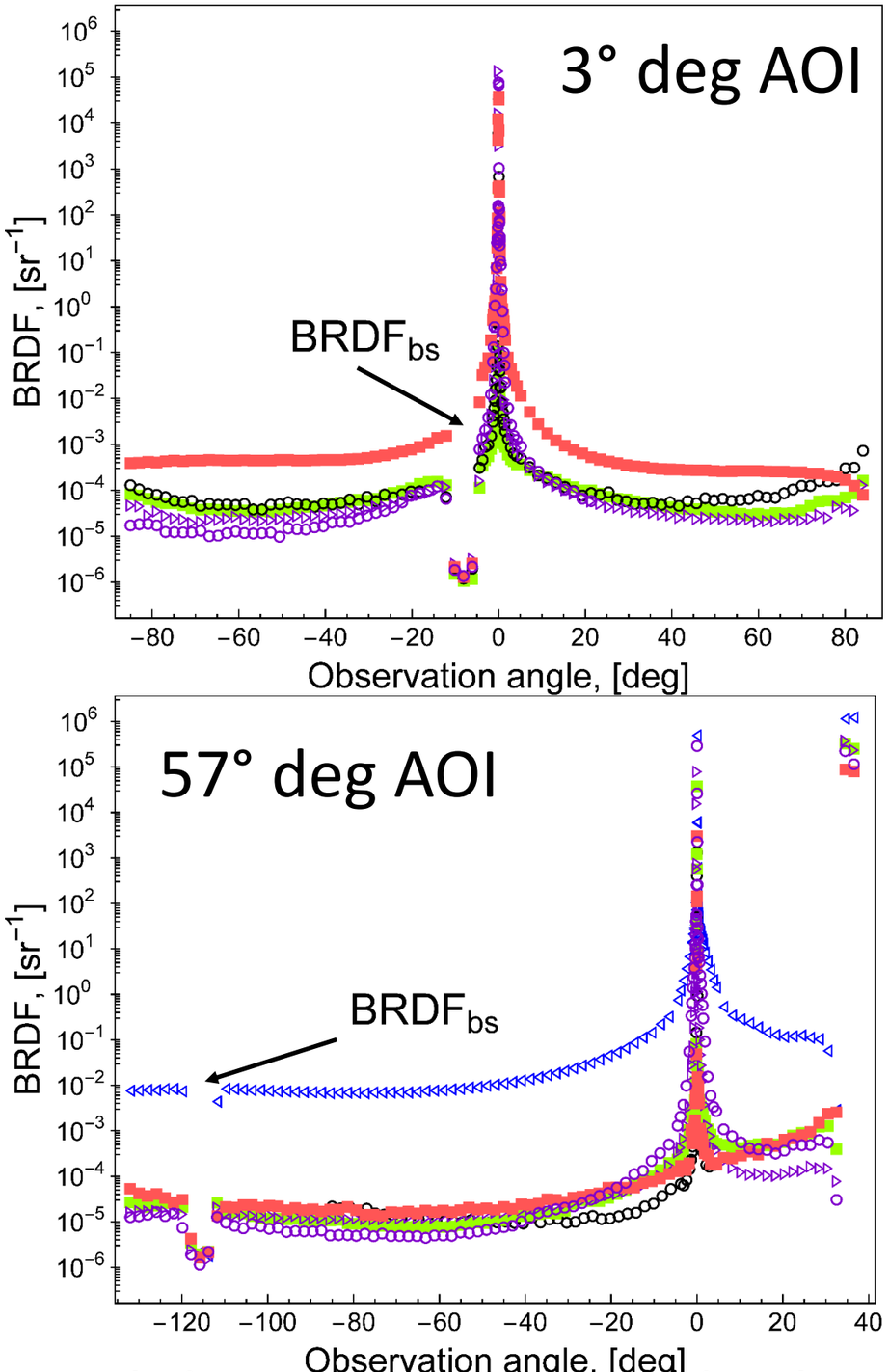
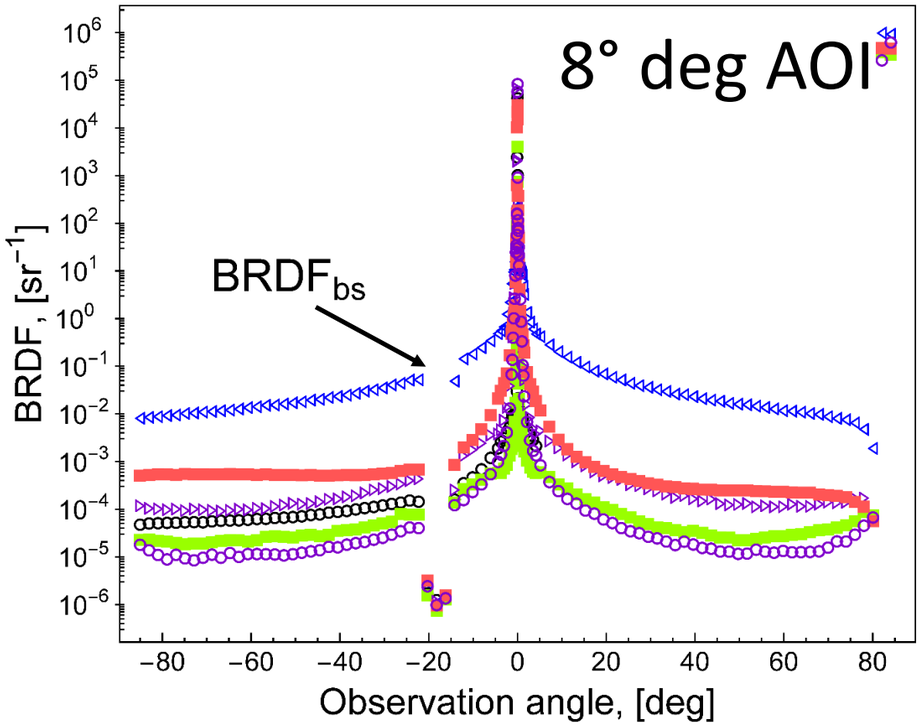
BRDF measurement





- Oxidized Stainless Steel (super #8)
- Black Glass
- AR coated Black Glass (broad band coating)

- Multi-layer AR on stainless steel Super#8
- Multi-layer AR on stainless steel Super#8 Redesigned
- DLC on stainless steel Super#8

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Reflectance squared as a function of back scatter at 8° AOI

Oxidized Stainless Steel (super #8)
Black Glass
AR coated Black Glass (broad band coating)

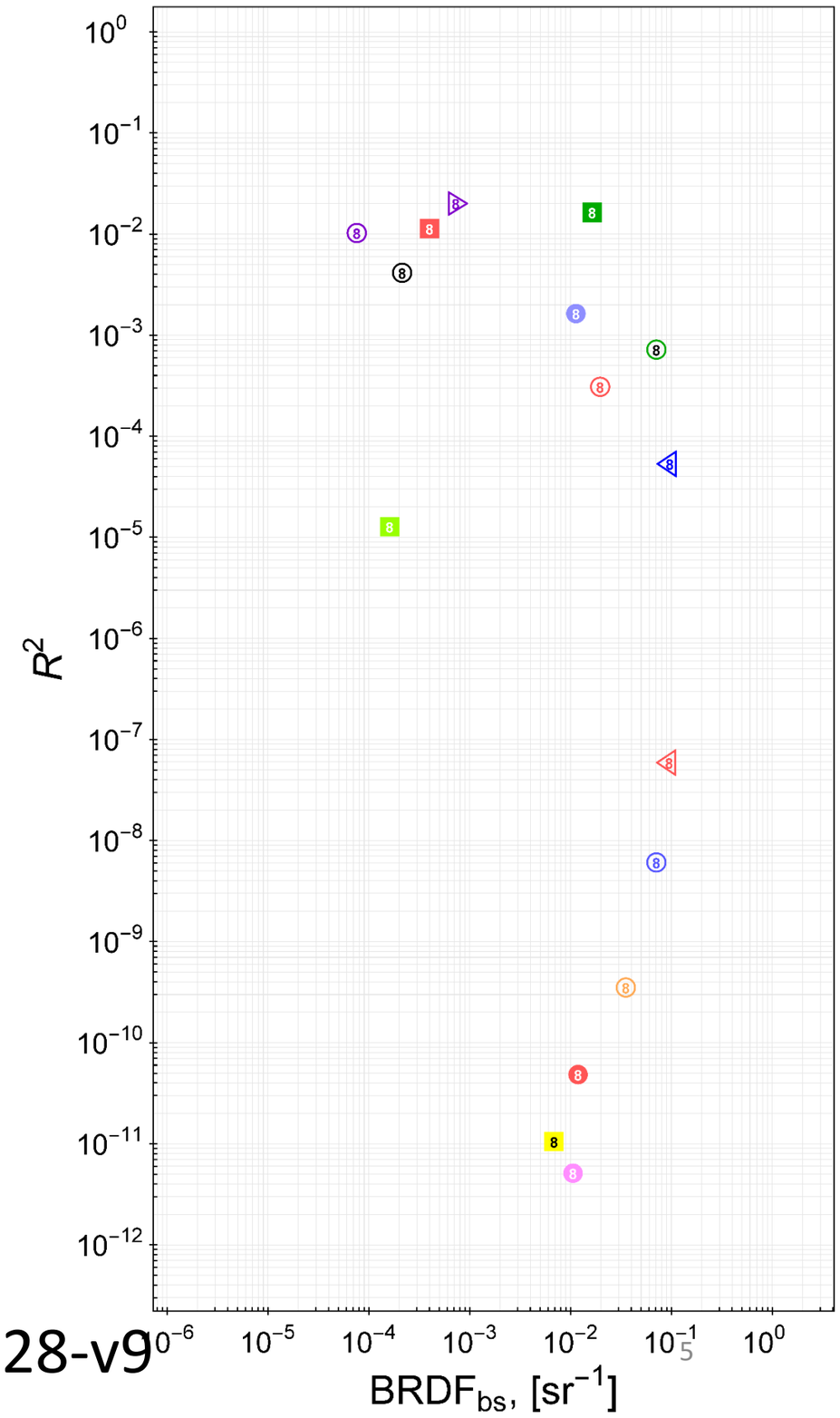
Diamond-like Carbon on stainless steel mill finish
Black Nickel on stainless steel mill finish (coating run 1)

Multi-layer AR (for 57 AOI) on stainless steel Super#8
Multi-layer AR on stainless steel Super#8 Redesigned
DLC on stainless steel Super#8

Chromium Oxide on stainless steel
Diamond-like Carbon on Cr Oxide on SSTL
“Black Nickel” on bead blasted SSTL
DLC on bead blasted SSTL

Structural black coating 1
Structural black coating 2

Black Nickel on stainless steel super #8 (coating run 2)
Black Nickel on stainless steel mill finish (coating run 2)



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Reflectance squared as a function of back scatter

Oxidized Stainless Steel (super #8)
Black Glass
AR coated Black Glass (broad band coating)

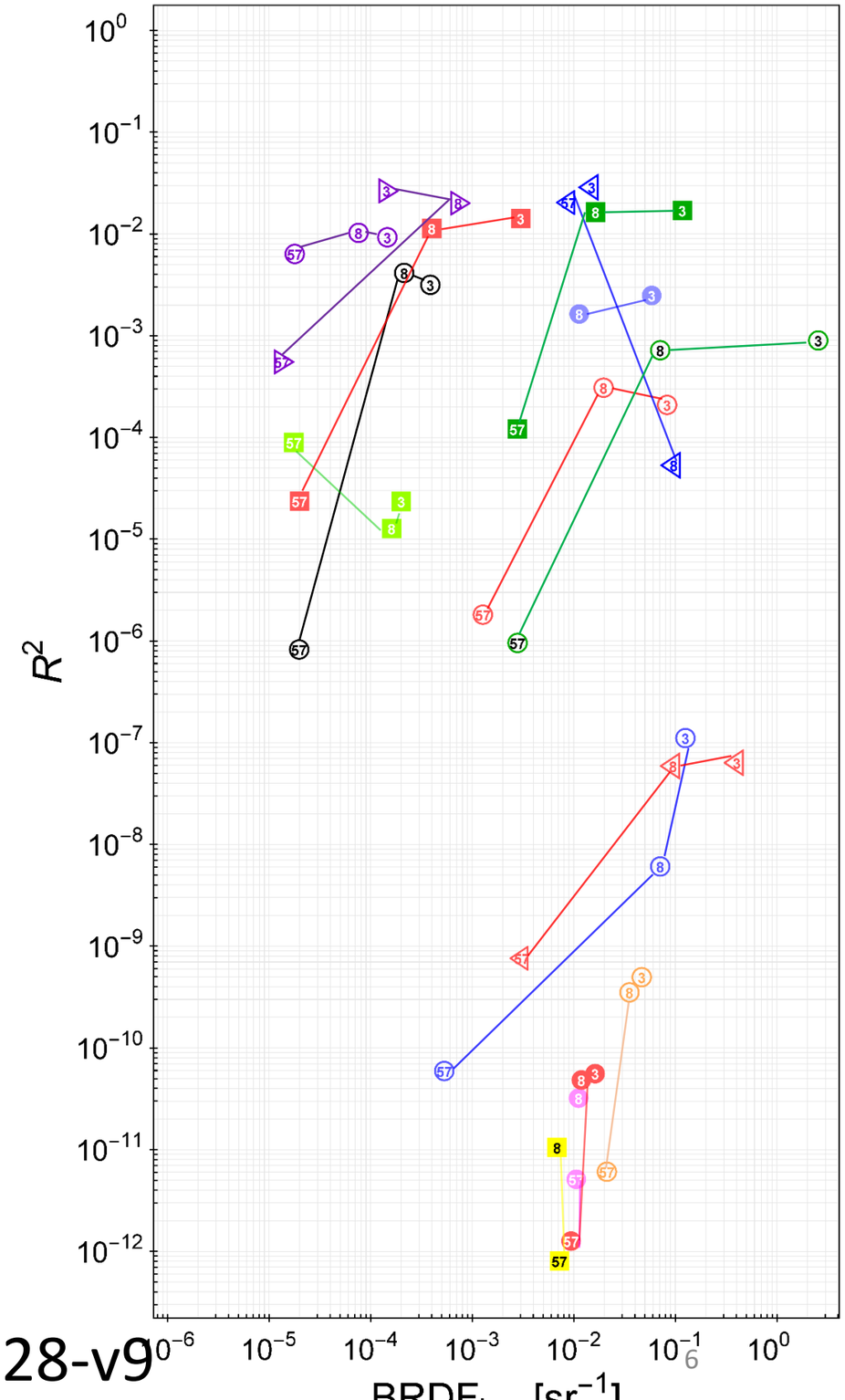
Diamond-like Carbon on stainless steel mill finish
Black Nickel on stainless steel mill finish (coating run 1)

Multi-layer AR (for 57 AOI) on stainless steel Super#8
Multi-layer AR on stainless steel Super#8 Redesigned
DLC on stainless steel Super#8

Chromium Oxide on stainless steel
Diamond-like Carbon on Cr Oxide on SSTL
“Black Nickel” on bead blasted SSTL
DLC on bead blasted SSTL

Structural black coating 1
Structural black coating 2

Black Nickel on stainless steel super #8 (coating run 2)
Black Nickel on stainless steel mill finish (coating run 2)



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Reflectance squared as a function of back scatter

On 05/16/17 the scatterometer`s failed laser was replaced with a new one. Reflectance at 57 AOI measured with the setup is about 100 times lower for shiny samples. Most likely polarization or alignment of the old laser was not good. Black glass and mAR samples were sent to Josh Smith for cross check measurement at Fullerton

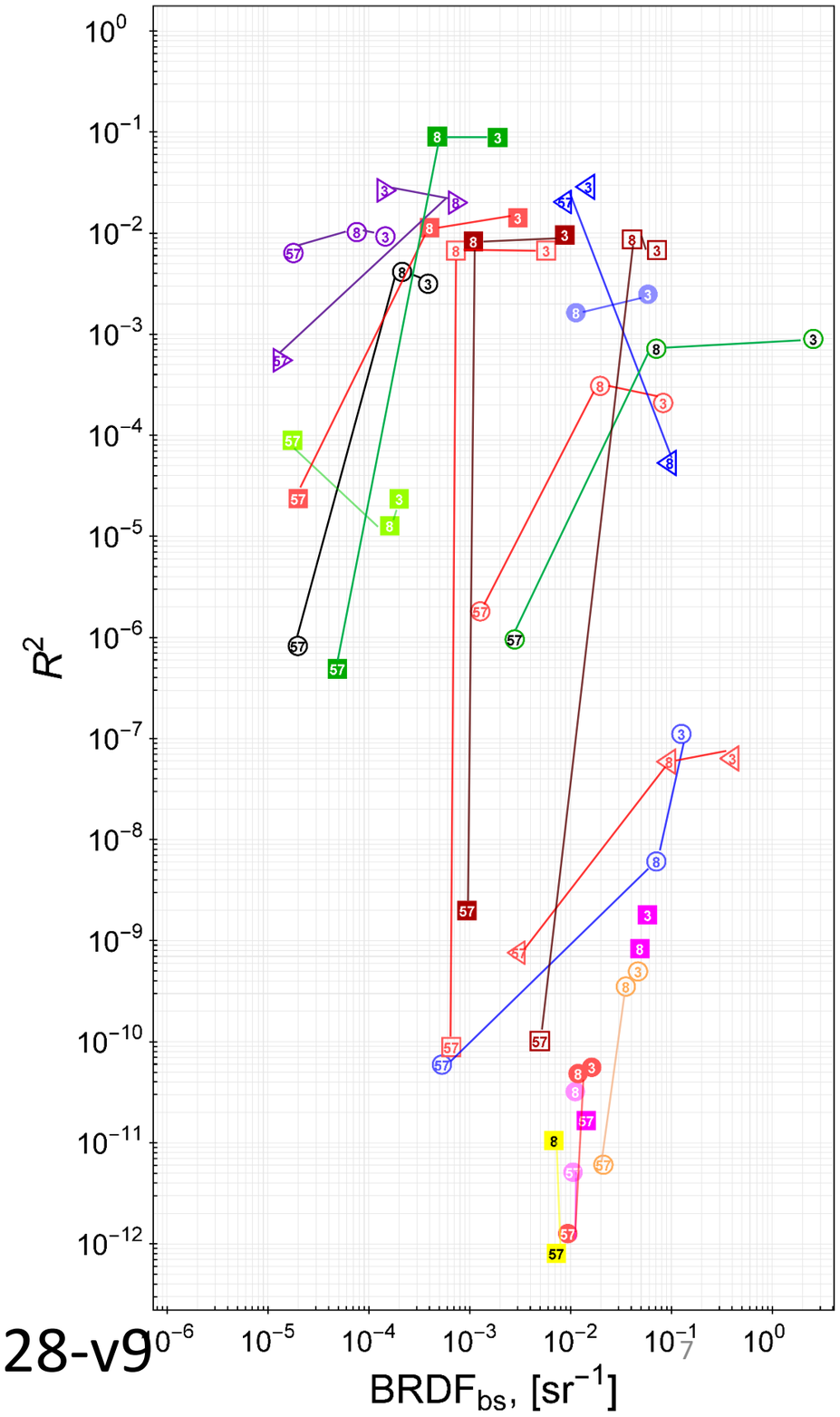
Oxidized Stainless Steel (super #8)
Black Glass
AR coated Black Glass (broad band coating)

Diamond-like Carbon on stainless steel mill finish
Black Nickel on stainless steel mill finish (coating run 1)

Multi-layer AR (for 57 AOI) on stainless steel Super#8
Multi-layer AR on stainless steel Super#8 Redesigned
DLC on SSTL non-directional super#8 (old and new laser)
DLC on SSTL directional super#8 (and respectively)

Chromium Oxide on stainless steel
Diamond-like Carbon on Cr Oxide on SSTL
“Black Nickel” on bead blasted SSTL
DLC on bead blasted SSTL

Structural black coating 1
Structural black coating 2
Black Nickel on stainless steel mill finish (coating run 2)
Black Nickel on stainless steel super #8 (coating run 3)



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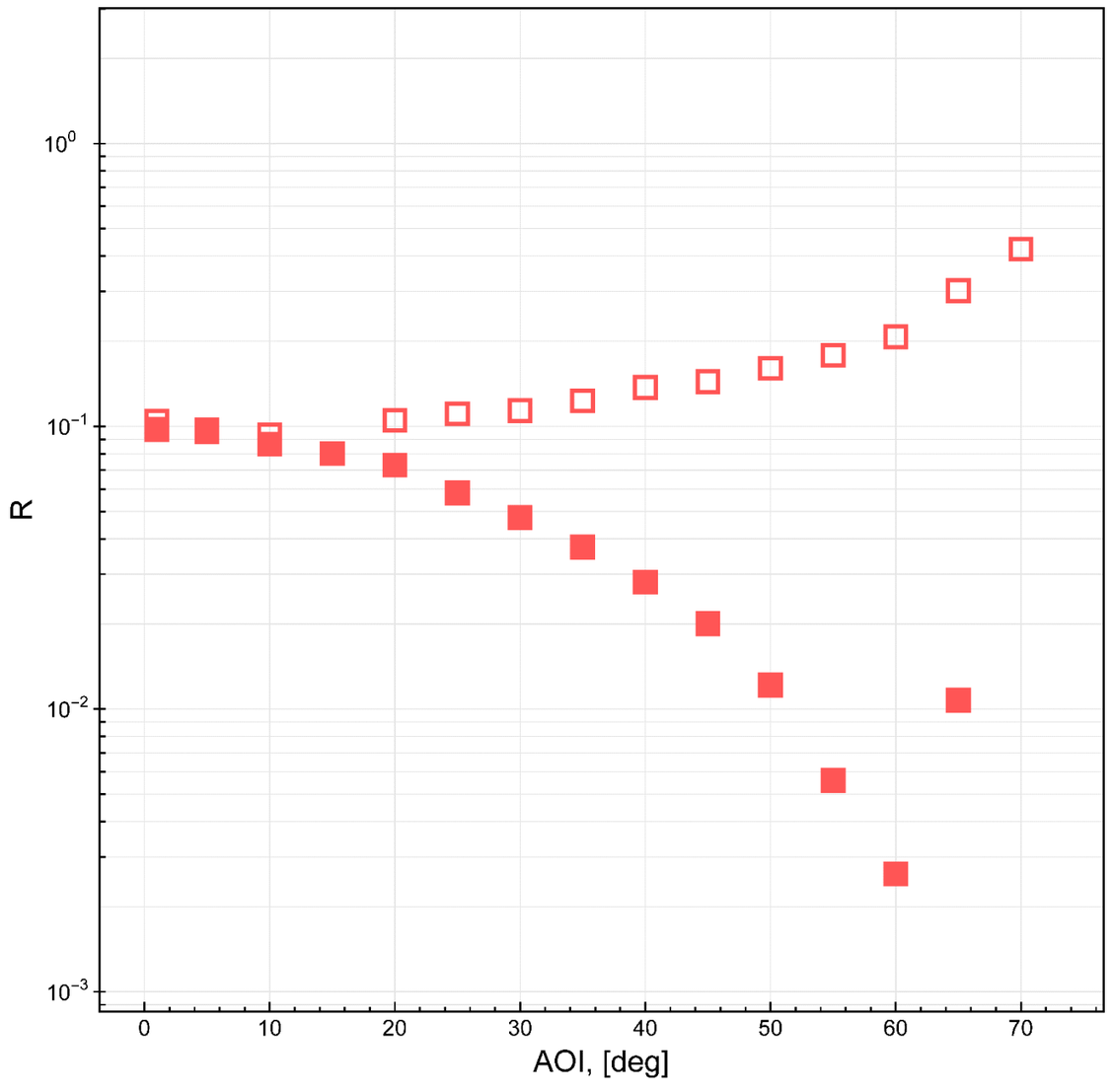
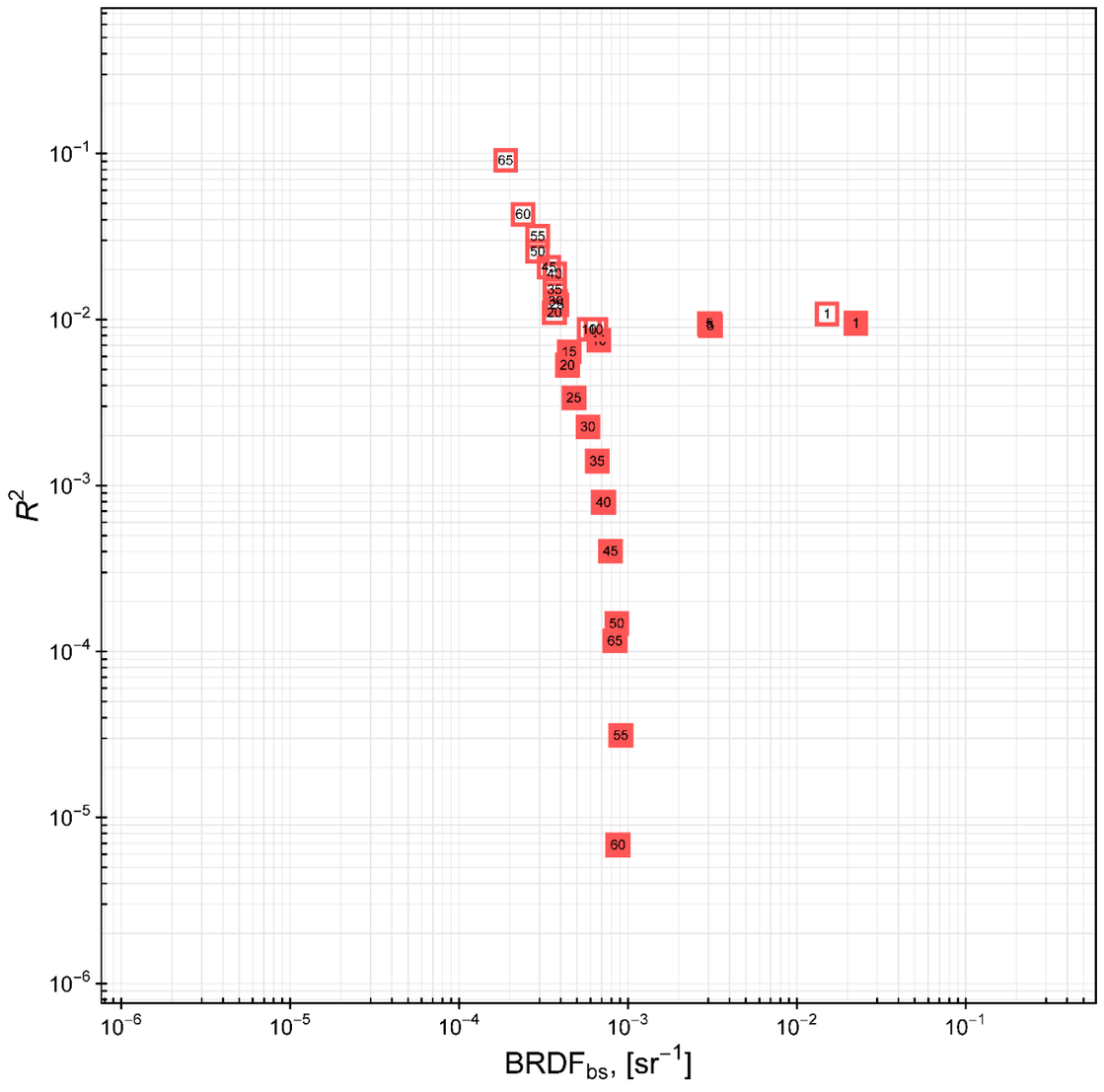
DLC on super #8 304 stainless steel sample https://dcc.ligo.org/S1700162

P-polarization
S-polarization





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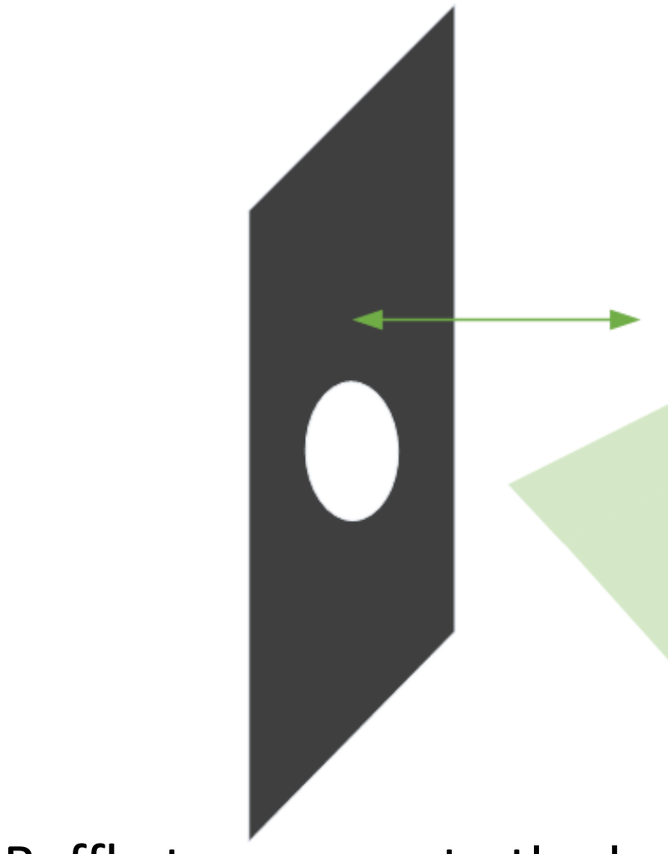
Polarization of the beam should be considered relatively to the baffle surface

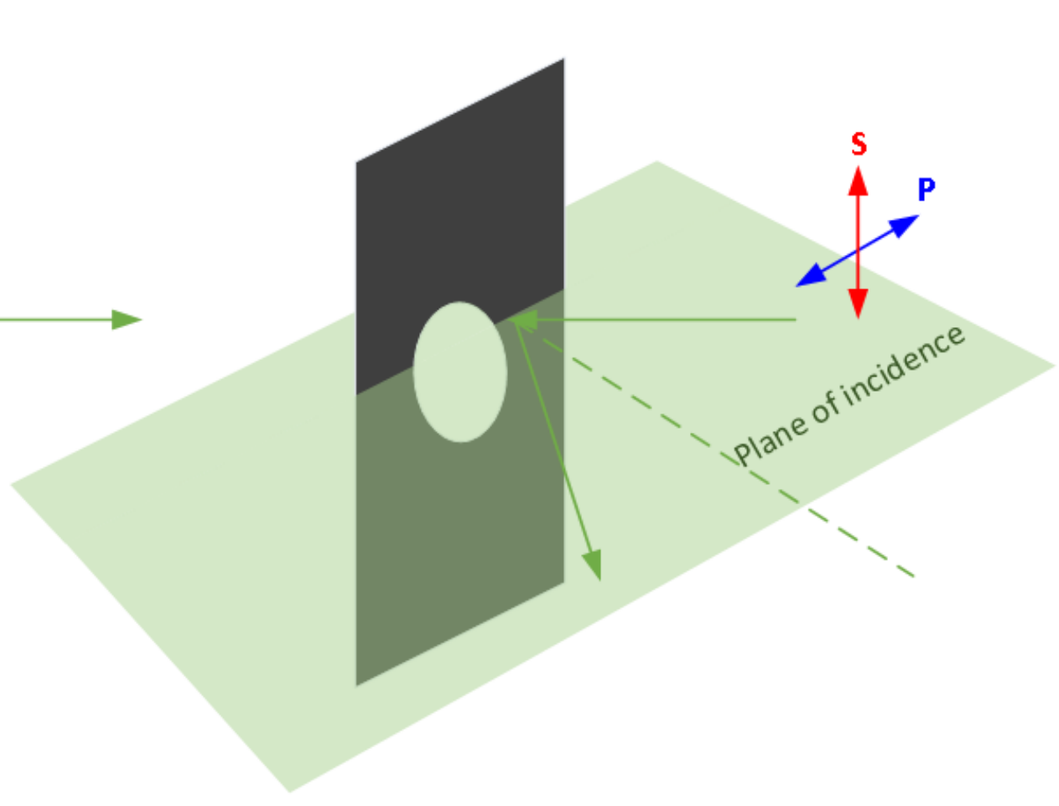
In most cases at LIGO the beam is horizontally polarized (same as at CASI setup)
If the baffle is yawed – consider reflectance measure for P-polarization
If the baffle is pitched– consider reflectance measure for S-polarization

For areas where polarization of the LIGO beam switches to vertical polarization the situation is opposite:
If the baffle is yawed – consider reflectance measure for S-polarization
If the baffle is pitched– consider reflectance measure for P-polarization

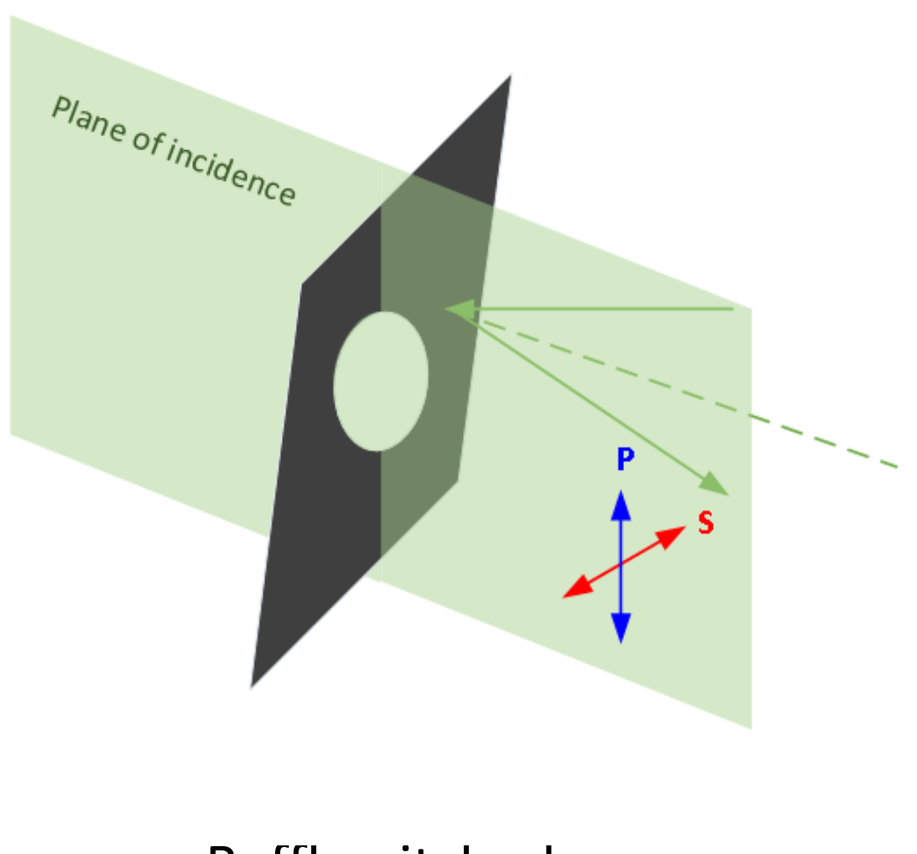
For most of the coatings reflectance for P- and S-polarization will be abut the same for AOI < 10 deg but differs significantly for large angles
STRAY light will likely be partially polarized in most cases



Baffle transverse to the beam



Baffle yawed



Baffle pitched

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