Fritted glass task group
OPS Summary
March 2017

Jacob C. Jonsson

Windows and Envelope Materials Group

Building Technology and Urban Systems Division

Name and scope change

- We are changing name from Fritted Glass TG to Diffuse Glazing TG to better represent that we are also dealing with diffuse interlayers and diffuse applied films
- *Find a way to obtain spectral data for diffuse glazing products in a manner that would allow WINDOW calculations of IGUs. Determine best practice how to obtain data and verify the accuracy of these practices.*

Outline for today's session

- Presentation of progress regarding 270 mm spheres with 100 mm apertures
- Plan for future work
- Presentation of ballot work regarding to 300-series documents

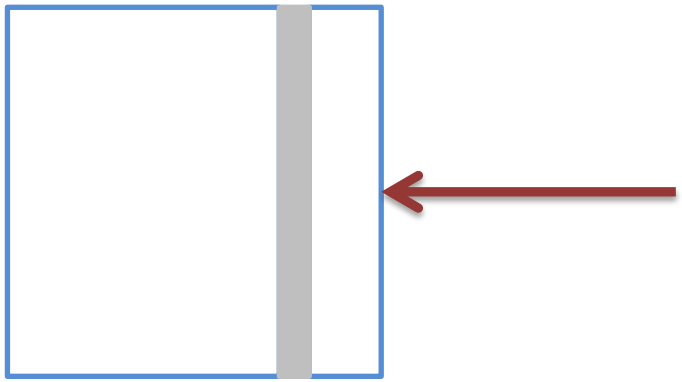
Discussion based presentation, interrupt with questions and comments as you see fit

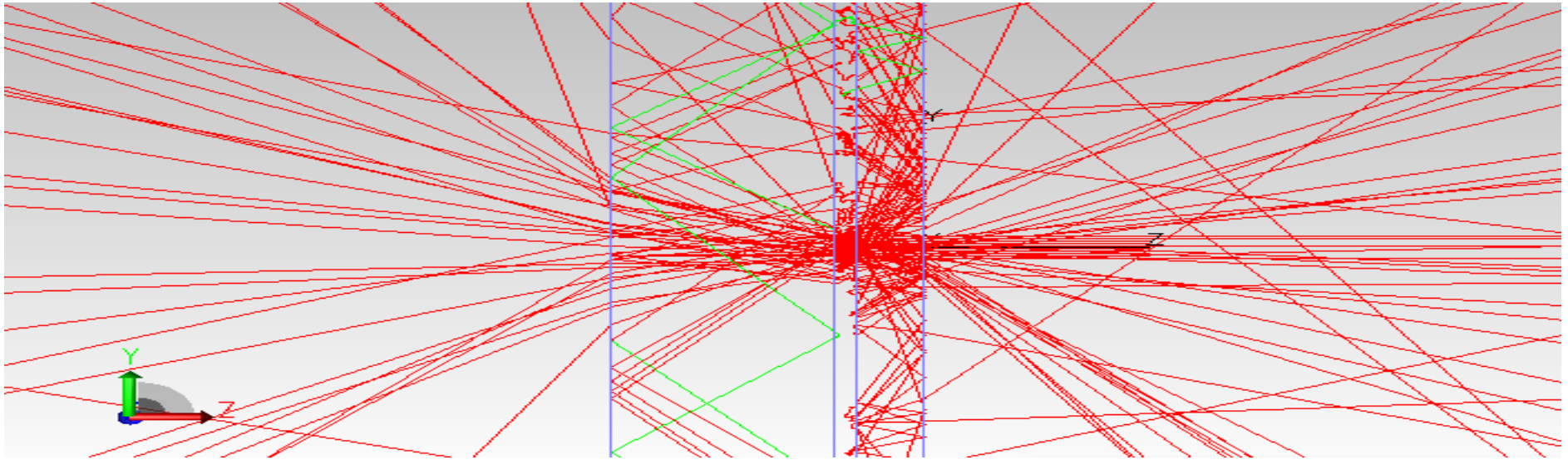
Determine best practice how to obtain data

- Use of 150 mm sphere has not yielded good enough results, look for commercial alternative
- First step was to find a set of measurements we can use as gold standard
- Four instruments
  - Guardian 270 mm sphere with 100/50 mm aperture
  - LBNL pgII goniophotometer
  - Fraunhofer ISE pgII goniophotometer
  - Fraunhofer 630 mm sphere with wide area illumination

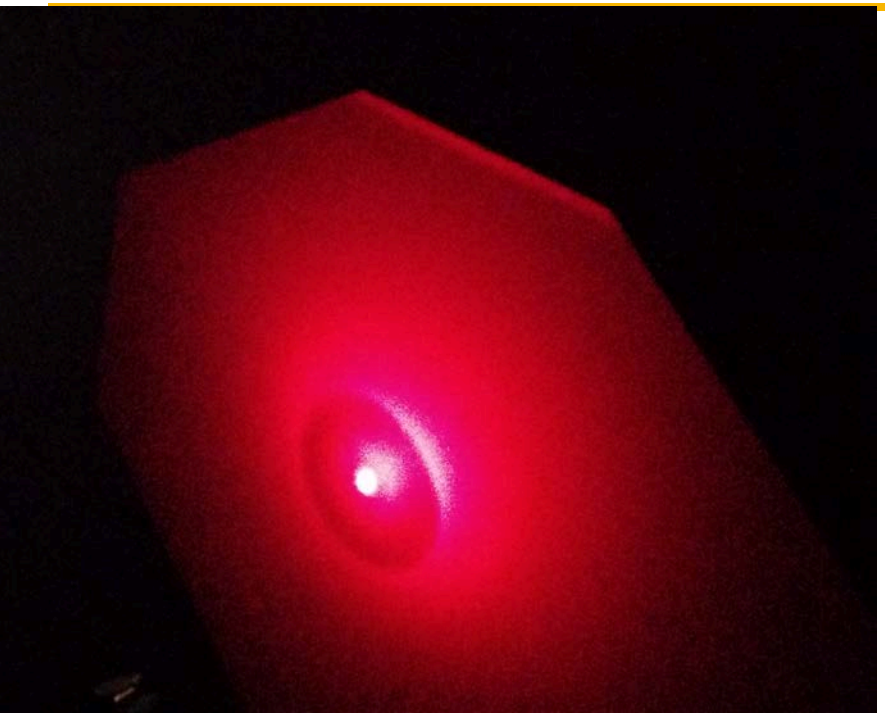
Sample visualization

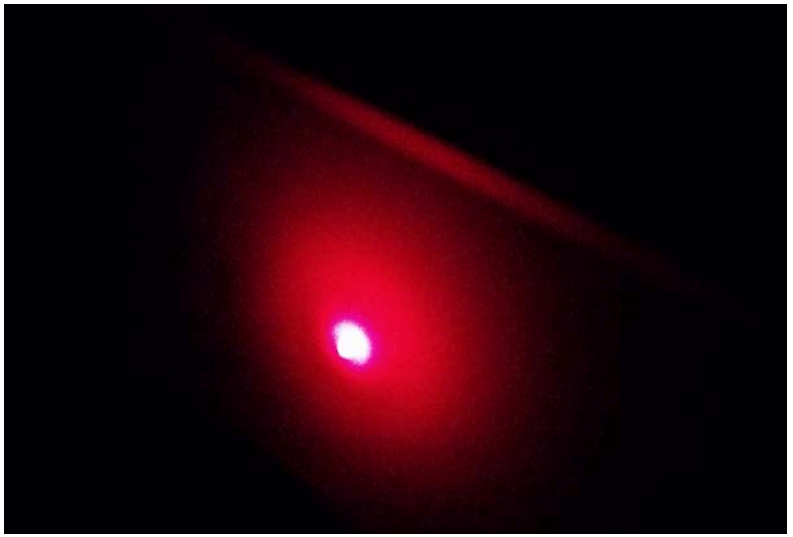
3 Layer laminate:
12 mm OptiWhite, low iron
0.030“ Saflex Arctic Snow
(transluscent white)PVB
3 mm Optiwhite





Qualitative images of laser pointer

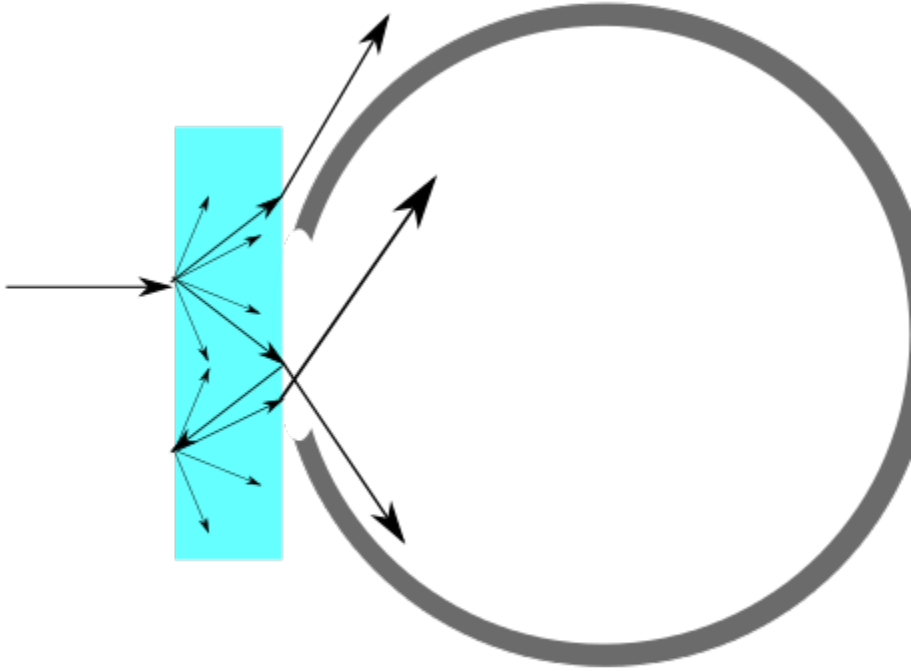




- Sample is ~ Letter sized and the reflectance is significant over a large area

Measurement problem

- Light not entering the integrating sphere is a systematic error
  - Sample dependent
    - Bulk/surface scattering
    - Thickness
  - Instrument dependent
    - Detector response vs angle of incidence
    - Sphere geometry



Current pursuit

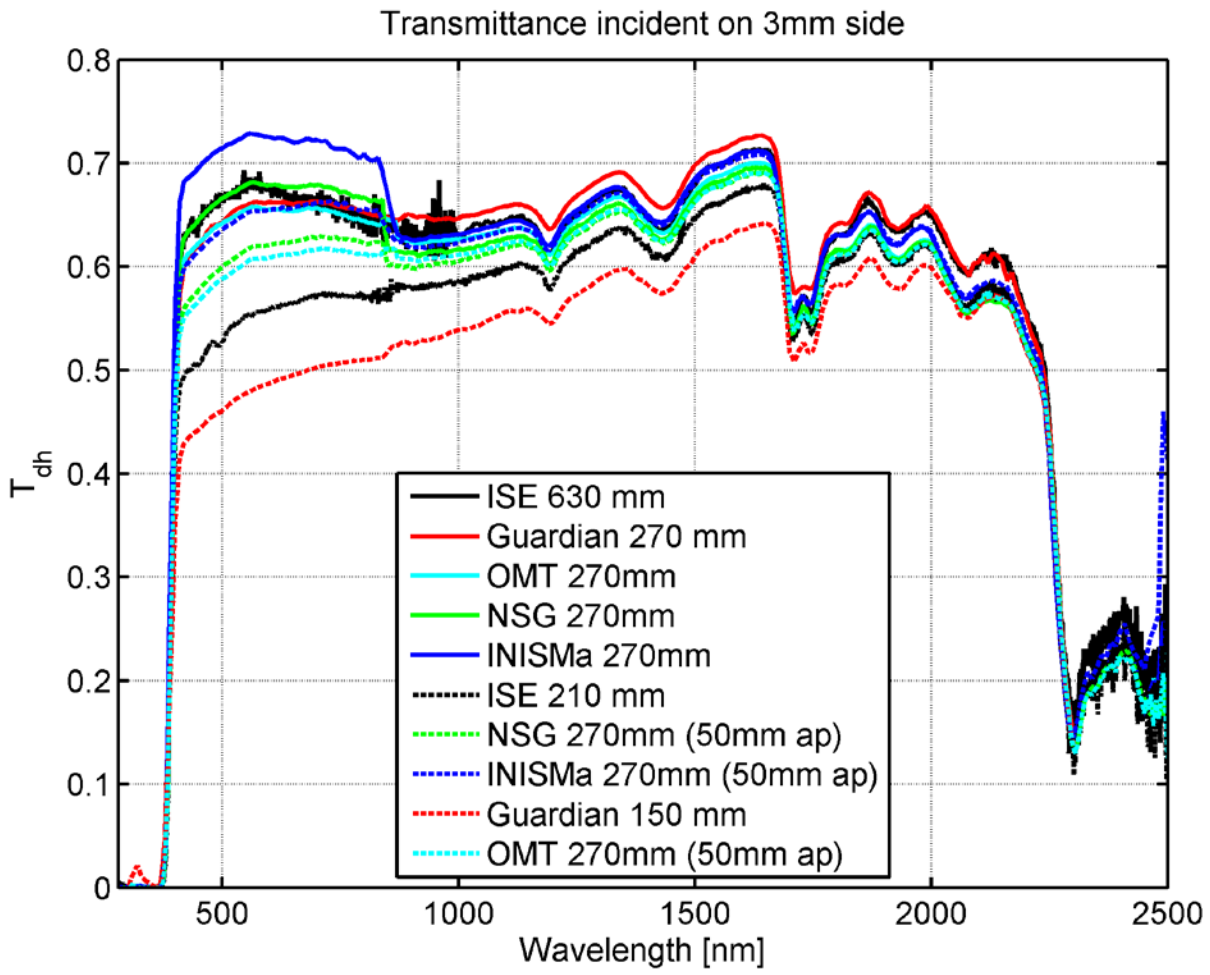
- 270 mm sphere with large aperture commercially available
  - 100 mm aperture reduces the side loss to reasonable levels
  - 3 in use in Europe that participated in this activity, including OMT who designed it for Perkin-Elmer
  - Have shown in specular ILC 2011 and 2015
- Wide area illumination and other special spheres can also work

The journeys of the L3 laminate sample

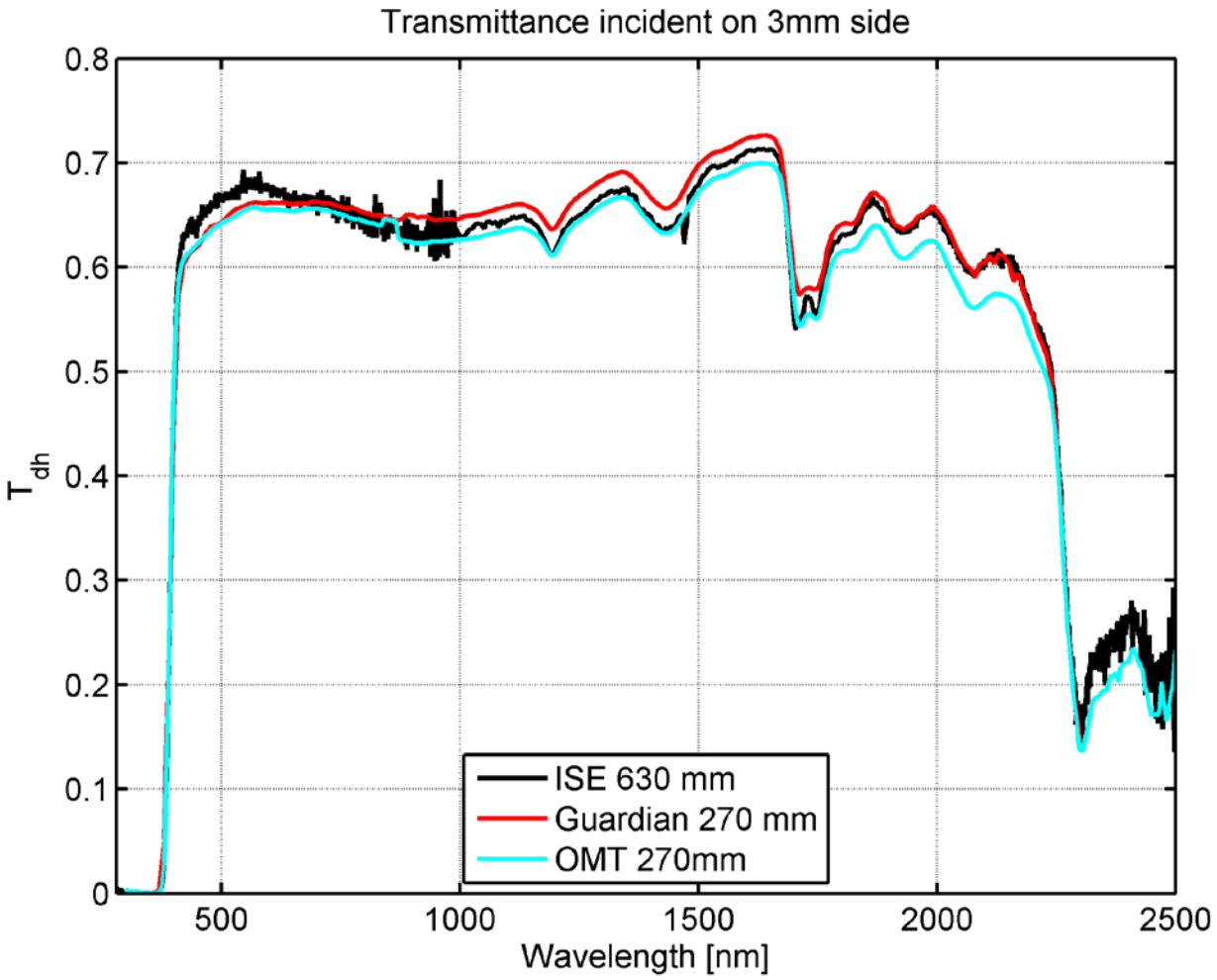
- NSG at Lathom, UK, Lambda1050 with upward looking 270mm integrating saphere (Perkin Elmer - OMT Solutions)
- INSIMa (INstitut Interuniversitaire des Silicates, Sols et Matériaux), Mons, Belgium, Lambda 750 with same sphere
- OMT Solutions, Modified 270 mm sphere
- All three participants measured with 100 mm and 50 mm apertures

All data transmittance 3mm case

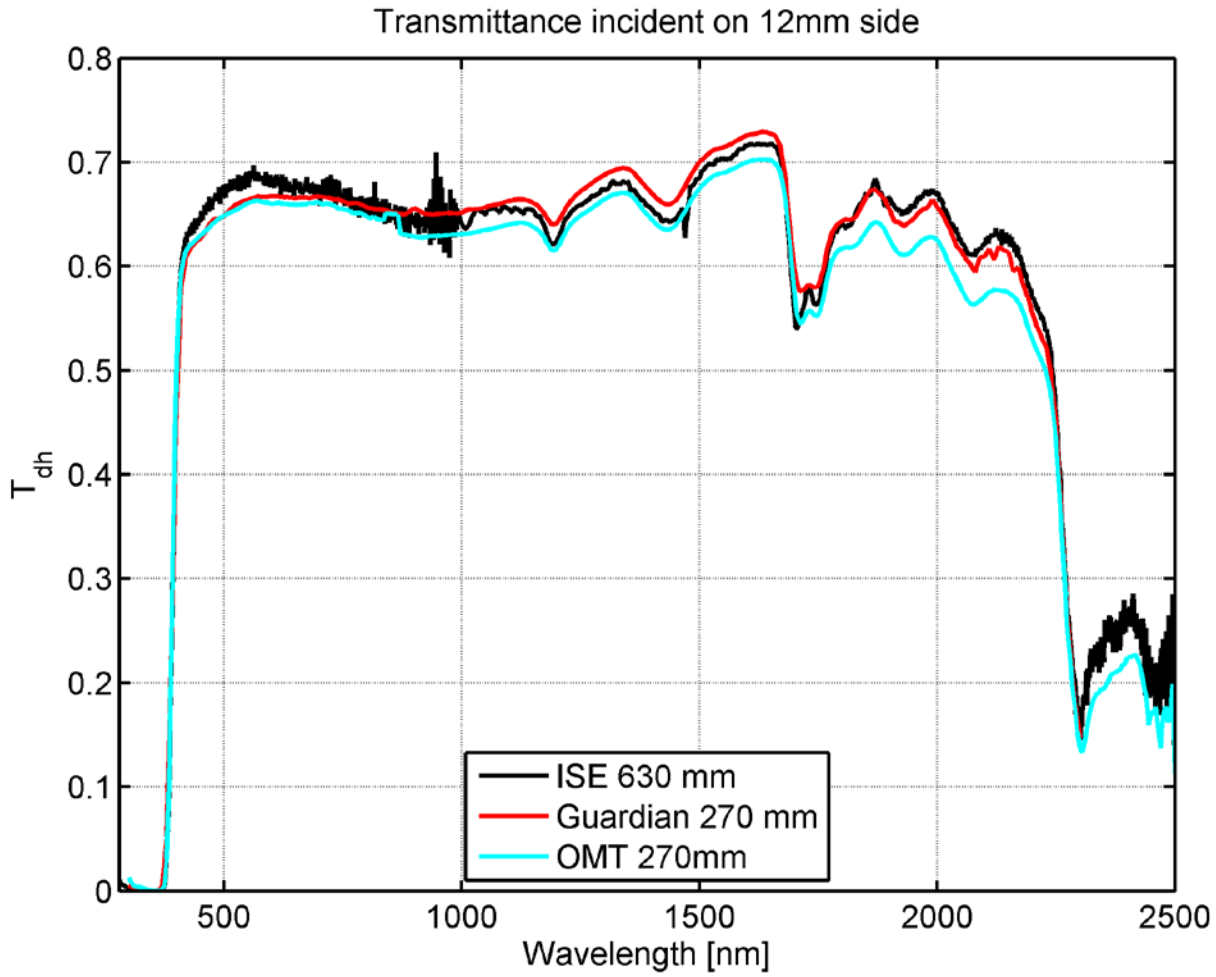
- Harder case
- Smaller spheres bad
- 270 spheres issues from NSG and INISma
- Focus on ISE, OMT, and Guardian



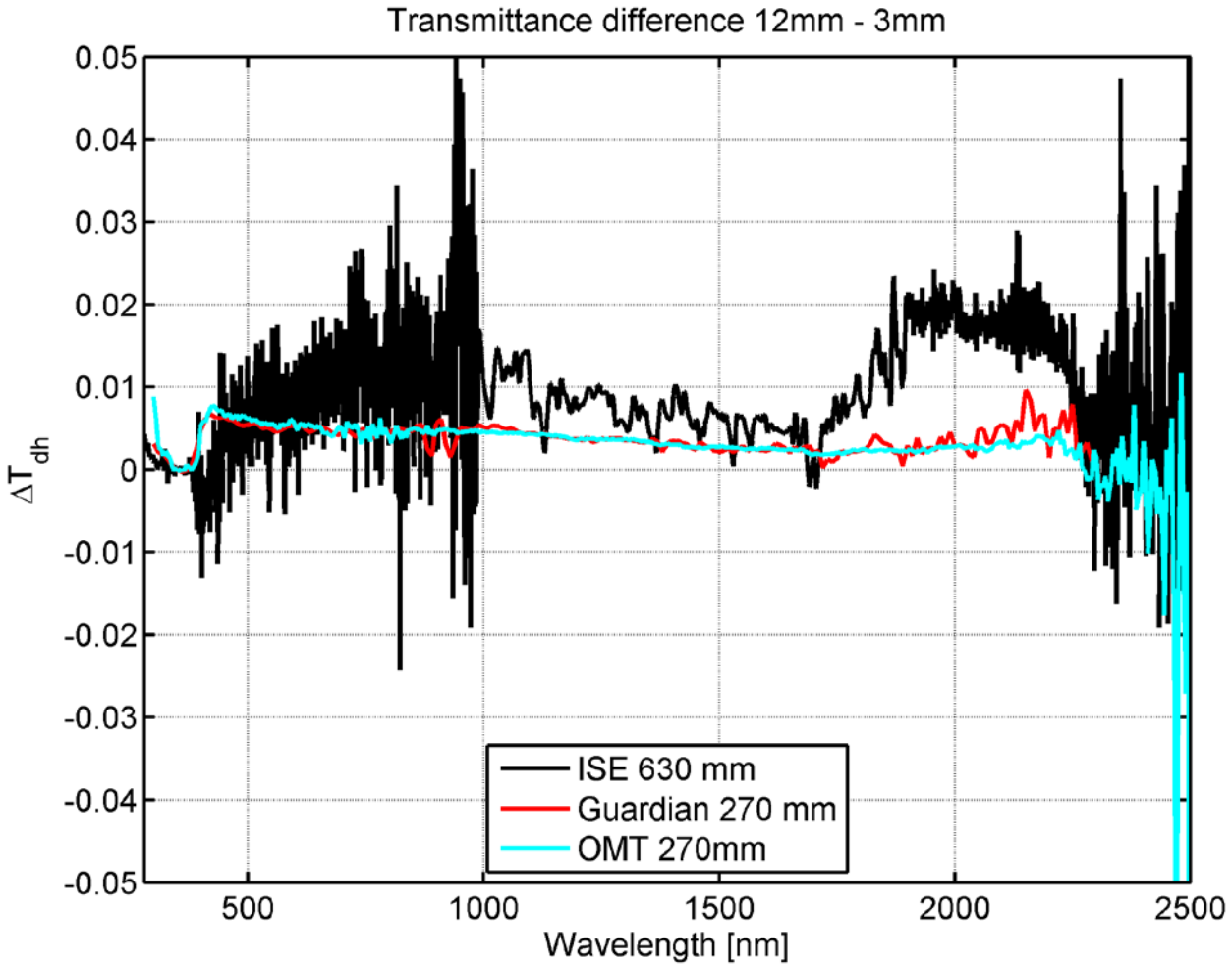
Comparison large spheres



270 mm spheres less loss

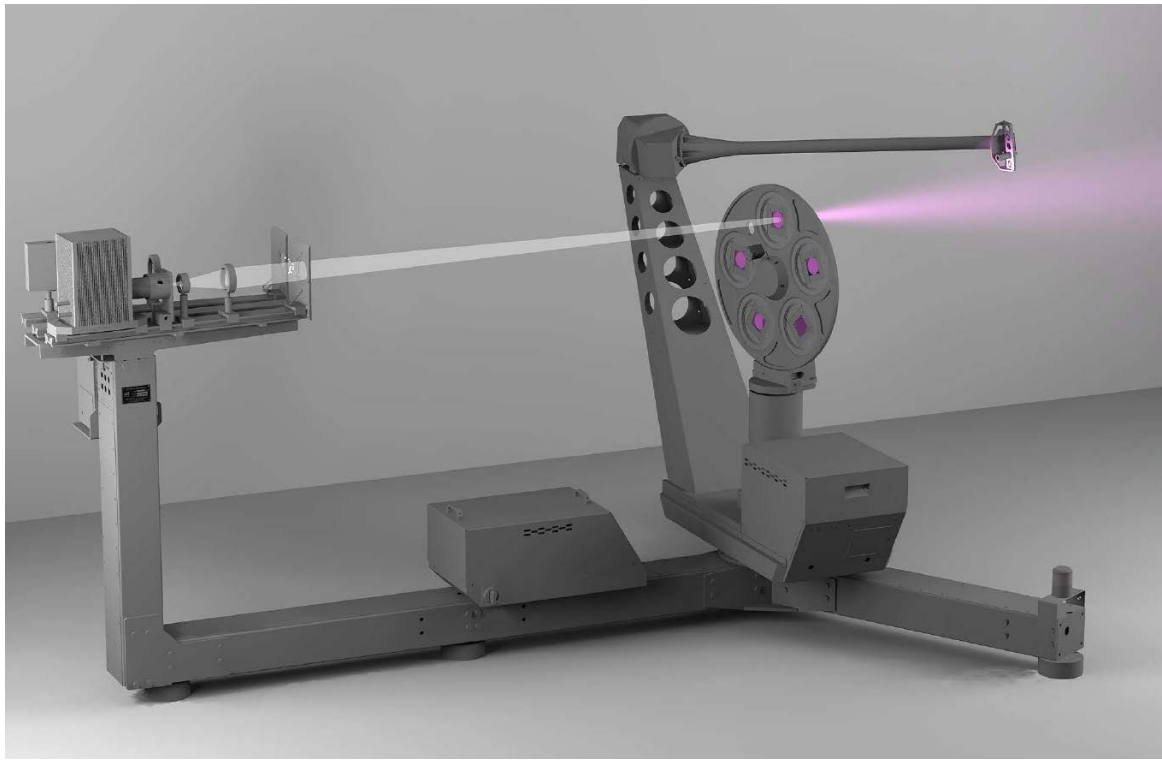


Difference front and back



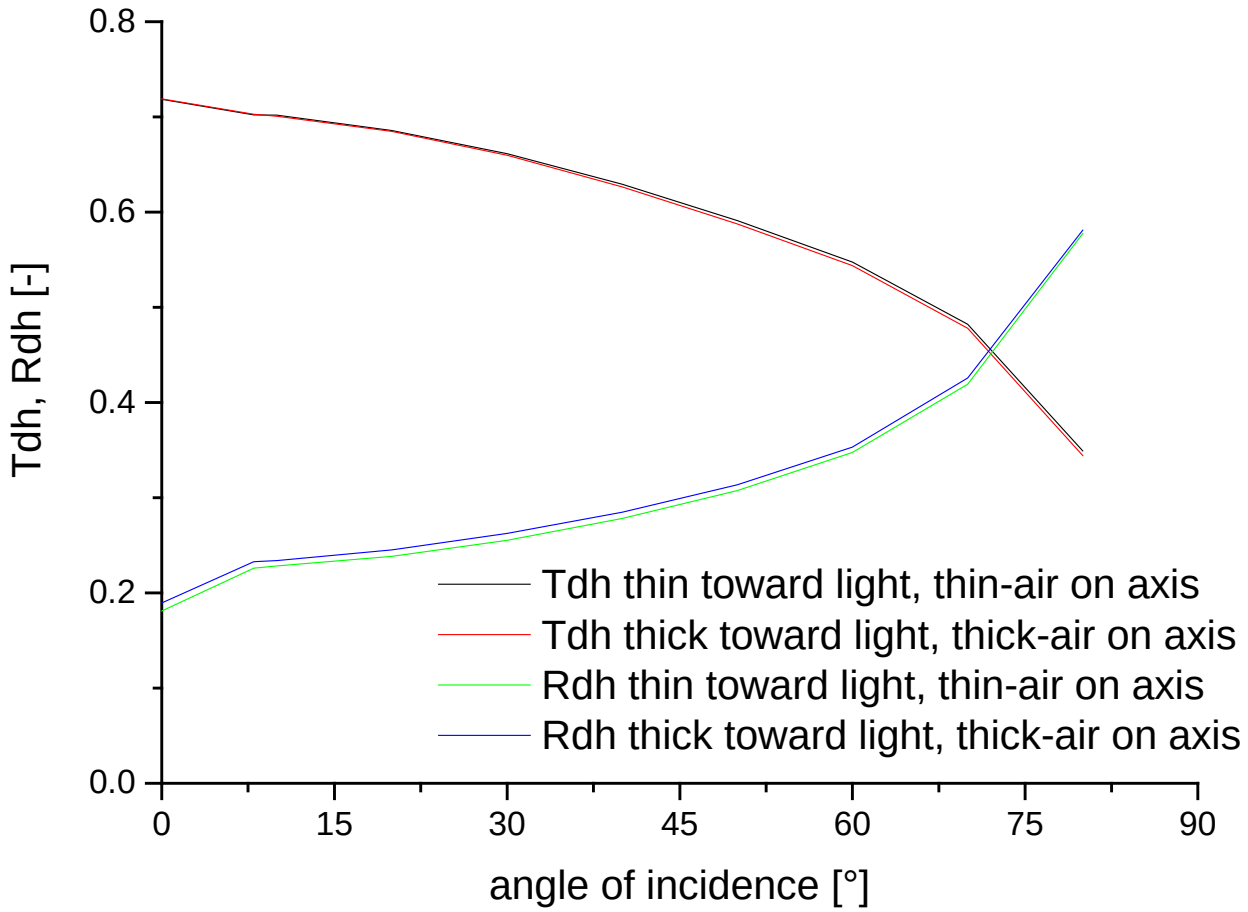
Goniophotometer measurements

- Captures angle resolved broadband signal
- Side loss has to be on the order of 10 inches
- Research tool and it is not trivial to replicate identical cond-itions between LBNL & ISE Learning through collaboration



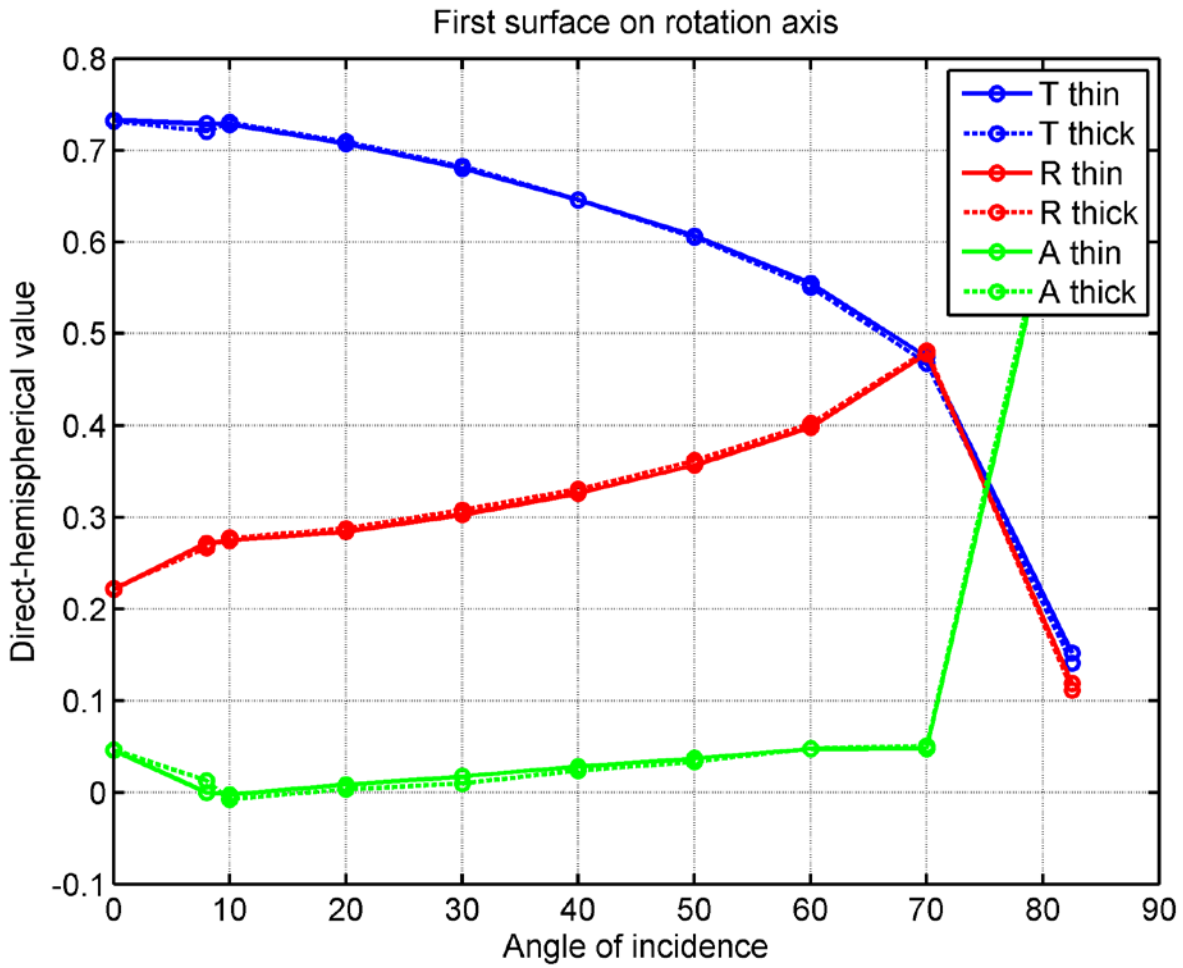
Angle-resolved data from ISE-pgII

- Visible value
- Almost no difference seen based on position of the diffusing interlayer, i.e. front/back of the sample



Angle-resolved data from lbl-pgII

- Visible value
- Almost no difference seen based on position of the diffusing interlayer
- Very low absorption at 10 degrees, solved



IR properties of rough samples

- Comparison of emisso-meter and FTIR for fritted glass with coatings
- Need to include IR sphere
- True value?

#	Sample Description	Side	Gloss*	Emissometer Reading	FTIR Emissivity	Decrease when movi
1	Uncoated V175	No Frit	74	0.827	0.846	0.019
	(White)	Frit	64	0.81	0.836	0.026
	Decrease as frit is added			0.017	0.01	0.036 <-moving
2	Uncoated V907	No Frit	75	0.822	0.846	0.024
	(Black)	Frit	67	0.813	0.84	0.027
				0.009	0.006	0.033
3	V175 with VE-85	No Frit	64	0.096	0.089	-0.007
	(White)	Frit	24	0.109	0.31	0.201
				-0.013	-0.221	-0.02
4	V907 with VE-85	No Frit	64	0.095	0.088	-0.007
	(Black)	Frit	31	0.12	0.25	0.13
				-0.025	-0.162	-0.032
5	V175 with VE-2M	No Frit	56	0.043	0.038	-0.005
	(White)	Frit	22	0.053	0.307	0.254
				-0.01	-0.269	-0.015
6	V907 with VE-2M	No Frit	56	0.042	0.037	-0.005
	(Black)	Frit	33	0.055	0.183	0.128
				-0.013	-0.146	-0.018
7	V175 with VNE-63	No Frit	79	0.03	0.025	-0.005
	(White)	Frit	43	0.036	0.263	0.227
				-0.006	-0.238	-0.011
8	V907 with VNE-63	No Frit	82	0.03	0.026	-0.004
	(Black)	Frit	51	0.046	0.231	0.185
				-0.016	-0.205	-0.02

Ballot strategy

- No intentional language regarding diffuse glazing in the current ballot
- Decided to try to tidy up documents with editorial changes in separate ballot to not be distracted by these for when the new diffuse language is added

Main components to include in 300 partially completed

- Definition of how to measure diffuse and specular component
- Definition of correction factors for diffuse signals

Main components to include in 301 partially completed

- Define difference between surface and bulk scattering
- Mirror 300 requirements for integrating spheres
- Validate emissometer measurements as a viable alternative to IR integrating spheres
- Include language for emissometer measurements

Main components to include in 302 partially completed

- Reporting requirements
- Tolerance for light scattering

NFRC 300 goals

- Section 2: Updated the products covered/not covered for clarity.
- Section 3: Updated the year on ASTM E 903, ISO 9050, ISO 15099 and updated the LBNL website.
- Section 4: Updated and added definitions both for clarity of old properties and for new.
- Section 6: Updated wavelength requirements to what is used for the IGDB and filled in gaps in the process
- Section 7: Specified specular in one case

NFRC 300 short comings

- We added large thickness as a sample property that requires special care. A specific number was left out as it would depend on the instrument geometry and the sample properties
  - Planned solution: Change the word definition in 2.2.3 where it references 6.1. Possibly extend the note in 6.1
- We lost a footnote in 2.1 when we moved solar heat gain coefficient, that should stay in
- The word Lambertian merits a definition in the terminology
- ASTM E275 was updated recently to cut out NIR
  - Update the Referenced documents to contain current titles and year on the standards

NFRC 301 goals and short comings

- Editorial changes of the blackbody temperature used, old number “23ºC (75ºF)” replaced by 27ºC
- Added standard E408 for FTIR instruments
  - Unintended consequence as it is not recommended for specular samples
  - Forgot to update year on standards
- Added reporting requirements to prepare for other use of integrating spheres and emissometers

NFRC 302 goals and short comings

- Continue the 302 TG work from 2013
- The ASTM standard talking about ILCs has been discontinued
  - Replace reference with outline for the NFRC ILC procedure (search and replace LBNL with less specific name)

1. Sample selection committee	7. LBNL packaging and shipping
2. Identify participants	8. Participants measure
3. Secure sample providers	9. Data sent to LBNL
4. Ship samples to LBNL	10. Initial report
5. LBNL writes instructions	11. Measurement iteration until passed
6. LBNL preliminary characterization	12. Final report with analysis

Future tasks

- Update 300 series documents (deal with current comments) and include work almost finished in
- Multi layer calculations need more work but premature if we do not have single layer data
- Computational means exist in Berkeley lab WINDOWS and Radiance but require models for angle dependence (incident and outgoing)
- Models exist but would require some validation
- ILC for measurement of diffuse glazing