ePIC pfRICH Aerogel QA Progress Report

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Outline

- ❑ Aerogel Factory n=1.02 tiles
- ❑ Aerogel QA Procedure

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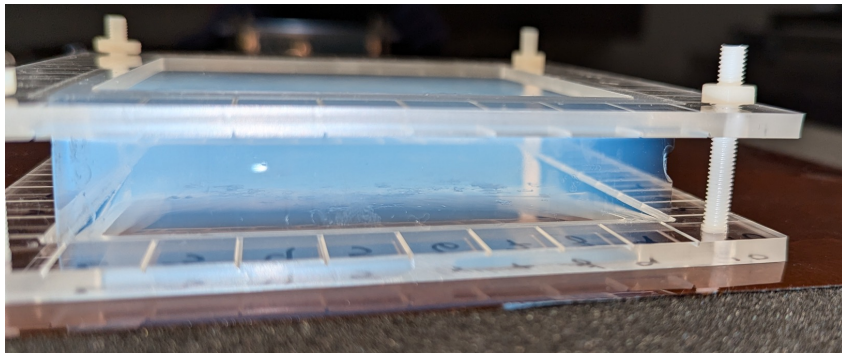
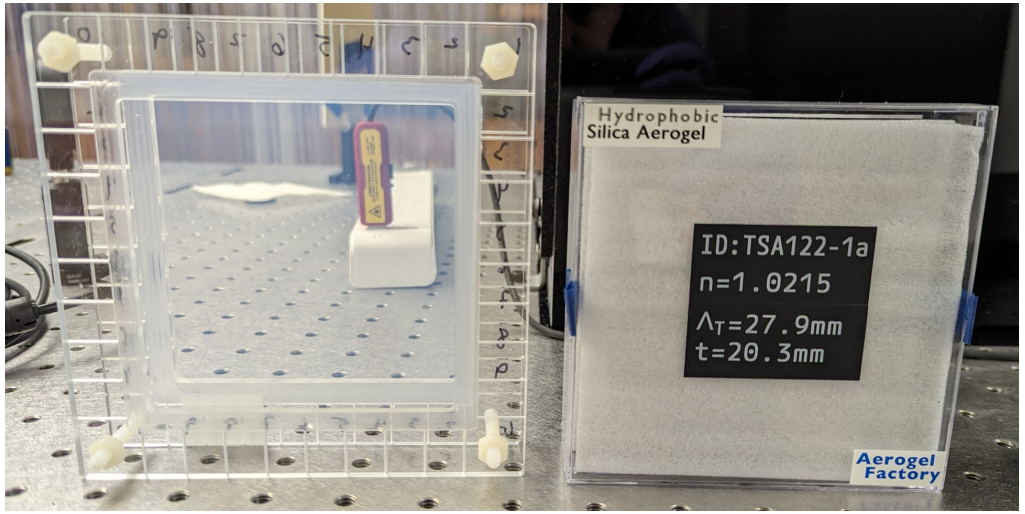
Aerogel Factory n=1.02 Tile

Type	n=1.02	n=1.02	n=1.02	n=1.02	n=1.02
Serial number	**TSA122-1a**	**TSA122-2a**	**TSA122-2b**	**TSA153-2**	**TSA153-3**
Refractive index (at 405 nm)	**1.0215**	**1.0215**	**1.0215**	**1.0215**	**1.0223**
Transmission length (at 400 nm) [mm]	27.9	33.3	34.1	28.0	30.0
Transmittance (at 400 nm) [%]	48.4	54.7	55.7	49.0	51.5
Lateral tile size (nominal) [mm]	107.1	107.2	107.1	107.5	106.8
Thickness (nominal) [mm]	20.3	20.1	19.9	20.0	19.9
Weight [g]	18.59	18.62	18.37	18.36	18.56
Density [g/cm^3]	0.080	0.081	0.080	0.079	0.082
Appearance	Good	Good	Good	Good	Good
File name of transmittance data [.txt]	tsa122-1a	tsa122-2a	tsa122-2b	tsa153-2	tsa153-3





n = 1.02 Tiles: Index of Refraction

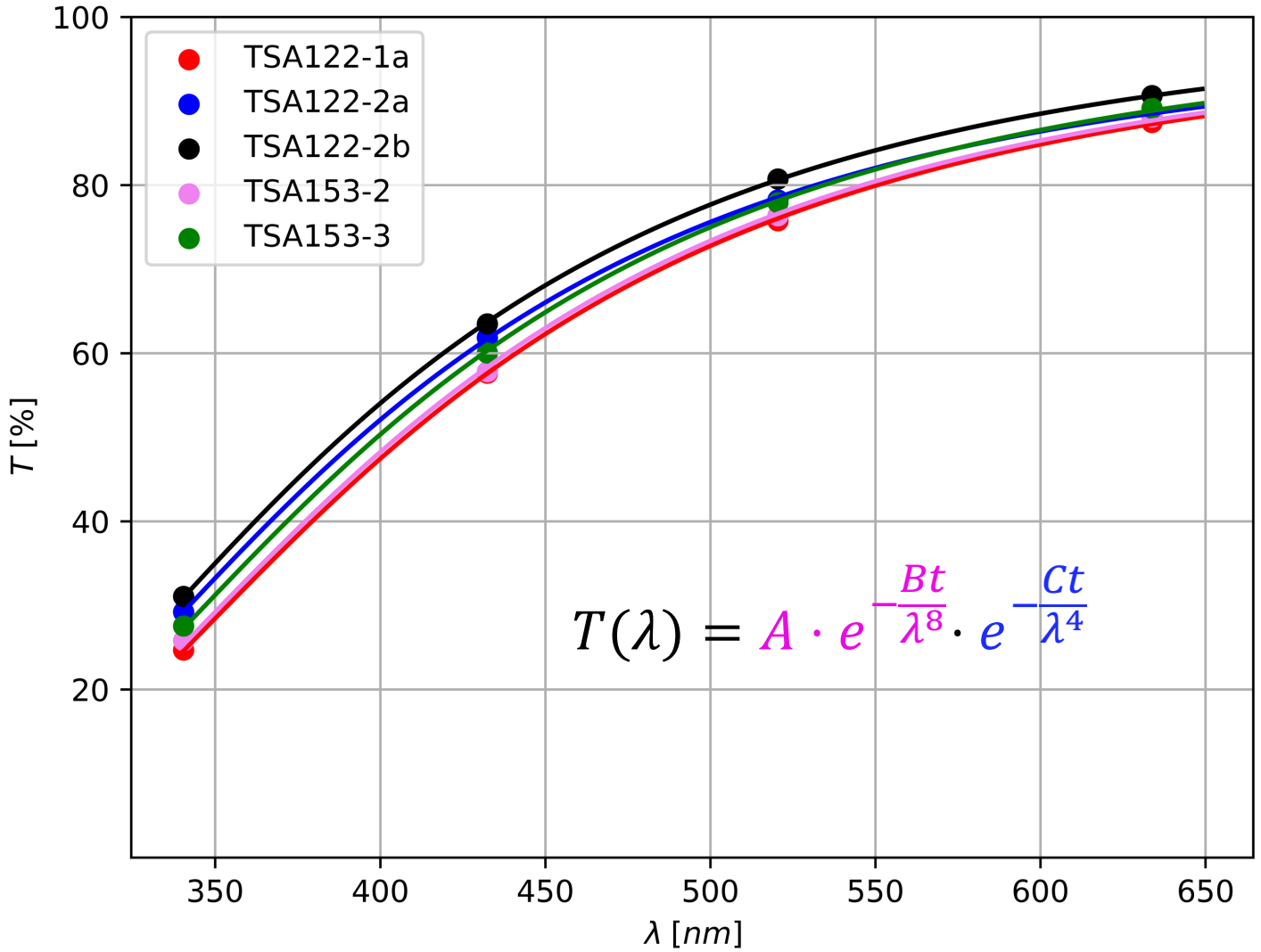
- Agree with Aerogel Factory specs

Index of refraction results. TU average of four corner measurements.

Tile	Measurement Source	LED λ $[nm]$	n	(AF – TU)/AF [%]
TSA122-1a	Aerogel Factory	405	1.0215	
	Temple	**403**	**1.0216 +/- 0.0026**	**0.013**
TSA122-2a	Aerogel Factory	405	1.0215	
	Temple	**403**	**1.0215 +/- 0.0026**	**0.002**
TSA122-2b	Aerogel Factory	405	1.0215	
	Temple	**403**	**1.0215 +/- 0.0026**	**0.002**
TSA153-2	Aerogel Factory	405	1.0215	
	Temple	**403**	**1.0219 +/- 0.0026**	**0.048**
TSA153-3	Aerogel Factory	405	1.0223	
	Temple	**403**	**1.0229 +/- 0.0026**	**0.060**

Transmittance

- n = 1.02 Aerogel Factory Tiles Transmittance



Fit Parameters

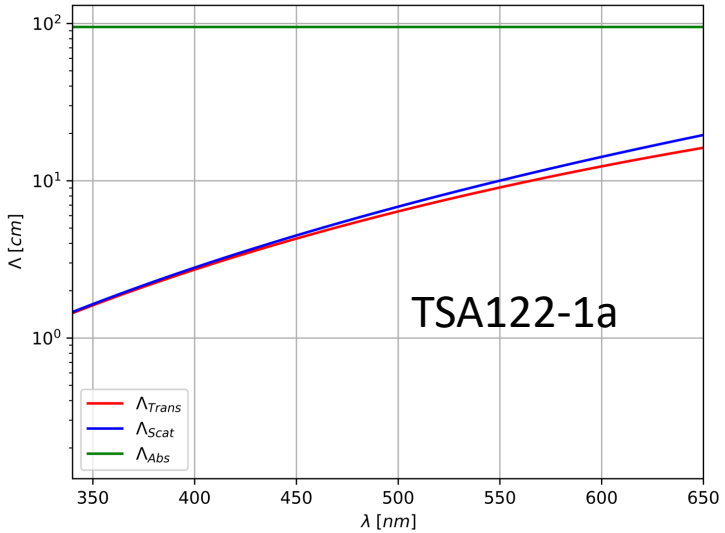
- B parameter found to be ~0
  - Will investigate further

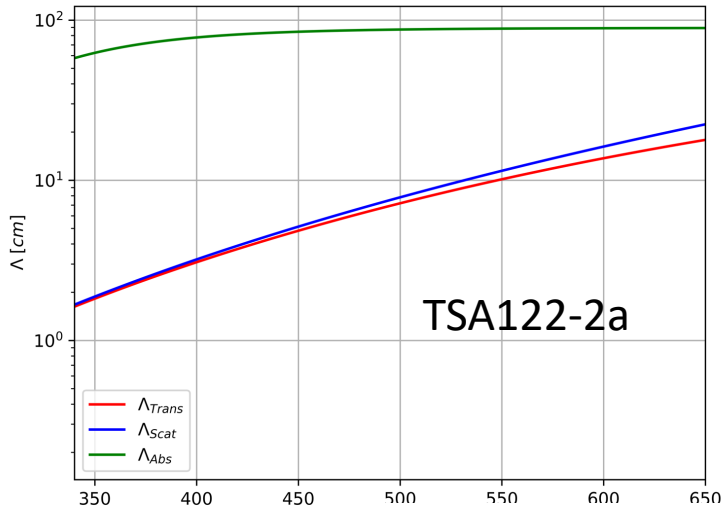
Hunt extended formula fit parameter results from TU measurements.

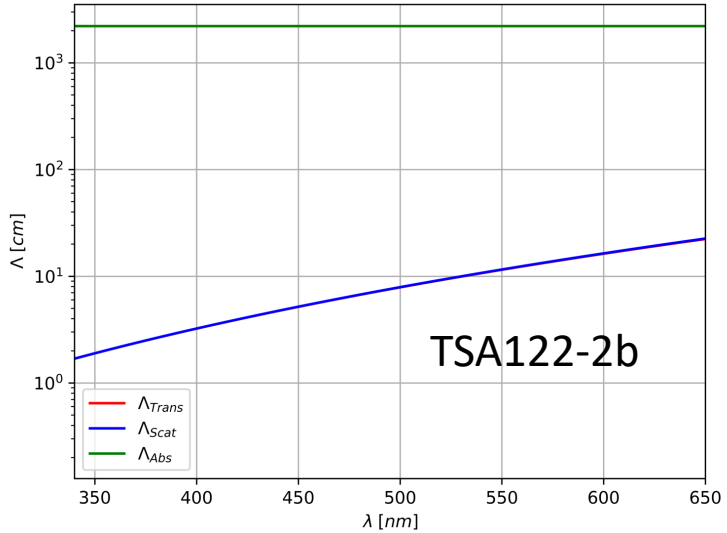
Tile	$t\ [cm]$	A	$B\ \left[\frac{\mu m^8}{cm}\right]$	$C\ \left[\frac{\mu m^4}{cm}\right]$
TSA122-1a	2.03	0.9789 ± 0.0173	$10^{-24} \pm 1.08\times10^{-5}$	0.0091 ± 0.0008
TSA122-2a	2.01	0.9778 ± 0.0168	$1.09\times10^{-6} \pm 9.96\times10^{-6}$	0.0080 ± 0.0007
TSA122-2b	1.99	0.9991 ± 0.0167	$10^{-25} \pm 9.70\times10^{-6}$	0.0079 ± 0.0007
TSA153-2	2.00	0.9814 ± 0.0172	$10^{-23} \pm 1.075\times10^{-5}$	0.0091 ± 0.0008
TSA153-3	1.99	0.9890 ± 0.0170	$10^{-24} \pm 1.037\times10^{-5}$	0.0087 ± 0.0008

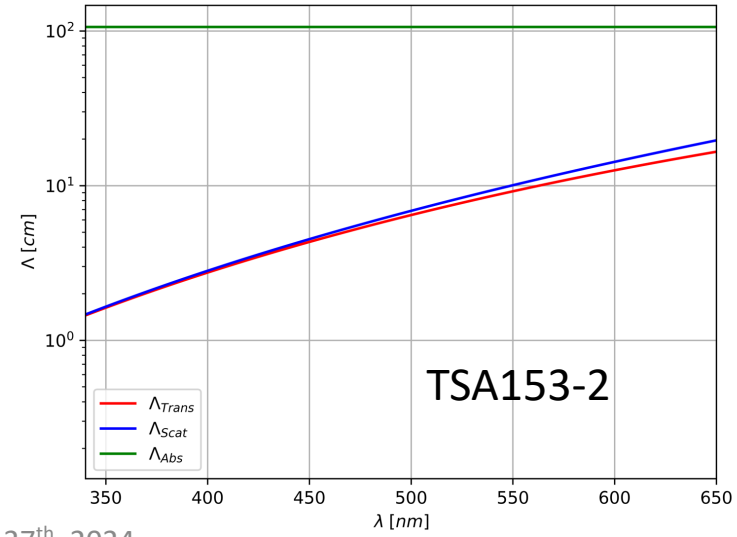
Lengths

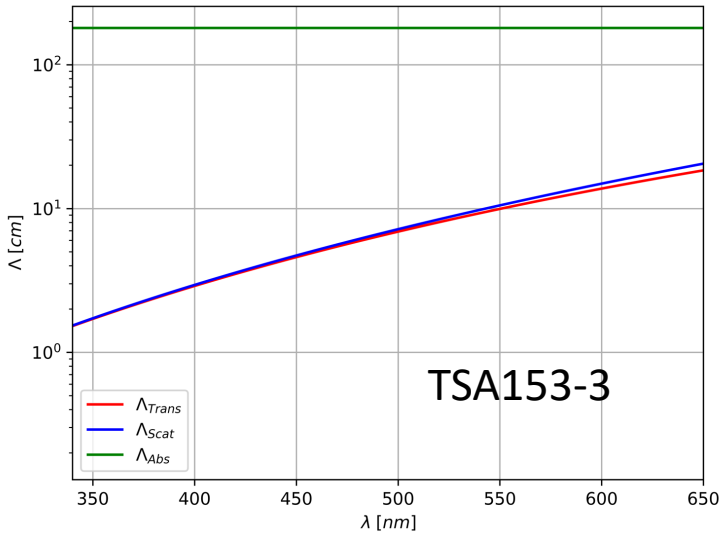
$$\Lambda_{transm} = -\frac{t}{\ln(T)} \qquad \Lambda_{scat} = \frac{\lambda^4}{C} \qquad \Lambda_{abs} = \frac{t\lambda^8}{Bt - \lambda^8 \ln(A)}$$











Quantities @ 400nm

- Within uncertainties of Aerogel Factory specs

Lengths calculated from TU fit results at $\lambda = 400\ nm$.

Tile	$t\ [cm]$	T[%] (TU)	T[%] (AF)	Λ_{Transm} [cm] (TU)	Λ_{Transm} [cm] (AF)
TSA122-1a	2.03	47.44 ± 3.45	48.4	2.722 ± 0.131	2.79
TSA122-2a	2.01	52.07 ± 3.57	54.7	3.080 ± 0.161	3.33
TSA122-2b	1.99	54.03 ± 3.59	55.7	3.232 ± 0.175	3.41
TSA153-2	2.00	48.22 ± 3.47	49.0	2.742 ± 0.135	2.80
TSA153-3	1.99	50.31 ± 3.51	51.5	2.897 ± 0.148	3.00

Outline

- Aerogel Factory n=1.02 tiles
- Aerogel QA Procedure

Aerogel QA Procedure

1. Properties of each Aerogel tile that needs to be determined
2. Process/procedures of how these parameters are determined
3. Experimental setup with which these parameters are measured
4. Bookkeeping: how we plan to collect, retain, store the information and make them accessible

Aerogel QA Procedure

1. Properties of each Aerogel tile that needs to be determined
   a. Visual inspection (e.g. cracks, marks …)
   b. Dimensions and weight
   c. Planarity – touch probes? Reference frame?
   d. Transmittance and its uniformity, fit parameters → Transmission length, scattering length, absorption length
   e. Index of refraction, variation of n

Acceptable tolerances will need to be worked out for all QA quantities

NIM A 433 (1999), 396

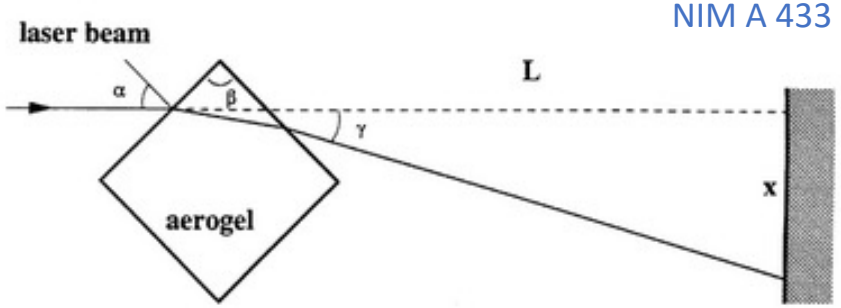


Fig. 1. The aerogel refractive index measurement.

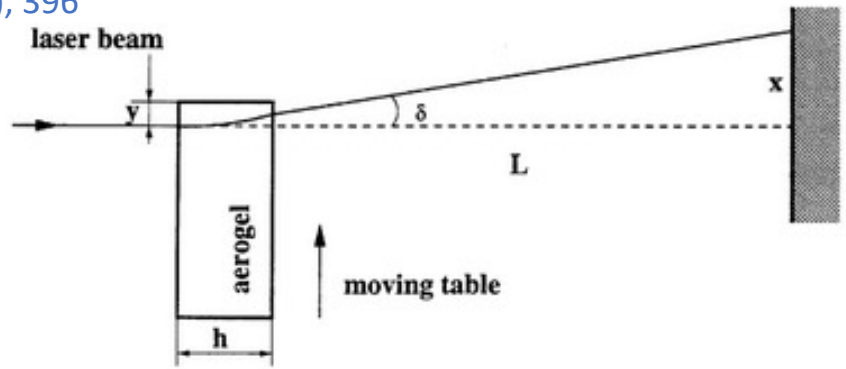


Fig. 2. The aerogel refractive index variation measurement.

Aerogel QA Procedure

2. Process/procedures of how these parameters are determined
3. Experimental setup with which these parameters are measured
4. Bookkeeping: how we plan to collect, retain, store the information and make them accessible
    - Will use database to track aerogel location, ID, measurement results, implement pass/fail checks based on tolerances …
    - Database software still TBD, but DB requirement document ensures proper bookkeeping will be available

Summary

- ❑ Measured Aerogel Factory n=1.02 tiles (5 tiles)
  - Measured index of refraction (via prism method) and transmittance
  - TU measurements found to be consistent (within uncertainties) with Aerogel Factory specs
- ❑ Continue investigating transmittance fitting procedure
- ❑ Investigate n variation measurement setup
- ❑ Follow up with QA procedures

Backup

Fit Transmittance

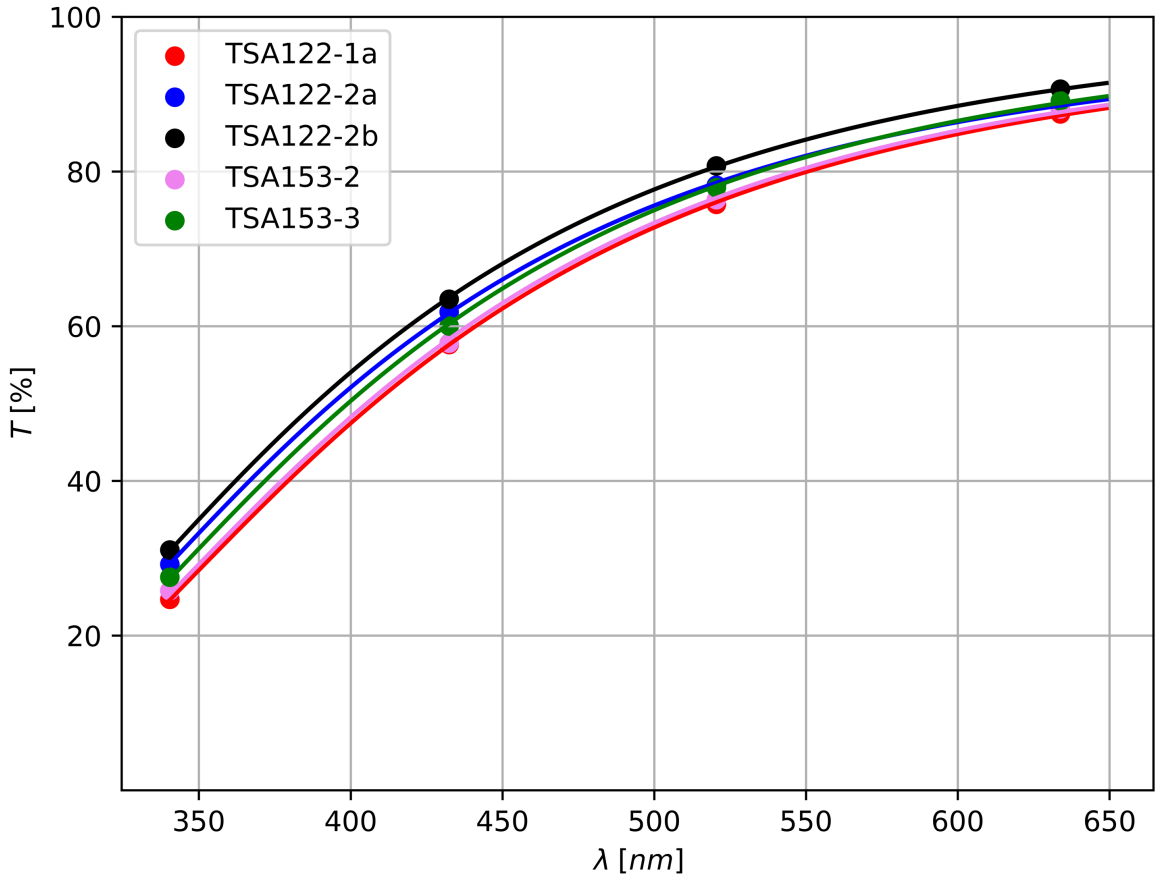
❑ Hunt Extended Formula

$$T(\lambda) = e^{-\frac{t}{\Lambda_{transm}}} = e^{-t\left(\frac{1}{\Lambda_{abs}} + \frac{1}{\Lambda_{scat}}\right)} = A \cdot e^{-\frac{Bt}{\lambda^8}} \cdot e^{-\frac{Ct}{\lambda^4}}$$

$$\Lambda_{transm} = -\frac{t}{\ln(T)}$$

$$\Lambda_{scat} = \frac{\lambda^4}{C}$$

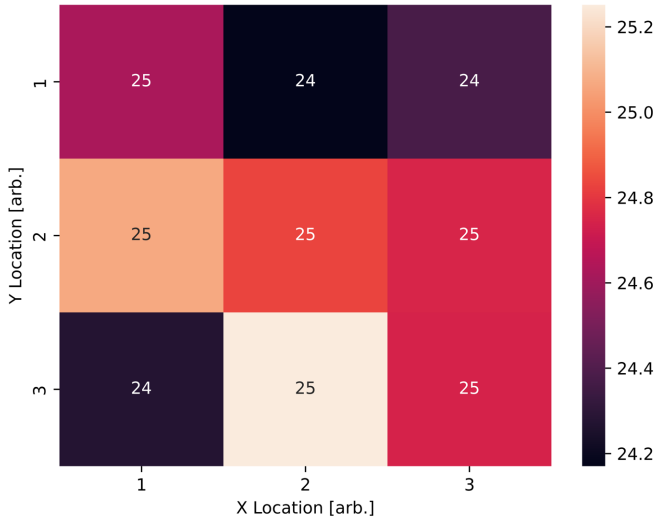
$$\Lambda_{abs} = \frac{t\lambda^8}{Bt - \lambda^8 \ln(A)}$$



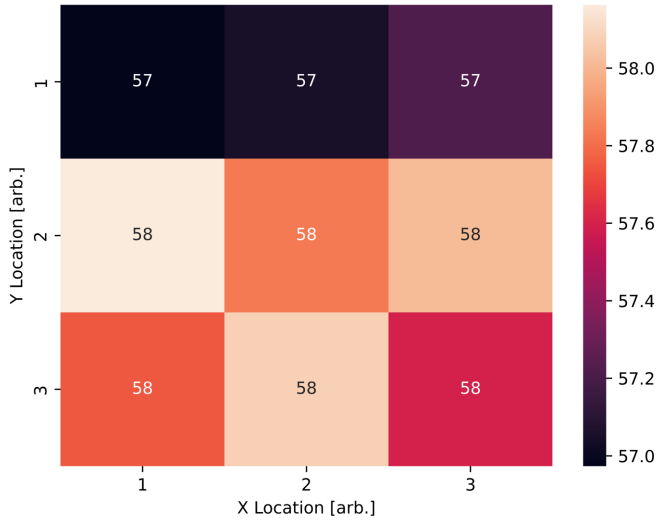
n = 1.02 Tiles: Transmittance Uniformity

- TSA122-1a

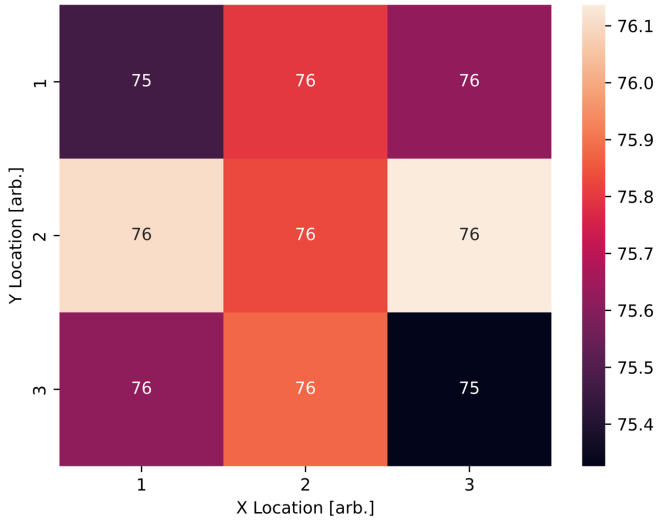
$< \lambda > = 340.5\ nm$



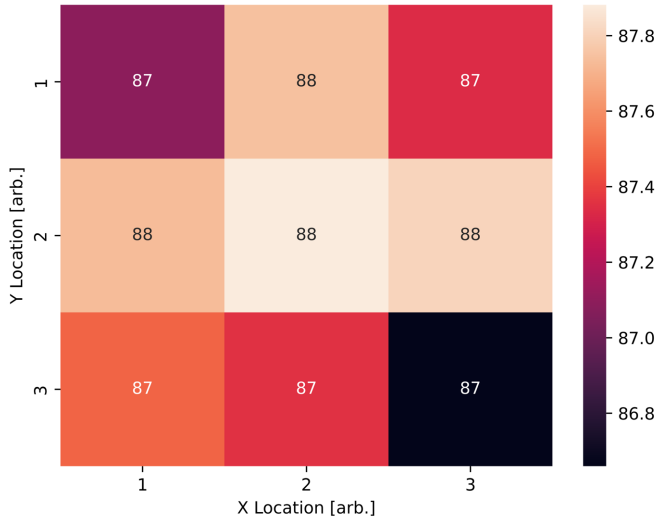
$< \lambda > = 432.4\ nm$



$< \lambda > = 520.5\ nm$



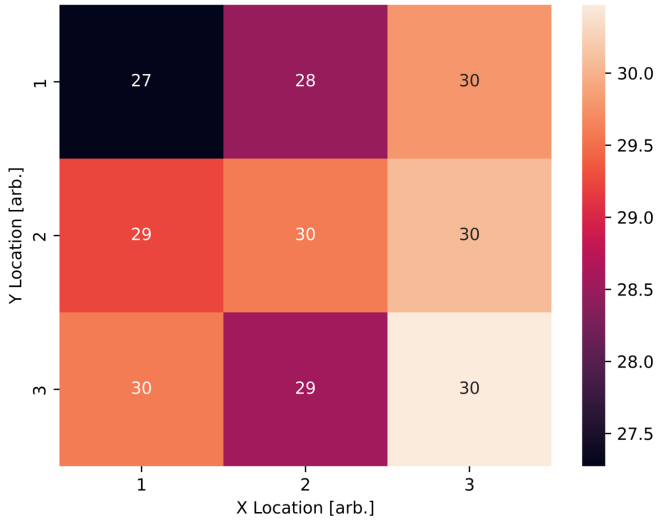
$< \lambda > = 633.8\ nm$



n = 1.02 Tiles: Transmittance Uniformity

- TSA122-2a

$< \lambda > = 340.5\ nm$



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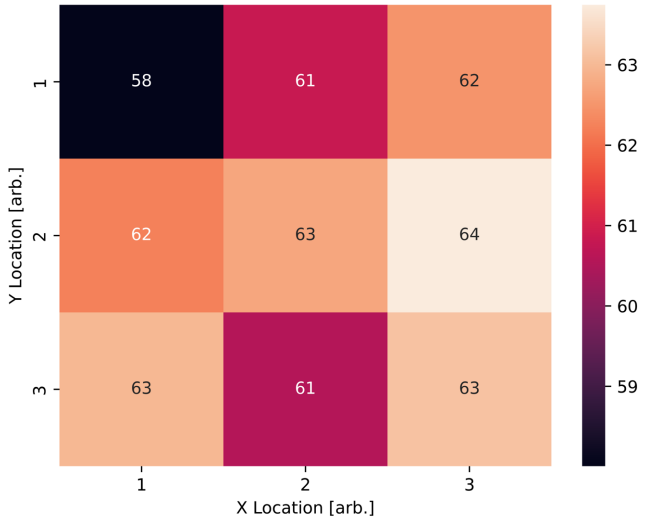

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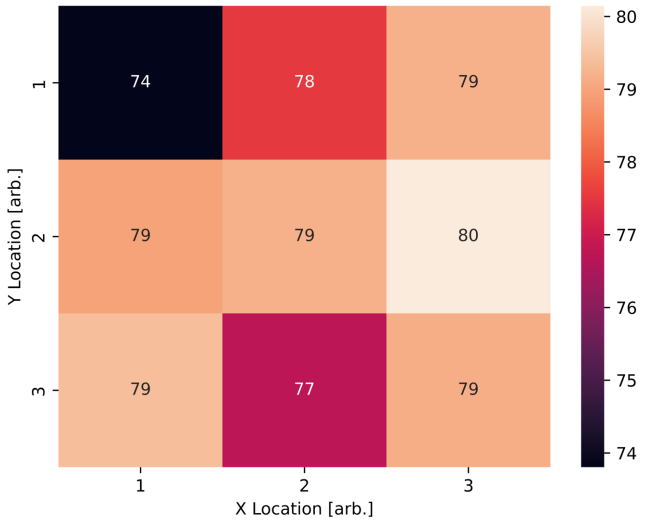

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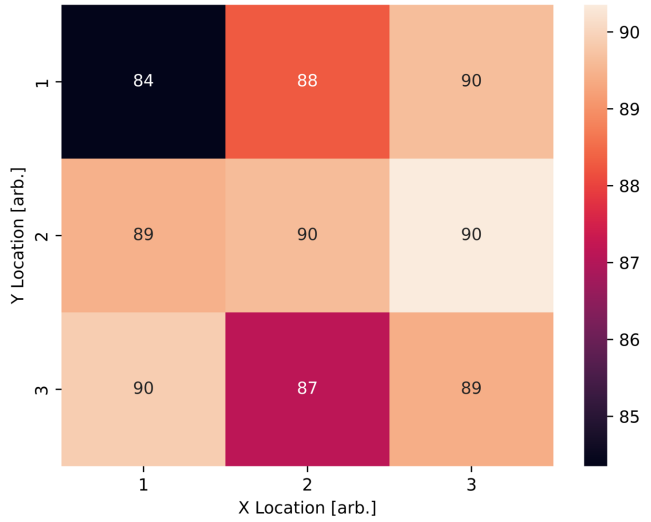
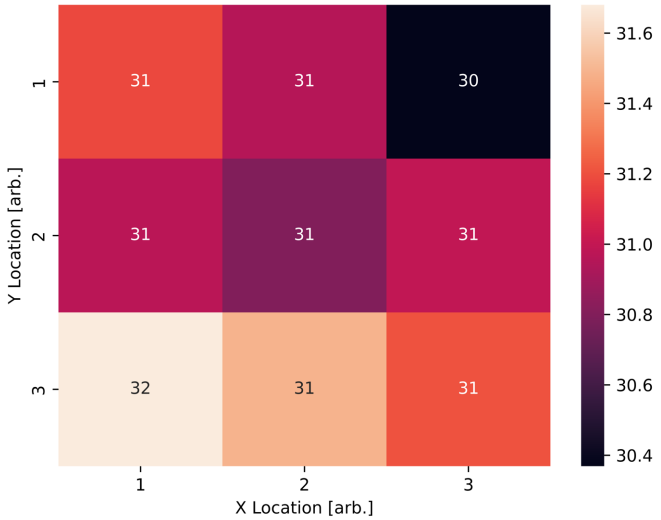


n = 1.02 Tiles: Transmittance Uniformity

- TSA122-2b

$< \lambda > = 340.5\ nm$



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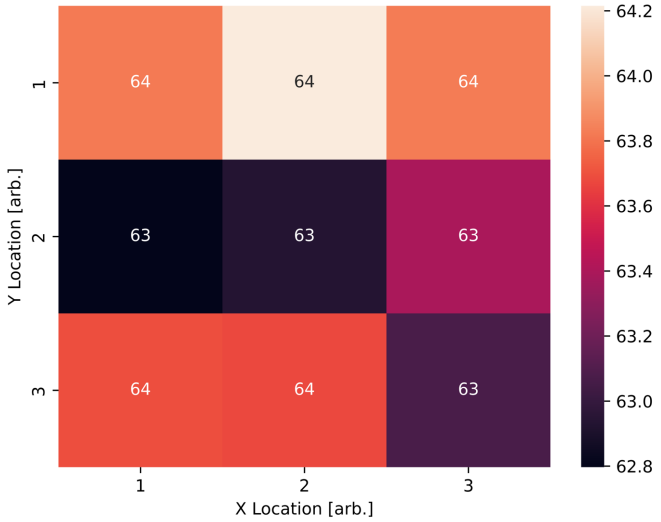

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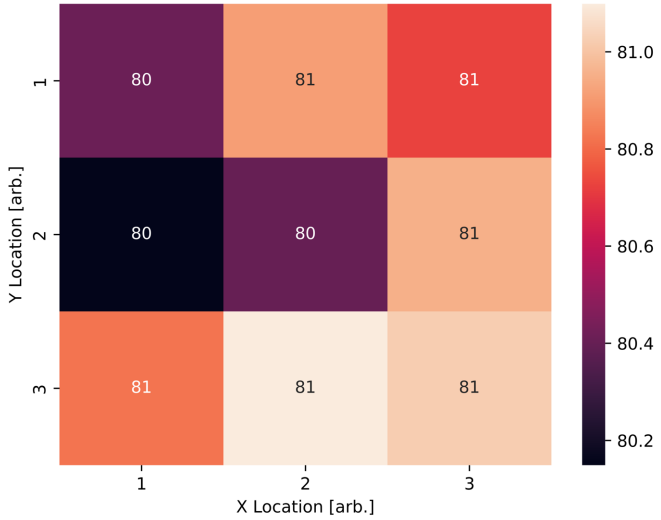

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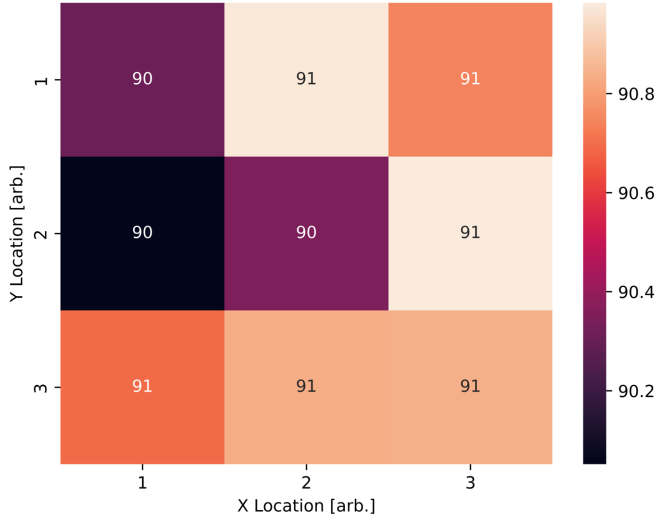
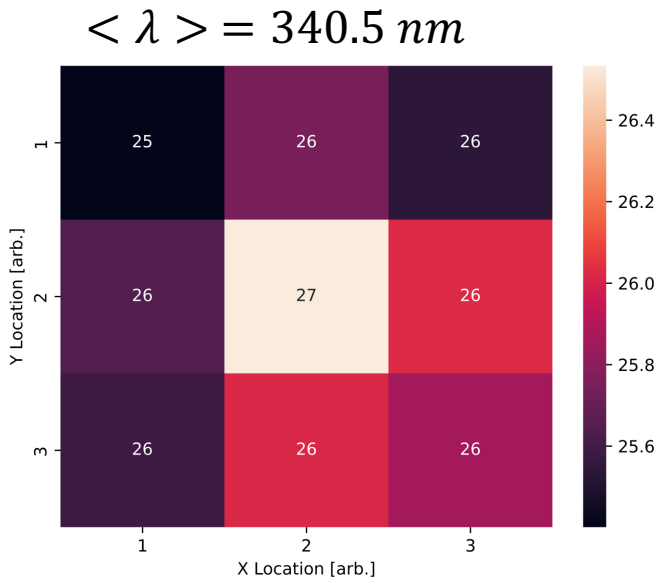
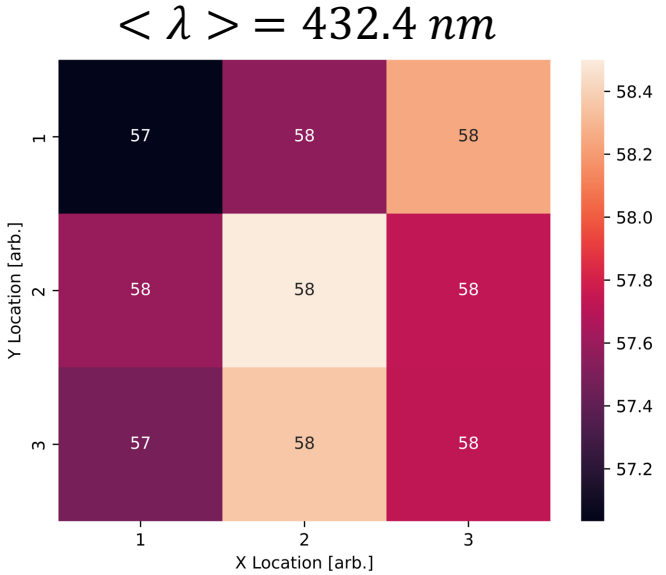
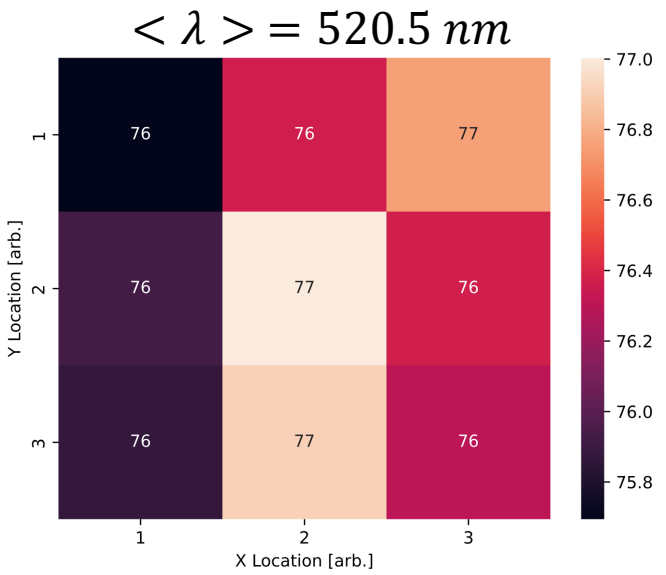


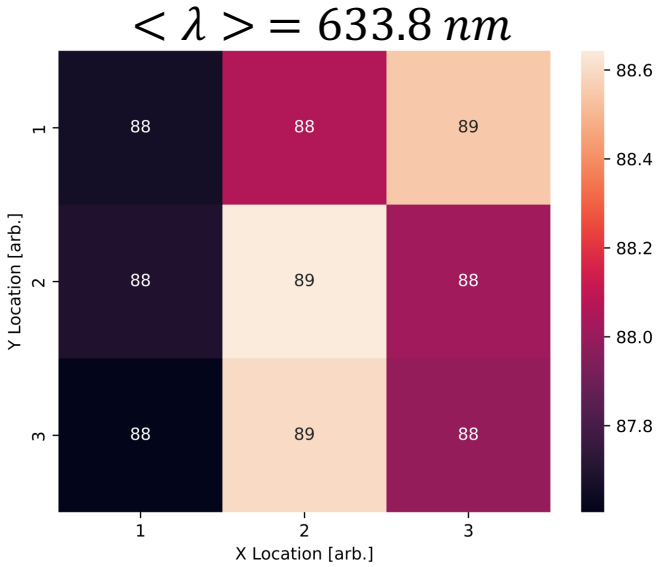
n = 1.02 Tiles: Transmittance Uniformity

- TSA153-2









n = 1.02 Tiles: Transmittance Uniformity

- TSA153-3

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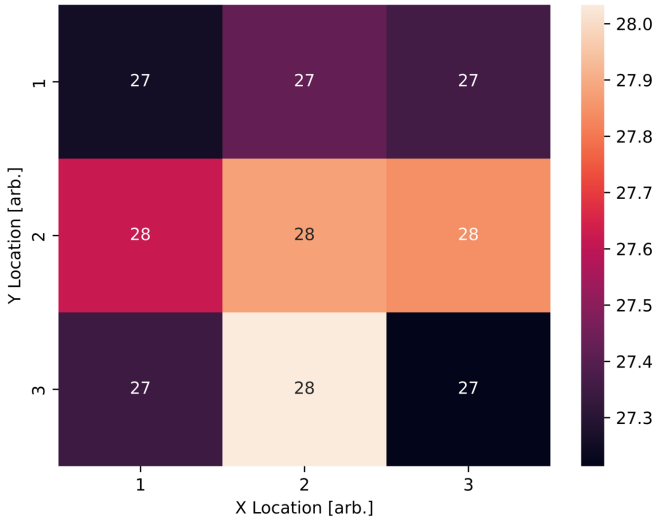

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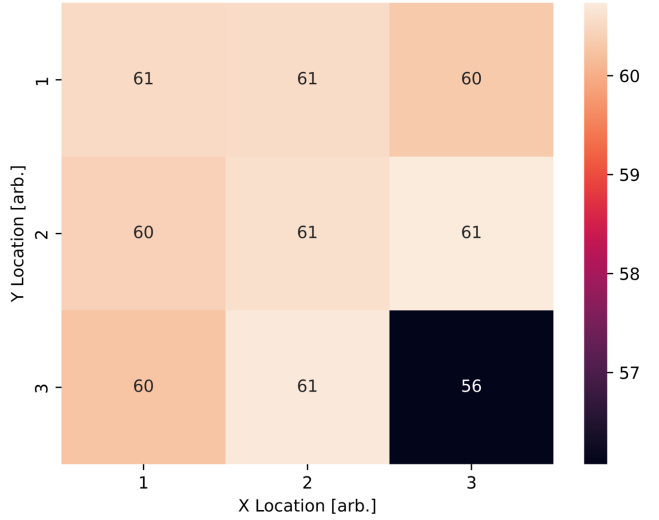

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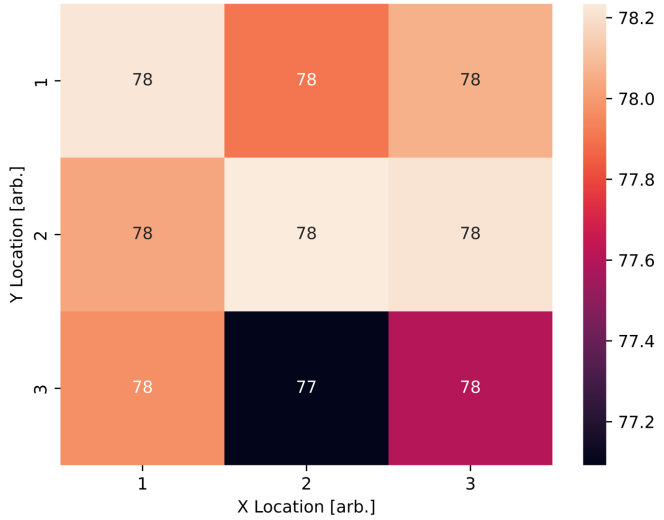

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