



Ray and Path Sorting in TracePro

A Lambda Research Corporation Webinar December 15, 2016



Presenter

Presenter

Dave Jacobsen Sr. Application Engineer Lambda Research Corporation

Moderator

Mike Gauvin Vice President of Sales and Marketing Lambda Research Corporation



Format

- A 25-30 minute presentation followed by a question and answer session
- Please submit your questions anytime using Question box in the GoToWebinar control panel





Additional Resources

- Past TracePro Webinars
 - http://www.lambdares.com/webinars
- TracePro Tutorial Videos
 - http://www.lambdares.com/videos
- TracePro Tutorials
 - <u>http://www.lambdares.com/features/tracepro-tutorials</u>
- Information on upcoming TracePro Training Classes
 - <u>http://www.lambdares.com/training/software-training</u>



Upcoming TracePro Training

- Jena, Germany
 - Introduction to TracePro March 6-7, 2017
 - Optimization with TracePro March 8-9, 2017
 - Stray Light Analysis using TracePro March 10, 2017
- Littleton, MA USA
 - Introduction to TracePro April 11-12, 2017
 - Optimization with TracePro–April 13-14, 2017
- Please ask us about custom onsite training



Latest TracePro and RayViz Release

TracePro 7.8.0 - Released October 1, 2016

RayViz 7.8.0 - Released October 1, 2016

Customers with current maintenance and support agreements can download this new release at:

http://www.lambdares.com/CustomerSupportCenter/index.php/trace-pro/current-release







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Agenda

- What is Ray Sorting and Path Sorting and how are they different
- Ray Sorting options in TracePro
- The Path Sort Table
- Defining Path Sort Filters
- Ray and Path Sorting uses, including stray light analysis
- Questions and Answers



Example TracePro Model

Crossed Czerny-Turner spectrometer









What is Ray and Path Sorting?



Ray and Path Sorting - Differences

- The Ray and Path Sorting tools are located in the Analysis menu in TracePro
- Can be used to display a subset of the complete raytrace results
- Ray Sorting shows all rays that meet a specified criteria
- Path Sorting shows rays that follow a discrete path to a selected surface
- The Ray and Path Sorting tools are available in all versions of TracePro
- Ray Sorting for Single and Multiple Bulk Scatter and Diffraction requires TracePro Standard or Expert
- Ray and Path Sorting can also be applied to the Irradiance/Illuminance Map



Ray and Path Sorting - Differences

Ray Sorting



Ray Sorting shows all rays that meet a specified criteria, such as hitting a selected surface, wavelength, or surface interaction type

Path Sorting shows all rays that follow a discrete path to reach a selected surface

Path Sorting









Ray Sorting allows for sorting rays based on a specified criteria

Analysis->Ray Sorting

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	Model:[Spectrometer.oml]	Ray Colors		
	E-G Spectrometer	Ray Sorting		
	in → Slit	Path Sort Table		
	Grating Grating Grating Grating Mirror Collimating Mirror	Irradiance/Illuminance Maps Irradiance/Illuminance Options	Ray Sorting	- 🗆 ×
	CCD Detector 	Luminance/Radiance Maps Luminance/Radiance Map Options	Ray Sort for N	10del Window.
		3D Irradiance/Illuminance 3D Irradiance/Illuminance Options	Sort Type: All Rays	<u>•</u>
	⊡-Surface 5 Entity 3 Block	Candela Plots > Candela Options	Sources: All	•
	Window Ortector Mount Grating Mount	Polarization Maps Polarization Options	Wavelength: All	•
	Collimating Mirror Mount	OPL/Time-of-flight Plot OPL/Time-of-flight Plot Options	% Starting Rays to Dis	play: 100
	E ✓ Cover E ✓ Slit Mount Tube	Incident Ray Table Ray Histories	Flux Display Range (as a	fraction of Peak Flux) ———
			Hux Range - Peak 1e-005	o watts
			Min	(0.0 - 1.0)



Sort Type Options

- Selected Surface
- Specular
- Single Surface Scatter
- Multiple Surface Scatter
- Single Bulk Scatter
- Multiple Bulk Scatter
- Single Diffraction
- Multiple Diffraction

Ray	Sort for Model W	indow.		
Sort Type	: All Rays	-]	
	All Rays			
6	Selected Surface	2		
Sources	Single Surface S	catter		
Wavelength	Multiple Surface	Scatter		
ne n	Single Bulk Scatt	er		
% Starting F	Single Diffraction	1		
Flux Display Ra	Multiple Diffracti	on	-ux)	
Flux Range - P	eak 1e-005 Watts			
Min	Max	(0	.0 - 1.0)	



Additional Sort Options

- Sort by Source
- Sort by Wavelength
- Display a percentage of the starting rays
- Sort by a range of flux values, as a fraction of the peak value

Ray Sorting	- 🗆 X
Ray Sort for Mod	del Window.
Sort Type: All Rays	•
Sources: All	•
Wavelength: All	•
% Starting Rays to Displa	ay: 100
Flux Display Range (as a fra	action of Peak Flux)
Flux Range - Peak 1e-005 V	Vatts



Initial raytrace results - not useable for analysis





Sort Type – Selected Surface





Sort Type – Wavelength





Sort Type – Selected Surface and Wavelength – note second order rays





Sort Type – Percentage of Starting Rays - - -Model:[Spectrometer.om]] G Spectrometer 🗄 🧹 Slit 🕀 🧹 Grating 🕀 🧹 Focusing Mirror E- Collimating Mirror E CCD Detector . Surface 0 Surface 1 Detector Surface 3 Surface 4 + Surface 5 Entity 3 Block 🕀 🧹 Window 🗄 🧹 Detector Mount E Grating Mount E Collimating Mirror Mount 🕀 🧹 Case + Cover 🗄 🧹 Slit Mount Tube Ray Sorting × Ray Sort for Model Window. Sort Type: All Rays • Sources: All • Wavelength: All -% Starting Rays to Display: 0.5 - 🗍 Flux Display Range (as a fraction of Peak Flux) Flux Range - Peak 1e-005 Watts Min Update Model Source Radiance



Sort Type – Specular Rays









Sort Type – Multiple Surface Scatter Rays – may require lower flux threshold





Sort Type – Range of Flux Values









The Path Sort Table



•

Analysis->Path Sort Table

Path Sorting allows for sorting rays by the discrete paths they take to a selected surface

TracePro Expert File Edit View Geometry Define Raytrace Optimize Analysis Reports Tools Utilities Macros Window Help 🗋 🗃 🔚 🎒 👗 🛍 🖼 🗠 🖂 🛞 🗊 🗰 🚺 🖌 Display Rays 📲 🖭 🕀 🖾 🐘 🕅 🤻 💦 **Display Selected Paths** 💥 🗸 🗸 🤋 🗉 🖸 🤈 1 🖼 🖉 🔍 🔍 🍭 🍭 🔍 🚋 👉 🔺 🖌 Ľz Ľz Ľx zľ **Display Selected Rays** Select Rays... Ray Colors... Model:[Spectrometer.oml] Ray Sorting... G Spectrometer 🗄 🧹 Slit Path Sort Table E Grating Irradiance/Illuminance Maps Focusing Mirror E Collimating Mirror Irradiance/Illuminance Options... CCD Detector Luminance/Radiance Maps... +- Surface 0 Luminance/Radiance Map Options... + Surface 1 + Detecto 3D Irradiance/Illuminance +- Surface 3 3D Irradiance/Illuminance Options.. +-Surface 4 - -+ Surface 5 Path Sort Table [Spectrometer.om] Candela Plots > -Entity 3 Candela Options... Sources: No. of intercepts: -Filter Editor -Block Apply Wavelengths: All -% of rays to display: 100 Select filters: 🔽 None -+ Vindow **Polarization Maps** 🗄 🧹 Detector Mount Polarization Options... Ray Path Source % of Total Path Type Wavelength No. Rays Absorbed Flux % of Total Incident Flux No. Intercepts No. Intercept Type Object Surface + Grating Mount ① 1 Slit Grid Source 0.4 0.129005549779135 49392 0.129005549779135 30.10 30,10 Specular **OPL/Time-of-flight Plot** Collimating Mirror Mount 2 Slit Grid Source 0.2 49934 0.128553687790855 30.00 0.128553687790855 30.00 Specular 3 Slit Grid Source 0.6 24809 0.0862091766888437 20.12 0.0862091766888437 20.12 Specular Focusing Mirror Mount OPL/Time-of-flight Plot Options... ① 4 Slit Grid Source 0.8 0.0847656197332225 0.0847656197332225 24379 19.78 19.78 Specular 🗄 🧹 Case ⊕ 5 Slit Grid Source 0.8 200 1.73135192951191e-005 0.00 1.73135192951191e-005 0.00 Single Surf Scat 8 Incident Ray Table E Cover ① 6 Slit Grid Source 0.8 124 9.71566949611267e-006 0.00 9.71566949611267e-006 0.00 Single Surf Scat 10 E Slit Mount Tube **Ray Histories** 7 Slit Grid Source 0.8 87 6 7911730791225e-006 0.00 6 7911730791225e-006 0.00 Single Surf Scat 10 8
 8 Slit Grid Source 0.6 4.56796072838936e-007 0.00 4.56796072838936e-007 0.00 Single Surf Scat 7 • 9 Slit Grid Source 0.4 4.56699408674095e-007 0.00 4.56699408674095e-007 0.00 Single Surf Scat 6 ● 10 Slit Grid Source 0.8 1.72581642881935e-007 0.00 1.72581642881935e-007 0.00 Single Surf Scat 8 11 Slit Grid Source 0.8 1.72505932439079e-007 0.00 1.72505932439079e-007 0.00 Single Surf Scat 8

12 Slit Grid Source 0.6

9.11860556920241e-008 0.00

9.11860556920241e-008 0.00

Single Surf Scat 7



Path Sort Table – Lists all the paths rays take to a selected surface

🔳 Path So	rt Table [Spectror	neter.oml]												- • •
	Sources:		.	No. of intercepts:			Fil	ter Editor			-			
	Wavelengths:			% of rays to display:		Solact filts			Appl	y				
	Therefore and the second secon		<u> </u>		100	Select litte	is je None	<u> </u>						
Ray Path	Source	Wavelength	No. Rays	Absorbed Flux	% of Total	Incident Flux	% of Total	Path Type	No. Intercepts	No.	Intercept Type	Object	Surface	· · · · · · · · · · · · · · · · · · ·
1	Slit Grid Source	0.4	49392	0.129005549779135	30.10	0.129005549779135	30.10	Specular	7					
⊕ 2	Slit Grid Source	0.2	49934	0.128553687790855	29.99	0.128553687790855	29.99	Specular	7					
3	Slit Grid Source	0.6	24809	0.0862091766888437	20.11	0.0862091766888437	20.11	Specular	7					
● 4	Slit Grid Source	0.8	24379	0.0847656197332225	19.78	0.0847656197332225	19.78	Specular	7					
	Slit Grid Source	0.8	180	1.55801147274786e-005	0.00	1.55801147274786e-005	0.00	Single Surf Scat	8					
	Slit Grid Source	0.8	124	9.71566949611267e-006	0.00	9.71566949611267e-006	0.00	Single Surf Scat	10					
• 7	Slit Grid Source	0.8	102	7.96361472605634e-006	0.00	7.96361472605634e-006	0.00	Single Surf Scat	10					
	Slit Grid Source	0.8	163	5.10063775120543e-006	0.00	5.10063775120543e-006	0.00	Single Surf Scat	11					
€ 9	Slit Grid Source	0.4	315	4.00133385772469e-006	0.00	4.00133385772469e-006	0.00	Single Surf Scat	5					
① 10	Slit Grid Source	0.8	305	3.88442867923526e-006	0.00	3.88442867923526e-006	0.00	Single Surf Scat	5					
① 11	Slit Grid Source	0.4	122	3.8115217689709e-006	0.00	3.8115217689709e-006	0.00	Single Surf Scat	10					
12	Slit Grid Source	0.6	276	3.51296523740237e-006	0.00	3.51296523740237e-006	0.00	Single Surf Scat	5					
13	Slit Grid Source	0.2	260	3.26619363480386e-006	0.00	3.26619363480386e-006	0.00	Single Surf Scat	5					
14	Slit Grid Source	0.6	62	2.15445074118627e-006	0.00	2.15445074118627e-006	0.00	Single Surf Scat	9					
① 15	Slit Grid Source	0.4	134	7.57887500631242e-007	0.00	7.57887500631242e-007	0.00	Single Surf Scat	11					
16	Slit Grid Source	0.2	103	7.40613806332179e-007	0.00	7.40613806332179e-007	0.00	Single Surf Scat	11					
① 17	Slit Grid Source	0.6	8	7.30425540752795e-007	0.00	7.30425540752795e-007	0.00	Single Surf Scat	7					
18	Slit Grid Source	0.6	19	6.60232345427624e-007	0.00	6.60232345427624e-007	0.00	Single Surf Scat	9					
19	Slit Grid Source	0.6	106	5.75610515892231e-007	0.00	5.75610515892231e-007	0.00	Single Surf Scat	11					
	Slit Grid Source	0.8	93	5.52073729286869e-007	0.00	5.52073729286869e-007	0.00	Single Surf Scat	9					
21	Slit Grid Source	0.4	1	4.56699408674095e-007	0.00	4.56699408674095e-007	0.00	Single Surf Scat	6					
① 22	Slit Grid Source	0.8	40	3.14059945287995e-007	0.00	3.14059945287995e-007	0.00	Multiple Surf Scat	9					
	Slit Grid Source	0.6	3	2.7358280821207e-007	0.00	2.7358280821207e-007	0.00	Single Surf Scat	7					
3 24	Slit Grid Source	0.6	35	2.70511238773133e-007	0.00	2.70511238773133e-007	0.00	Multiple Surf Scat	9					
25	Slit Grid Source	0.8	49	2.55459299919144e-007	0.00	2.55459299919144e-007	0.00	Single Surf Scat	11					
	Slit Grid Source	0.2	32	2.46357710548204e-007	0.00	2.46357710548204e-007	0.00	Multiple Surf Scat	9					
27	Slit Grid Source	0.4	22	1.71522988717445e-007	0.00	1.71522988717445e-007	0.00	Multiple Surf Scat	9					
	Slit Grid Source	0.8	3	1.63383115334241e-007	0.00	1.63383115334241e-007	0.00	Single Surf Scat	15					
• 29 • 29	Slit Grid Source	0.6	20	1.2073626454074e-007	0.00	1.2073626454074e-007	0.00	Single Surf Scat	9					· · · · · · · · · · · · · · · · · · ·



Path Sort Table – Shows Source, Wavelength, No. of Rays, Absorbed Flux, % of Total, Path Type, and No. of Intercepts for each path. Columns can be sorted in ascending or descending order.

Path So	rt Table [Spectron	neter.oml]												
	Sources:		•	No. of intercepts:			Fil	ter Editor			1			
	Wavelengths: A	1	•	% of rays to display:	100	Select filte	ers: 🔽 None	-	Appi	У				
ay Path	Source	Wavelength	No. Rays	Absorbed Flux	% of Total	Incident Flux	% of Total	Path Type	No. Intercepts	No.	Intercept Type	Object	Surface	
) 1	Slit Grid Source	0.4	49392	0.129005549779135	30.10	0.129005549779135	30.10	Specular	7					
2	Slit Grid Source	0.2	49934	0.128553687790855	29.99	0.128553687790855	29.99	Specular	7					
3	Slit Grid Source	0.6	24809	0.0862091766888437	20.11	0.0862091766888437	20.11	Specular	7					
4	Slit Grid Source	0.8	24379	0.0847656197332225	19.78	0.0847656197332225	19.78	Specular	7					
5	Slit Grid Source	0.8	180	1.55801147274786e-005	0.00	1.55801147274786e-005	0.00	Single Surf Scat	8					
6	Slit Grid Source	0.8	124	9.71566949611267e-006	0.00	9.71566949611267e-006	0.00	Single Surf Scat	10					
7	Slit Grid Source	0.8	102	7.96361472605634e-006	0.00	7.96361472605634e-006	0.00	Single Surf Scat	10					
8 (Slit Grid Source	0.8	163	5.10063775120543e-006	0.00	5.10063775120543e-006	0.00	Single Surf Scat	11					
9	Slit Grid Source	0.4	315	4.00133385772469e-006	0.00	4.00133385772469e-006	0.00	Single Surf Scat	5					
9 10	Slit Grid Source	0.8	305	3.88442867923526e-006	0.00	3.88442867923526e-006	0.00	Single Surf Scat	5					
) 11	Slit Grid Source	0.4	122	3.8115217689709e-006	0.00	3.8115217689709e-006	0.00	Single Surf Scat	10					
0 12	Slit Grid Source	0.6	276	3.51296523740237e-006	0.00	3.51296523740237e-006	0.00	Single Surf Scat	5					
0 13	Slit Grid Source	0.2	260	3.26619363480386e-006	0.00	3.26619363480386e-006	0.00	Single Surf Scat	5					
0 14	Slit Grid Source	0.6	62	2.15445074118627e-006	0.00	2.15445074118627e-006	0.00	Single Surf Scat	9					
0 15	Slit Grid Source	0.4	134	7.57887500631242e-007	0.00	7.57887500631242e-007	0.00	Single Surf Scat	11					-
9 16	Slit Grid Source	0.2	103	7.40613806332179e-007	0.00	7.40613806332179e-007	0.00	Single Surf Scat	11					-
D 17	Slit Grid Source	0.6	8	7.30425540752795e-007	0.00	7.30425540752795e-007	0.00	Single Surf Scat	7					
D 18	Slit Grid Source	0.6	19	6.60232345427624e-007	0.00	6.60232345427624e-007	0.00	Single Surf Scat	9					
Đ 19	Slit Grid Source	0.6	106	5.75610515892231e-007	0.00	5.75610515892231e-007	0.00	Single Surf Scat	11					
Đ 20	Slit Grid Source	0.8	93	5.52073729286869e-007	0.00	5.52073729286869e-007	0.00	Single Surf Scat	9					
D 21	Slit Grid Source	0.4	1	4.56699408674095e-007	0.00	4.56699408674095e-007	0.00	Single Surf Scat	6					
D 22	Slit Grid Source	0.8	40	3.14059945287995e-007	0.00	3.14059945287995e-007	0.00	Multiple Surf Scat	9	-				
23	Slit Grid Source	0.6	3	2.7358280821207e-007	0.00	2.7358280821207e-007	0.00	Single Surf Scat	7	-				
24	Slit Grid Source	0.6	35	2.70511238773133e-007	0.00	2.70511238773133e-007	0.00	Multiple Surf Scat	9	-	-	-		
Đ 25	Slit Grid Source	0.8	49	2.55459299919144e-007	0.00	2.55459299919144e-007	0.00	Single Surf Scat	11					
26	Slit Grid Source	0.2	32	2.46357710548204e-007	0.00	2.46357710548204e-007	0.00	Multiple Surf Scat	9	-				
27	Slit Grid Source	0.4	22	1.71522988717445e-007	0.00	1.71522988717445e-007	0.00	Multiple Surf Scat	9				-	
€ 28	Slit Grid Source	0.8	3	1.63383115334241e-007	0.00	1.63383115334241e-007	0.00	Single Surf Scat	15	-				
20	Slit Grid Source	0.6	20	1 20726264540746 007	0.00	1 20726264540746 007	0.00	Single Surf Sect	0	-		-		



Path Sort Table – Expand the path by double clicking on the "+" next to the path number to show the surface interactions for that path

E Path So	rt Table [Spectron	neter.oml]												- • •
	Sources: A Wavelengths: A	1	•	No. of intercepts:	100	Select filte	Filters: 🔽 None	ter Editor	Apply	/				
Ray Path	Source	Wavelength	No. Rays	Absorbed Flux	% of Total	Incident Flux	% of Total	Path Type	No. Intercepts	No.	Intercept Type	Object	Surface	^
Θ_1	Slit Grid Source	0.4	49392	0.129005549779135	30.10	0.129005549779135	30.10	Specular	7					
										1	Emitted			
										2	SpecRefl	Collimating Mirror	Mirror Surface	
										3	SpecRefl	Grating	Grating Surface	
										4	SpecRefl	Focusing Mirror	Mirror Surface	
										5	SpecTran	Window	Surface 2	
										6	SpecTran	Window	Surface 2	
										7	At Surface	CCD Detector	Detector	
€ 2	Slit Grid Source	0.2	49934	0.128553687790855	29.99	0.128553687790855	29.99	Specular	7					
⊕ 3	Slit Grid Source	0.6	24809	0.0862091766888437	20.11	0.0862091766888437	20.11	Specular	7					
⊕ 4	Slit Grid Source	0.8	24379	0.0847656197332225	19.78	0.0847656197332225	19.78	Specular	7					
⊕ 5	Slit Grid Source	0.8	180	1.55801147274786e-005	0.00	1.55801147274786e-005	0.00	Single Surf Scat	8					
	Slit Grid Source	0.8	124	9.71566949611267e-006	0.00	9.71566949611267e-006	0.00	Single Surf Scat	10					
• 7	Slit Grid Source	0.8	102	7.96361472605634e-006	0.00	7.96361472605634e-006	0.00	Single Surf Scat	10					
	Slit Grid Source	0.8	163	5.10063775120543e-006	0.00	5.10063775120543e-006	0.00	Single Surf Scat	11					
⊕ 9	Slit Grid Source	0.4	315	4.00133385772469e-006	0.00	4.00133385772469e-006	0.00	Single Surf Scat	5					
10	Slit Grid Source	0.8	305	3.88442867923526e-006	0.00	3.88442867923526e-006	0.00	Single Surf Scat	5					
11	Slit Grid Source	0.4	122	3.8115217689709e-006	0.00	3.8115217689709e-006	0.00	Single Surf Scat	10					
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15	Slit Grid Source	0.4	134	7.57887500631242e-007	0.00	7.57887500631242e-007	0.00	Single Surf Scat	11					
16	Slit Grid Source	0.2	103	7.40613806332179e-007	0.00	7.40613806332179e-007	0.00	Single Surf Scat	11					
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	Slit Grid Source	0.8	93	5.52073729286869e-007	0.00	5.52073729286869e-007	0.00	Single Surf Scat	9					
	Slit Grid Source	0.4	1	4.56699408674095e-007	0.00	4.56699408674095e-007	0.00	Single Surf Scat	6					
	Slit Grid Source	0.8	40	3.14059945287995e-007	0.00	3.14059945287995e-007	0.00	Multiple Surf Scat	9					×



Path Sort Table – Expand the path by clicking on the "+" next to the path number to show the surface interactions for that path

🔳 Path So	rt Table [Spectron	neter.oml]												- 0
	Sources: A	N	•	No. of intercepts:			Filt	ter Editor	Appl		i i			
	Wavelengths:	1	•	% of rays to display:	100	Select filte	ers: 🔽 None	•	Арр	У				
Ray Path	Source	Wavelength	No. Rays	Absorbed Flux	% of Total	Incident Flux	% of Total	Path Type	No. Intercepts	No.	Intercept Type	Object	Surface	
● 1	Slit Grid Source	0.4	49392	0.129005549779135	30.10	0.129005549779135	30.10	Specular	7					
€ 2	Slit Grid Source	0.2	49934	0.128553687790855	29.99	0.128553687790855	29.99	Specular	7					
€ 3	Slit Grid Source	0.6	24809	0.0862091766888437	20.11	0.0862091766888437	20.11	Specular	7					
⊕ 4	Clit Caid Course	0.0	24270	0.0047656107222225	10.70	0.0047656107222225	10.70	Succular	7					
Θ5	Slit Grid Source	0.8	180	1.55801147274786e-005	0.00	1.55801147274786e-005	0.00	Single Surf Scat	8					
										1	Emitted			
										2	SpecRefl	Collimating Mirror	Mirror Surface	
		-								3	SpecRefl	Grating	Grating Surface	
										4	SpecRefl	Collimating Mirror	Mirror Surface	
										5	RandRefl	Slit	Surface 2	
										6	SpecTran	Window	Surface 2	
										7	SpecTran	Window	Surface 2	
								-		8	At Surface	CCD Detector	Detector	/
	Slit Grid Source	0.8	124	9.7 00094901 2076-000	0.00	9.7 00094901 2076-000	0.00	Single Suff Scat	10					
	Slit Grid Source	0.8	102	7.96361472605634e-006	0.00	7.96361472605634e-006	0.00	Single Surf Scat	10					
Ð 8	Slit Grid Source	0.8	163	5.10063775120543e-006	0.00	5.10063775120543e-006	0.00	Single Surf Scat	11				-	
• q	Slit Grid Source	0.4	315	4.00133385772469e-006	0.00	4.00133385772469e-006	0.00	Single Surf Scat	5				-	
€ 10	Slit Grid Source	0.8	305	3.88442867923526e-006	0.00	3 88442867923526e-006	0.00	Single Surf Scat	5					
① 10	Slit Grid Source	0.4	122	3.8115217689709e-006	0.00	3.8115217689709e-006	0.00	Single Surf Scat	10					
12	Slit Grid Source	0.6	276	3 51296523740237e-006	0.00	3 51296523740237e-006	0.00	Single Surf Scat	5					
13	Slit Grid Source	0.2	260	3 26619363480386=-006	0.00	3 26619363480386=-006	0.00	Single Surf Scat	5					
14	Slit Grid Source	0.6	62	2 15445074118627-006	0.00	2 15445074118627-006	0.00	Single Surf Scat	9				-	
14	Slit Grid Source	0.4	13/	7 578875006312/2~007	0.00	7 578875006312/2~007	0.00	Single Surf Scat	11	-				
15	Site Grid Source	0.7	102	7.40612006222170- 007	0.00	7.40612006222170- 007	0.00	Single Surf Cest	11	-				
 10 17 	Silt Grid Source	0.2	0	7.400130003321798-007	0.00	7.400130003321798-007	0.00	Single Suff Scat	7					
• 1/ • 10	Sill Grid Source	0.0	0	7.50425540752795e-007	0.00	7.50425540752795e-007	0.00	Single Surf Scat	1					
0 18 0 10	Site Grid Source	0.0	19	0.00232345427024e-007	0.00	0.00232345427024e-007	0.00	Single Surf Scat	9	-				
• 19 • 20	Sitt Grid Source	0.0	106	5.75010515892231e-007	0.00	5.75010515892231e-007	0.00	Single Surf Scat	11	-				
• 20	Slit Grid Source	8.0	93	5.52073729286869e-007	0.00	5.52073729286869e-007	0.00	Single Surf Scat	9	-				
C 21	Slit Grid Source	0.4	1	4.56699408674095e-007	0.00	4.56699408674095e-007	0.00	Single Surf Scat	6	-				



Path Sort Table – Expand the path by clicking on the "+" next to the path number to show the surface interactions for that path

Path So	rt Table [Spectror	neter.oml]											
	Sources: A	H	•	No. of intercepts:			Filt	ter Editor	Ann	v	1		
	Wavelengths: A	II.	•	% of rays to display:	100	Select filte	rs: 🔽 None	•		,			
Ray Path	Source	Wavelength	No. Rays	Absorbed Flux	% of Total	Incident Flux	% of Total	Path Type	No. Intercepts	No.	Intercept Type	Object	Surface
€ 7	Slit Grid Source	0.8	102	7.96361472605634e-006	0.00	7.96361472605634e-006	0.00	Single Surf Scat	10				
8 (Slit Grid Source	0.8	163	5.10063775120543e-006	0.00	5.10063775120543e-006	0.00	Single Surf Scat	11				
9	Slit Grid Source	0.4	315	4.00133385772469e-006	0.00	4.00133385772469e-006	0.00	Single Surf Scat	5				
D 10	Slit Grid Source	0.8	305	3.88442867923526e-006	0.00	3.88442867923526e-006	0.00	Single Surf Scat	5				
) 11	Slit Grid Source	0.4	122	3.8115217689709e-006	0.00	3.8115217689709e-006	0.00	Single Surf Scat	10				
9 12	Slit Grid Source	0.6	276	3.51296523740237e-006	0.00	3.51296523740237e-006	0.00	Single Surf Scat	5				
D 13	Slit Grid Source	0.2	260	3.26619363480386e-006	0.00	3.26619363480386e-006	0.00	Single Surf Scat	5				
D 14	Slit Grid Source	0.6	62	2.15445074118627e-006	0.00	2.15445074118627e-006	0.00	Single Surf Scat	9				
D 15	Slit Grid Source	0.4	134	7.57887500631242e-007	0.00	7.57887500631242e-007	0.00	Single Surf Scat	11				
0 16	Slit Grid Source	0.2	103	7.40613806332179e-007	0.00	7.40613806332179e-007	0.00	Single Surf Scat	11				
D 17	Slit Grid Source	0.6	8	7.30425540752795e-007	0.00	7.30425540752795e-007	0.00	Single Surf Scat	7				
Ð 18	Slit Grid Source	0.6	19	6.60232345427624e-007	0.00	6.60232345427624e-007	0.00	Single Surf Scat	9				
D 19	Slit Grid Source	0.6	106	5.75610515892231e-007	0.00	5.75610515892231e-007	0.00	Single Surf Scat	11				
D 20	Slit Grid Source	0.8	93	5.52073729286869e-007	0.00	5.52073729286869e-007	0.00	Single Surf Scat	9	-			
D 21	Slit Grid Source	0.4	1	4.56699408674095e-007	0.00	4.56699408674095e-007	0.00	Single Surf Scat	6				
22	Slit Grid Source	0.8	40	3.14059945287995e-007	0.00	3.14059945287995e-007	0.00	Multiple Surf Scat	9	-			
) 22	CIT C LL C	0.6	2	2 7250200021207- 007	0.00	2 7250200021207 . 007	0.00	Circle Conterna	7				
24	Slit Grid Source	0.6	35	2.70511238773133e-007	0.00	2.70511238773133e-007	0.00	Multiple Surf Scat	9				
					1					1	Emitted		
										2	SpecRefl	Collimating Mirror	Mirror Surface
										3	SpecRefl	Grating	Grating Surface
										4	SpecRefl	Focusing Mirror	Mirror Surface
										5	RandRefl	Case	Surface 6
										6	RandRefl	Grating	Surface 4
										7	SpecTran	Window	Surface 2
										8	SpecTran	Window	Surface 2
										9	At Surface	CCD Detector	Detector
25	Slit Grid Source	0.8	49	2.55459299919144e-007	0.00	2.55459299919144e-007	0.00	Single Surf Scat	11				
D 26	Slit Grid Source	0.2	22	2.46357710548204c 007	0.00	2 46257710549204e 007	0.00	Multiple Surf Cost	0				



Analysis -> Display Selected Paths - Shows the selected path graphically





Analysis -> Display Selected Paths – Shows the selected path graphically





Analysis -> Display Selected Paths – Shows the selected path graphically



TracePro

Analysis -> Display Selected Paths – Shows the selected path graphically

	x x z z x y z x x x x x x x x x x x x x	- Y							
[Spectrometer.om]]		🛛 🔳 Path S	ort Table [Spectron	meter.oml]					
trometer lit irating ocusing Mirror			Sources: A Wavelengths: A	1 <u>-</u>	No. of intercepts: % of rays to display:	100	Select filt	Filter Editor	Apply
Collimating Mirror		Ray Path	Source	Wavelength No.	Rays Absorbed Flux	% of Total	Incident Flux	% of Total Path Type	No. Intercepts
urface 0		⊕ 1	Slit Grid Source	0.4 4939	2 0.129005549779135	30.10	0.129005549779135	30.10 Specular	7
urface 1		⊕ 2	Slit Grid Source	0.2 4993	4 0.128553687790855	29.99	0.128553687790855	29.99 Specular	7
etector		€ 3	Slit Grid Source	0.6 2480	9 0.0862091766888437	20.11	0.0862091766888437	20.11 Specular	7
urface 3		⊕ 4	Slit Grid Source	0.8 2437	9 0.0847656197332225	19.78	0.0847656197332225	19.78 Specular	7
/ace 4		⊕ 5	Slit Grid Source	0.8 180	1.55801147274786e-005	0.00	1.55801147274786e-005	0.00 Single Surf Sc	at 8
3		⊕ 6	Slit Grid Source	0.8 124	9.71566949611267e-006	0.00	9.71566949611267e-006	0.00 Single Surf Sc	at 10
		• 7	Slit Grid Source	0.8 102	7.96361472605634e-006	0.00	7.96361472605634e-006	0.00 Single Surf Sc	at 10
harris and the second sec		⊕ 8	Slit Grid Source	0.8 163	5.10063775120543e-006	0.00	5.10063775120543e-006	0.00 Single Surf Sc	at 11
ount	Y III Y	⊕ 9	Slit Grid Source	0.4 315	4.00133385772469e-006	0.00	4.00133385772469e-006	0.00 Single Surf Sc	at 5
t .		● 10	Slit Grid Source	0.8 305	3.88442867923526e-006	0.00	3.88442867923526e-006	0.00 Single Surf Sc	at 5
or Mount		● 11	Slit Grid Source	0.4 122	3.8115217689709e-006	0.00	3.8115217689709e-006	0.00 Single Surf Sc	at 10
		12	Slit Grid Source	0.6 276	3.51296523740237e-006	0.00	3.51296523740237e-006	0.00 Single Surf Sc	at 5
		13	Slit Grid Source	0.2 260	3.26619363480386e-006	0.00	3.26619363480386e-006	0.00 Single Surf Sc	at 5
		14	Slit Grid Source	0.6 62	2.15445074118627e-006	0.00	2.15445074118627e-006	0.00 Single Surf Sc	at 9
		① 15	Slit Grid Source	0.4 134	7.57887500631242e-007	0.00	7.57887500631242e-007	0.00 Single Surf Sc	at 11
		16	Slit Grid Source	0.2 103	7.40613806332179e-007	0.00	7.40613806332179e-007	0.00 Single Surf Sc	at 11
		● 17	Slit Grid Source	0.6 8	7.30425540752795e-007	0.00	7.30425540752795e-007	0.00 Single Surf Sc	at 7
			Slit Grid Source	0.6 19	6.60232345427624e-007	0.00	6.60232345427624e-007	0.00 Single Surf Sc	at 9
- 1		● 19	Slit Grid Source	0.6 106	5.75610515892231e-007	0.00	5.75610515892231e-007	0.00 Single Surf Sc	at 11
			Slit Grid Source	0.8 93	5.52073729286869e-007	0.00	5.52073729286869e-007	0.00 Single Surf Sc	at 9
			Slit Grid Source	0.4 1	4.56699408674095e-007	0.00	4.56699408674095e-007	0.00 Single Surf Sc	at 6
		• 22	Slit Grid Source	0.8 40	3.14059945287995e-007	0.00	3.14059945287995e-007	0.00 Multiple Surf	Scat 9
			Slit Grid Source	0.6 3	2.7358280821207e-007	0.00	2.7358280821207e-007	0.00 Single Surf Sc	at 7
- 1		• 24	Slit Grid Source	0.6 35	2.70511238773133e-007	0.00	2.70511238773133e-007	0.00 Multiple Surf	Scat 9
		C 25	Slit Grid Source	0.8 49	2.55459299919144e-007	0.00	2.55459299919144e-007	0.00 Single Surf Sc	at 11
		€ 26	Slit Grid Source	0.2 32	2.46357/10548204e-007	0.00	2.4655//10548204e-007	0.00 Multiple Surf	Scat 9
		@ 27	Slit Grid Source	0.4 22	1./1522988/1/445e-00/	0.00	1./1522988/1/445e-007	0.00 Multiple Surf	scat 9
		€ 28 (€ 28	Slit Grid Source	0.6 3	1.000001100042416-007	0.00	1.033031133342416-007	0.00 Single Surf Sc	at 15
		(29 (20	Slit Grid Source	0.0 20	1.20/30204340/4e-00/	0.00	1.20/30204340/46-00/	0.00 Single Surf Sc	at 9
		⊕ 30 ⊕ 31	Slit Grid Source	0.0 4	1.091030372790/88-007	0.00	1.051050372790708-007	0.00 Single Suff Sc	at 14 Scat 0
	v	(27	Slit Grid Source	0.0 13	0.047502006792926-000	0.00	0.047502006792920-009	0.00 Multiple Suff	Scat 9
	•	€ 32 (€ 32	Slit Grid Source	0.4 12	9.69736728247596+-005	0.00	9.69736728247596-009	0.00 Multiple Surf	Scat 9
		· 33	Slit Grid Source	0.9 10	9.09/30/2024/3908-000	0.00	0.67704755160165e-008	0.00 Single Suff Sc	st 11
		€ 35	Slit Grid Source	0.8 1	8 67130582624766-009	0.00	8 67130582624766-008	0.00 Single Surf Sc	at 8
		€ 35 € 36	Slit Grid Source	0.6 10	8.10349158362317=-005	0.00	8.10349158362317-009	0.00 Multiple Surf	Scat 9
		- 50		10		- 100		in any court	[*








TracePro 7.8 adds the ability to apply filters to the Path Sort table to look for specific path types

Path So	rt Table [Spectro	meter.oml]															x
	Sources: A Wavelengths: A	JI	•	No. c % of ray	of intercepts: ys to display:	100		Select filte	Filters: 🔽 None	er Editor	Ар	ply					
Ray Path	Source	Wavelength	No. Rays	Absorbed	Flux 🗸	7 % of Total	Incident	Flux	% of Total	Path Type	No. Intercept	No.	Intercept Type	Object	Surface		^
⊕ 1	Slit Grid Source	0.4	49392	0.1290055	49779135	30.10	0.1290055	49779135	30.10	Specular	7						
⊕ 2	Slit Grid Source	0.2	49934	0.1285536	87790855	29.99	0.1285536	87790855	29.99	Specular	7						
3	Slit Grid Source	0.6	24800	0.0862001	766999/27	20.11	0.0862001	766999437	20.11	Specular	7	8				_	
• 4	Slit Grid Source	0.8	Path Sor	t Filter Edite	or[Spectrome	ter.oml]										×	
⊕ 5	Slit Grid Source	0.8															
€ 6	Slit Grid Source	0.8				Name:	Spectrome	ter						-			
• 7	Slit Grid Source	0.8		. 1	0	01:+/0			Internet	T		_		_		- 1	
8 8	Slit Grid Source	0.8	Add H	lter	Operator	Object/Group		Surrace	- David Daf	туре							
⊕ 9	Slit Grid Source	0.4	Delete I	Filter		continuating iv		viinor sunace									
① 10	Slit Grid Source	0.8	Insert Se	lection													
① 11	Slit Grid Source	0.4	- Inder Coe	lection													
① 12	Slit Grid Source	0.6	Add R	ow													
13	Slit Grid Source	0.2	-														
14	Slit Grid Source	0.6	Delete	Row													
15	Slit Grid Source	0.4															
16	Slit Grid Source	0.2															
17	Slit Grid Source	0.6															
18	Slit Grid Source	0.6															
① 19	Slit Grid Source	0.6															
	Slit Grid Source	0.8															
21	Slit Grid Source	0.4															
22	Slit Grid Source	0.8															
23	Slit Grid Source	0.6															
24	Slit Grid Source	0.6															
① 25	Slit Grid Source	0.8															~
Y																	



Click Filter Editor in the Path Sort Table to open the Path Sort Filter Editor

🔳 Path So	rt Table [Spectrometer.o	ml]						
	Sources: All Wavelengths: All	<u> </u>	No. of intercepts: of rays to display: 100	Selec	Filter Editor	Apply		
Ray Path	Source Wave	Path Sort Filter Edi	tor[Spectrometer.oml]	1.51	0/ (T. L. D. J. T.	N IS SONT IN T		×
⊕ 1 ⊕ 2	Slit Grid Source 0.4							_
⊕ 2	Slit Grid Source 0.6		Name: Spe	ctrometer			-	
• 4 • 4	Slit Grid Source 0.8		On anti- Object/General	Cutan	Internet Trees			
⊕ 5	Slit Grid Source 0.8	Add Hitter	Collimating Mirror	Mirror Surface	RandRefl			
⊕ 6	Slit Grid Source 0.8	Delete Filter	Commating Winter		- Kanuken			
T 10 10 10 10 10 10 10 10 10 10 10 10 10	Slit Grid Source 0.8	Insert Selection						
	Slit Grid Source 0.8							
• 9	Slit Grid Source 0.4	Add Row						
⊕ 10 ⊕ 11	Slit Grid Source 0.8	Delete Row						
• 11 • 12	Slit Grid Source 0.4							
12	Slit Grid Source 0.0							
	Slit Grid Source 0.6							
15	Slit Grid Source 0.4							
16	Slit Grid Source 0.2							
17	Slit Grid Source 0.6							
18	Slit Grid Source 0.6							
19	Slit Grid Source 0.6							
⊕ 20	Slit Grid Source 0.8							
• 21	Slit Grid Source 0.4							
• 22 • 22	Slit Grid Source 0.8							
€ 24	Slit Grid Source 0.6							
() 25	Slit Grid Source 0.8							v.
Y			,					



To define a new Path Sort Filter, click Add Filter, enter a name for the Filter, and then click OK.

rath sort filter t	cutor[spectrometer.om]			
	Name: Spec	trometer		•
Add Filter	Operator Object/Group	Surface	Intercept Type	
Delete Filter	Collimating Mirror	Mirror Surface	RandRefl	
nsert Selection				
Add Row				
Delete Row				
Delete KOW		Path Sort Filter		
		Enter new pa	th sort filter name:	
		Webinar Exa	ample	
			OK Cancel	



The Path Sort Filter Editor allows you to define the objects, surfaces, surface intercept types, and an operator for the filter

	Name: W	ebinar Example		•	
Add Filter	Operator Object/Group	Surface	Intercept Type		
Delete Filter	Collimating Mirr	or 🔄 Mirror Surface	Any		
Insert Selection					
Add Row					
Delete Row					



The Object/Group dropdown menu lists the objects and groups in the current TracePro model

Path Sort Filter Editor[Spectrometer.oml]		- 0	×
Name: Webinar Example	•		
Add Filter Operato Object/Group Surface Intercept Type Collimating Mirror V Mirror Surface V Any			
Delete Filter Collimating Mirror CCD Detector			
Add Row Focusing Mirror Mount			
Delete Row			
			Тга

The Surface dropdown menu lists the surfaces for the selected Object/Group

	Name: Wel	nar Example	•	
Add Filter	Operator Object/Group	Surface Intercept Type		
Delete Filter	Collimating Mirro	Mirror Surface 🚽 A 19		
sert Selection		Mirror Surface A Surface 1		
		Surface 2 Surface 3		
Add Row		Surface 4		
Delete Row		Junace J		



The Intercept dropdown menu lists the options for the surface intercept/interactions

		Name: Webin	ar Example			•	
Add Filter	Operator	Object/Group	Surface	Intercept Type			
Delete Filter	less.	Collimating Mirror	 Mirror Surface 	Any			
nsert Selection			Intercen	t Types	_		
Add Row			Miss	c types	_		
Delete Row			Any Speck	efl	-		
			Spect	efl			
			RandT ImpRe	ran fl			
			ImpTra RandD	iffRefl			
			ImpDif RandD	fRefl iffTran			
			RandV	olume			
			GrinTra RepTil	an eTran			
				OK Cancel]		
					-		



Available Intercept Types





Click Add Row to add a new row to the Filter table

		Name: Webin	ar Example		 •	
Add Filter	Operator	Object/Group	Surface	Intercept Typ		
Delete Filter		Spectrometer	 Any 	▼ Any		
Deleter inter	AND 💌	Collimating Mirror	 Mirror Surface 	 SpecRefl 		
Insert Selection						
Add Pow						
Add Kow						
Delete Row						



To delete a row, select the row and then click Delete Row

		Name: Webir	nar Example		_	
Add Filter	Operator	Object/Group	Surface	Intercept Type		
Delete Filter		Collimating Mirror	 Mirror Surface 	SpecRefl		
Delete Filter	ND 👤	Spectrometer	✓ Any	Any		
insert Selection						
Add Row						
Delete Row						

IIacepio

The available Operators are AND and OR

ath Sort Filter E	ditor[Spectrom	eter.oml]				_	• ×	×		
		Name: Webina	r Example		•					
Add Filter	Operator	bject/Group	Surface	Intercept Type						
Delete Filter		Collimating Mirror 👱	Mirror Surface	SpecRefl						
sert Selection	AND -	Case _	Any	RandRefl						
ISET COECCUOIT	OR									
Add Row										
Delete Row										

The following filter example will show the ray paths that have a Specular Reflection from the Mirror Surface of the Collimating Mirror and a Random Reflection from any surface of the Case

Path Sort Filter Ed	tor[Spectrometer.oml]			×
	Name: Webinar Example	•		
Add Filter	Operator Object/Group Surface Intercept Type			
Delete Filter	Collimating Mirror V Mirror Surface V SpecRefl			
Insert Selection				
Add Row				
Delete Row				



Click the X in the upper right corner to save the filter and close the Path Sort Filter Editor

Add Filter		· · · · · · · · · · · · · · · · · · ·		•	
	Operator Object/Gro	oup Surface	Intercept Type		
Delete Filter	Collimating	g Mirror 💌 Mirror Surf	ace 💌 SpecRefl		
insert Selection	AND Case	Any	RandRefl		
Add Row					
Delete Row					
Delete ROW					

Path Sort Filters are saved with the TracePro model

🔳 Path So	rt Table [Spectror	neter.oml]												x
	Sources: A Wavelengths: A	N	•	No. of intercepts:	100	Select filte	Filt rs: 🔽 Webir	er Editor Dar Example 💌	Appl	y	J			
Ray Path	Source	Wavelength	No. Rays	Absorbed Flux	% of Total	Incident Flu	% Spect	rometer	No. Intercepts	No.	In ercept Type	Object	Surface	^
● 1	Slit Grid Source	0.8	124	9.71566949611267e-006	0.00	9.71566949611267e-006	0.00	Single Sun Scat	10					
	Slit Grid Source	0.4	122	3.8115217689709e-006	0.00	3.8115217689709e-006	0.00	Single Surf Scat	10					
⊕ 3	Slit Grid Source	0.6	62	2.15445074118627e-006	0.00	2.15445074118627e-006	0.00	Single Surf Scat	9]	
● 4	Slit Grid Source	0.4	134	7.57887500631242e-007	0.00	7.57887500631242e-007	0.00	Single Surf Scat	11					
€ 5	Slit Grid Source	0.2	103	7.40613806332179e-007	0.00	7.40613806332179e-007	0.00	Single Surf Scat	11					
	Slit Grid Source	0.6	8	7.30425540752795e-007	0.00	7.30425540752795e-007	0.00	Single Surf Scat	7					
• 7	Slit Grid Source	0.6	19	6.60232345427624e-007	0.00	6.60232345427624e-007	0.00	Single Surf Scat	9					
	Slit Grid Source	0.6	106	5.75610515892231e-007	0.00	5.75610515892231e-007	0.00	Single Surf Scat	11					
• 9	Slit Grid Source	0.8	93	5.52073729286869e-007	0.00	5.52073729286869e-007	0.00	Single Surf Scat	9					
● 10	Slit Grid Source	0.8	40	3.14059945287995e-007	0.00	3.14059945287995e-007	0.00	Multiple Surf Scat	9					
① 11	Slit Grid Source	0.6	3	2.7358280821207e-007	0.00	2.7358280821207e-007	0.00	Single Surf Scat	7					
① 12	Slit Grid Source	0.6	35	2.70511238773133e-007	0.00	2.70511238773133e-007	0.00	Multiple Surf Scat	9					
13	Slit Grid Source	0.8	49	2.55459299919144e-007	0.00	2.55459299919144e-007	0.00	Single Surf Scat	11					
① 14	Slit Grid Source	0.2	32	2.46357710548204e-007	0.00	2.46357710548204e-007	0.00	Multiple Surf Scat	9					
① 15	Slit Grid Source	0.4	22	1.71522988717445e-007	0.00	1.71522988717445e-007	0.00	Multiple Surf Scat	9					
① 16	Slit Grid Source	0.6	20	1.2073626454074e-007	0.00	1.2073626454074e-007	0.00	Single Surf Scat	9					
① 17	Slit Grid Source	0.8	13	1.06282311219003e-007	0.00	1.06282311219003e-007	0.00	Multiple Surf Scat	9					
18	Slit Grid Source	0.2	12	9.94750390678283e-008	0.00	9.94750390678283e-008	0.00	Multiple Surf Scat	9					
① 19	Slit Grid Source	0.4	12	9.69736728247596e-008	0.00	9.69736728247596e-008	0.00	Multiple Surf Scat	9					
	Slit Grid Source	0.6	10	8.10349158362317e-008	0.00	8.10349158362317e-008	0.00	Multiple Surf Scat	9					
	Slit Grid Source	0.6	10	7.73033363035338e-008	0.00	7.73033363035338e-008	0.00	Multiple Surf Scat	9					
	Slit Grid Source	0.8	15	7.68719208852042e-008	0.00	7.68719208852042e-008	0.00	Single Surf Scat	12					
23	Slit Grid Source	0.4	11	7.36475240261803e-008	0.00	7.36475240261803e-008	0.00	Multiple Surf Scat	9					
	Slit Grid Source	0.8	9	7.26463419981319e-008	0.00	7.26463419981319e-008	0.00	Multiple Surf Scat	9					
• 25	Slit Grid Source	04	q	7 18287909736956e-008	0.00	7 18287909736956e-008	0.00	Multiple Surf Scat	Q					×



Select the new Filter in the Select Filters dropdown menu and then click Apply to apply the filter to the Path Sort Table

🔳 Path So	rt Table [Spectror	meter.oml]												- • •
	Sources: A Wavelengths: A	N . N	•	No. of intercepts: % of rays to display:	100	Select filte	Filters: 🔽 Webin	er Editor	Appl	/	l			
Ray Path	Source	Wavelength	No. Rays	Absorbed Flux	% of Total	Incident Flu	% Spect	trometer	No. Intercepts	No.	In ercept Type	Object	Surface	^
⊕ 1	Slit Grid Source	0.8	124	9.71566949611267e-006	0.00	9.71566949611267e-006	0.60	nar Example Single Sun Scat	10					
⊕ 2	Slit Grid Source	0.4	122	3.8115217689709e-006	0.00	3.8115217689709e-006	0.00	Single Surf Scat	10					
⊕ 3	Slit Grid Source	0.6	62	2.15445074118627e-006	0.00	2.15445074118627e-006	0.00	Single Surf Scat	9					
⊕ 4	Slit Grid Source	0.4	134	7.57887500631242e-007	0.00	7.57887500631242e-007	0.00	Single Surf Scat	11					
⊕ 5	Slit Grid Source	0.2	103	7.40613806332179e-007	0.00	7.40613806332179e-007	0.00	Single Surf Scat	11					
⊕ 6	Slit Grid Source	0.6	8	7.30425540752795e-007	0.00	7.30425540752795e-007	0.00	Single Surf Scat	7					
• 7	Slit Grid Source	0.6	19	6.60232345427624e-007	0.00	6.60232345427624e-007	0.00	Single Surf Scat	9					
• 8	Slit Grid Source	0.6	106	5.75610515892231e-007	0.00	5.75610515892231e-007	0.00	Single Surf Scat	11					
• 9	Slit Grid Source	0.8	93	5.52073729286869e-007	0.00	5.52073729286869e-007	0.00	Single Surf Scat	9					
① 10	Slit Grid Source	0.8	40	3.14059945287995e-007	0.00	3.14059945287995e-007	0.00	Multiple Surf Scat	9					
① 11	Slit Grid Source	0.6	3	2.7358280821207e-007	0.00	2.7358280821207e-007	0.00	Single Surf Scat	7					
① 12	Slit Grid Source	0.6	35	2.70511238773133e-007	0.00	2.70511238773133e-007	0.00	Multiple Surf Scat	9					
① 13	Slit Grid Source	0.8	49	2.55459299919144e-007	0.00	2.55459299919144e-007	0.00	Single Surf Scat	11					
⊕ 14	Slit Grid Source	0.2	32	2.46357710548204e-007	0.00	2.46357710548204e-007	0.00	Multiple Surf Scat	9					
① 15	Slit Grid Source	0.4	22	1.71522988717445e-007	0.00	1.71522988717445e-007	0.00	Multiple Surf Scat	9					
16	Slit Grid Source	0.6	20	1.2073626454074e-007	0.00	1.2073626454074e-007	0.00	Single Surf Scat	9					
① 17	Slit Grid Source	0.8	13	1.06282311219003e-007	0.00	1.06282311219003e-007	0.00	Multiple Surf Scat	9					
18	Slit Grid Source	0.2	12	9.94750390678283e-008	0.00	9.94750390678283e-008	0.00	Multiple Surf Scat	9					
19	Slit Grid Source	0.4	12	9.69736728247596e-008	0.00	9.69736728247596e-008	0.00	Multiple Surf Scat	9					
	Slit Grid Source	0.6	10	8.10349158362317e-008	0.00	8.10349158362317e-008	0.00	Multiple Surf Scat	9					
	Slit Grid Source	0.6	10	7.73033363035338e-008	0.00	7.73033363035338e-008	0.00	Multiple Surf Scat	9					
	Slit Grid Source	0.8	15	7.68719208852042e-008	0.00	7.68719208852042e-008	0.00	Single Surf Scat	12					
	Slit Grid Source	0.4	11	7.36475240261803e-008	0.00	7.36475240261803e-008	0.00	Multiple Surf Scat	9					
	Slit Grid Source	0.8	9	7.26463419981319e-008	0.00	7.26463419981319e-008	0.00	Multiple Surf Scat	9					
() 25	Slit Grid Source	04	q	7 18287909736956e-008	0.00	7 18287909736956e-008	0.00	Multinle Surf Scat	Q					×



Example paths from the filtered Path Sort Table





Example paths from the filtered Path Sort Table





Example paths from the filtered Path Sort Table





More complex path filters can be defined – the following filter shows ray paths that have a Specular Reflection from the Collimating Mirror, Grating, Focusing Mirror, and any type of reflection from the Slit.

	ditor[Spect	trom	eter.oml]									_	×
			Name: Web	inar	Example 2						•		
Add Filter	Opera	tor	Object/Group		Surface		Intercept Type						
Delete Filter			Collimating Mirror	-	Mirror Surface	•	SpecRefl						
Deleterniter	AND	-	Grating	•	Grating Surface	•	SpecRefl						
Insert Selection	AND	-	Focusing Mirror	•	Mirror Surface	•	SpecRefl						
Add Down	AND	-	Slit	-	Any	-	Any						
AUU KOW													
Delete Row													



More complex path filters can be defined – the following filter shows ray paths that have a Specular Reflection from the Collimating Mirror, Grating, Focusing Mirror, and any type of reflection from the Slit.





The following filter shows ray paths that have either a Specular or Random Reflection from the Focusing Mirror

Path Sort Filter E	ditor[Spectror	meter.oml]					<u>196</u> 0	
		Name: We	binar Example 3			•		
Add Filter	Operator	Object/Group	Surface	Intercept Type				
Delete Filter		Focusing Mirror	 Mirror Surface 	SpecRefl				
sert Selection	OR _	Focusing Mirror	✓ Mirror Surface	▼ RandRefI				
Add Pow								
Delete Row								
Delete ROW								



The following filter shows ray paths that have either a Specular or Random Reflection from the Focusing Mirror



TracePro

The following filter shows ray paths that have either a Specular or Random Reflection from the Focusing Mirror

QQQ555 + ×	(12 to to 1 = 0 9 : 0 K (] H (→ b y' to y to 1, y to 1) 1 = 0 → → → → → → → → → → → → → → → → → → →										_
[Spectrometer.oml]		Path So	rt Table [Spectrom	neter.oml]							•
ctrometer			Fourtons All		No of in	torcoptor			the Educ		
Grating			Sources. Al	-	• No. 01 Inc	le cepts.]			Titer Cultor	Appl	iy
ocusing Mirror			Wavelengths: All	1	✓ % of rays to	display: 100	Select fil	ters: T Web	binar Exam 💌	-	
Collimating Mirror		Ray Path	Source	Wavelength M	o, Rays Absorbed Flu	v ⊽ % of Tot	al Incident Flux	% of Tota	Path Type	No. Intercepts	No
Surface 0		⊕ 1	Slit Grid Source	0.4 4	9392 0.12900554977	9135 30.10	0.129005549779135	30.10	Specular	7	-
Surface 1		⊕ 2	Slit Grid Source	0.2 4	.9934 0.12855368775	0855 29.99	0.128553687790855	29.99	Specular	7	t
Detector		3	Slit Grid Source	0.6 2	4809 0.08620917668	88437 20.11	0.0862091766888437	20.11	Specular	7	
Surface 3		⊕ 4	Slit Grid Source	0.8 2	4379 0.08476561973	32225 19.78	0.0847656197332225	19.78	Specular	7	
ourface 4		€ 5	Slit Grid Source	0.8 1.	9.71566949611	267e-006 0.00	9.71566949611267e-006	0.00	Single Surf Scat	10	
Entity 3		⊕ 6	Slit Grid Source	0.8 10	02 7.96361472605	634e-006 0.00	7.96361472605634e-006	0.00	Single Surf Scat	10	
Block		• 7	Slit Grid Source	0.8 1	63 5.10063775120	0543e-006 0.00	5.10063775120543e-006	0.00	Single Surf Scat	11	
Vindow		• 8	Slit Grid Source	0.4 1.	22 3.81152176897	09e-006 0.00	3.8115217689709e-006	0.00	Single Surf Scat	10	Ι
etector Mount		€ 9	Slit Grid Source	0.6 6	2 2.15445074118	627e-006 0.00	2.15445074118627e-006	0.00	Single Surf Scat	9	1
ating Mount		10	Slit Grid Source	0.4 1	34 7.57887500631	242e-007 0.00	7.57887500631242e-007	0.00	Single Surf Scat	11	
ocusing Mirror Mount		● 11	Slit Grid Source	0.2 1/	03 7.40613806332	179e-007 0.00	7.40613806332179e-007	0.00	Single Surf Scat	11	
se		● 12	Slit Grid Source	0.6 19	9 6.60232345427	624e-007 0.00	6.60232345427624e-007	0.00	Single Surf Scat	9	
ver		13	Slit Grid Source	0.6 14	06 5.75610515892	231e-007 0.00	5.75610515892231e-007	0.00	Single Surf Scat	11	
Mount Tube		● 14	Slit Grid Source	0.8 9	3 5.52073729286	5869e-007 0.00	5.52073729286869e-007	0.00	Single Surf Scat	9	4
		• 15	Slit Grid Source	0.4 1	4.56699408674	1095e-007 0.00	4.56699408674095e-007	0.00	Single Surf Scat	6	+
		• 16	Slit Grid Source	0.8 40	3.14059945287	995e-007 0.00	3.14059945287995e-007	0.00	Multiple Surf Scat	9	4
		• 17	Slit Grid Source	0.6 3	5 2.70511238773	1133e-007 0.00	2.70511238773133e-007	0.00	Multiple Surf Scat	9	+
		18	Slit Grid Source	0.8 49	9 2.55459299919	0.00 0.00 0.00	2.55459299919144e-007	0.00	Single Surf Scat	11	+
		0 19	Slit Grid Source	0.2 3.	2 2.46357/10548	\$204e-007 0.00	2.46357/10548204e-007	0.00	Multiple Surf Scat	9	+
		€ 20 € 21	Slit Grid Source	0.4 2	2 1./1522988/1/	445e-007 0.00	1./1522988/1/445e-00/	0.00	Multiple Surf Scat	9	+
		() 21 () 22	Slit Grid Source	0.6 3	1.03303113334	2416-007 0.00	1.033631135342416-007	0.00	Single Suff Scat	15	ł
		• 22 • 22	Slit Grid Source	0.6 2	1 0016305737	0.00	1.20/50204340/48-00/	0.00	Single Suff Scat	9	÷
		€ 24	Slit Grid Source	0.0 4	3 1.05282211210	003e-007 0.00	1.057030372790706-007	0.00	Multiple Surf Scat	0	t
		⊕ 25	Slit Grid Source	0.0 1.	2 9.94750390670	283e-008 0.00	9.94750390678283e-008	0.00	Multiple Surf Scat	9	t
			Slit Grid Source	0.4 1	2 9.6973672824	7596e-008 0.00	9.69736728247596e-008	0.00	Multiple Surf Scat	9	t
			Slit Grid Source	0.8 1	0 9.6779475516	9165e-008 0.00	9.67794755169165e-008	0.00	Single Surf Scat	11	t
			Slit Grid Source	0.6 1	0 8.10349158362	1317e-008 0.00	8.10349158362317e-008	0.00	Multiple Surf Scat	9	t
			Slit Grid Source	0.4 3	8.08178417905	296e-008 0.00	8.08178417905296e-008	0.00	Single Surf Scat	15	t
		30	Slit Grid Source	0.6 1	0 7.73033363035	338e-008 0.00	7.73033363035338e-008	0.00	Multiple Surf Scat	9	t
		31	Slit Grid Source	0.8 1	5 7.68719208852	042e-008 0.00	7.68719208852042e-008	0.00	Single Surf Scat	12	t
	Y	32	Slit Grid Source	0.4 1	1 7.36475240261	803e-008 0.00	7.36475240261803e-008	0.00	Multiple Surf Scat	9	
	1	33	Slit Grid Source	0.8 9	7.26463419981	319e-008 0.00	7.26463419981319e-008	0.00	Multiple Surf Scat	9	
	7	34	Slit Grid Source	0.4 9	7.18287909736	956e-008 0.00	7.18287909736956e-008	0.00	Multiple Surf Scat	9	
		35	Slit Grid Source	0.8 1	4 7.10053799128	8113e-008 0.00	7.10053799128113e-008	0.00	Single Surf Scat	12	
		36	Slit Grid Source	0.2 7	5.46171576268	831e-008 0.00	5.46171576268831e-008	0.00	Multiple Surf Scat	9	

TracePro







- Simplifying raytrace results
- Reducing number of rays shown on screen
- Identifying anomalous ray paths
- Stray light analysis
- Ray and Path Sorting can also be used with the Irradiance/Illuminance Maps in TracePro



Initial raytrace results - not useable for analysis





Model Source Radiance

Specular rays shown Model:[Spectrometer.oml] G Spectrometer 🗄 🧹 Slit 🕀 🧹 Grating E V Focusing Mirror 🗄 🧹 Collimating Mirror E CCD Detector Surface 0 Surface 1 Detector + Surface 3 Surface 4 Surface 5 Entity 3 Block 🛨 🧹 Window E V Detector Mount 🗄 🧹 Grating Mount E 🗸 Collimating Mirror Mount E V Focusing Mirror Mount 🕀 🧹 Case Ray Sorting × _ 🗄 🧹 Cover 🖭 🧹 Slit Mount Tu Ray Sort for Model Window. Sort Type: Specular -For the currently selected surface Sources: All • Wavelength: All -% Starting Rays to Display: 100 Flux Display Range (as a fraction of Peak Flux) Flux Range - Peak 1e-005 Watts Max Update







Path Sorting can show anomalous ray paths that may need to be mitigated. This example shows unwanted reflections from the slit.





Stray light can be analyzed and evaluated using Path Sorting. The example below shows light scattered to the detector from the collimating mirror.





Stray light can be analyzed and evaluated using Path Sorting. The example below shows light scattered to the detector from the spectrometer case.





The Ray and Path Sorting tables can also be used in conjunction with the Irradiance/Illuminance Maps.

- To use Ray Sorting, open the Irradiance/Illuminance Map, and then go to Analysis->Ray Sorting
- The Ray Sorting selections can then applied in the same manner as for graphical ray sorting
- To use Path Sorting, open the Path Sort Table, select a path, go to Analysis->Display Selected Paths, and then open the Irradiance/Illuminance Map
- Selecting a different path in the Path Sort Table will update the Irradiance/Illuminance Map



Ray Sorting in Irradiance/Illuminance Map to show 0.2um rays





Irradiance/Illuminance Map results for a selected path

∰ % № 18 ∽ ~ (0 € €) 🖉 📉 🕫 🖾 🗖 🗖 🗖 🖉 🖉 🖉	I 🔤 🕀	🖾 📉 🕅 9	N?							
	ĭx zĭ zĭ t, ,∃ x5 t, ,ĭ t, ½ 4 → H	3 ⊜ K	P 🕀 =	* 🖓 🖌 🦻	↓ ₩						
d:[Spectrometer.oml]		Path So	rt Table [Spectre	meter.oml]					Irradiance/	Illuminance Map:[Spectrometer.oml]	
ectrometer						and a strength of the				Total - Irradiance Map for Incident Flux	
Slit			Sources:	All	-	No. of intercepts:				CCD Detector Detector Global Coordinates	
Focusing Mirror			Wavelengths:	All	•	% of rays to display:	100	Select filte	W/m ²		
Collimating Mirror					1				0.095		
CCD Detector		Ray Path	Source	Wavelength	No. Rays	Absorbed Flux	7 % of Total	Incident Flux			
Surface 0		<u> </u>	Silt Grid Source	0.4	49392	0.129005549779135	30.10	0.129003049779135	0.09		
Detector		02	Slit Grid Source	0.2	249934	0.026303087790833	29.99	0.0263001766999427	0.005		
Surface 3		(A	Slit Grid Source	0.0	24009	0.0847656107332225	10.79	0.0802091700888437	0.085		
Surface 4		€ 5	Slit Grid Source	0.8	180	1.55801147274786e-00	0.00	1.55801147274786e-0	0.08		
urface 5		⊕ 6	Slit Grid Source	0.8	124	9.71566949611267e-00	0.00	9.71566949611267e-0	0.00		
Rinck		• 7	Slit Grid Source	0.8	102	7.96361472605634e-00	0.00	7.96361472605634e-0	0.075	_	
Vindow		• 8	Slit Grid Source	0.8	163	5.10063775120543e-00	0.00	5.10063775120543e-0			
etector Mount		€ 9	Slit Grid Source	0.4	315	4.00133385772469e-00	0.00	4.00133385772469e-0	0.07		
rating Mount		● 10	Slit Grid Source	0.8	305	3.88442867923526e-00	0.00	3.88442867923526e-0			
ollimating Mirror Mount		11	Slit Grid Source	0.4	122	3.8115217689709e-006	0.00	3.8115217689709e-00	0.065		0.1
ase		12	Slit Grid Source	0.6	276	3.51296523740237e-00	0.00	3.51296523740237e-0	0.00	(-1416268809135088894(b31682)3)	0.09
over		13	Slit Grid Source	0.2	260	3.26619363480386e-00	0.00	3.26619363480386e-0	0.06		0.08
it Mount Tube		14	Slit Grid Source	0.6	62	2.15445074118627e-00	0.00	2.15445074118627e-0	0.055		0.07
		15	Slit Grid Source	0.4	134	7.57887500631242e-00	0.00	7.57887500631242e-0	0.000	(s)	0.06
		● 16	Slit Grid Source	0.2	103	7.40613806332179e-00	0.00	7.40613806332179e-0	0.05	e e	0.04
		• 17	Slit Grid Source	0.6	8	7.30425540752795e-00	0.00	7.30425540752795e-0			0.03
		18	Slit Grid Source	0.6	19	6.60232345427624e-00	0.00	6.60232345427624e-0	0.045	<u> </u>	0.02
		0 19	Slit Grid Source	0.6	106	5.75610515892231e-00	0.00	5.75610515892231e-0			0.01
		0 20	Silt Grid Source	0.8	93	5.52073729280809e-00	0.00	5.520/3/29280809e-0	0.04		0
		⊕ 21 € 22	Slit Grid Source	0.4	40	2 14050045297005e-00	0.00	2 14050045287005e-0	0.005	(11(6202,09,35)388,970,63.6203)	- Horizontal
		(22 (23	Slit Grid Source	0.6	3	2 7358280821207#-007	0.00	2 7358280821207#-00	0.035	(millimeters)	- Vertical
			Slit Grid Source	0.6	35	2.70511238773133e-00	0.00	2.70511238773133e-0	0.03		
			Slit Grid Source	0.8	49	2.55459299919144e-00	0.00	2,55459299919144e-0	0.00		
			Slit Grid Source	0.2	32	2.46357710548204e-00	0.00	2.46357710548204e-0	0.025		
			Slit Grid Source	0.4	22	1.71522988717445e-00	0.00	1.71522988717445e-0			
			Slit Grid Source	0.8	3	1.63383115334241e-00	0.00	1.63383115334241e-0	0.02		
		29	Slit Grid Source	0.6	20	1.2073626454074e-007	0.00	1.2073626454074e-00			
		30	Slit Grid Source	0.8	4	1.09163857279878e-00	0.00	1.09163857279878e-0	0.015		
		31	Slit Grid Source	0.8	13	1.06282311219003e-00	0.00	1.06282311219003e-0			
	Y	32	Slit Grid Source	0.2	12	9.94750390678283e-00	0.00	9.94750390678283e-0	0.01		
	1	33	Slit Grid Source	0.4	12	9.69736728247596e-00	0.00	9.69736728247596e-0	0.005		
	Z	34	Slit Grid Source	0.8	10	9.67794755169165e-00	0.00	9.67794755169165e-0	0.005		
		35	Slit Grid Source	0.8	1	8.67130582624766e-00	0.00	8.67130582624766e-0	0		
		36	Slit Grid Source	0.6	10	8.10349158362317e-00	0.00	8.10349158362317e-0 🗸	U U	Min:1.4599e-014 Max:0.094021 Ave:0.031721	







Summary and Questions


Summary and Questions

The TracePro features powerful and easy to use Ray and Path Sorting tools:

- \checkmark The ray display can be simplified for better clarity and understanding
- ✓ Sort rays based on criteria such as surface interaction type, wavelength, percentage of starting rays, etc...
- \checkmark Sort rays based on the path they take to get to a selected surface
- ✓ Sorted results can also be displayed in the Irradiance/Illuminance Map
- ✓ Excellent tools for stray light analysis

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