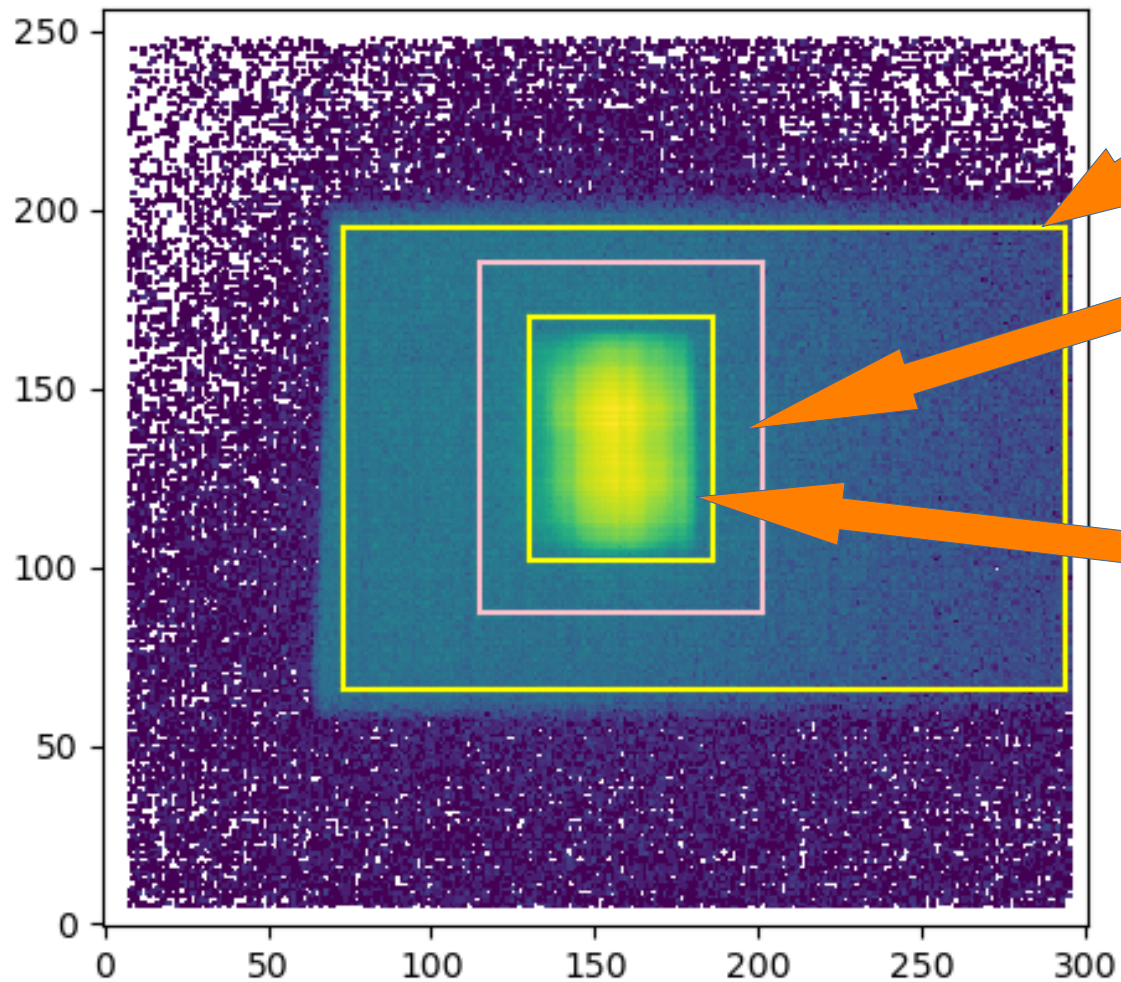


SNS 2020 Intensity Analysis Update

initial preliminary attempt

ORNL n \rightarrow n' Group Meeting
4-20-2023
Cary Rock

pc-18-table.txt



“Background” Region (BR)

$$73 \leq x \leq 294$$

$$66 \leq y \leq 195$$

“Scattering” Region (SR)

$$115 \leq x \leq 201$$

$$87 \leq y \leq 185$$

“Peak” Region (PR) – not the same as Dr. Gonzalez’ ROI

$$130 \leq x \leq 186$$

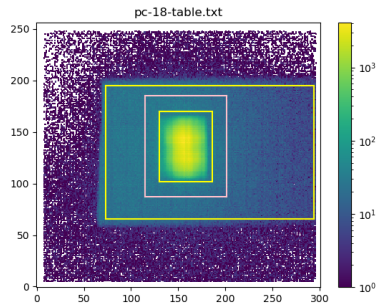
$$102 \leq y \leq 170$$

Outside the BR, hits are discarded

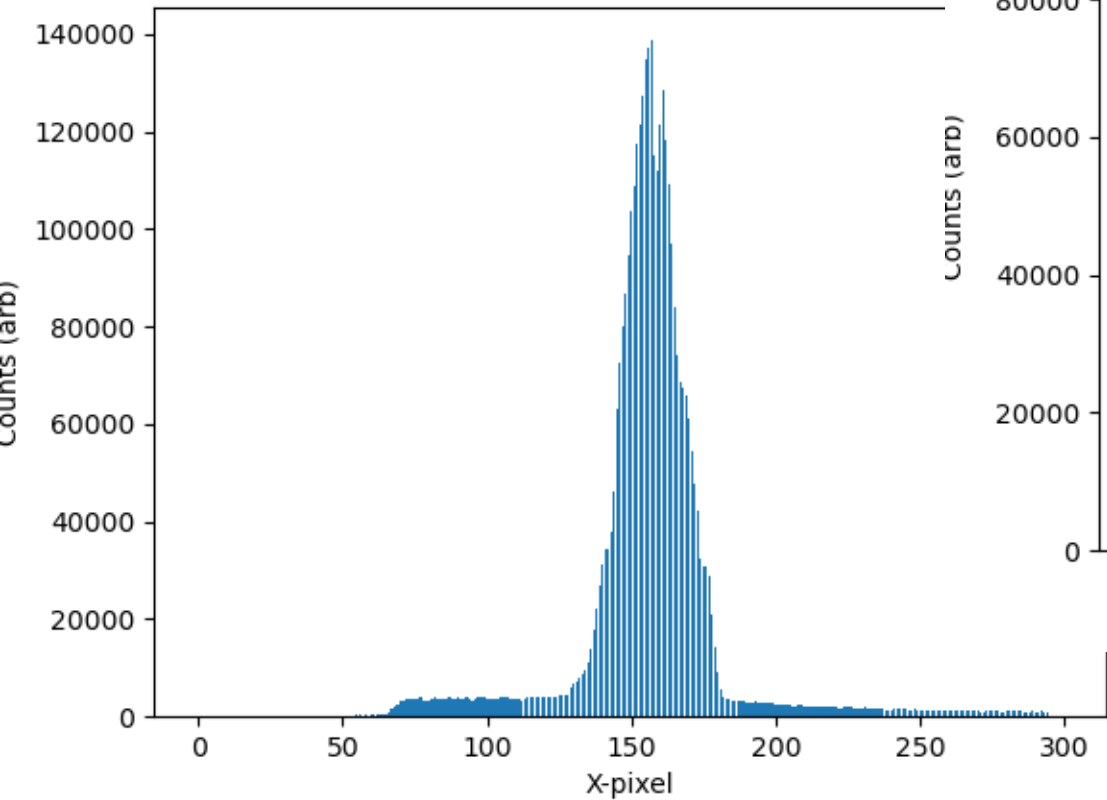
Pixels with content of “0” are ignored

Intensity (log)

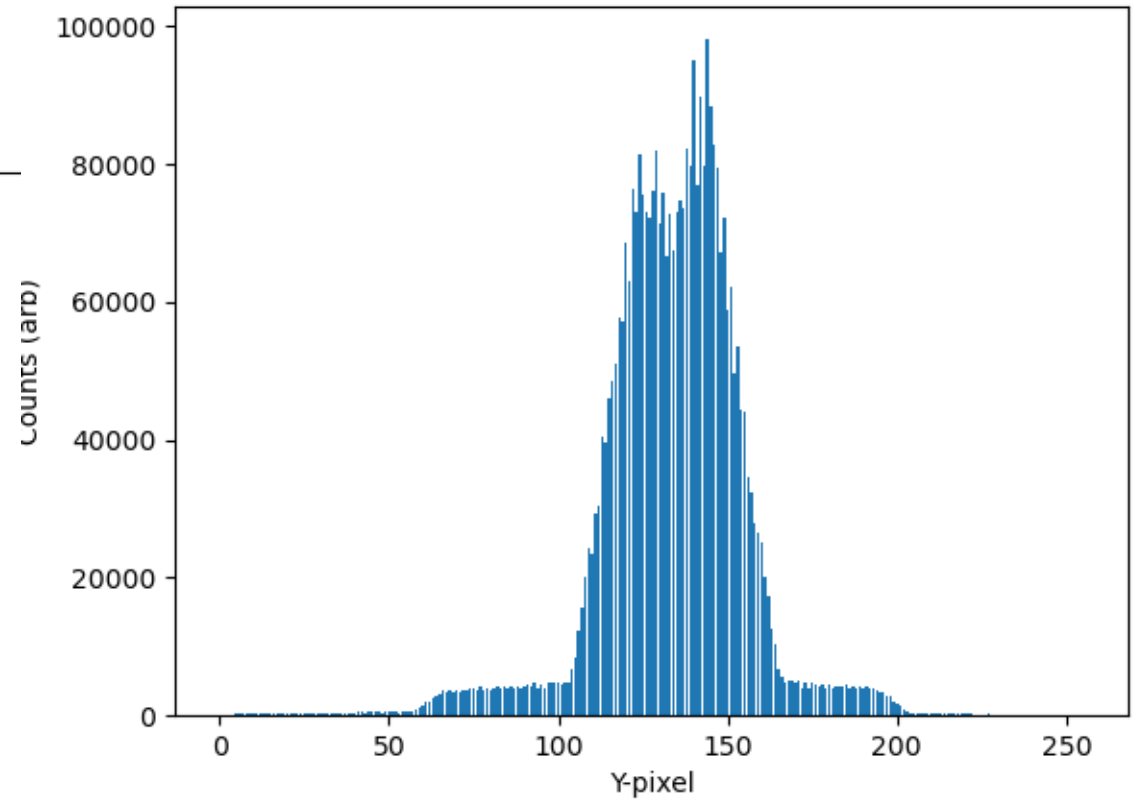
18 Polycarbonate Data



Whole Detector - X



Whole Detector - Y



Plane Fit

Plane Fit

Region: x in [73, 294] y in [66, 195]

	b0 initial	b0 fit	bx fit	by fit	X ²	NDoF - 3 (?)	X ² /(NDoF-3)
18	2.273E+01	3.465E+01	-1.029E-01	7.674E-03	18693.27	15971	1.170E+00
19	2.022E+01	3.104E+01	-9.094E-02	7.017E-03	18393.76	15969	1.152E+00
20	1.822E+01	2.807E+01	-8.108E-02	5.864E-03	18212.59	15964	1.141E+00
21	1.639E+09	2.538E+01	-7.026E-02	4.318E-03	17594.91	15967	1.102E+00
22	1.520E+01	2.305E+01	-6.257E-02	2.930E-03	17543.69	15966	1.099E+00
24	1.274E+01	1.946E+01	-4.93E-02	-1.345E-03	17043.13	15958	1.068E+00
140	1.000E+00	1.047E+00	-5.732E-05	-8.604E-05	18.91	748	2.528E-02
142	1.000E+00	1.008E+00	1.065E-04	-2.528E-05	19.00	754	2.520E-02

Gaussian Fit

	<u>Gaussian Fit</u> Region:		ROIx in [130, 186]		ROIy in [102, 170]		NDoF - 3	X ² /(NDoF-3)
	A init	A fit	x in [ROI-15, ROI+15]	sigx fit	y in [ROI-15, ROI+15]	sigy fit		
18	3.201E+01	6.873E+01	2.064E+01	2.143E+01	36335.19	4925	7.378E+00	
19	2.046E+01	3.050E+01	2.485E+01	2.534E+01	29012.15	4925	5.891E+00	
20	1.502E+01	1.724E+01	2.965E+01	-3.037E+01	27168.44	4925	5.516E+00	
21	1.014E+01	1.105E+01	-3.507E+01	3.493E+01	26280.34	4925	5.336E+00	
22	8.381E+00	7.468E+00	4.233E+01	4.236E+01	26748.77	4925	5.431E+00	
24	3.925E+00	5.055E+00	5.268E+01	5.462E+01	26616.86	4925	5.404E+00	
140	-9.720E-01	9.744E-01	4.435E+05	7.276E+02	19620.45	4925	3.984E+00	
142	-9.711E-01	err	err	err	19468.05	4925	3.953E+00	

Plane-fit Parameters for 18 PC

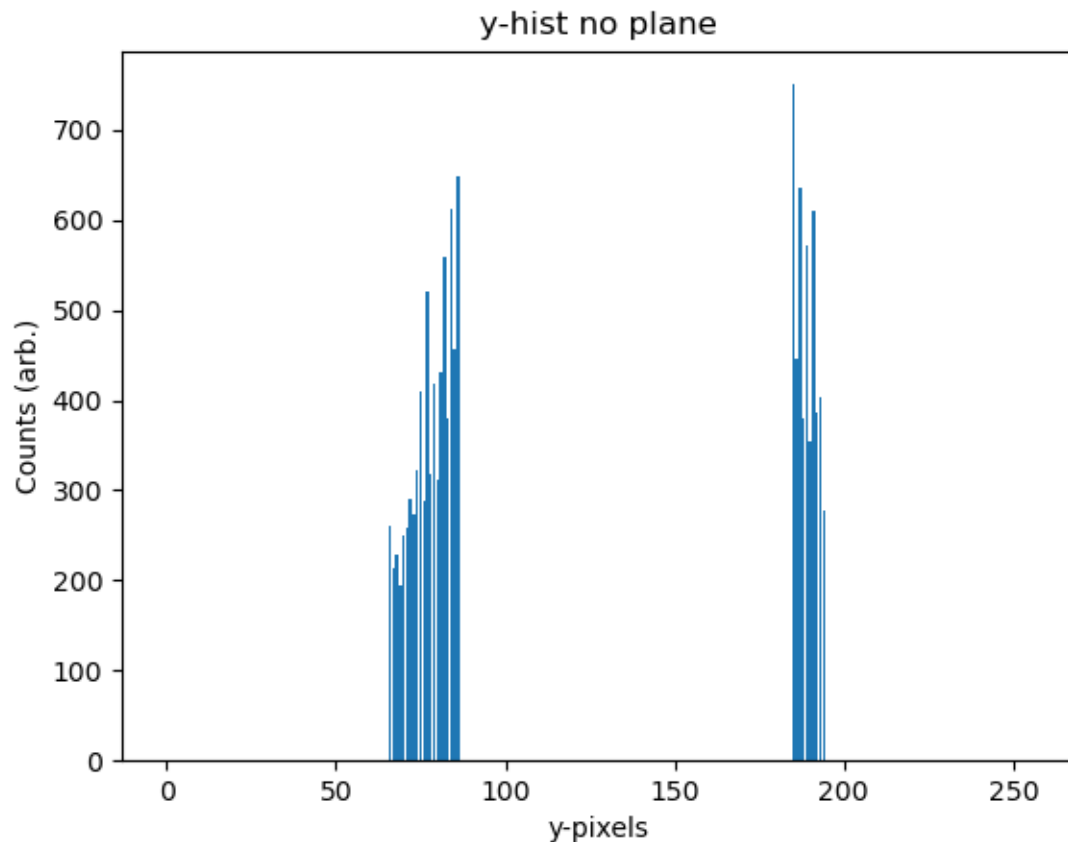
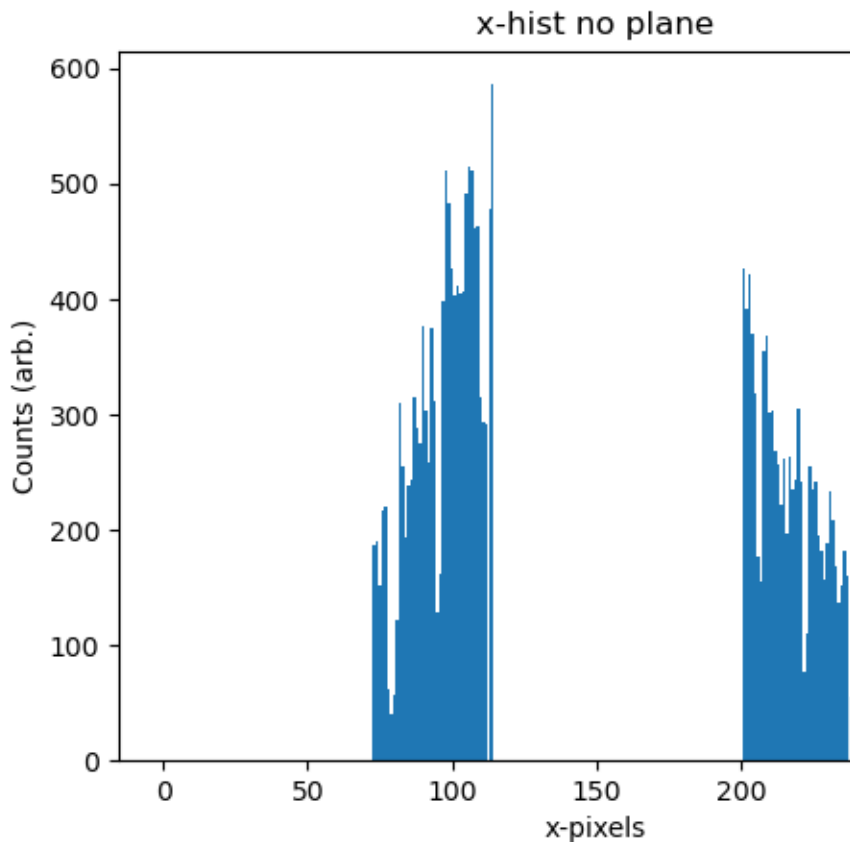
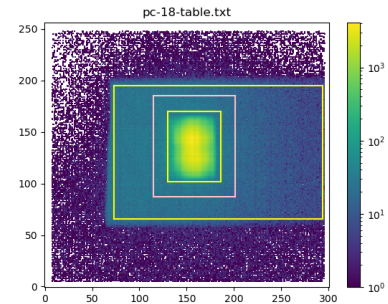
Fit within the $FR = BR - SR$ (BR boundaries inclusive, SR boundaries exclusive)

```
Initial fitting parameters: [22.732456140350877, 0.0, 0.0]
popt:
[ 3.46525402e+01 -1.02943298e-01  7.67375417e-03]
pcov:
[[ 1.92048442e-02 -3.47807011e-05 -9.03349489e-05]
 [-3.47807011e-05  1.88654022e-07 -1.20260778e-08]
 [-9.03349489e-05 -1.20260778e-08  7.39689518e-07]]
count: 15971      chi2: 18693.266909732683      chi2/N: 1.1704506236135923
```

Little Problem: “count” does not
match the number of pixels within the
fitting region – being investigated

Result of the subtraction of plane-fit from “raw data”
in preparation for the gaussian fit in the gaussian
fitting region (GFR) = SR – PR

This (plane) subtraction not used in gaussian fit



Result of the gaussian fit

Initial fitting parameters: [32.012827984747936, 23.781010408064535, 28.876941209792648]

popt: sigma_x sigma_y
[68.73587748 20.64169943 21.43460713]

pcov: ~14 mm, ~15 mm

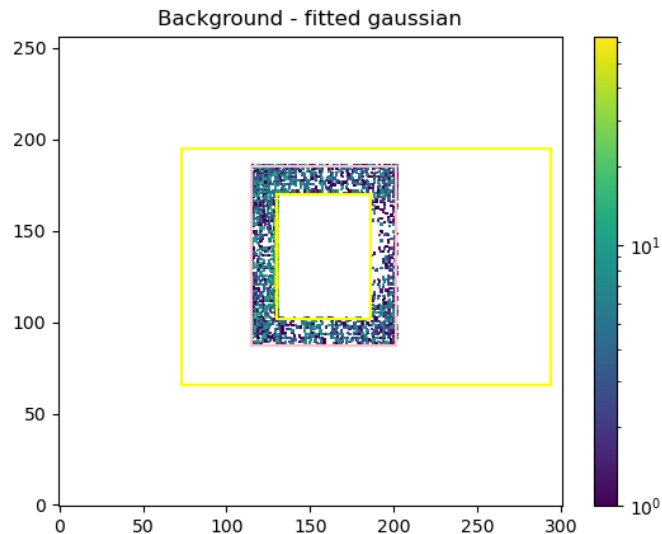
[[8.38501263 -0.84011595 -0.65236269]

[-0.84011595 0.09561388 0.06150021]

[-0.65236269 0.06150021 0.06699522]]

count: 4925 chi2: 36335.599350448305

chi2/N: 7.377786670141788



Since the beam is x-y asymmetric (y-width > x-width), we expect $\text{sigma}_y > \text{sigma}_x$

Little Problem: number of used pixels is still mysterious

χ^2/N is not great, either

Result of the gaussian fit

Initial fitting parameters: [32.012827984747936, 23.781010408064535, 28.876941209792648]

popt: sigma_x sigma_y
[68.73587748 20.64169943 21.43460713]

pcov: ~14 mm, ~15 mm

Lawrence's: sigma = 32 mm (symmetric)

[[8.38501263 -0.84011595 -0.65236269]

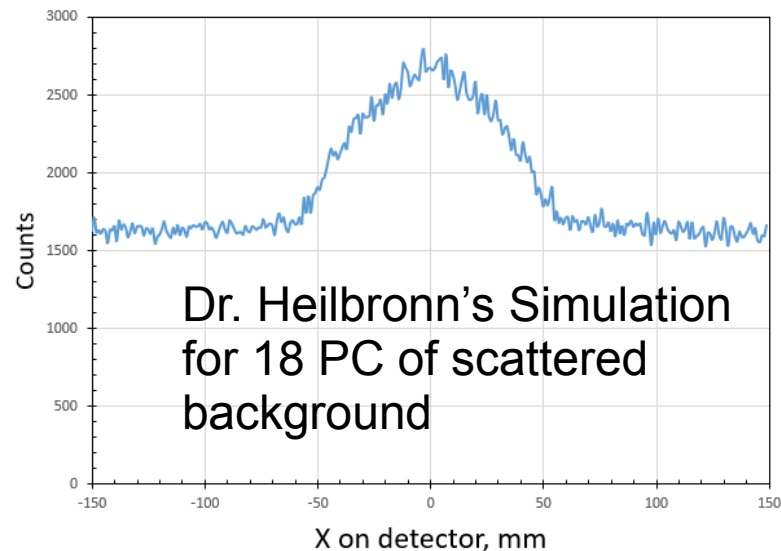
[-0.84011595 0.09561388 0.06150021]

[-0.65236269 0.06150021 0.06699522]]

count: 4925 chi2: 36335.599350448305

chi2/N: 7.377786670141788

18 pc X-mm only scattered



Little Problem: number of used pixels is still mysterious

χ^2/N is not great, either

Combination fit with 6 Parameters – Plane + Gauss

Fitting region will be BR – PR
PR will be tuned for each individual run

```
Initial fitting parameters: [22.732456140350877, 0.0, 0.0, 2.273245614035088, 48.8360035165611, 48.41134261641709]
popt:
[ 3.17913987e+01 -9.20379331e-02  4.73609682e-03  1.78560907e+01
 -3.57462013e+01 -3.00090395e+01]
pcov:
[[ 4.10177795e-02 -1.01195894e-04 -8.19832191e-05  6.30778334e-02
  1.04791643e-01  9.79134902e-02]
 [-1.01195894e-04  3.90037293e-07 -3.96596915e-08 -1.59147968e-04
 -3.21923083e-04 -2.54856917e-04]
 [-8.19832191e-05 -3.96596915e-08  7.50954379e-07  4.66110858e-05
  1.12872437e-04 -5.03480202e-05]
 [ 6.30778334e-02 -1.59147968e-04  4.66110858e-05  1.02981811e+00
  8.72812473e-01  5.27498925e-01]
 [ 1.04791643e-01 -3.21923083e-04  1.12872437e-04  8.72812473e-01
  9.64947868e-01  5.40419070e-01]
 [ 9.79134902e-02 -2.54856917e-04 -5.03480202e-05  5.27498925e-01
  5.40419070e-01  5.62295593e-01]]
count: 15971      chi2: 17758.245561598465      chi2/N: 1.111905676638812
```

Fit shows strange behavior –
sign of sigma's not essential, but
should be understood

Count shows same number of
events as for plane – algorithm is
working, but needs improvement

Conclusion

- No results to report yet
- Working code, but needs errors corrected
 - `Scipy.optimize.curve_fit` returning negative sigma values, etc.

What's Next

- 1) Fix all errors
- 2) Fit all 6 intensity files and find the covariant matrix for all parameters
- 3) This information (cov. matrix + parameters) will be used by James to produce the error associated with the fit of the background