

Mott Detector Rates

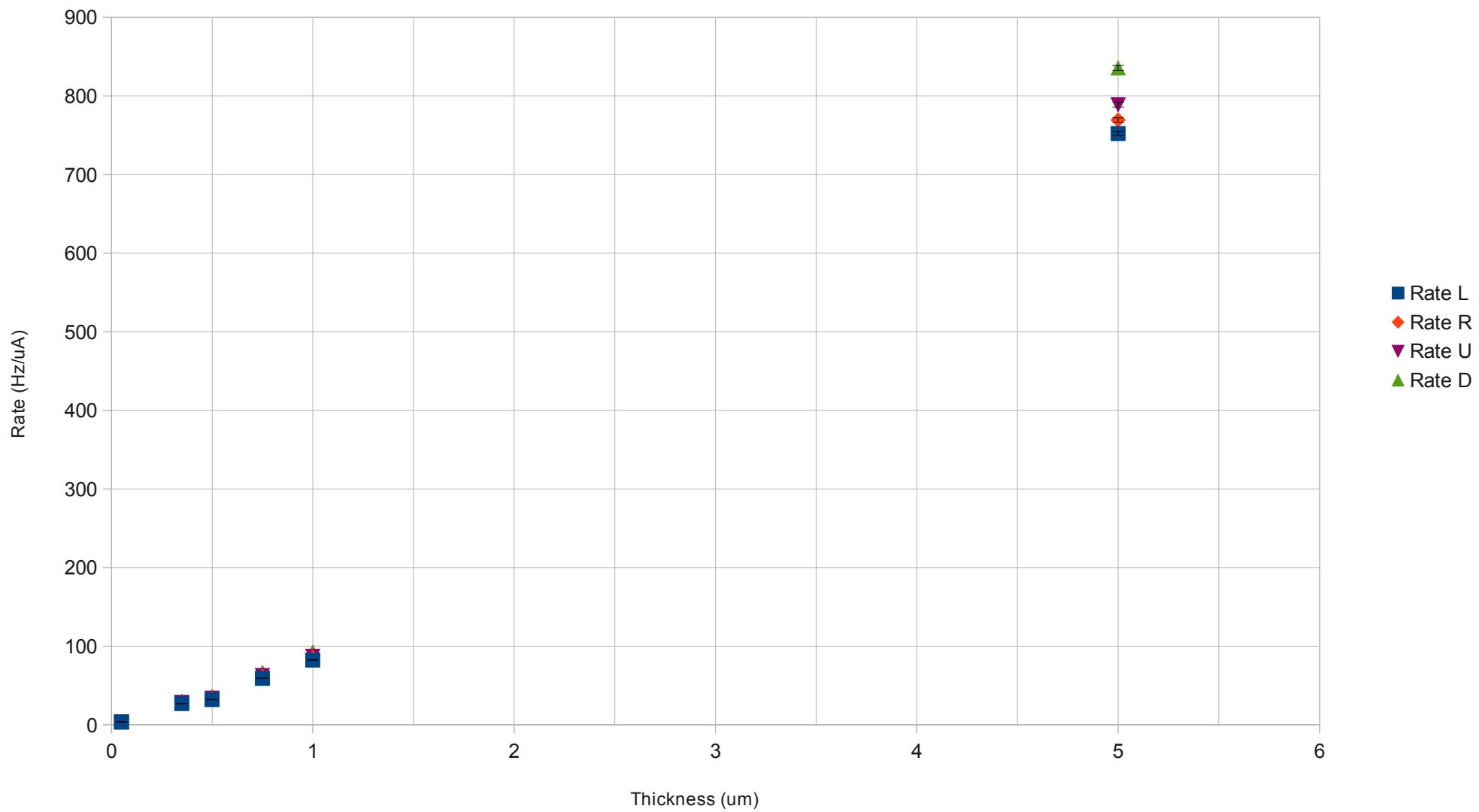
$$R = \frac{N}{IT} \qquad \sigma_R = R \sqrt{\frac{1}{N} + \left(\frac{\sigma_I}{I}\right)^2 + \frac{1}{4T^2}}$$

- $\sigma_N = N^{1/2}$ $\sigma_T = 1/2$ sec
- [N] : counts [I] : uA [T] : sec [R] : Hz/uA

Foil (um)	# of Runs	Left Rate (Hz/uA)	Right Rate (Hz/uA)	Up Rate (Hz/uA)	Down Rate (Hz/uA)
5.0	10	752.23 ± 2.75	769.47 ± 2.81	788.82 ± 2.88	835.65 ± 3.04
1.0	6	82.34 ± 0.29	85.42 ± 0.30	87.32 ± 0.31	92.47 ± 0.32
0.75	6	59.11 ± 0.21	61.69 ± 0.22	62.81 ± 0.22	66.54 ± 0.23
0.5	5	32.14 ± 0.11	33.33 ± 0.11	33.98 ± 0.11	36.28 ± 0.12
0.35	4	26.85 ± 0.10	27.73 ± 0.10	28.42 ± 0.11	30.10 ± 0.11
0.05 (1)	7	3.58 ± 0.01	3.51 ± 0.01	3.75 ± 0.01	4.00 ± 0.01
0.05 (2)	4	3.53 ± 0.02	3.44 ± 0.02	3.74 ± 0.02	3.92 ± 0.02

Detector Rates vs Gold Target Thickness

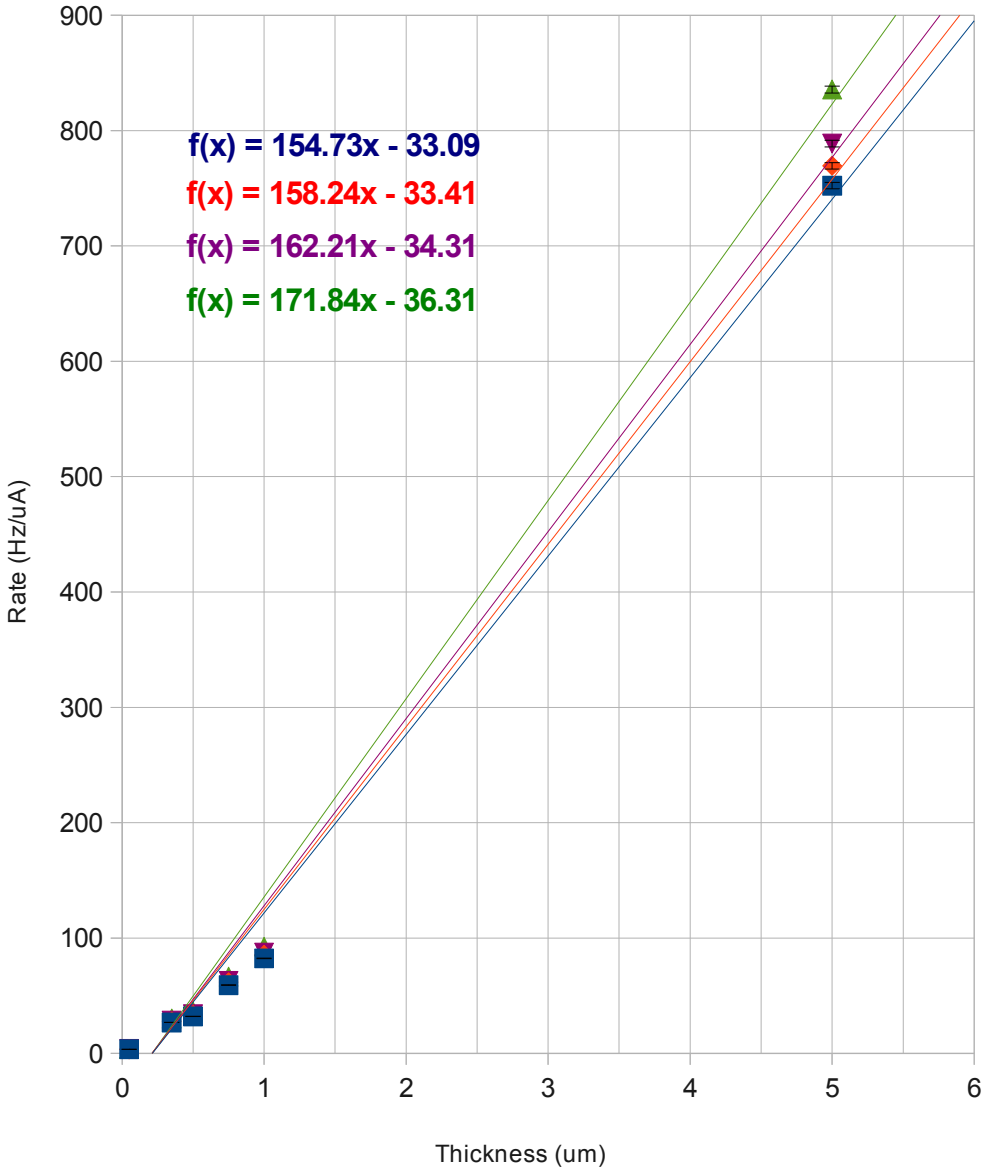
All Foils



Detector Rates vs Gold Target Thickness

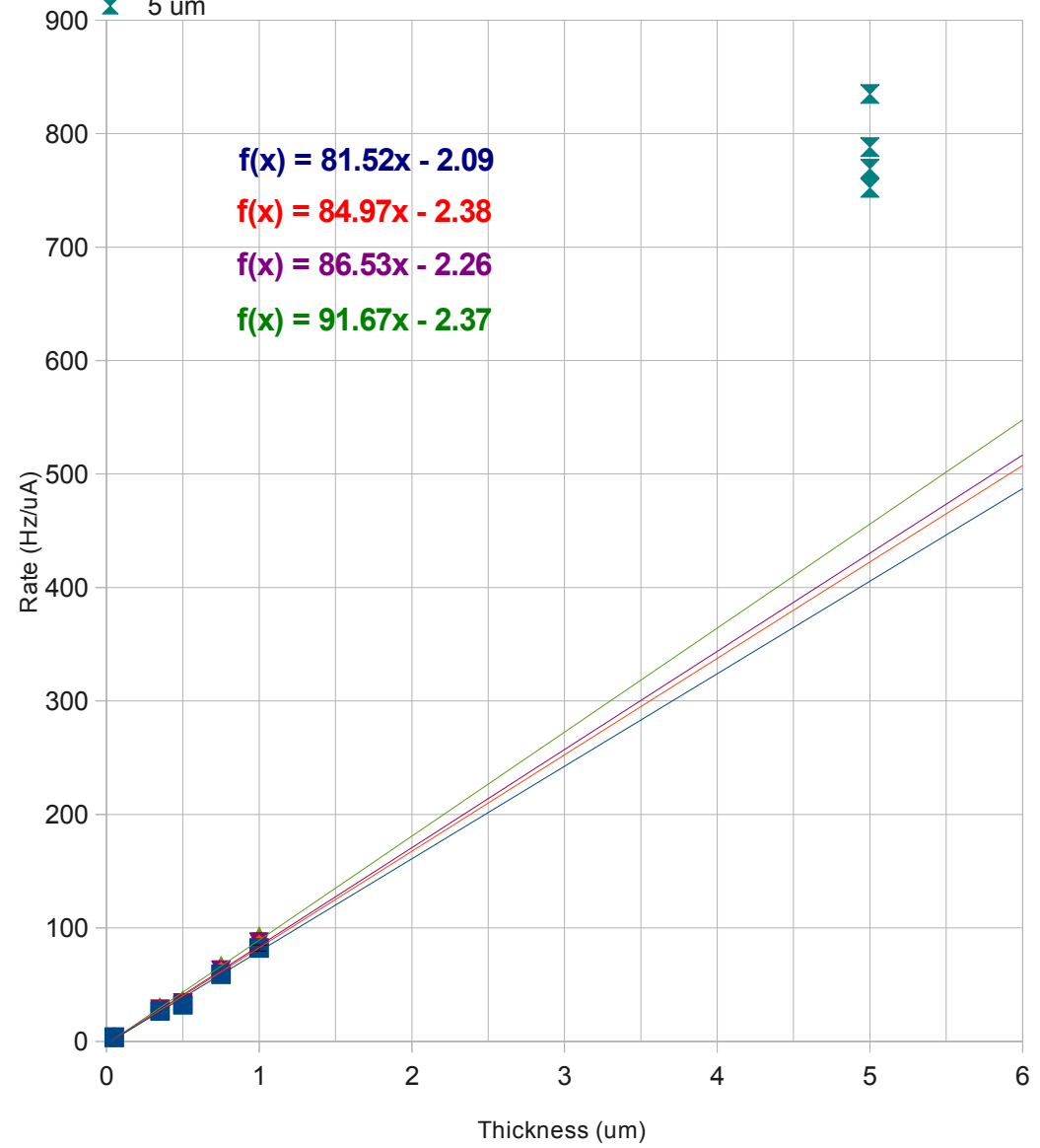
All Foils

- Rate L — Linear (Rate L) ◆ Rate R — Linear (Rate R)
- ▼ Rate U — Linear (Rate U) ▲ Rate D — Linear (Rate D)



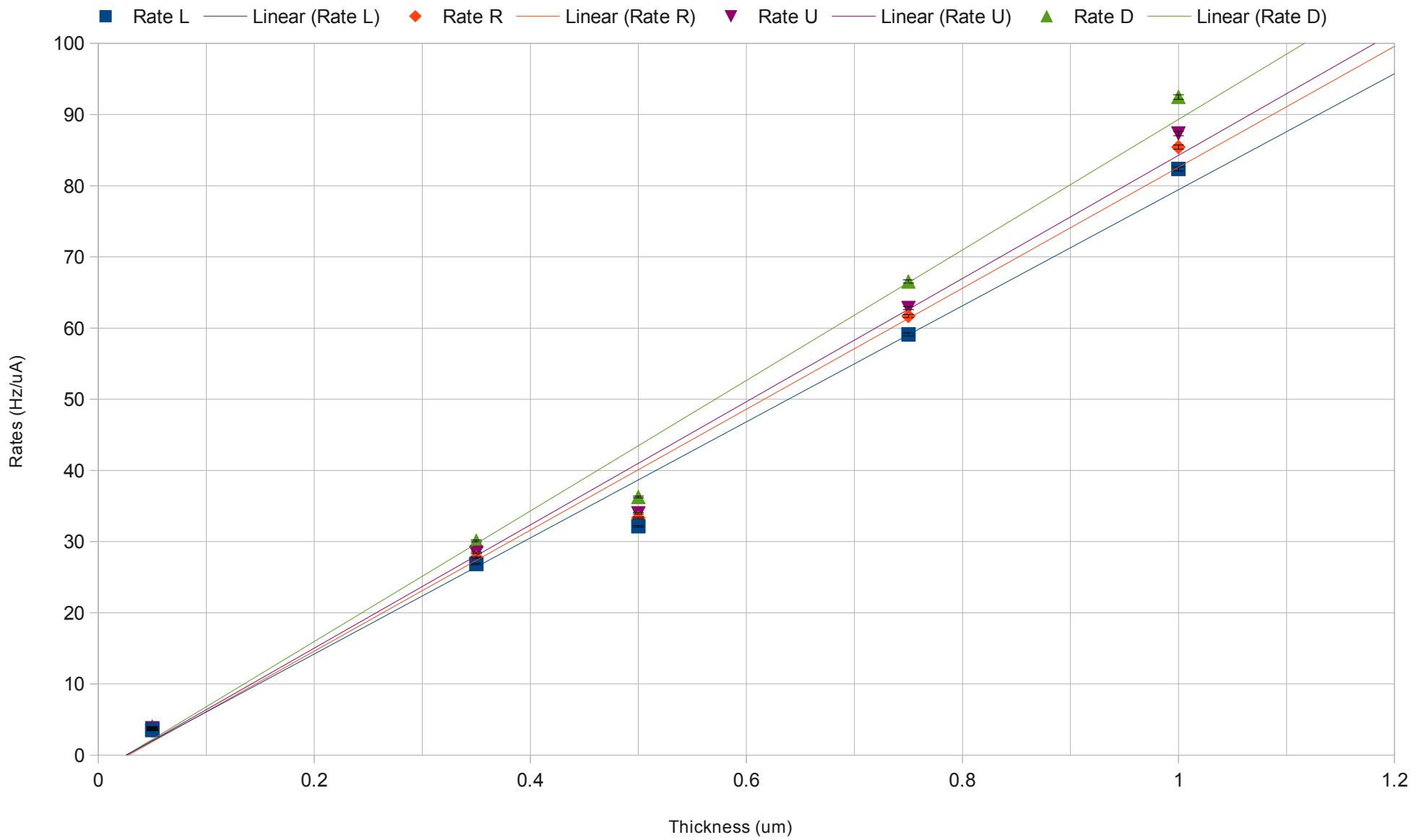
Detector Rates vs Gold Target Thickness without 5 um in fits

- Rate L — Linear (Rate L) ◆ Rate R — Linear (Rate R)
- ▼ Rate U — Linear (Rate U) ▲ Rate D — Linear (Rate D)
- ⋈ 5 um



Detector Rates vs Gold Target Thickness

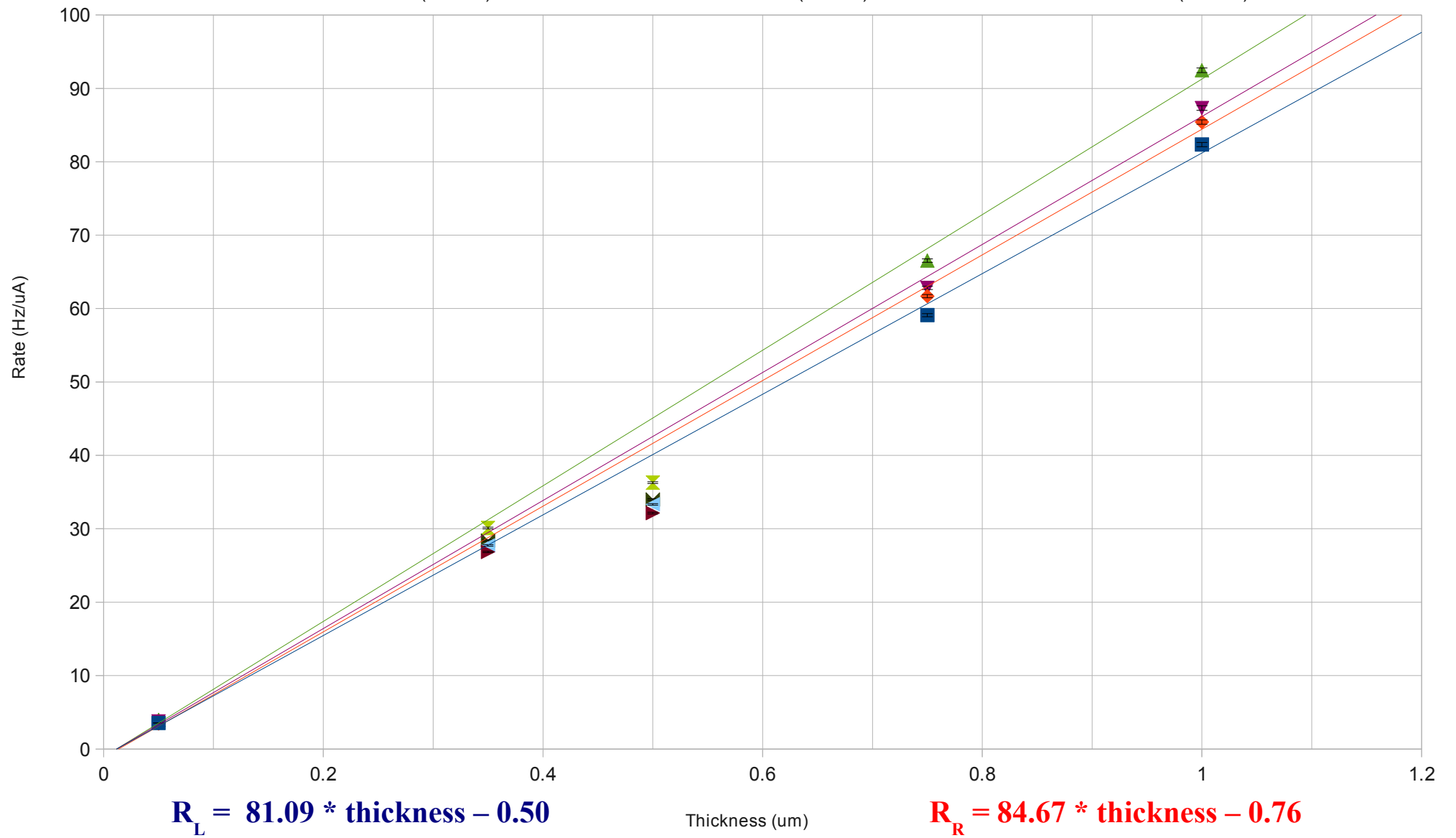
All foils except 5 μm



Detector Rates vs Gold Target Thickness

Fit without 0.5 and 0.35 um Foils; Averaged two 0.05 um foils

- Rate L
- Linear (Rate L)
- ▶ 0.5 and 0.35 L
- ◀ 0.5 and 0.35 R
- ✦ 0.5 and 0.35 U
- ✧ 0.5 and 0.35 D
- ◆ Rate R
- Linear (Rate R)
- ▼ Rate U
- Linear (Rate U)
- ▲ Rate D
- Linear (Rate D)



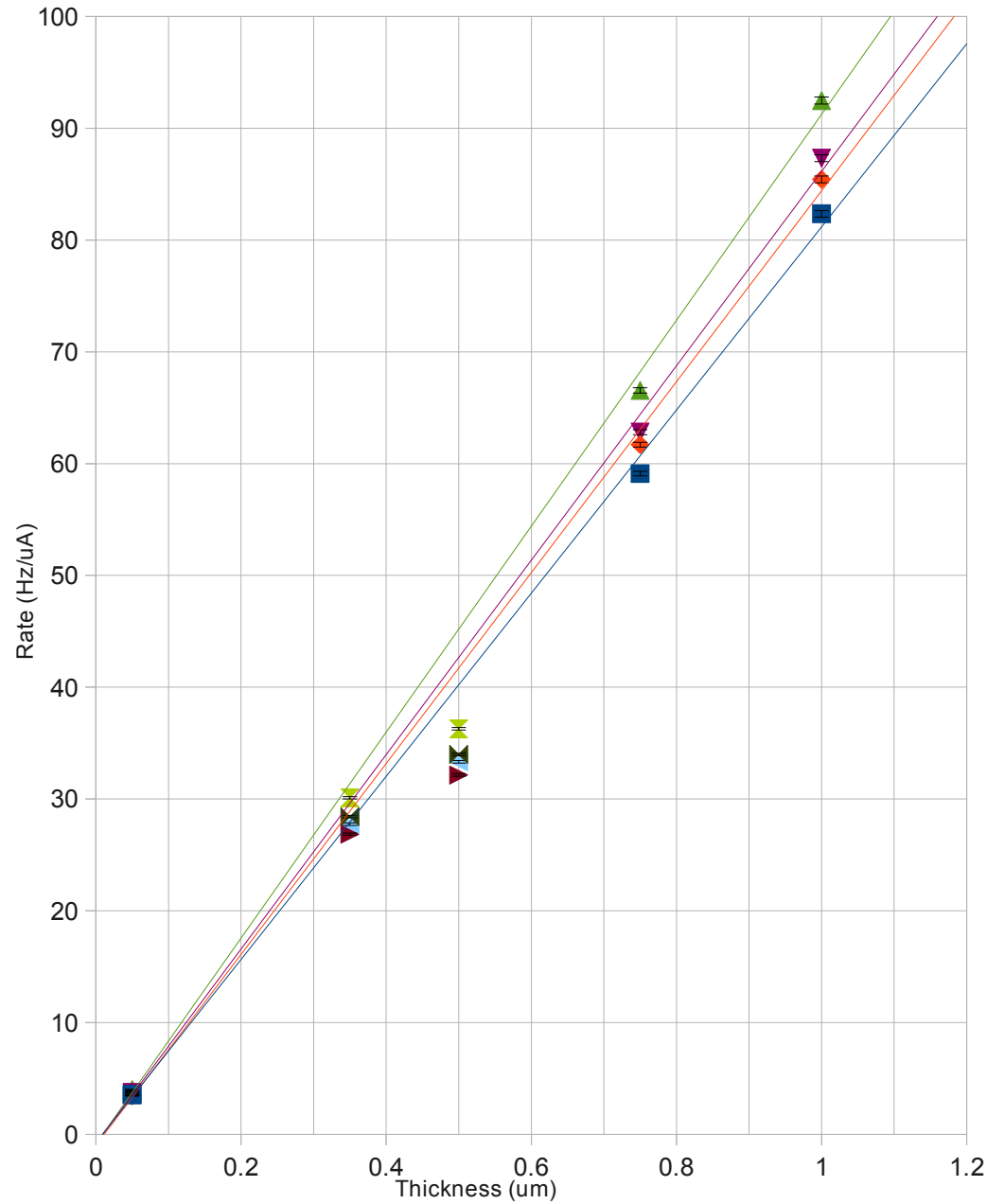
$$R_L = 81.09 * \text{thickness} - 0.50$$

$$R_R = 84.67 * \text{thickness} - 0.76$$

$$R_U = 86.12 * \text{thickness} - 0.56$$

$$R_D = 91.23 * \text{thickness} - 0.60$$

Detector Rates vs Gold Target Thickness
 0.35, 0.5, and 5.0 μm Foils Omitted in Fits; 0.05 μm Foils Averaged



Left Detector

$$R_L = 81.09 * \text{thickness} - 0.50$$

$$m_L = 81.0921 \quad \pm 1.796 \quad (2.215\%)$$

$$b_L = -0.501236 \quad \pm 0.1598 \quad (31.87\%)$$

Right Detector

$$R_R = 84.67 * \text{thickness} - 0.76$$

$$m_R = 84.6714 \quad \pm 1.551 \quad (1.832\%)$$

$$b_R = -0.759694 \quad \pm 0.1331 \quad (17.52\%)$$

Up Detector

$$R_U = 86.12 * \text{thickness} - 0.56$$

$$m_U = 86.1228 \quad \pm 1.801 \quad (2.091\%)$$

$$b_U = -0.561106 \quad \pm 0.1587 \quad (28.29\%)$$

Down Detector

$$R_D = 91.23 * \text{thickness} - 0.60$$

$$m_D = 91.2298 \quad \pm 1.889 \quad (2.07\%)$$

$$b_D = -0.604876 \quad \pm 0.165 \quad (27.28\%)$$

$$R_L(d) = 81.09 * d - 0.50$$

$$R_R(d) = 84.67 * d - 0.76$$

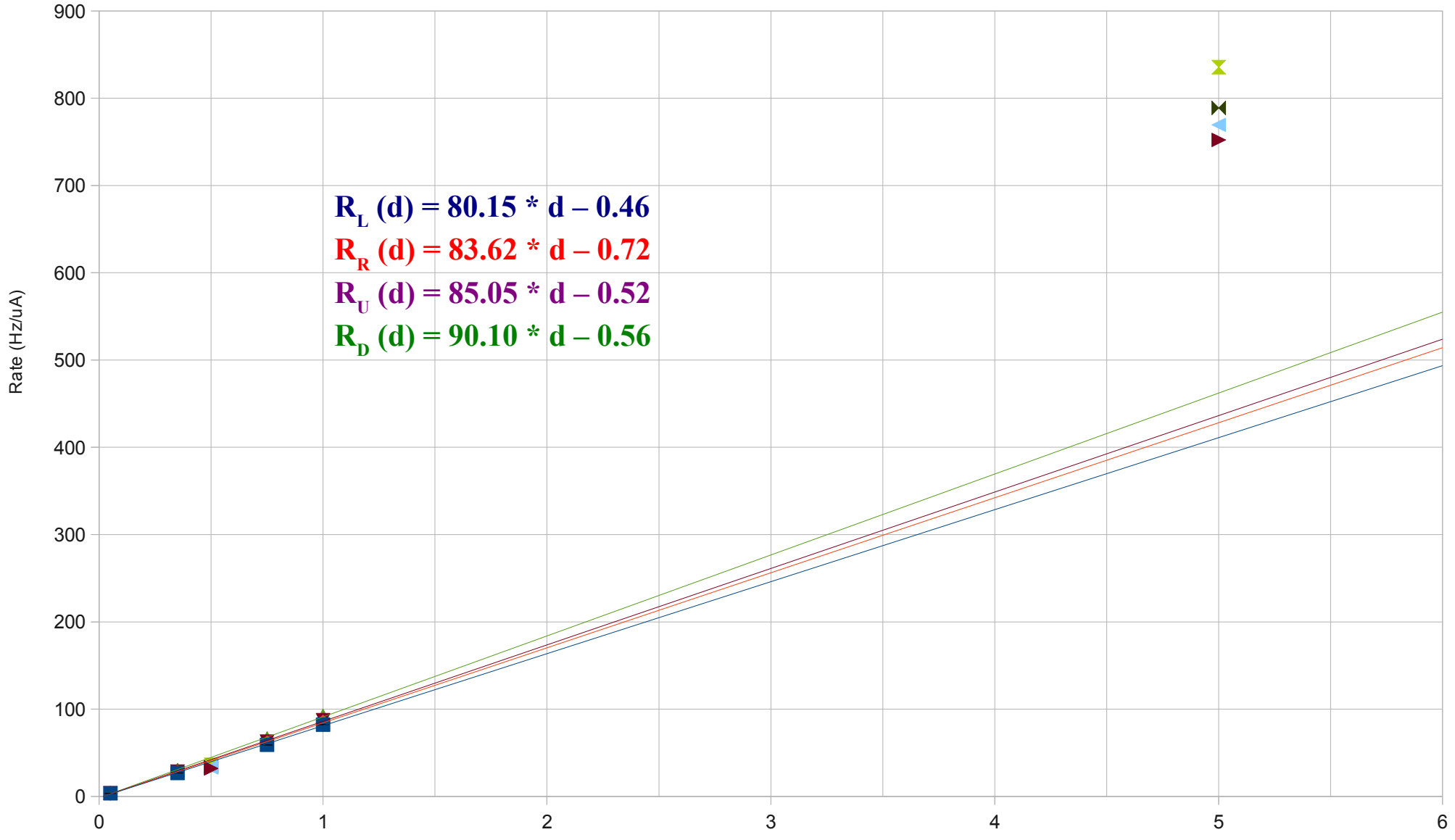
$$R_U(d) = 86.12 * d - 0.56$$

$$R_D(d) = 91.23 * d - 0.60$$

Gold 5.0, 0.5, 0.35 um Residuals						
d (um)	Left Measured Rate (Hz/uA)	$R_L(d)$ (Hz/uA)	Difference \ Percent Difference	Right Measured Rate (Hz/uA)	$R_R(d)$ (Hz/uA)	Difference \ Percent Difference
5.0	752.22	404.95	347.27 \ 60 %	769.47	422.59	346.88 \ 58 %
0.5	32.14	40.05	7.91 \ 22 %	33.33	41.58	8.25 \ 22 %
0.35	26.85	27.88	1.03 \ 3.8 %	27.74	28.87	1.13 \ 4.7 %
d (um)	Up Measured Rate (Hz/uA)	$R_U(d)$ (Hz/uA)	Difference \ Percent Difference	Down Measured Rate (Hz/uA)	$R_D(d)$ (Hz/uA)	Difference \ Percent Difference
5.0	788.82	430.04	358.78 \ 59 %	835.65	455.55	380.10 \ 59 %
0.5	33.98	42.50	8.52 \ 22 %	36.28	45.02	8.74 \ 22 %
0.35	28.42	29.58	1.16 \ 4.0 %	30.10	31.33	1.23 \ 4.0 %

Detector Rates vs Gold Target Thickness
 0.35 μm included in fits; 5.0 and 0.5 μm foils excluded from fits; 0.05 μm points averaged

- Rate L
 — Linear (Rate L)
 ▶ 5.0 and 0.5 L
 ◀ 5.0 and 0.5 R
 ◀▶ 5.0 and 0.5 U
 ✕ 5.0 and 0.5 D
 ◊ Rate R
- Linear (Rate R)
 ▼ Rate U
 — Linear (Rate U)
 ▲ Rate D
 — Linear (Rate D)



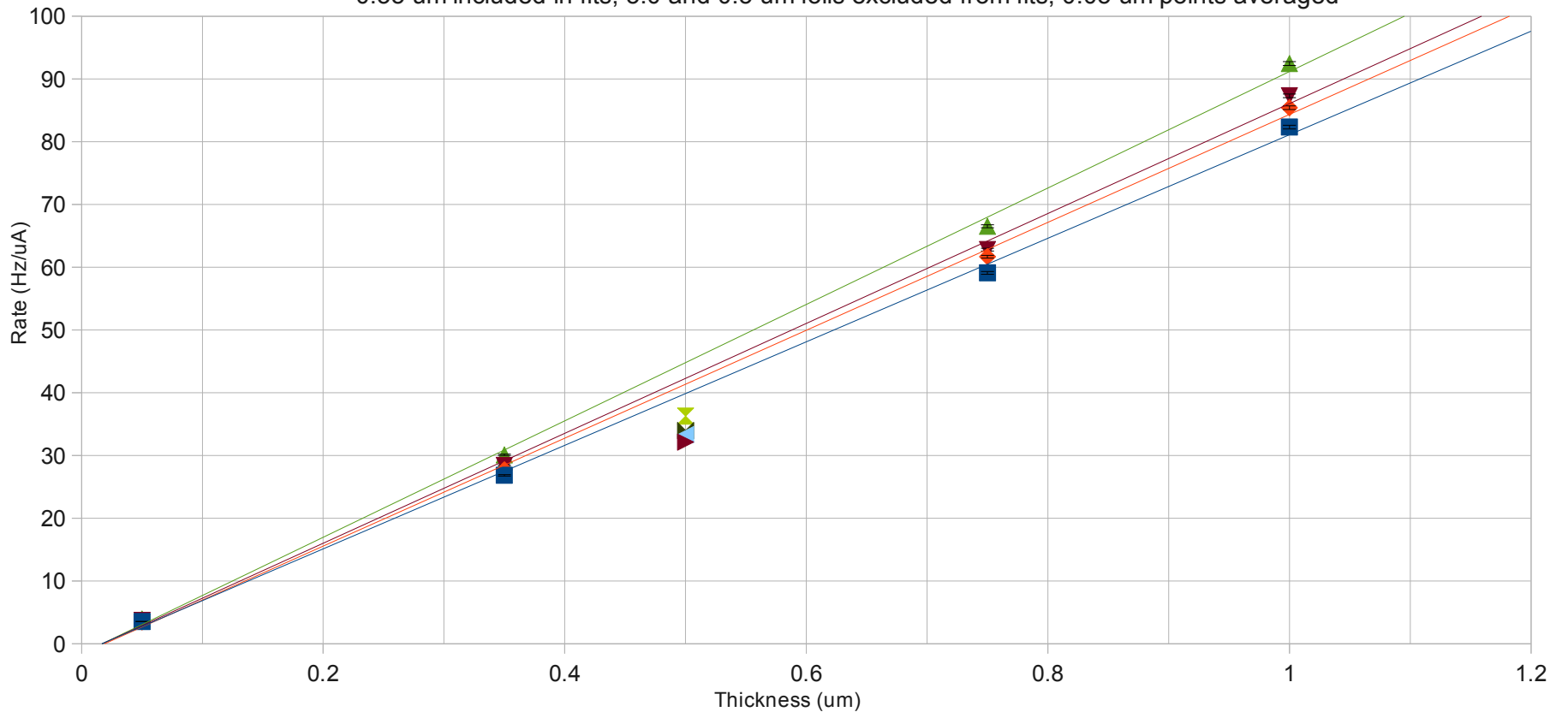
$R_L(d) = 80.15 * d - 0.46$
 $R_R(d) = 83.62 * d - 0.72$
 $R_U(d) = 85.05 * d - 0.52$
 $R_D(d) = 90.10 * d - 0.56$

Detector Rates

Detector	Slope	Slope w/o 0.35 um Foil	Intercept	Intercept w/o 0.35 um Foil
Left	80.15 ± 1.55 (1.93%)	$81.09 \pm 2 \%$	-0.46 ± 0.16 (33.8%)	$-0.50 \pm 32 \%$
Right	83.62 ± 1.54 (1.84%)	$84.67 \pm 2 \%$	-0.72 ± 0.15 (20.9%)	$-0.76 \pm 18 \%$
Up	85.05 ± 1.65 (1.94%)	$86.12 \pm 2 \%$	-0.52 ± 0.17 (32.0%)	$-0.56 \pm 28 \%$
Down	90.10 ± 1.74 (1.93%)	$91.23 \pm 2 \%$	-0.56 ± 0.17 (30.9%)	$-0.60 \pm 27 \%$

Detector Rates vs Gold Target Thickness

0.35 um included in fits; 5.0 and 0.5 um foils excluded from fits; 0.05 um points averaged



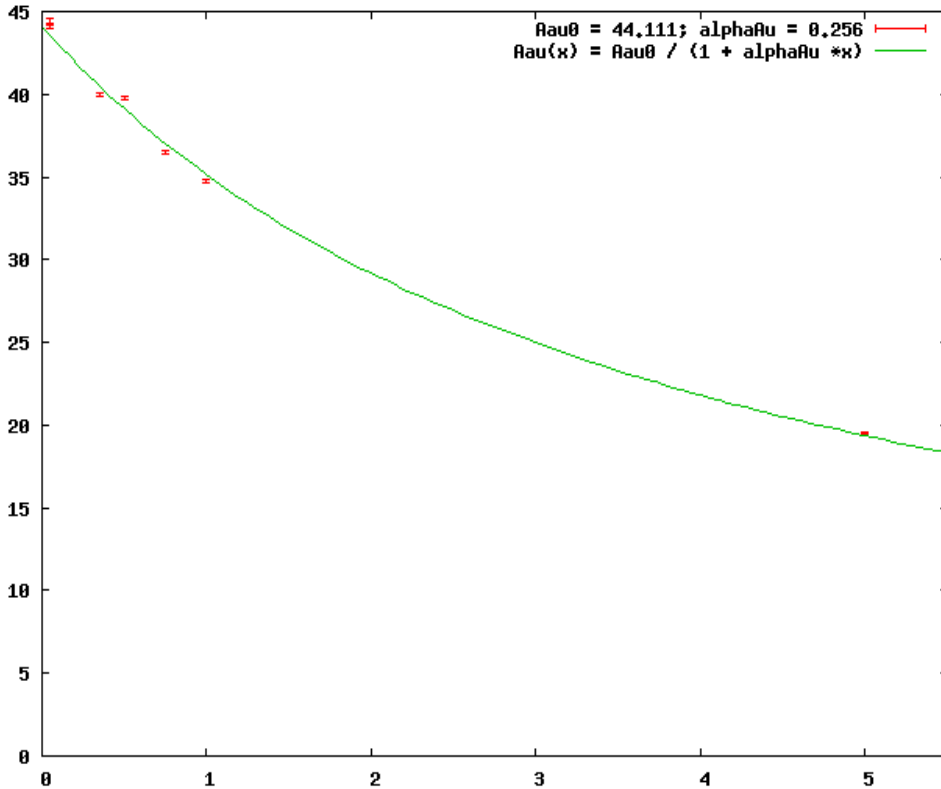
Conclusions

- All 4 detector rates between ~ 80 and ~ 90 Hz/($\mu\text{A} * \mu\text{m}$)
- Down detector counting $\sim 5\%$ more than other detectors
- 5 μm foil producing $\sim 60\%$ higher rate than expected
 - Commensurate with that of a ~ 9.3 μm foil, if fits are correct
- 0.5 μm foil producing $\sim 20\%$ lower rate than expected
 - If 0.5 μm foil was 0.4 μm , percent differences between fit rates and measured rates – Left: 1.69% Right: 1.81% Up: 1.42% Down: 2.22%
- 0.35 μm foil producing expected rates within margins of error

Comparison of (α) s from Vertical Asymmetry vs Target Thickness

Previous Determination of α

All foils included, separate 0.05 μm points

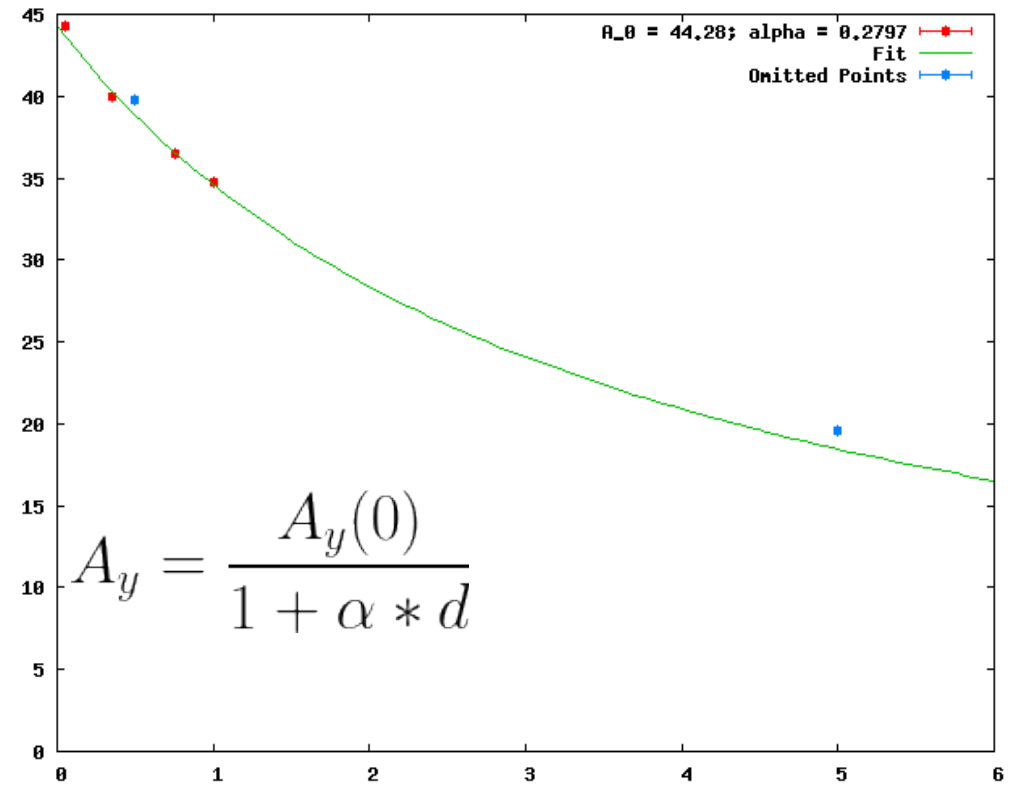


$$A_y(0) = 44.11 \pm 0.39 \quad \alpha = 0.2556 \pm 0.0100$$

Thickness (μm)	Vertical Asymmetry (%)	Uncertainty (%)
5	19.54785919	0.069419082
1	34.79233046	0.099728434
0.75	36.50794476	0.102499582
0.5	39.73921066	0.110489932
0.35	39.99009375	0.113531039
0.05	44.16049341	0.160451524
0.05	44.36033989	0.209641786

Determination of α

5.0 and 0.5 μm excluded, averaged 0.05 μm points



$$A_y(0) = 44.28 \pm 0.52 \quad \alpha = 0.2797 \pm 0.0210$$

Thickness (μm)	Vertical Asymmetry (%)	Uncertainty (%)
1	34.79233046	0.099728434
0.75	36.50794476	0.102499582
0.35	39.99009375	0.113531039
0.05	44.26041665	0.185046655