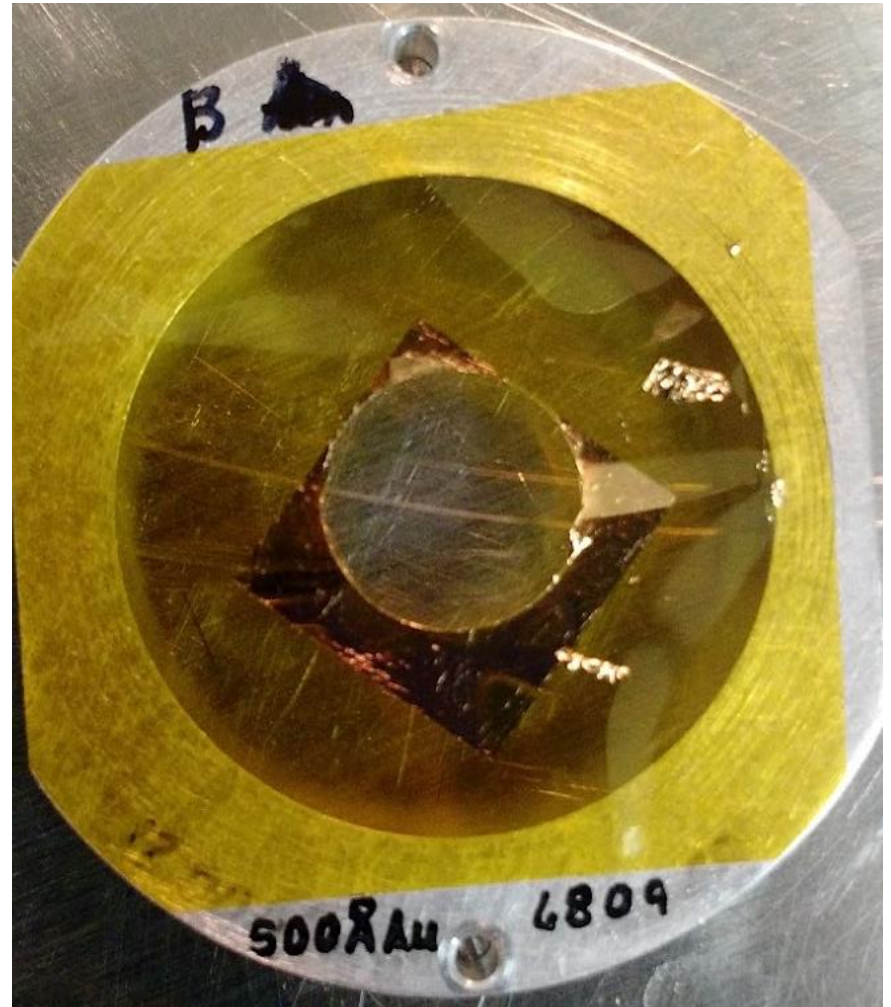


# Extrapolation update

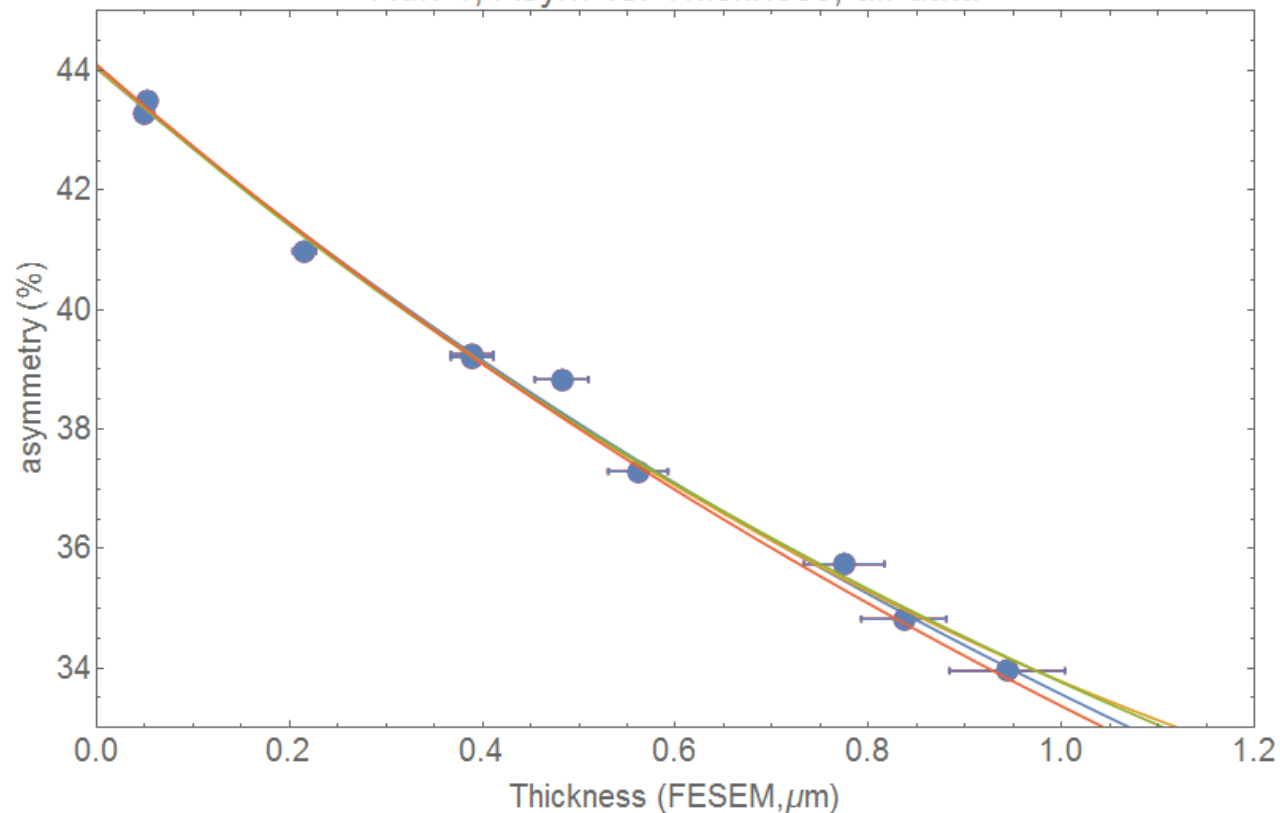
24 February 2017

# Thinnest foil?

- Wrote to Lebow to verify plastic backing
- Their records indicate 6809 is 30 nm gold on 300 nm Parylene N backing?!
- This was measured at 52 nm FESEM



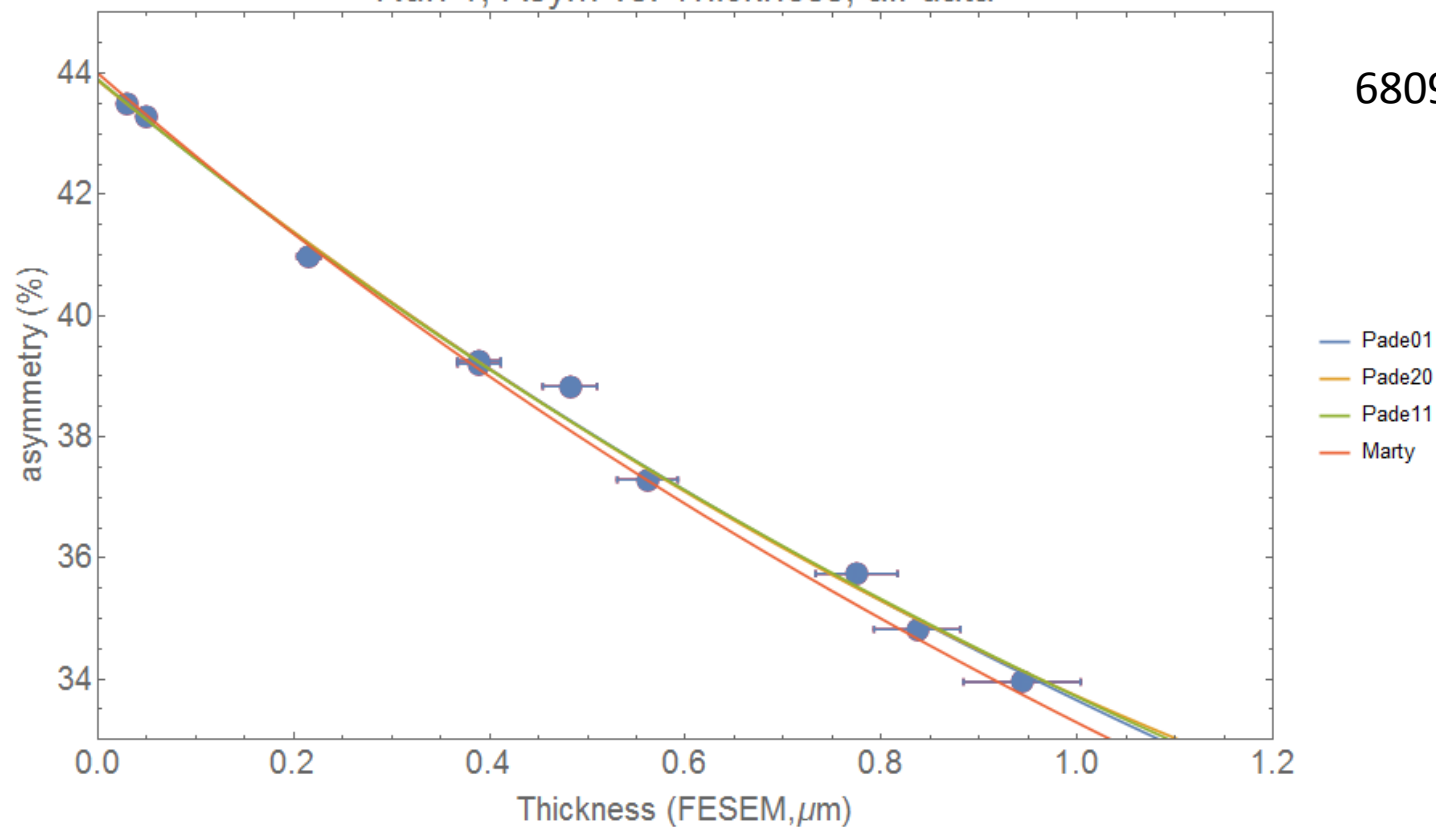
Run 1, Asym vs. Thickness, all data



6809 = 52 nm

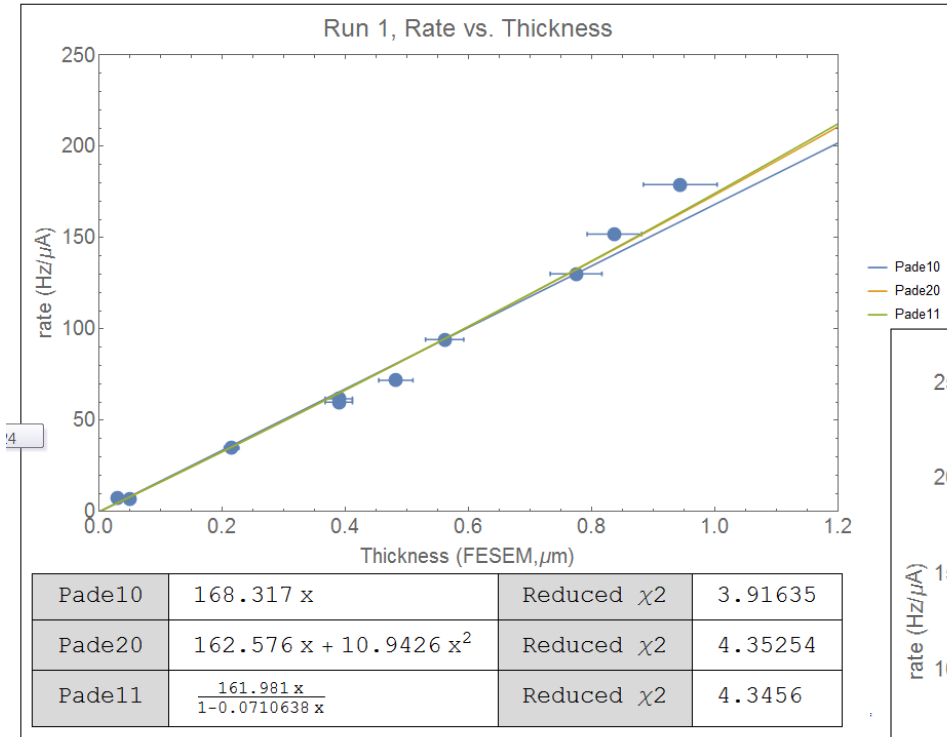
Pade01	$\frac{44.0395}{1+0.312289 x}$	Reduced $\chi^2$	1.15953
Pade20	$44.0492 - 13.7301 x + 3.45486 x^2$	Reduced $\chi^2$	1.36746
Pade11	$\frac{44.0928+3.36456 x}{1+0.405728 x}$	Reduced $\chi^2$	1.27408
Marty	$-\frac{85.9731 (-0.101574+0.000682 x)}{0.198+0.062 x}$	Reduced $\chi^2$	1.18032
Marty Intercept	44.1042		

Run 1, Asym vs. Thickness, all data



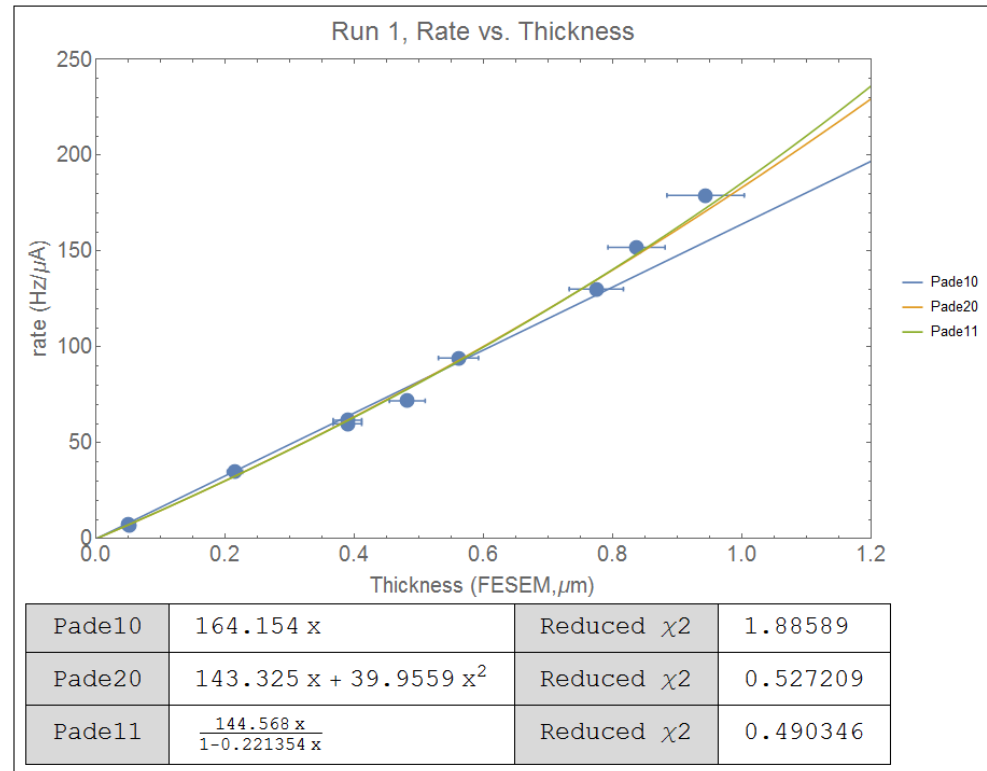
Pade01	$\frac{43.8885}{1+0.304301 x}$	Reduced $\chi^2$	0.821235
Pade20	$43.8776 - 13.0527 x + 2.89727 x^2$	Reduced $\chi^2$	0.991149
Pade11	$\frac{43.9001+0.91529 x}{1+0.329545 x}$	Reduced $\chi^2$	0.940989
Marty	$-\frac{85.7681 (-0.101574+0.000682 x)}{0.198+0.062 x}$	Reduced $\chi^2$	1.19832
Marty Intercept	43.999		

# Rate vs. Thickness Run 1



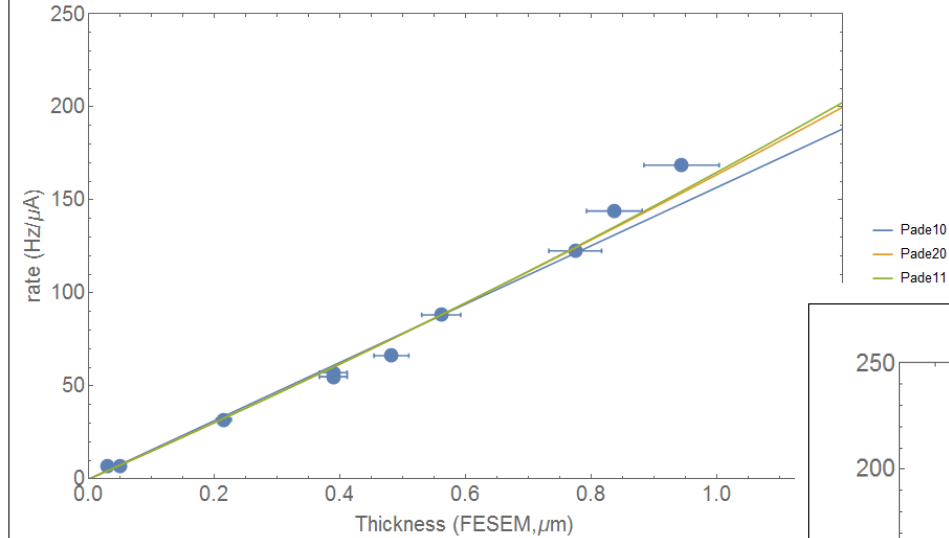
30 nm

52 nm



# Rate vs. Thickness?

Run 2, Rate vs. Thickness

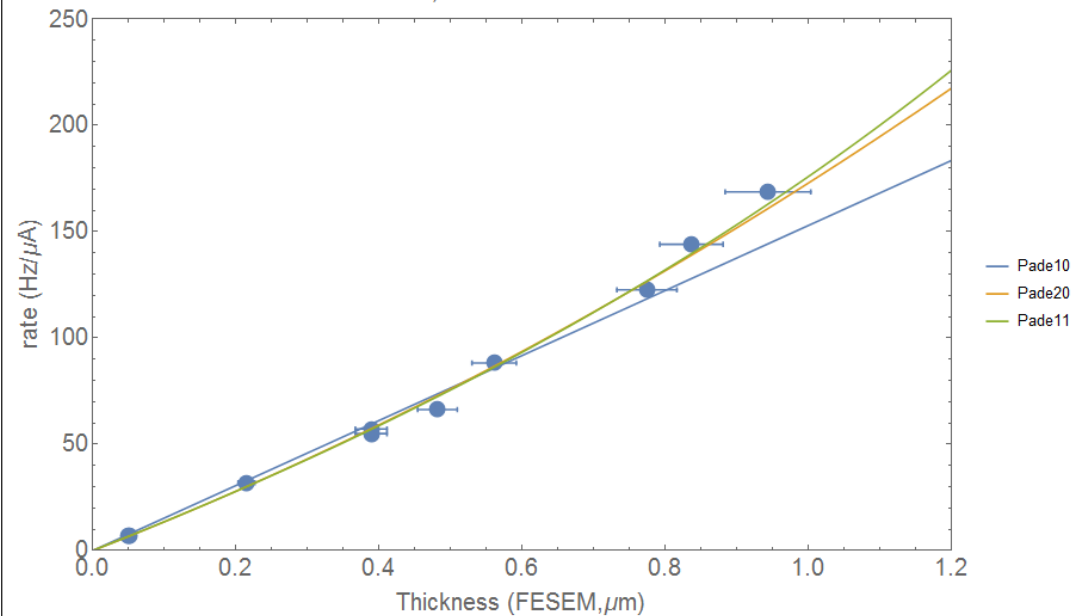


Pade10	$156.822 x$	Reduced $\chi^2$	4.267
Pade20	$149.182 x + 14.5143 x^2$	Reduced $\chi^2$	4.631
Pade11	$\frac{148.427 x}{1-0.100298 x}$	Reduced $\chi^2$	4.609

30 nm

52 nm

Run 2, Rate vs. Thickness



Pade10	$152.94 x$	Reduced $\chi^2$	2.29963
Pade20	$131.098 x + 41.7925 x^2$	Reduced $\chi^2$	0.523999
Pade11	$\frac{132.405 x}{1-0.247392 x}$	Reduced $\chi^2$	0.462955

# 30 or 52 nm?

- I'll double check with Lebow, send them image
- Rate data looks like foil is 52 nm
- Ao drops with 30 nm, but looks more linear?

# Pade analysis

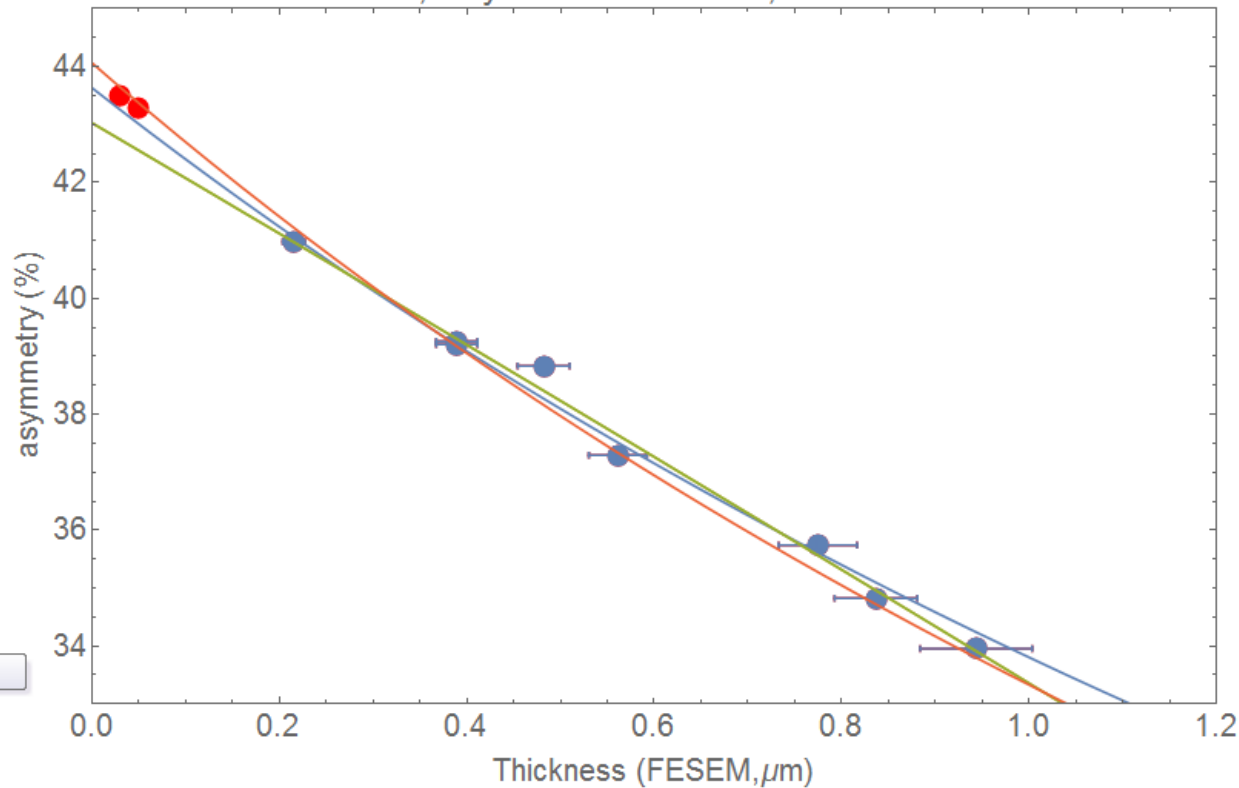
- Pade is an statistical technique. It is descriptive rather than predictive. The reason for doing the Pade analysis was
  - If Marty's Geant4 didn't work out
  - To look statistically at the data and see uncertainty in Ao due to different viable fitting functions
  - To be able to handle data that we don't have models for, such as asym vs rate



# Geant4 simulations

- Geant4 simulations strive to be predictive rather than descriptive
  - They use first principles calculations to predict functional form of the data
  - They don't change shape since the only factor is a scaling factor to get the smallest variation between fit and the data points

Run 1, Asym vs. Thickness, foils >50 nm



Parameters allowed to vary as two points removed highlighted in Yellow

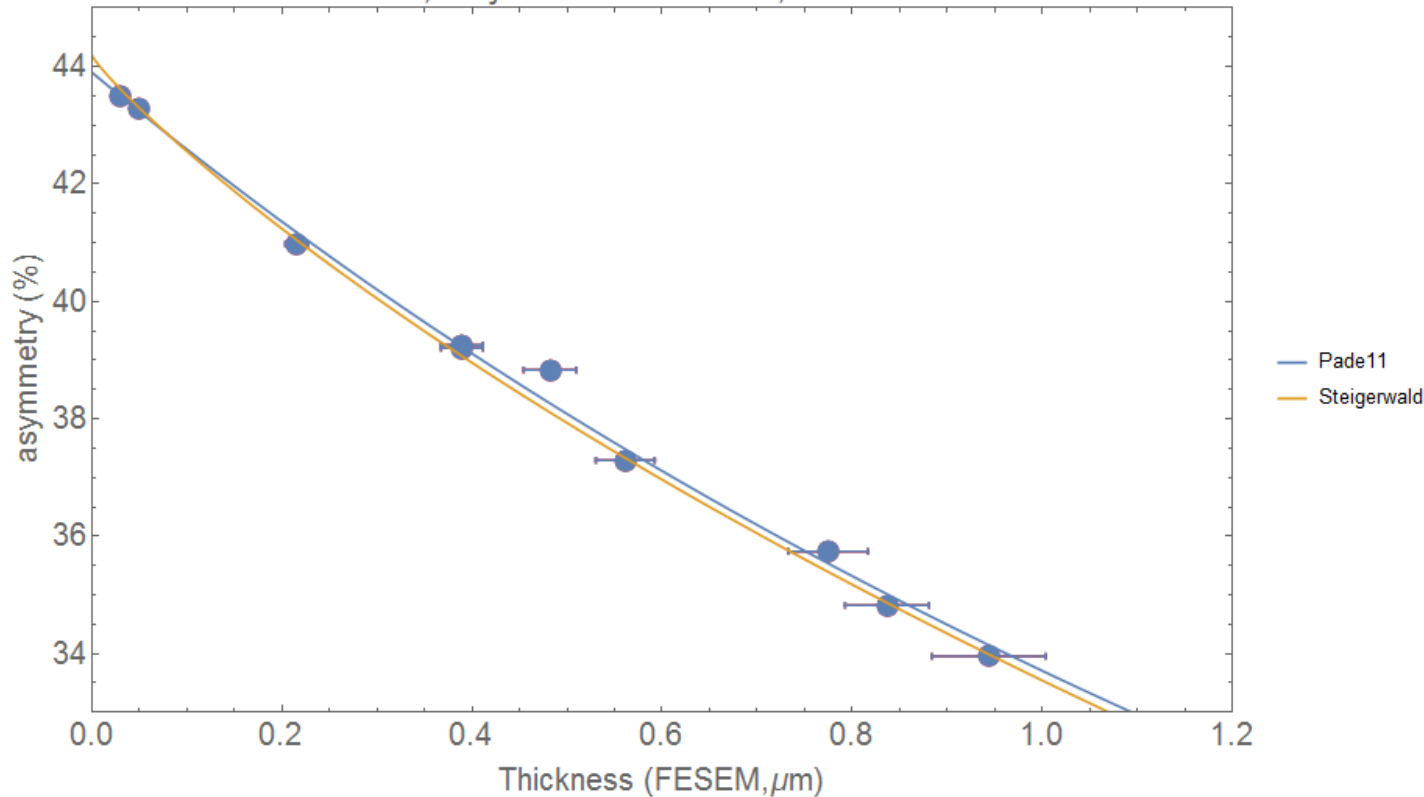
Pade01	$\frac{43.6333}{1+0.290798 x}$	Reduced $\chi^2$	0.953795
Pade20	$43.0279 - 9.51265 x - 0.157844 x^2$	Reduced $\chi^2$	0.783894
Pade11	$\frac{43.0282 - 10.2091 x}{1 - 0.0161361 x}$	Reduced $\chi^2$	0.783928
Marty	$-\frac{85.8918 (-0.101574 + 0.000682 x)}{0.198 + 0.062 x}$	Reduced $\chi^2$	1.44743
Marty Intercept	44.0625		

# Pade vs. Geant

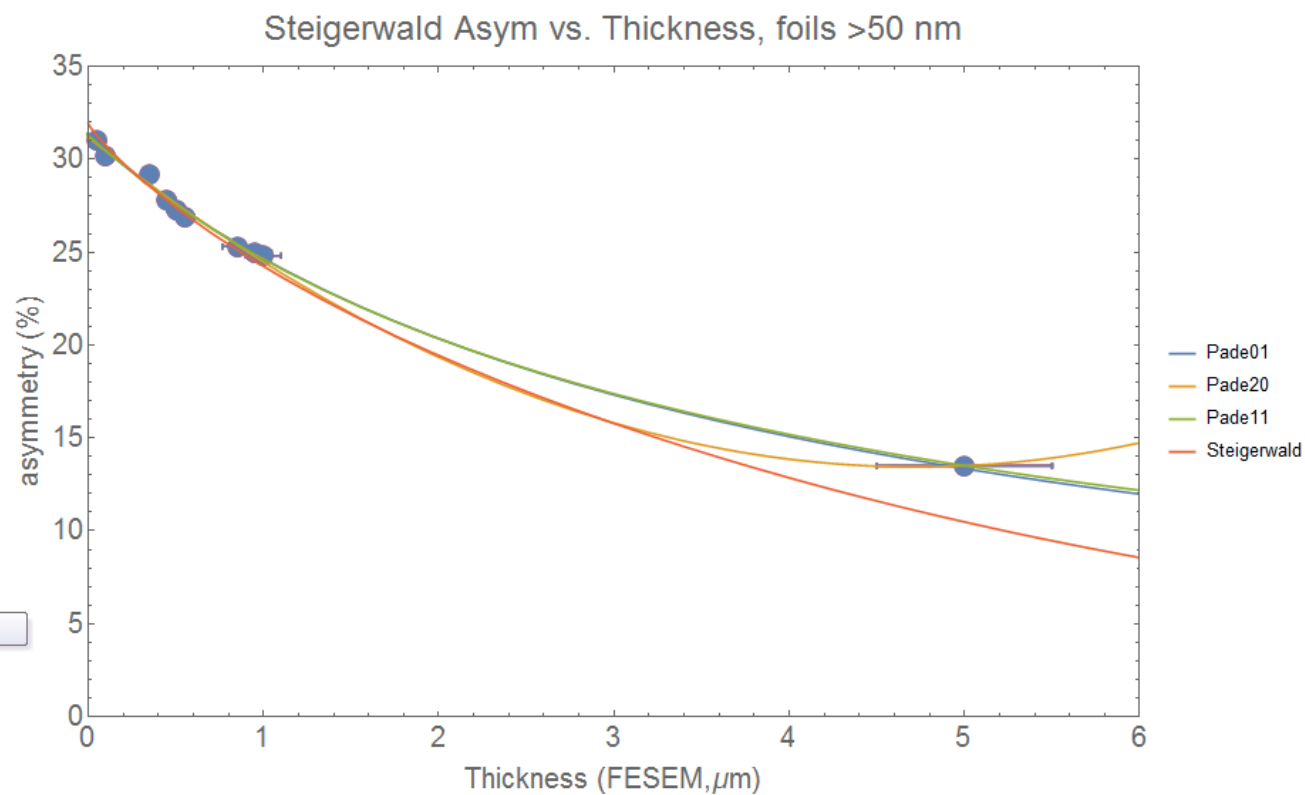
- The Pade analysis is descriptive.
  - Excellent for determining point within the data range
  - Useful for extrapolating beyond data range for small amounts
  - Pade analysis leads to Geant4 predicted form (+1 more)
  - Required for A vs. Rate – no Geant4 model there
- The Geant4 simulations strive to be predictive
  - They should work for larger data ranges
  - They are much more computationally intensive
  - Marty's fits the data pretty well, is understood

# Should we show Steigerwald function with our data?

Run 1, Asym vs. Thickness, foils >50 nm



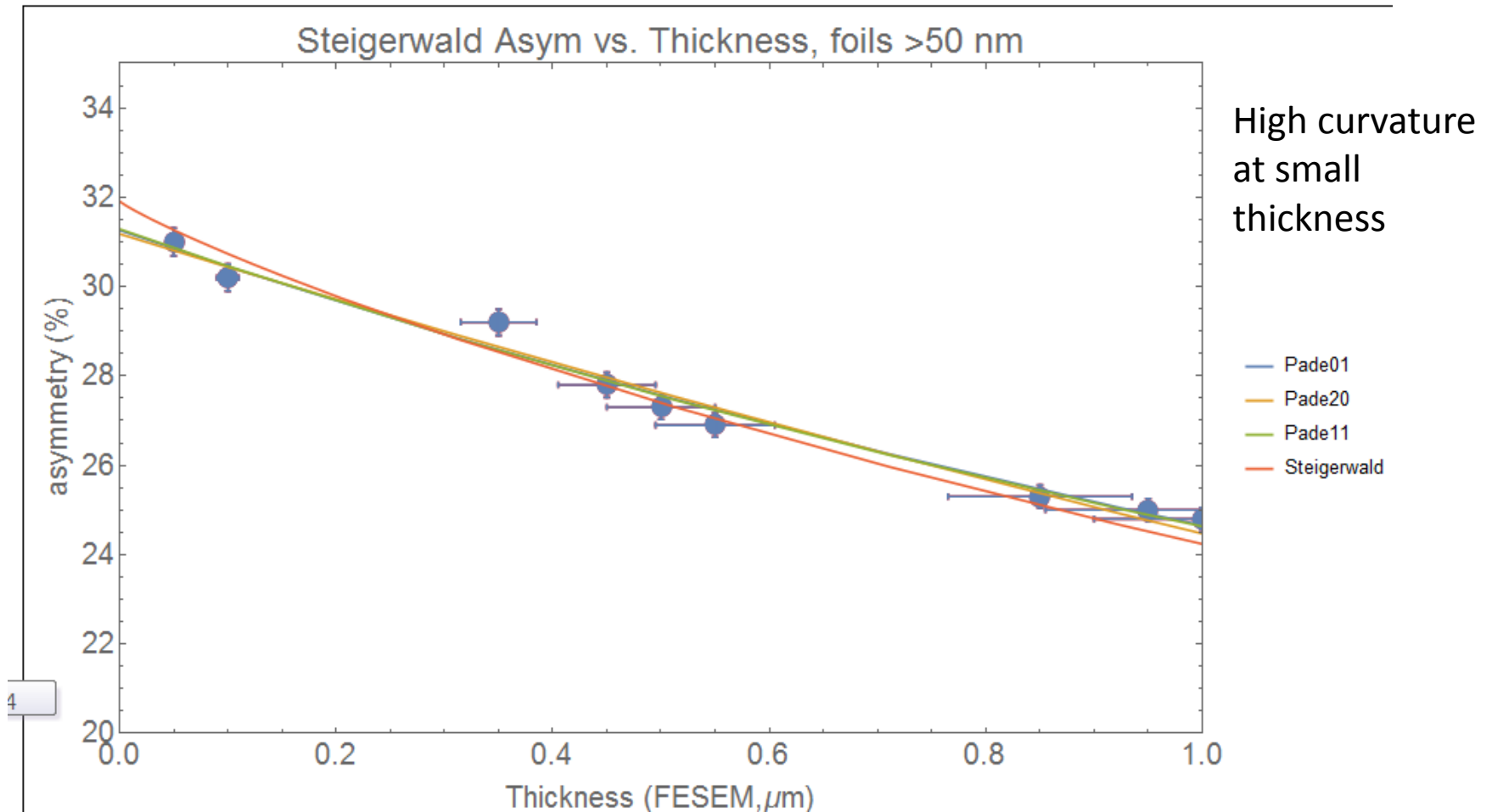
Padell	$\frac{43.9001+0.91529 x}{1+0.329545 x}$	Reduced $\chi^2$	0.940989
Steigerwald	$\frac{44.1862 (1+0.00272 x^{0.866})}{1+0.23 x^{0.866}+0.0729 x+0.0146 x^2+0.00339 x^3}$	Reduced $\chi^2$	1.02463



Predicts his  
largest foil  
poorly

Pade01	$\frac{31.262}{1+0.268499 x}$	Reduced $\chi^2$	0.594895
Pade20	$31.1807 - 7.51361 x + 0.795546 x^2$	Reduced $\chi^2$	0.707159
Pade11	$\frac{31.2901+0.225298 x}{1+0.280068 x}$	Reduced $\chi^2$	0.666981
Steigerwald	$\frac{31.914 (1+0.00272 x^{0.866})}{1+0.23 x^{0.866}+0.0729 x+0.0146 x^2+0.00339 x^3}$	Reduced $\chi^2$	2.65774

# Steigerwald data set zoomed in



# Should we include Steigerwald analysis of our data

- Determined for 5 MeV, we are not at this energy
- Only if we understand why he has this function with odd exponents and low thickness curvature
- We understand the physics in Marty's Geant – stick with that for this round?
- Michael's has really high order terms, hooks up left of data, which is dangerous

# Fitting left to do

- Settle 30 vs. 52 nm fit
- Are we ready for working on graphs in publication form?
- Tech note on Pade analysis is in progress
  - Supplemental material can now be submitted with Phys. Rev. C articles, tech notes can be attached to the paper
  - <https://journals.aps.org/authors/supplemental-materials-journals>