PQS Project

Meeting 2022-01-28 1:00pm

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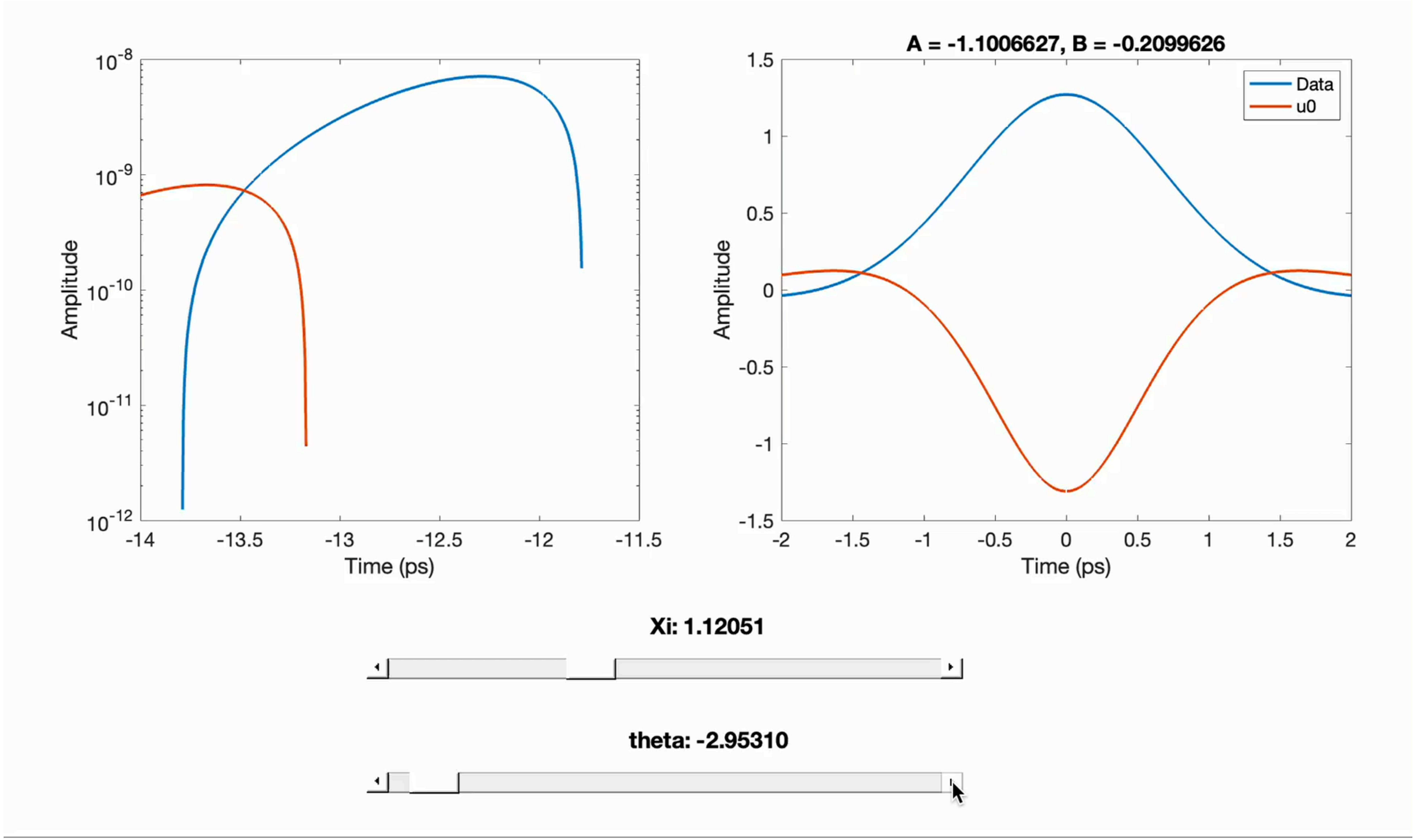
Project 1

$$\underbrace{u'''' + 4\sigma^4 u}_{L} + \underbrace{\Gamma u^3}_{N} = 0, \qquad \sigma^4 := \frac{6\mu}{|\beta_4|}, \Gamma := \frac{24\gamma}{|\beta_4|}$$

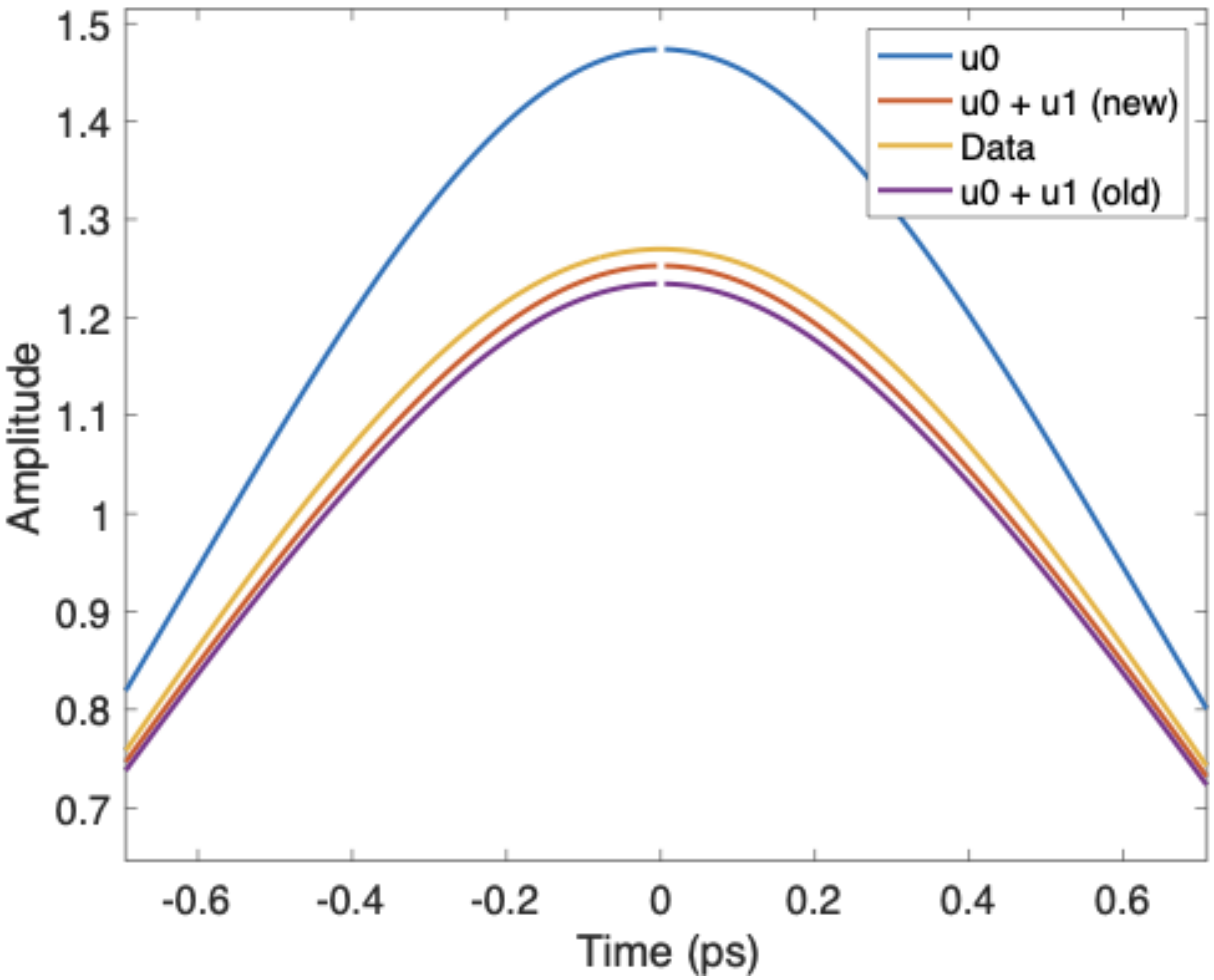
- For the zeroth order ansatz, determined the coefficients that match with data by writing
$$A\frac{\cos}{\cosh} + B\frac{\sin}{\sinh} \equiv \Xi\left(\cos\theta\frac{\cos}{\cosh} + \sin\theta\frac{\sin}{\sinh}\right)$$
  - Where Ξ controls the amplitude, θ controls the phase
  - Found: $\Xi = 1.1205 \pm 0.0001, \theta = 1.1620 \pm 0.0001$ and $A = 0.445408, B = 1.02817$

Project 1



A = -1.1006627, B = -0.2099626
Data
u0
Amplitude
Time (ps)
Xi: 1.12051
theta: -2.95310

Project 1



1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
Amplitude
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
Time (ps)
u0
u0 + u1 (new)
Data
u0 + u1 (old)

Project 1

Revised the method that I used to find u^(1) etc., and found that the coefficients had an additional linear term:

$$
\begin{aligned}
c_0 &= \tfrac{A}{4} - \left(2A^3 + 9A^2B + 6AB^2 + 9B^3\right)\varphi = 0.15371 \\
c_1 &= -\tfrac{B}{4} + 3\left(3A^3 + 2A^2B + 3AB^2 - 2B^3\right)\varphi = -0.253315 \\
c_2 &= \tfrac{A}{4} - 3\left(2A^3 + 3A^2B - 2AB^2 + 3B^3\right)\varphi = 0.137759 \\
c_3 &= -\tfrac{B}{4} + \left(9A^3 - 6A^2B + 9AB^2 - 2B^3\right)\varphi = -0.259133
\end{aligned}
$$

where

$$\varphi := \frac{\Gamma}{1280\sigma^4}$$

Project 1

We can find higher order solutions by solving

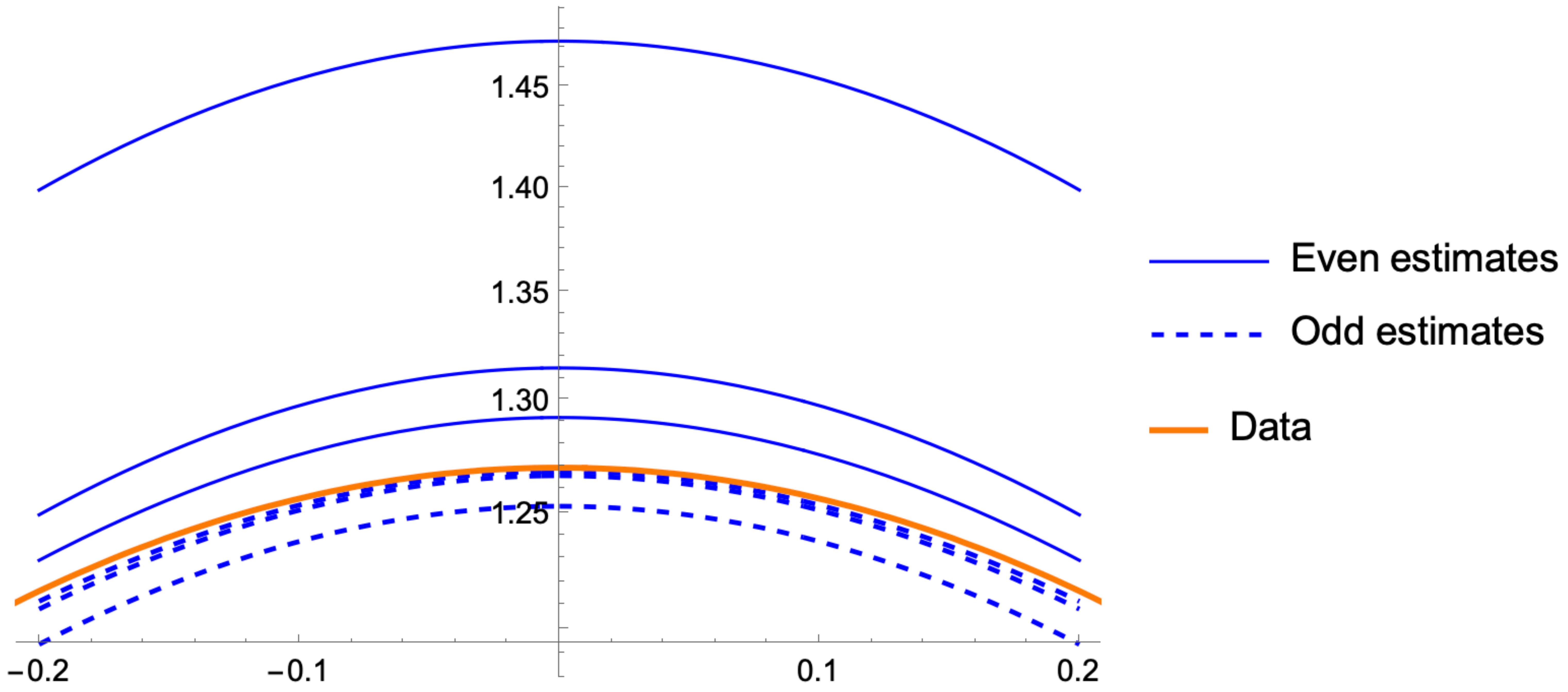
$$L\left[\sum_{j=0}^{n} u^{(j)}\right] + N\left[\sum_{j=0}^{n-1} u^{(j)}\right] \equiv 0$$

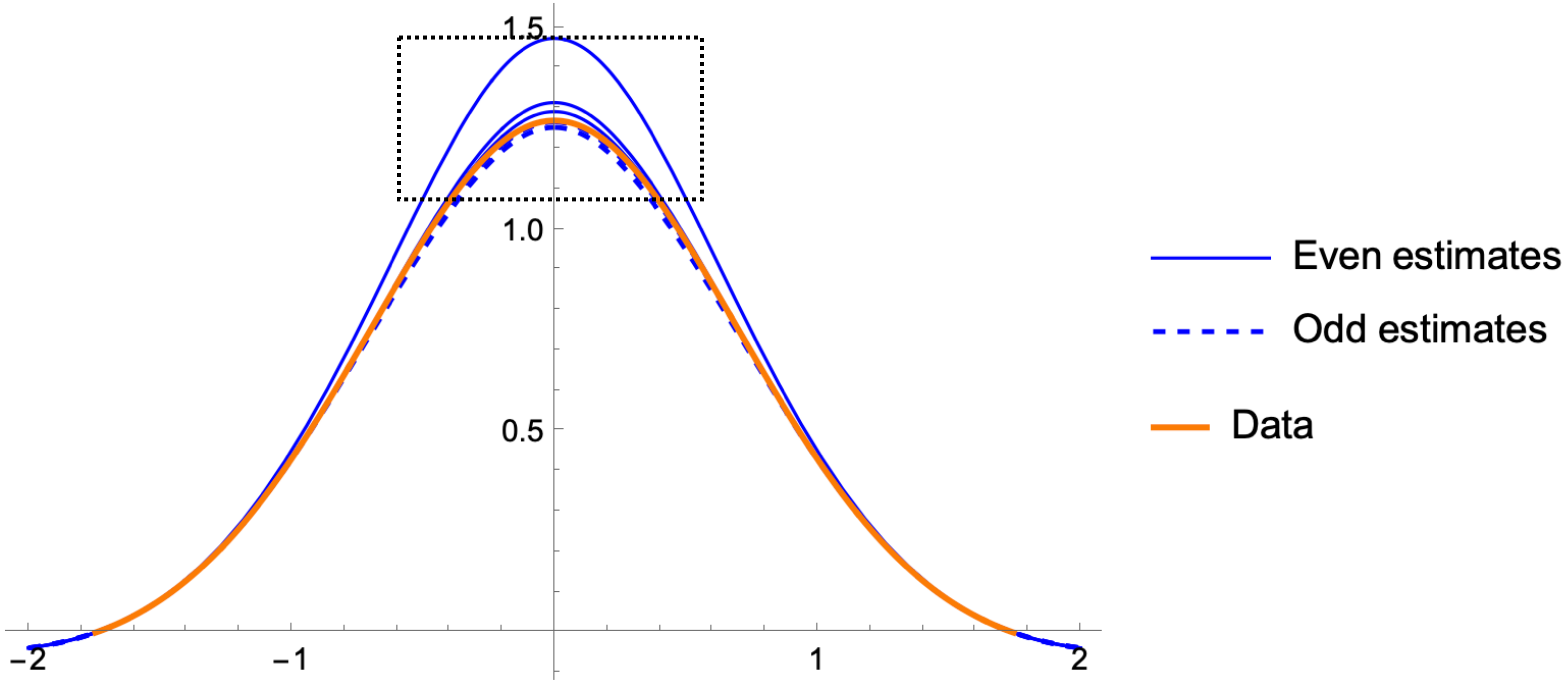
up to $(2n+1)$th order.

Linear terms appear in most of the coefficients:

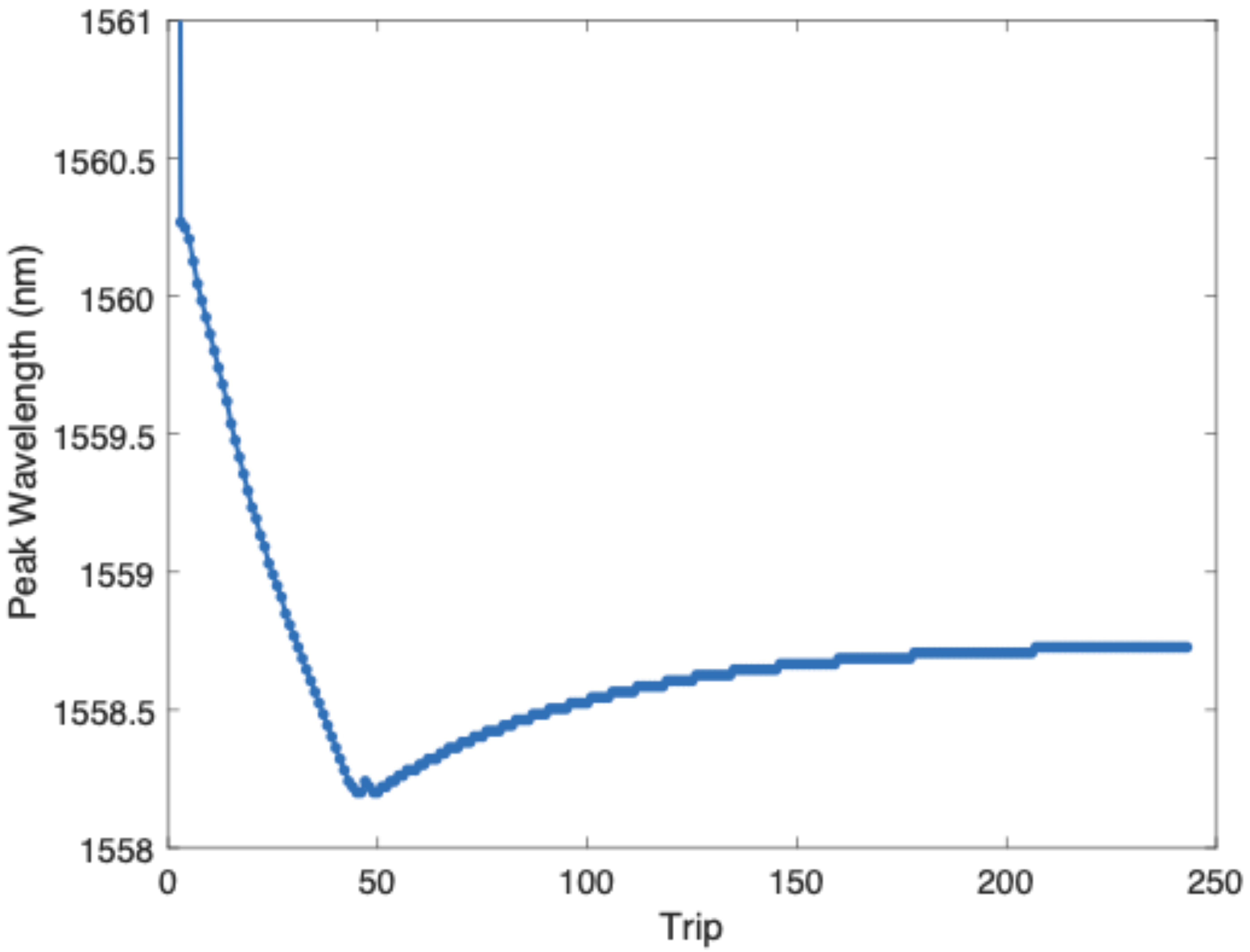
Function	$u^{(1)}$	$u^{(2)}$	$u^{(3)}$	$u^{(4)}$	$u^{(5)}$	$u^{(6)}$
Order	3	5	7	9	11	13
Coefficients	A/4	A/8	5A/64	7A/128	21A/512	33A/1024
	-B/4	-B/8	-5B/64	-7B/128	-21B/512	-33B/1024
	A/4	...	-A/64	-A/64	-7A/512	-3A/256
	-B/4	...	B/64	B/64	7B/512	3B/256
		-A/8	-A/64	...	A/256	5A/1024
		B/8	B/64	...	-B/256	-5B/1024
			5A/64	A/64	A/256	...
			-5B/64	-B/64	-B/256	...
				-7A/128	-7A/512	-5A/1024
				7B/128	7B/512	5B/1024
					21A/512	3A/256
					-21B/512	-3B/256
						-33A/1024
						33B/1024

Project 1


1.45
1.40
1.35
1.30
1.25
−0.2
−0.1
0.1
0.2
Even estimates
Odd estimates
Data


1.5
1.0
0.5
−2
−1
1
2
Even estimates
Odd estimates
Data

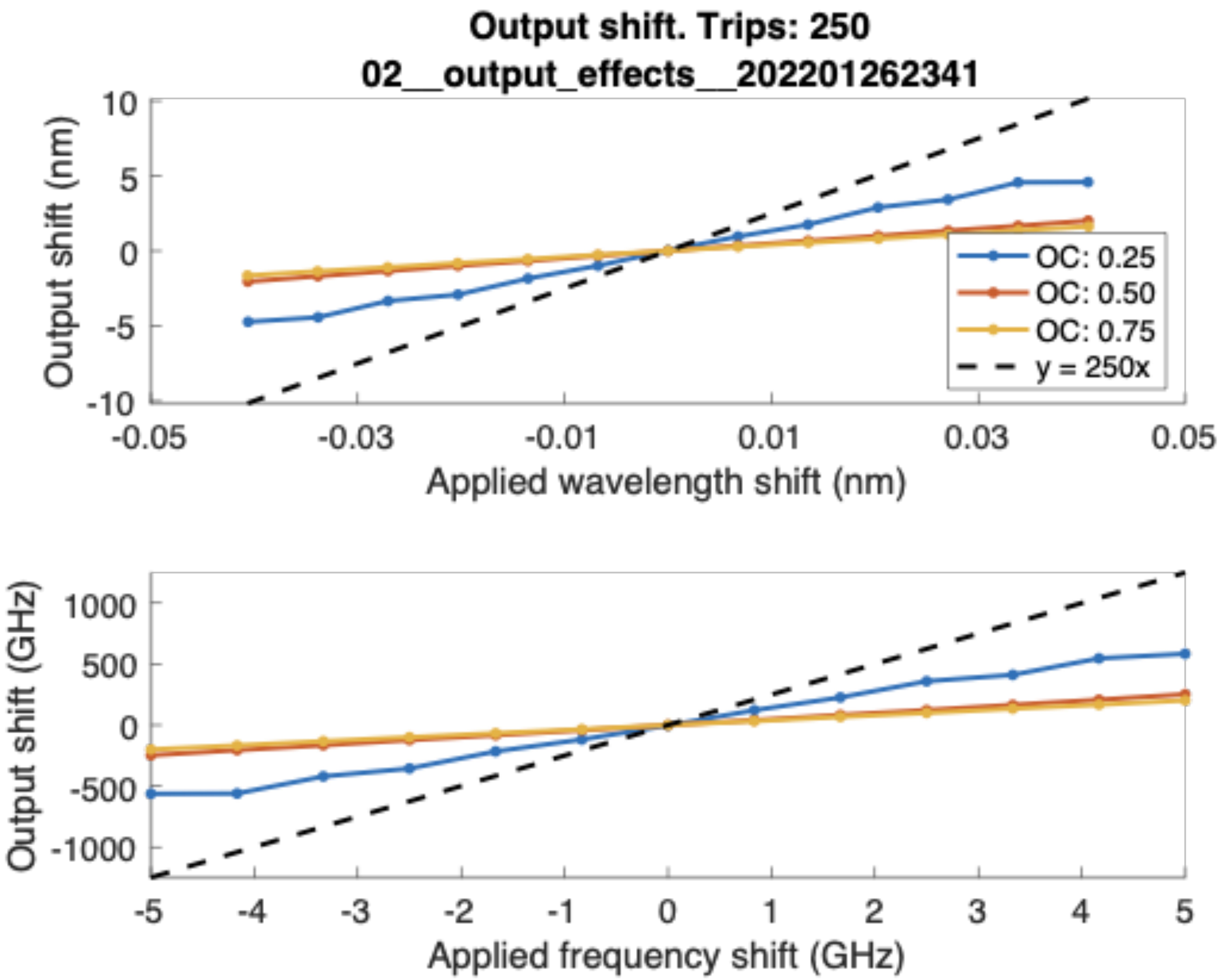
Project 2



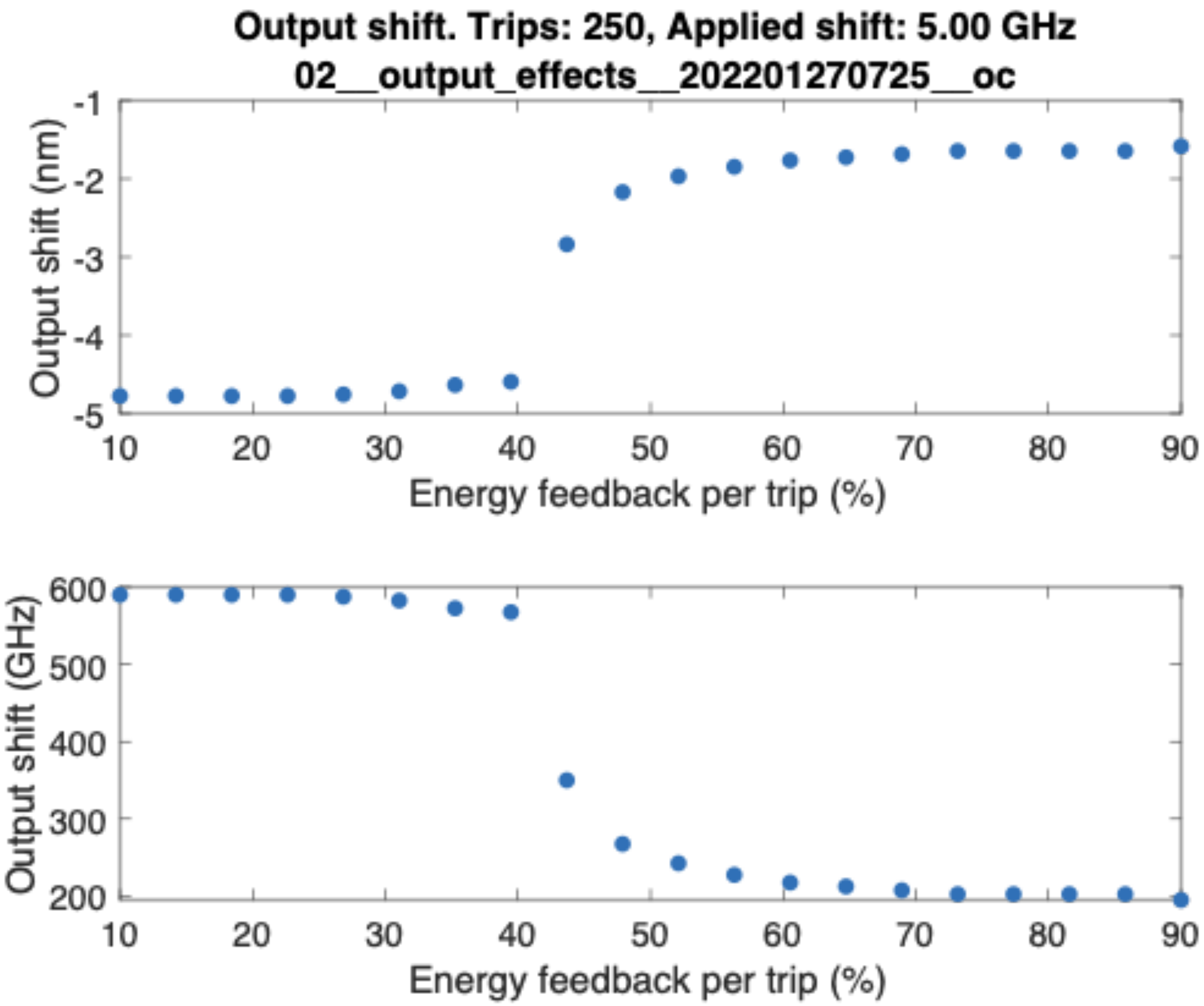
1561
1560.5
1560
1559.5
1559
1558.5
1558
0
50
100
150
200
250
Peak Wavelength (nm)
Trip

Project 2

"OC: 0.3" or "30% energy feedback per trip" means that 30% of the energy returns to the loop after each round trip, 70% exits via the output coupler



Project 2



Output shift. Trips: 250, Applied shift: 5.00 GHz
02__output_effects__202201270725__oc
Output shift (nm)
-1
-2
-3
-4
-5
10
20
30
40
50
60
70
80
90
Energy feedback per trip (%)
Output shift (GHz)
600
500
400
300
200
10
20
30
40
50
60
70
80
90
Energy feedback per trip (%)