PQS

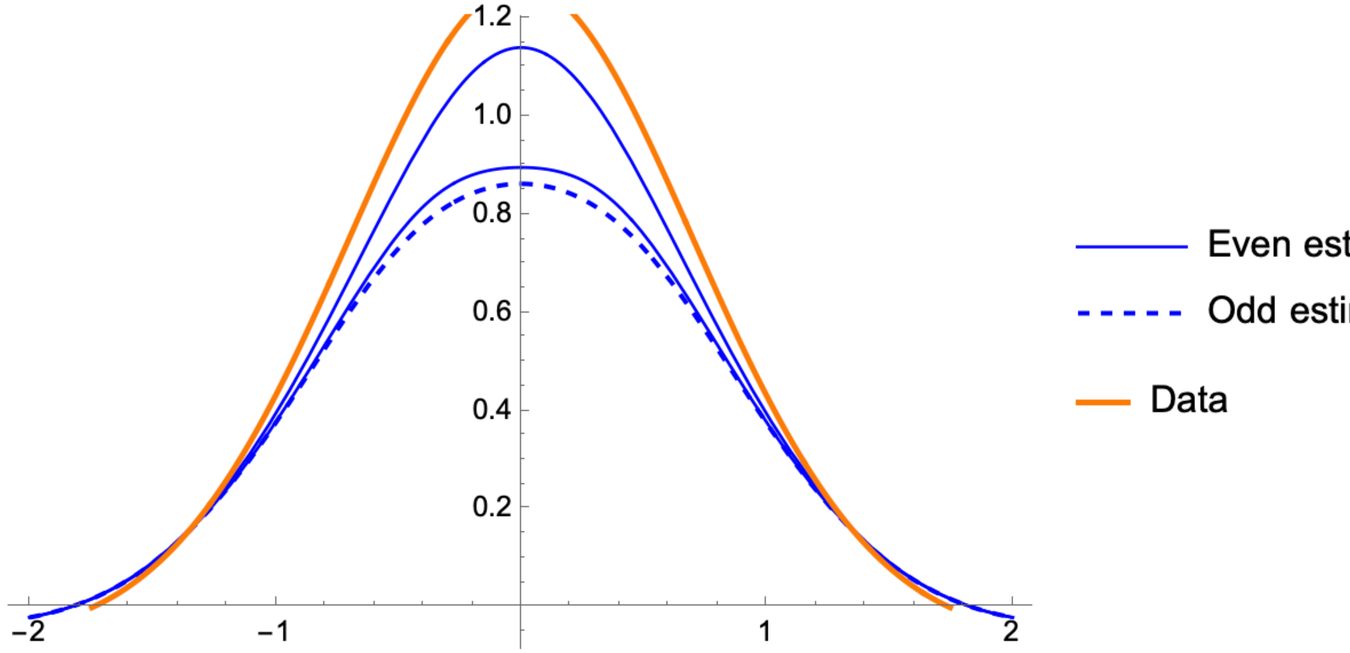
Meeting 2022-02-04 1pm

Progress

- Analytic:
  - Attempted to find conditions on A, B from the DE itself, without looking at the numerical solution
- Numeric:
  - Considered how the output coupling affects the evolution of the soliton at each trip
  - Looked initially at quartic dispersion

Analytic

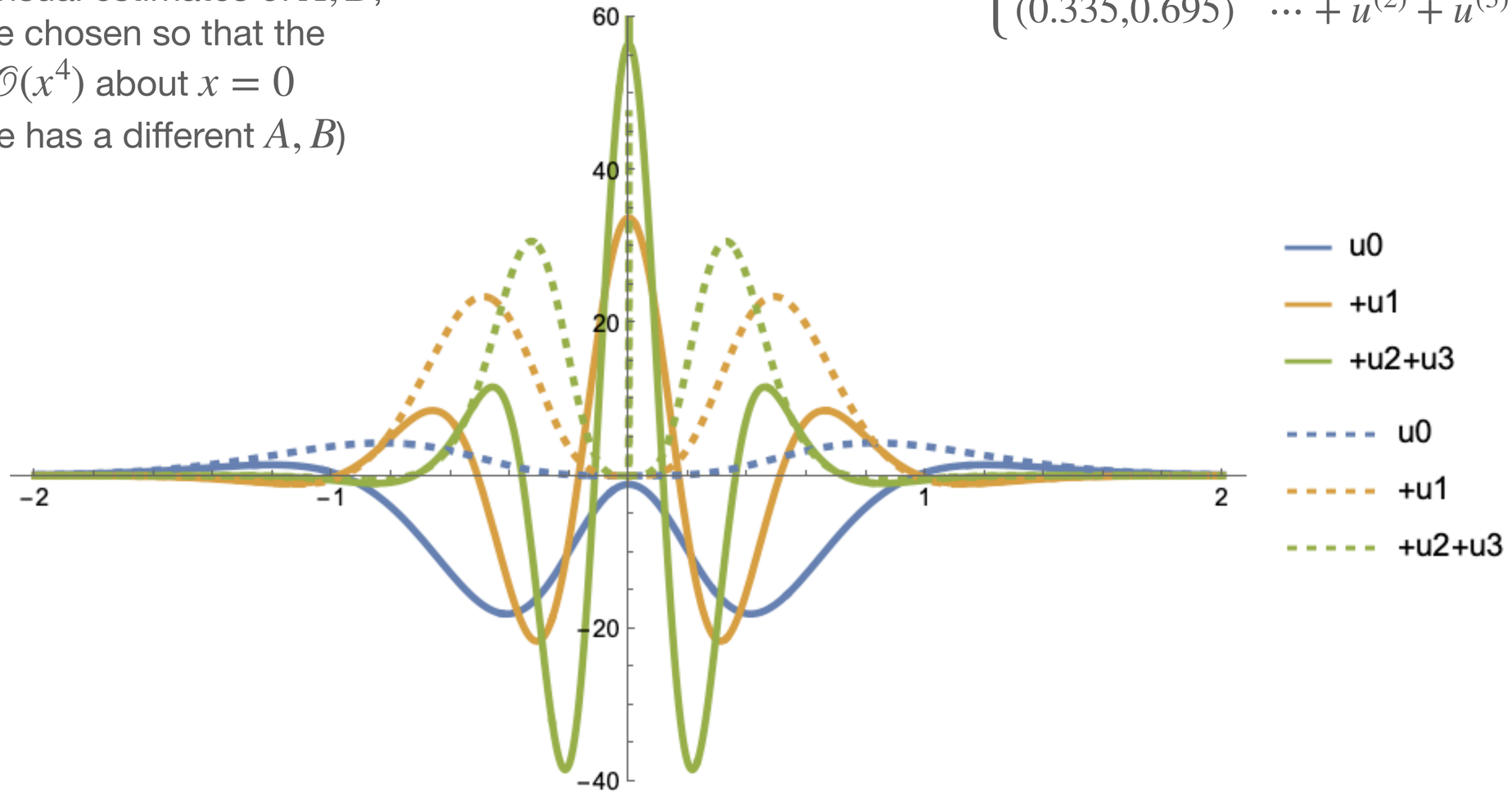
- Process
  - 1. Substitute u0 + u1 into the DE
  - 2. Taylor expand the result about 0, to the order x^2
  - 3. Equate the coefficients of x^0 and x^2 to 0 to solve for A, B
- Result:
  - {A -> 0.242423, B -> 0.898534}
  - (Our current estimates are A -> 0.445408, B -> 1.02817



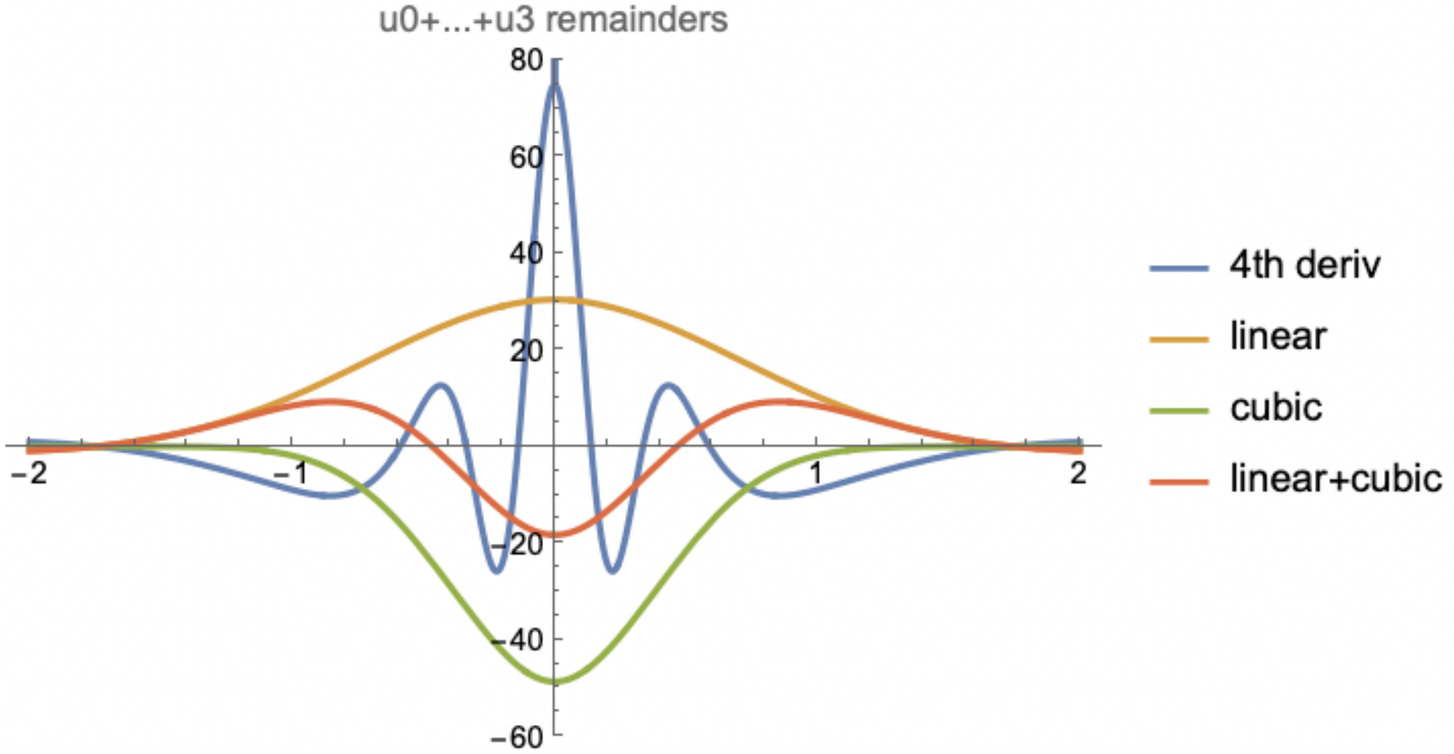
Plotting $\frac{d^4u}{dt^4} + 4\sigma^4 u + \Gamma u^3$ for different u functions and different substitutions of A, B

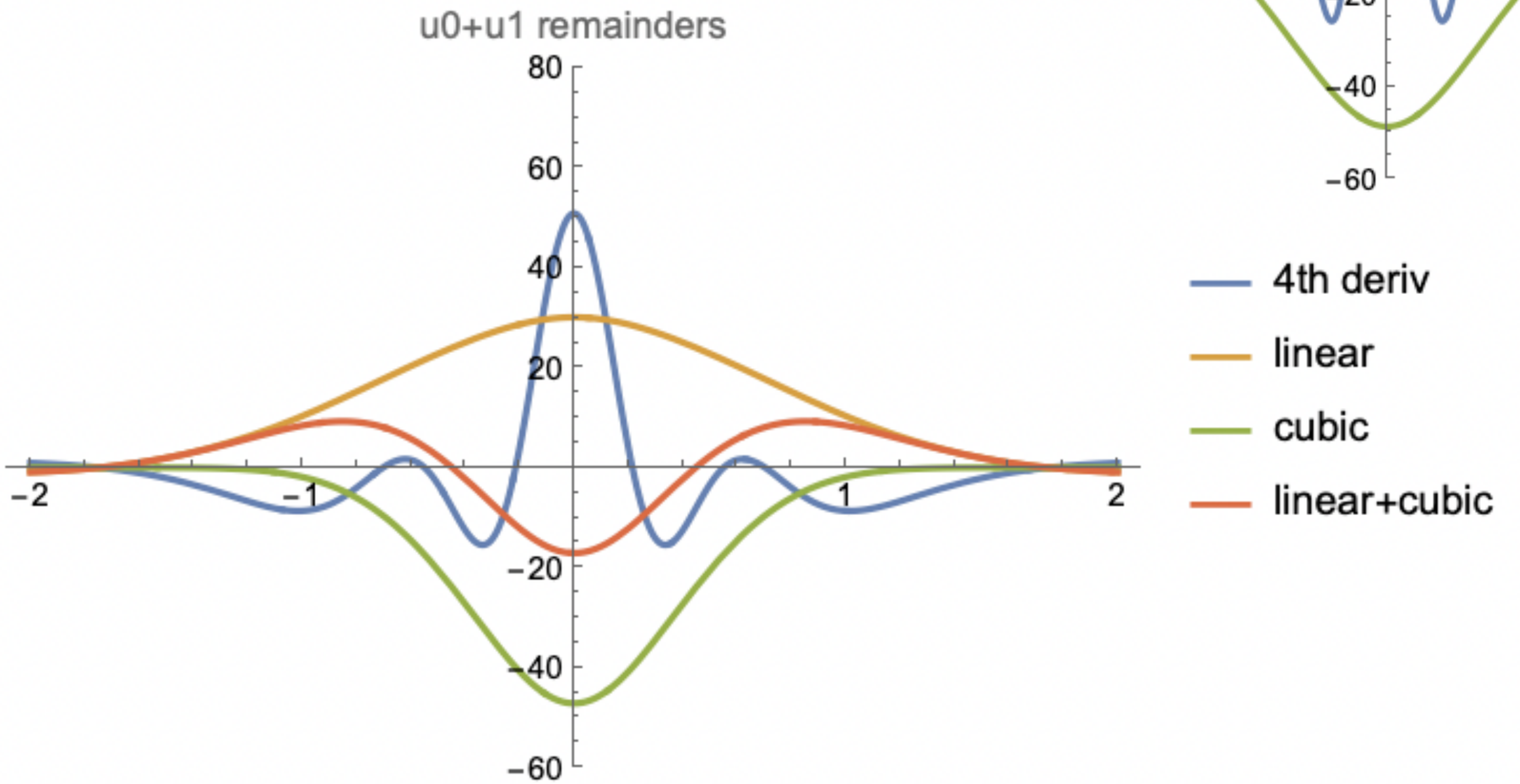
Solid lines are our visual estimates of A, B; dashed lines are chosen so that the remainder is $\mathcal{O}(x^4)$ about $x = 0$ (Each dashed line has a different A, B)

$$(A,B) = \begin{cases} (0.445,1.028) & \text{visual} \\ (0.0333,1.15) & u^{(0)} \\ (0.242,0.899) & \cdots + u^{(1)} \\ (0.335,0.695) & \cdots + u^{(2)} + u^{(3)} \end{cases}$$

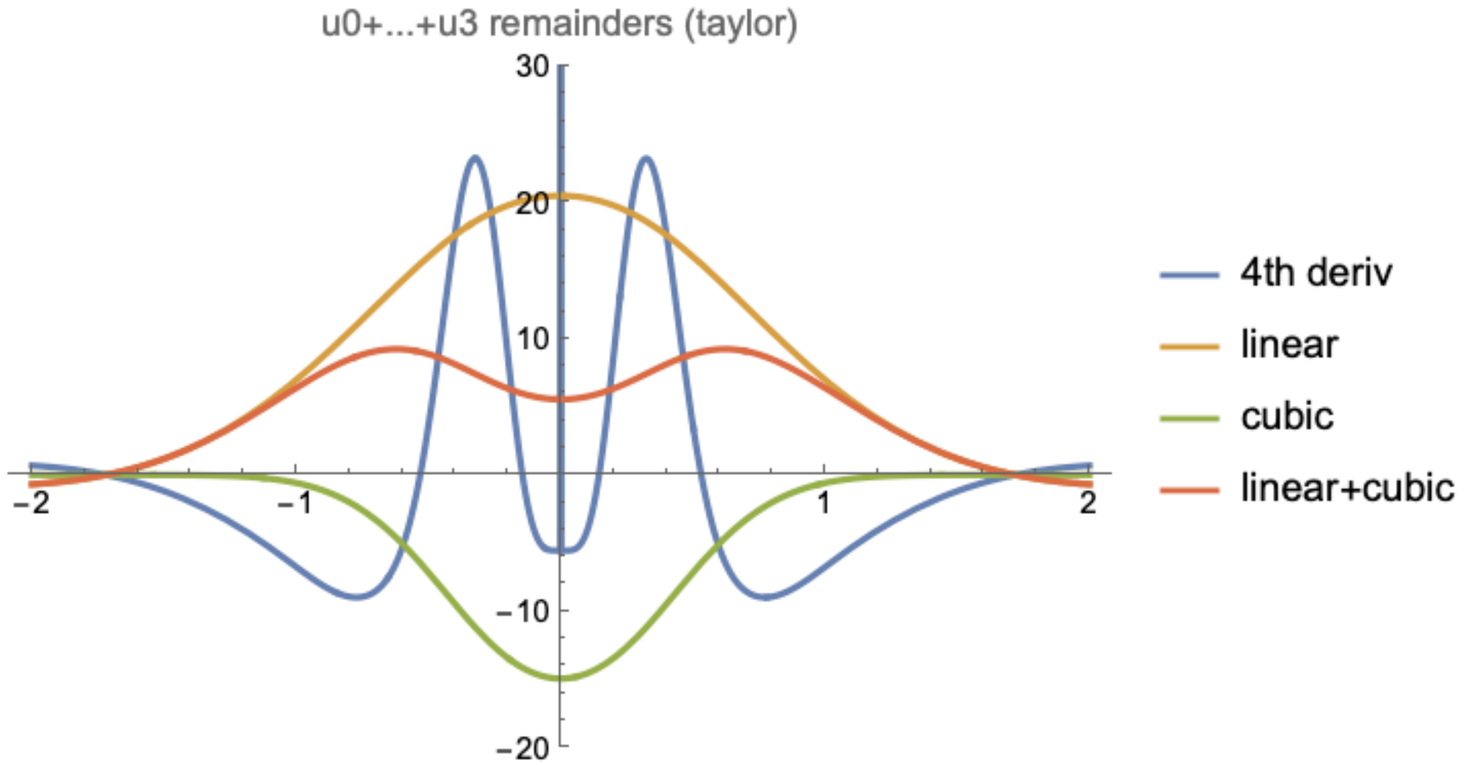


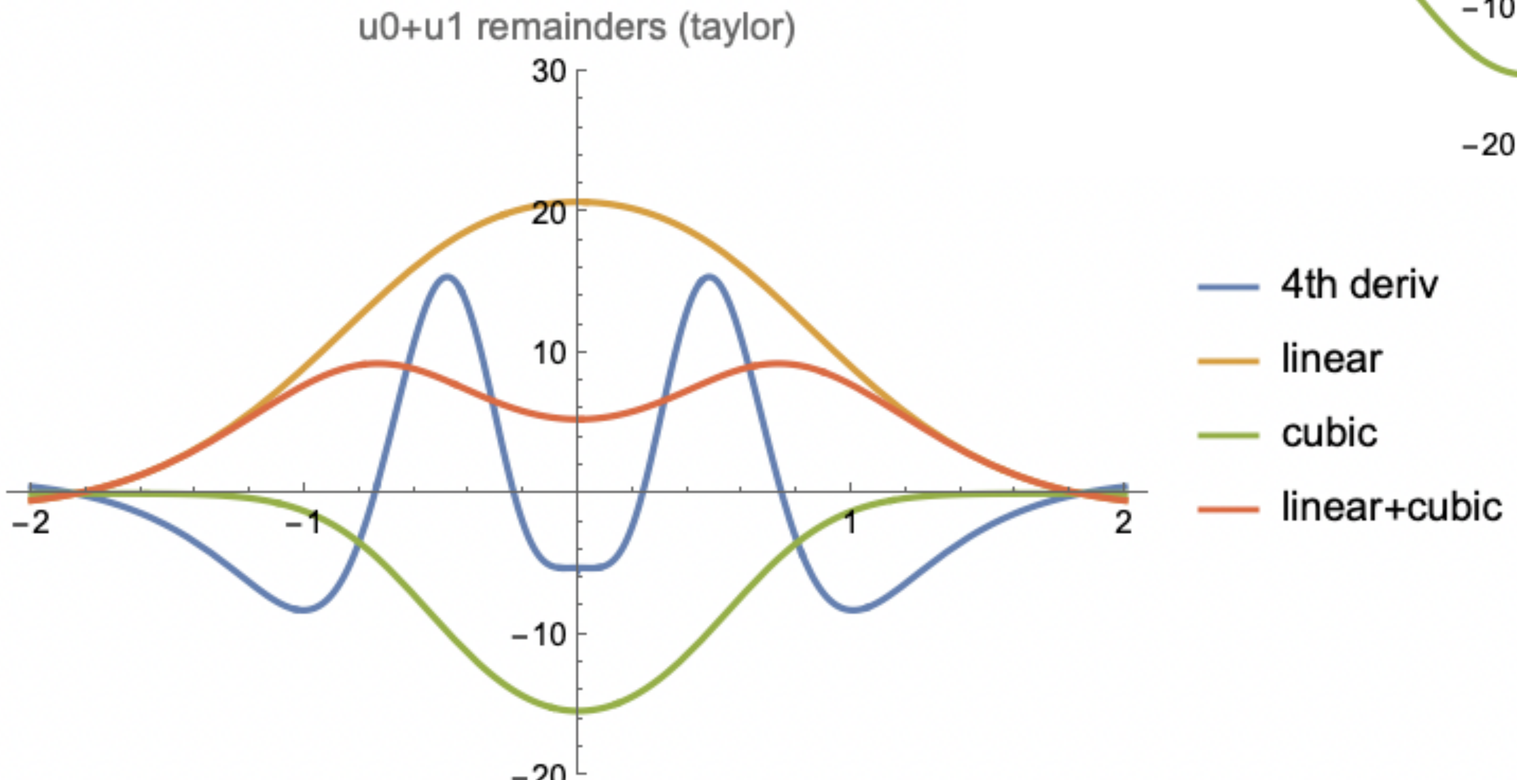
Plotting $\frac{d^4u}{dt^4}, \quad 4\sigma^4 u, \quad \Gamma u^3$ for the visual estimates of A, B





Plotting $\frac{d^4u}{dt^4}, \quad 4\sigma^4 u, \quad \Gamma u^3$ for the Taylor estimates of A, B





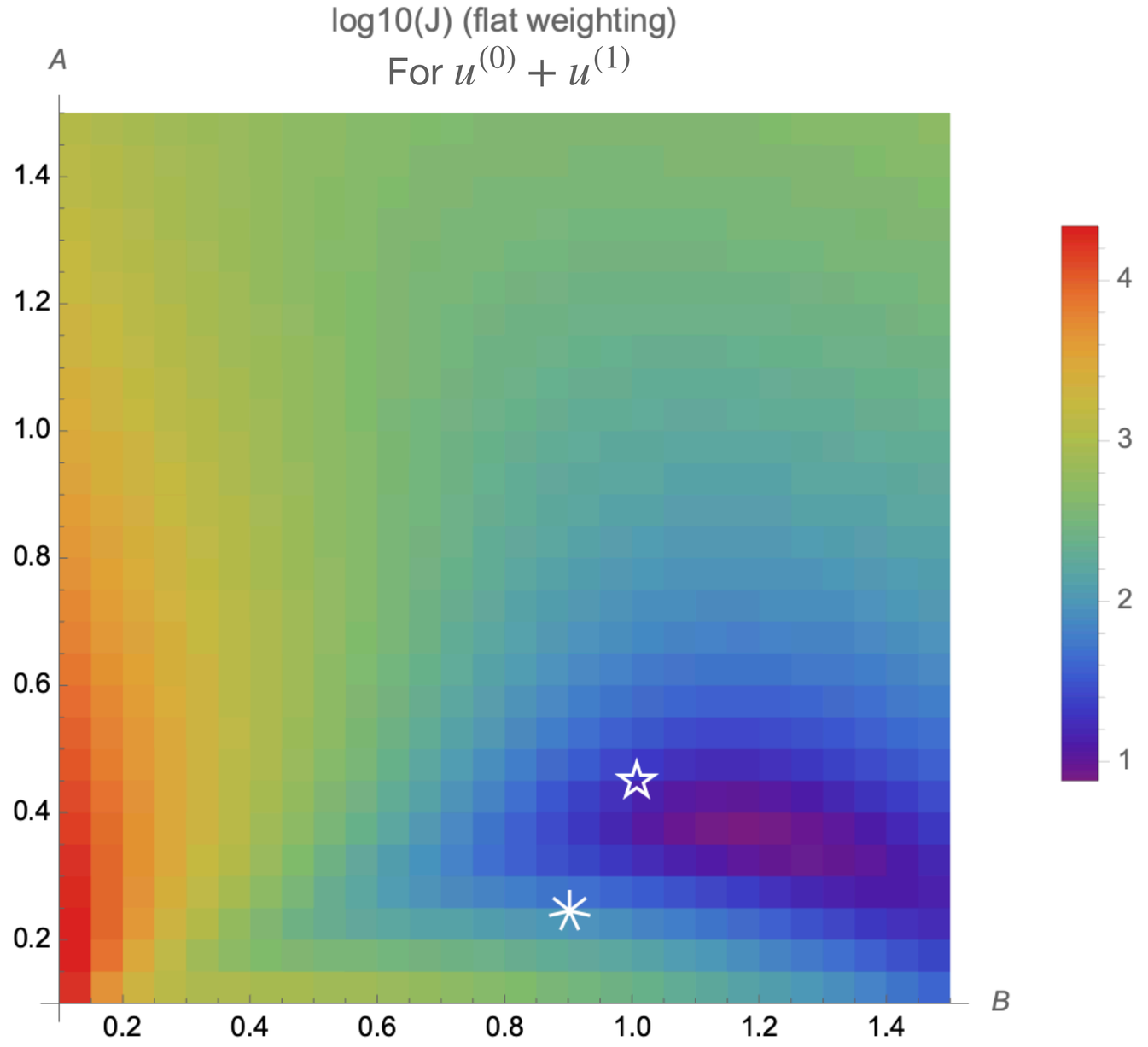
Calculate the squared area under the curve

$$I = \int_{\mathbb{R}} w(x') \left[D\left(x';\ u^{(0)} + u^{(1)}, (A, B)\right) \right]^2 \mathrm{d}x'$$

Where $w(\cdot)$ is chosen so the $w(x) = 0$ for $|x| < \epsilon$
(to prevent divergence in the numeric integration)

$$(A, B) = \begin{cases} (0.445, 1.028) & \text{visual} \\ (0.0333, 1.15) & u^{(0)} \\ (0.242, 0.899) & \cdots + u^{(1)} \\ (0.335, 0.695) & \cdots + u^{(2)} + u^{(3)} \end{cases}$$

The ★ is the visual estimate, the * is the Taylor estimate for $u^{(0)} + u^{(1)}$



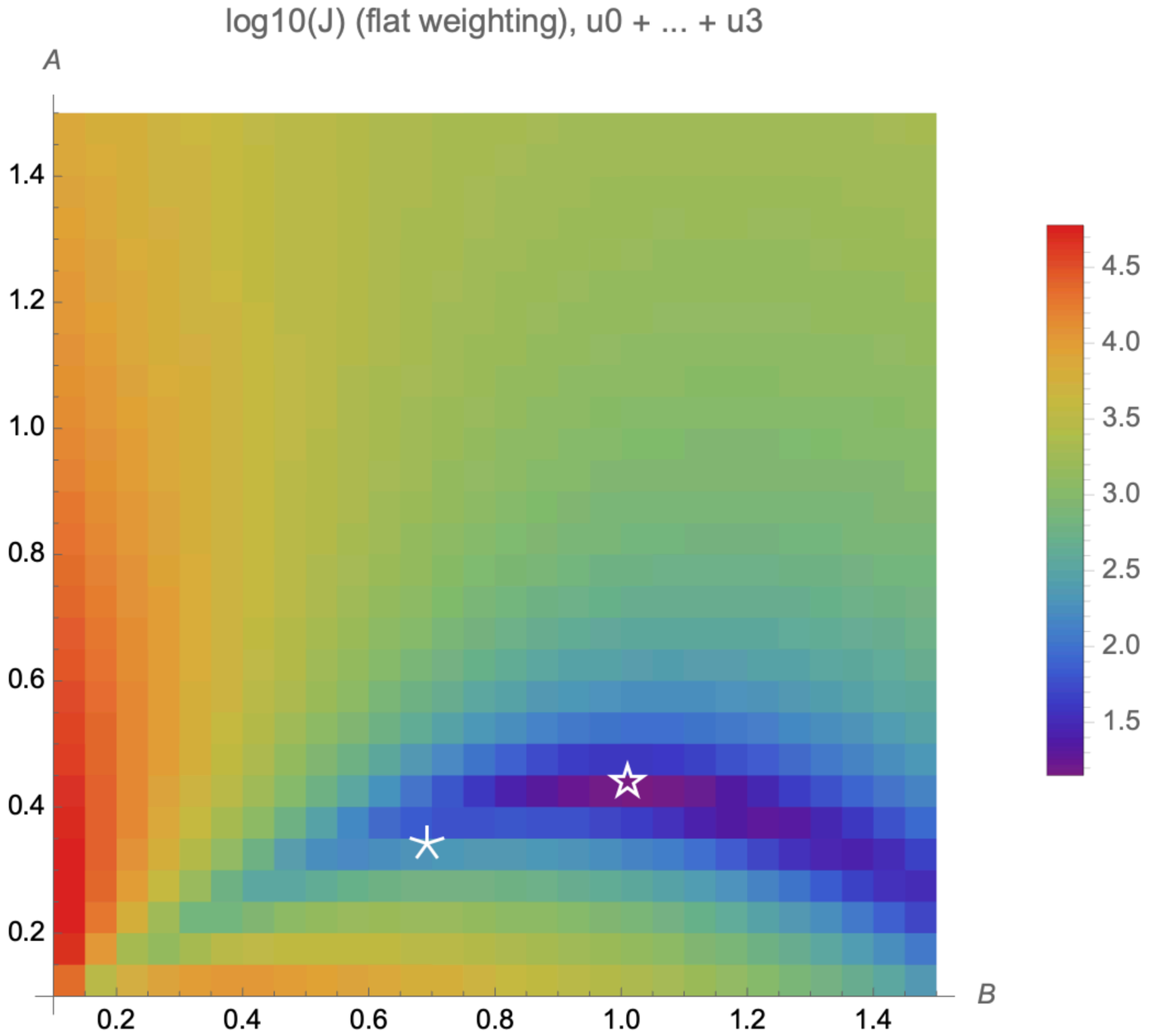
Calculate the squared area under the curve

$$I = \int_{\mathbb{R}} w(x') \left[D\left(x';\ u^{(0)} + \cdots + u^{(3)}, (A, B)\right) \right]^2 \mathrm{d}x'$$

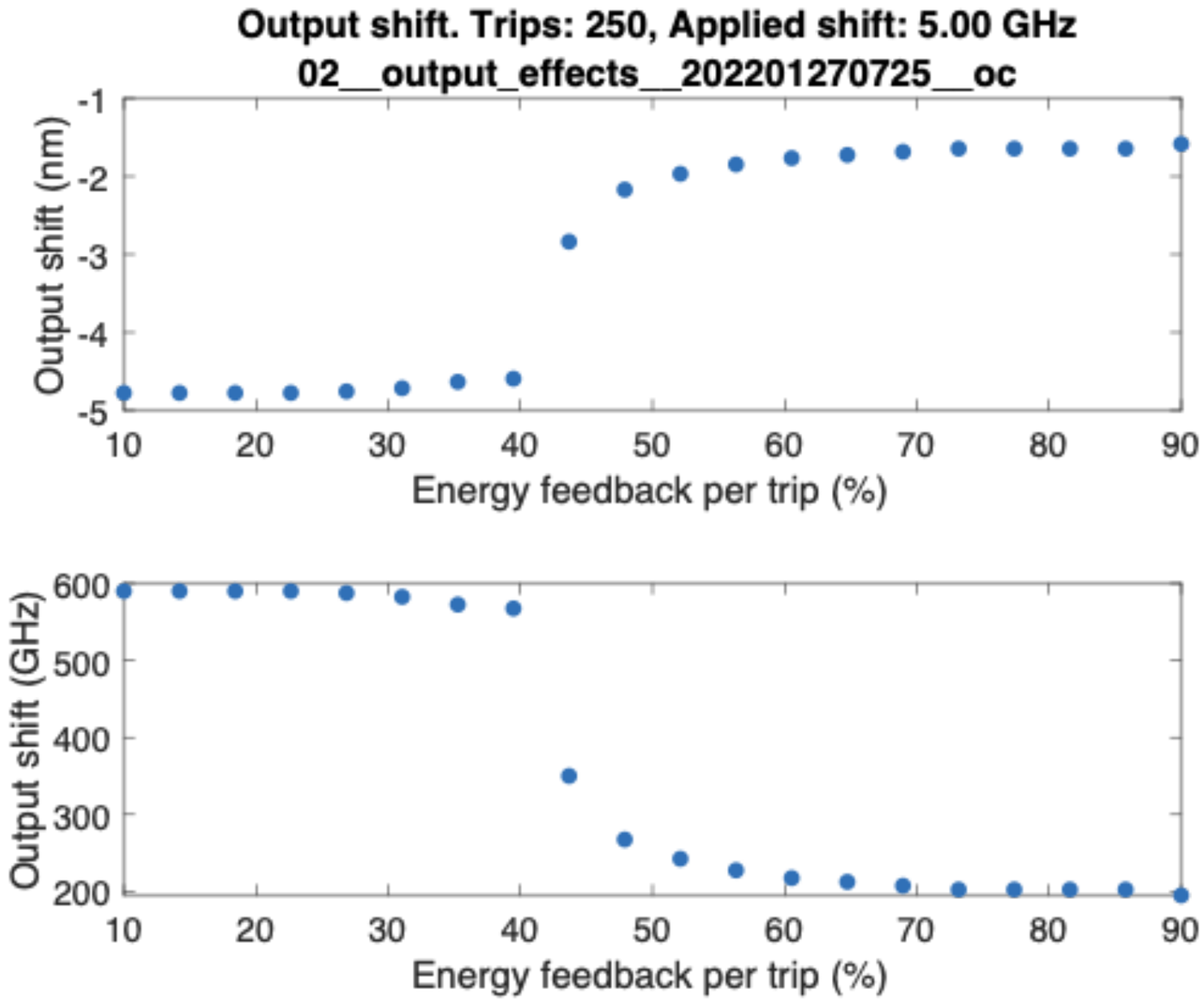
Where $w(\,\cdot\,)$ is chosen so the $w(x) = 0$ for $|x| < \epsilon$
(to prevent divergence in the numeric integration)

$$(A, B) = \begin{cases} (0.445, 1.028) & \text{visual} \\ (0.0333, 1.15) & u^{(0)} \\ (0.242, 0.899) & \cdots + u^{(1)} \\ (0.335, 0.695) & \cdots + u^{(2)} + u^{(3)} \end{cases}$$

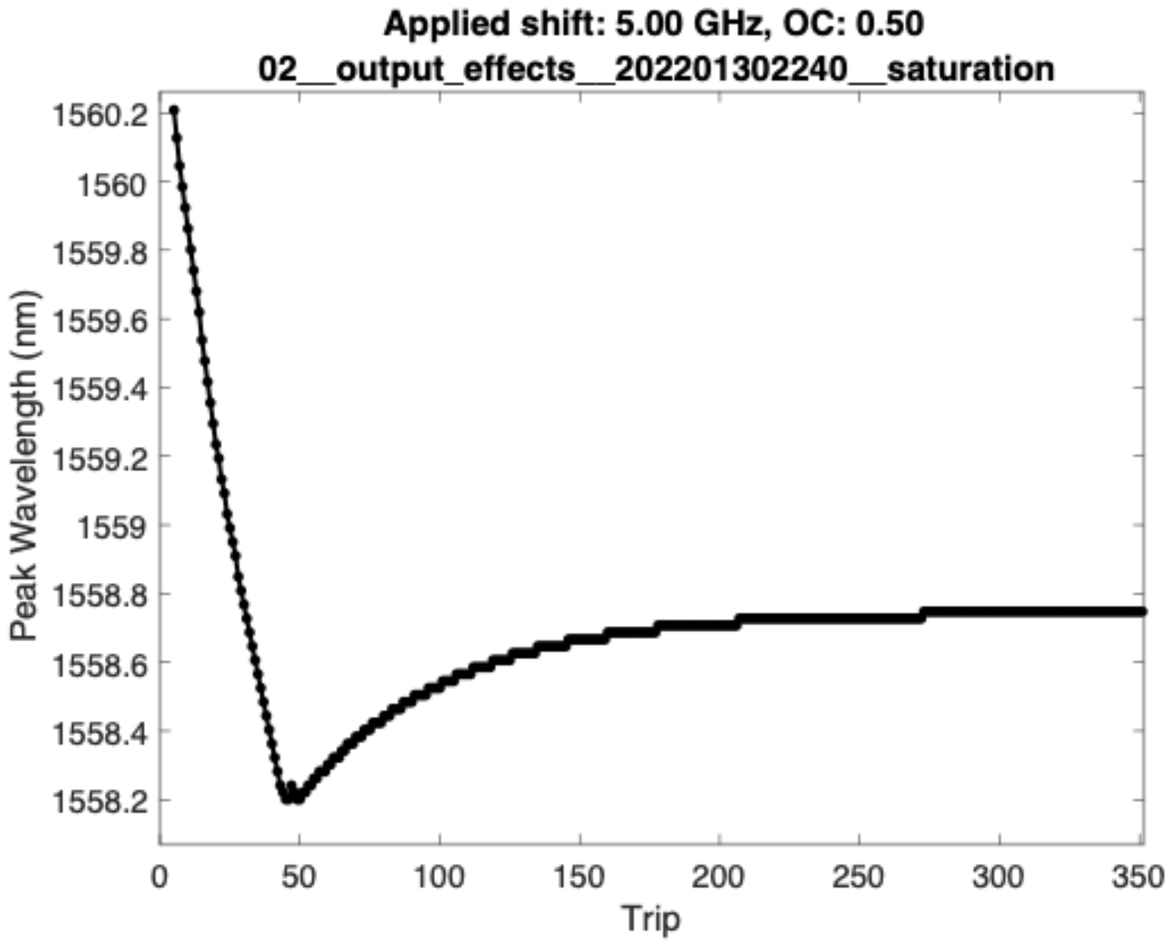
The ⋆ is the visual estimate, the * is the Taylor estimate for $u^{(0)} + \cdots + u^{(3)}$

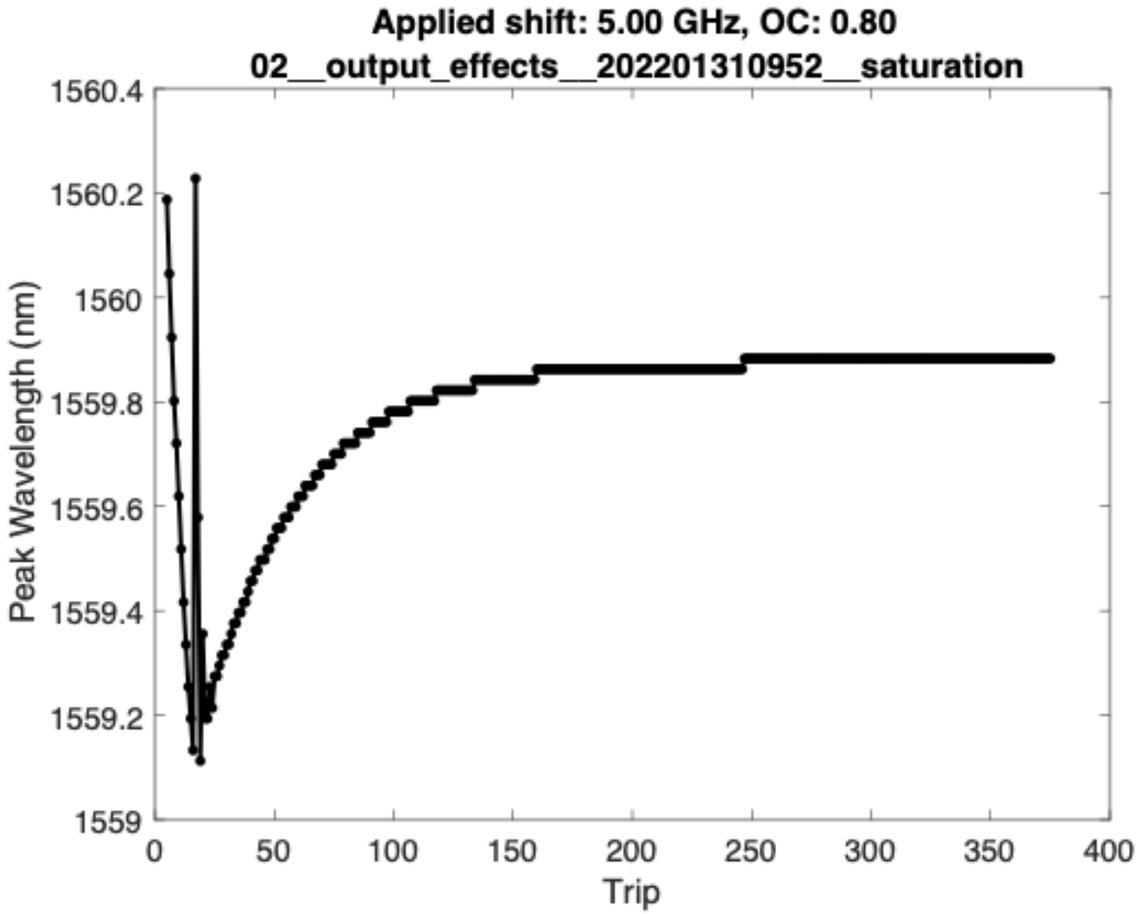


Numeric

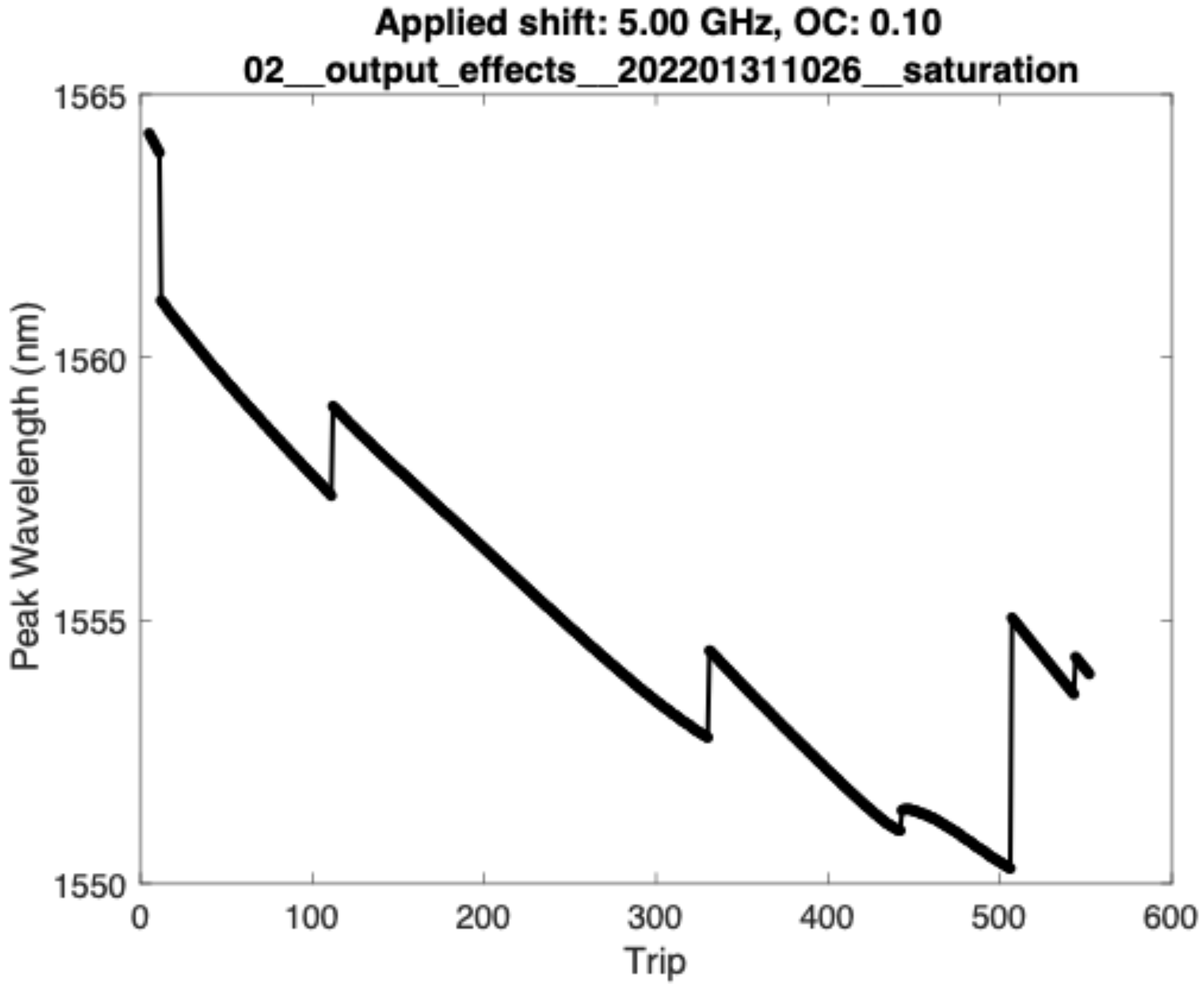

Output shift. Trips: 250, Applied shift: 5.00 GHz
02__output_effects__202201270725__oc
Output shift (nm)
-1
-2
-3
-4
-5
10
20
30
40
50
60
70
80
90
Energy feedback per trip (%)
Output shift (GHz)
600
500
400
300
200
10
20
30
40
50
60
70
80
90
Energy feedback per trip (%)

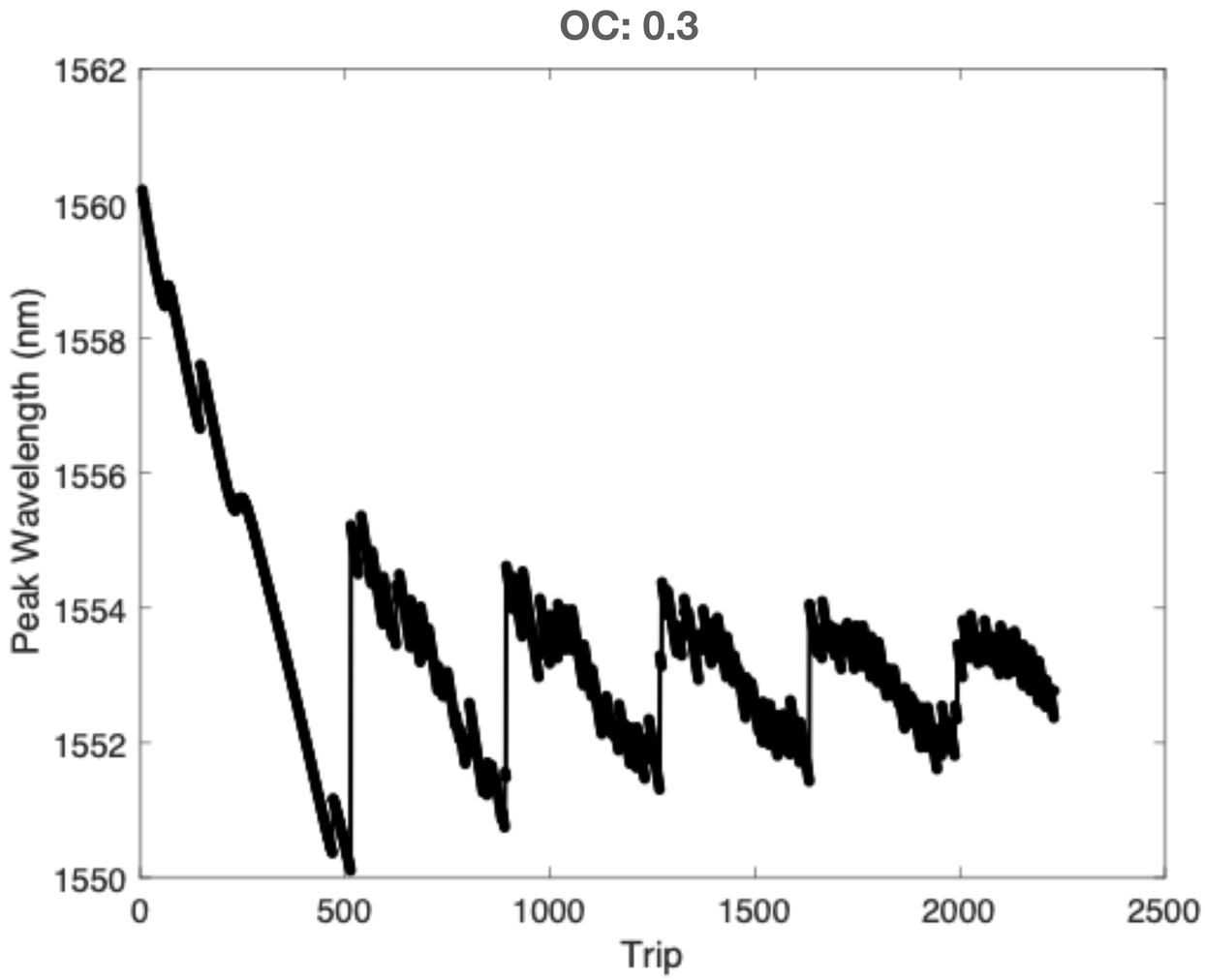
Numeric


Applied shift: 5.00 GHz, OC: 0.50
02__output_effects__202201302240__saturation
Peak Wavelength (nm)
1560.2
1560
1559.8
1559.6
1559.4
1559.2
1559
1558.8
1558.6
1558.4
1558.2
0
50
100
150
200
250
300
350
Trip


Applied shift: 5.00 GHz, OC: 0.80
02__output_effects__202201310952__saturation
Peak Wavelength (nm)
1560.4
1560.2
1560
1559.8
1559.6
1559.4
1559.2
1559
0
50
100
150
200
250
300
350
400
Trip

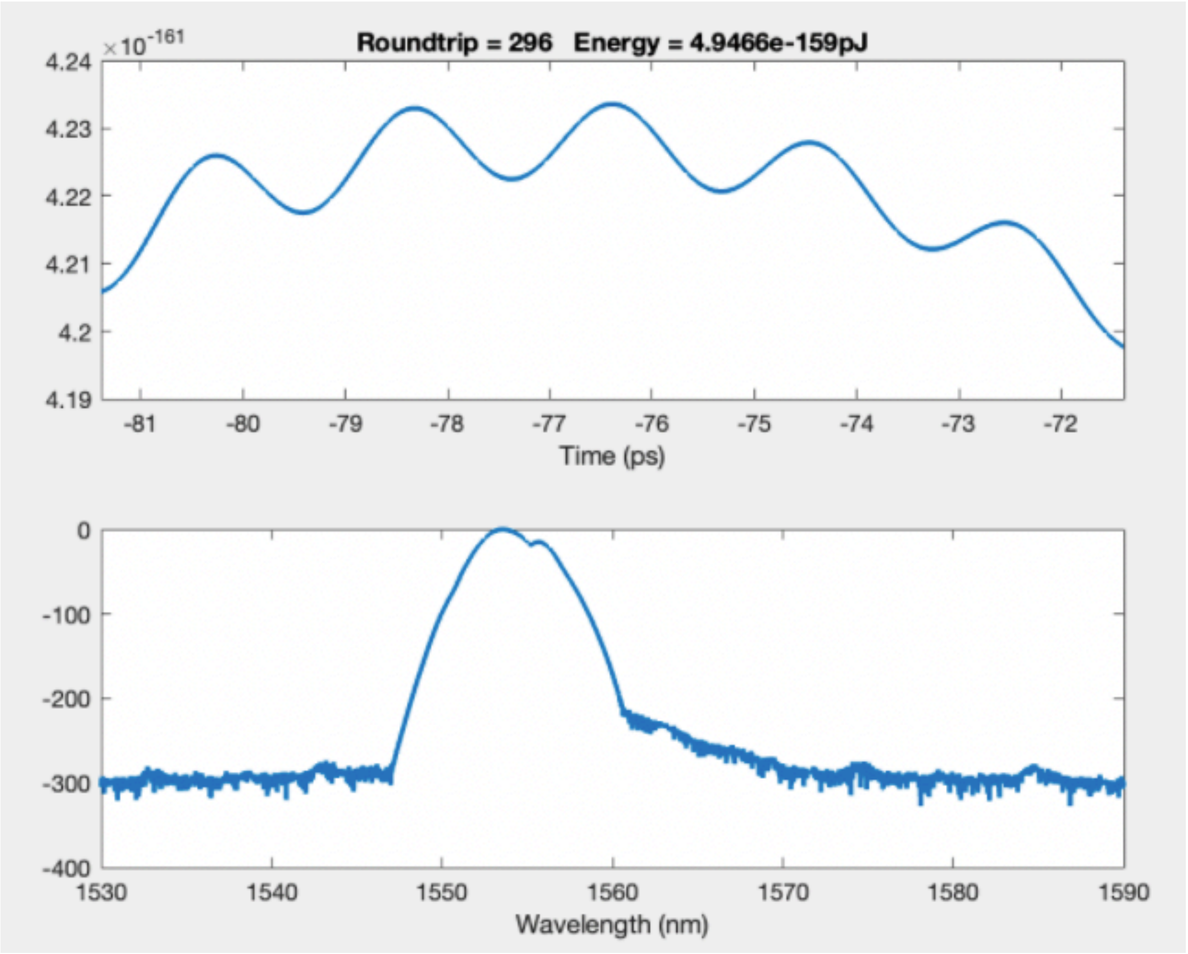
Numeric


Applied shift: 5.00 GHz, OC: 0.10
02__output_effects__202201311026__saturation
Peak Wavelength (nm)
Trip
1565
1560
1555
1550
0
100
200
300
400
500
600

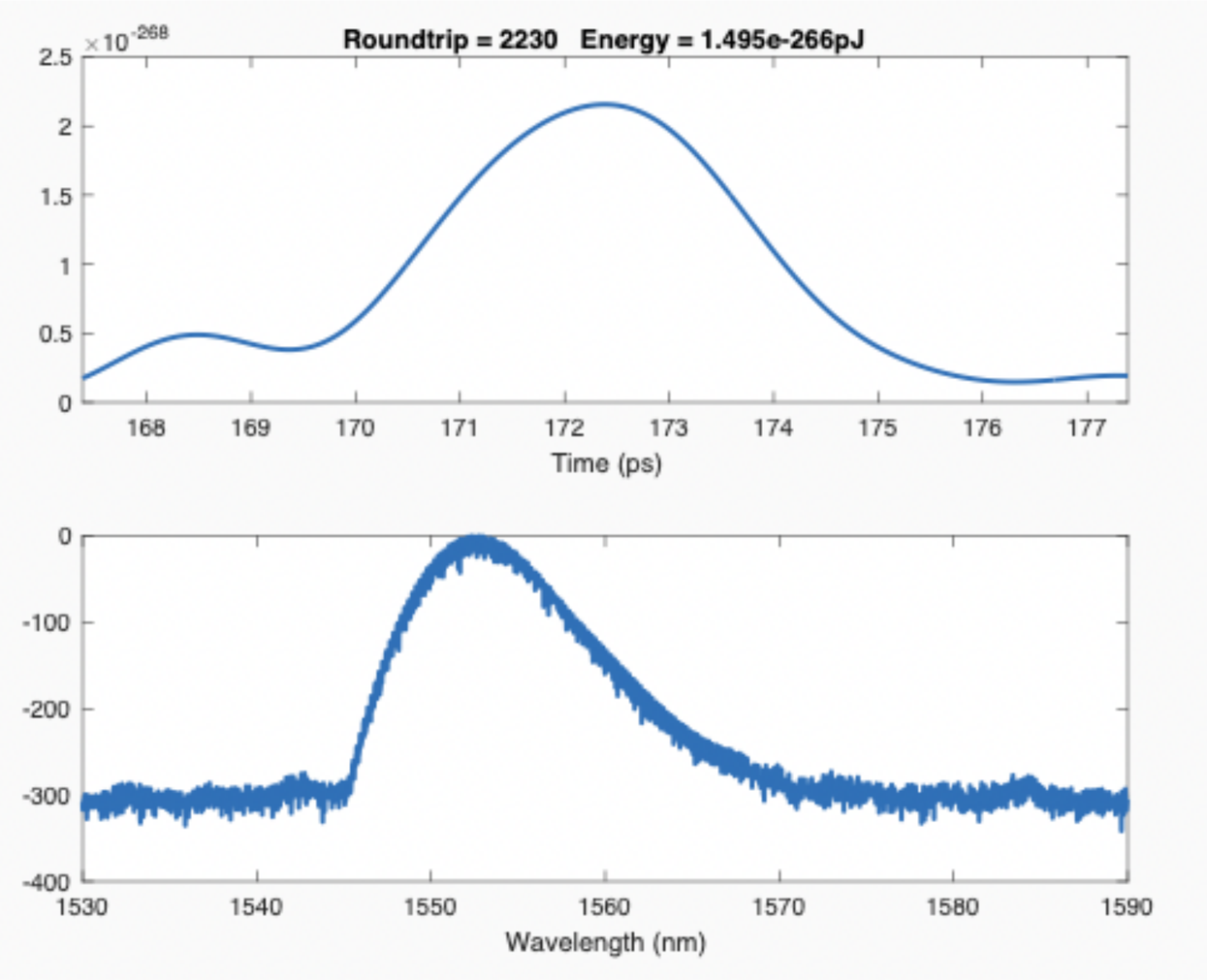

OC: 0.3
Peak Wavelength (nm)
Trip
1562
1560
1558
1556
1554
1552
1550
0
500
1000
1500
2000
2500

Numeric

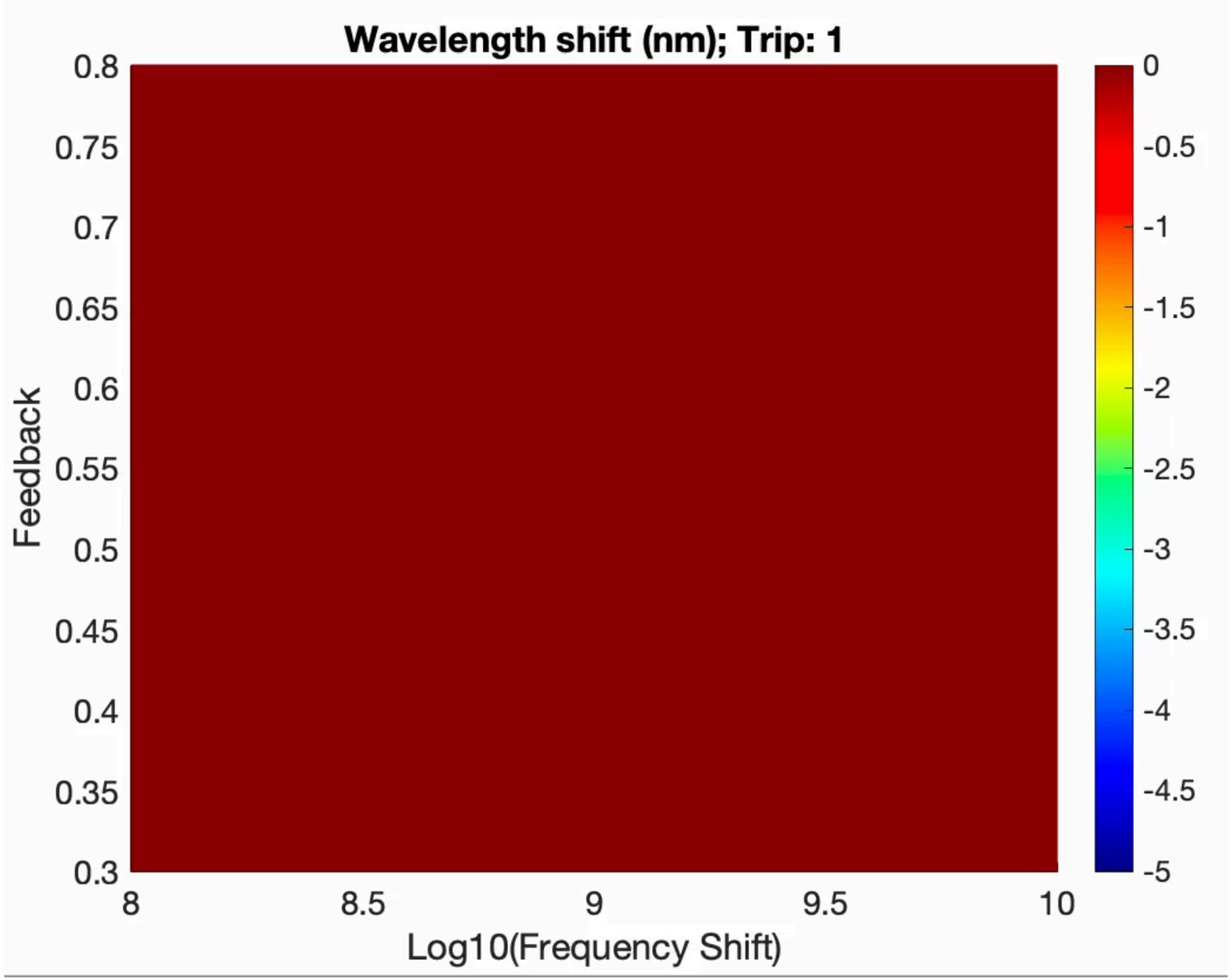
OC: 0.1



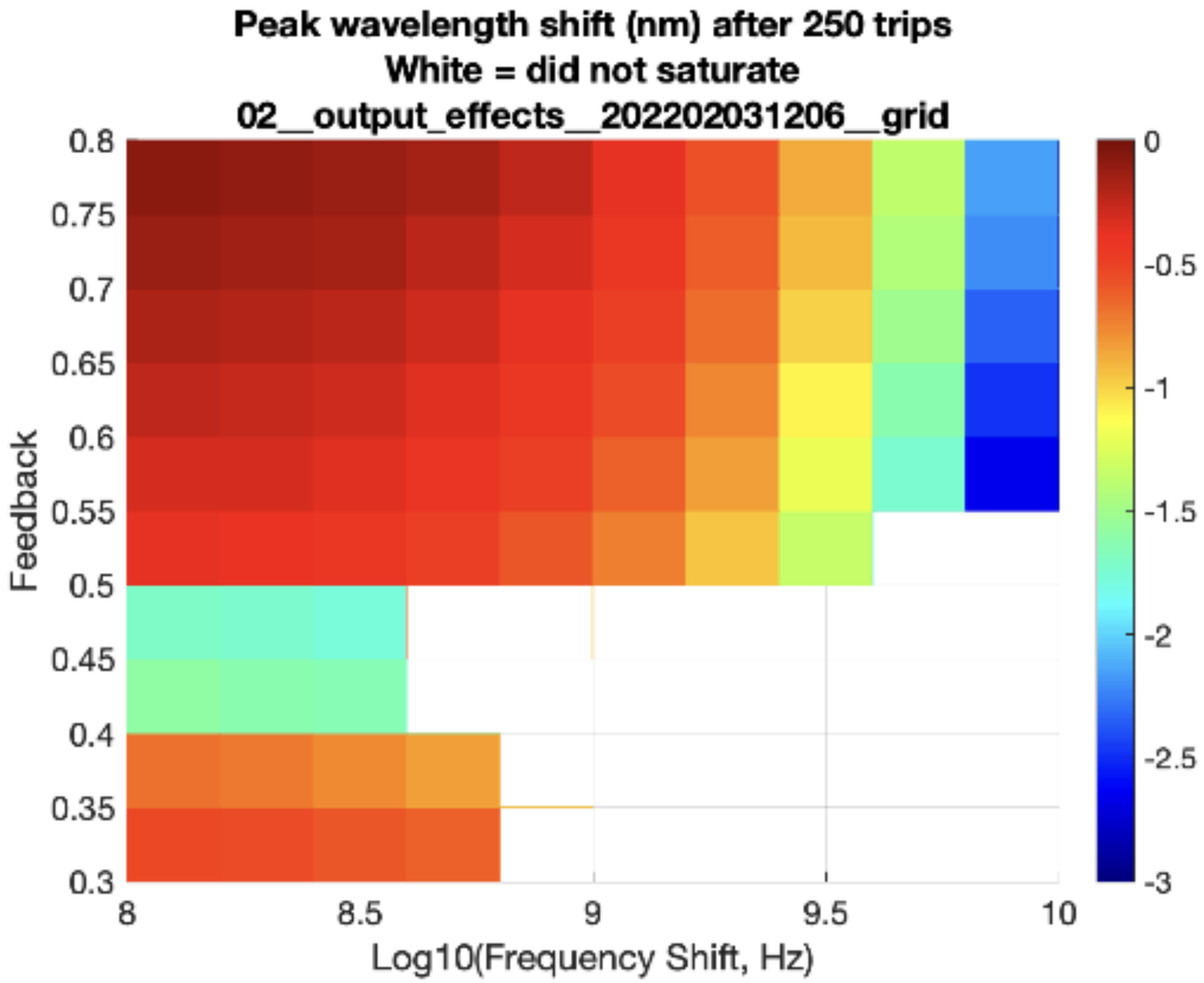
OC: 0.3



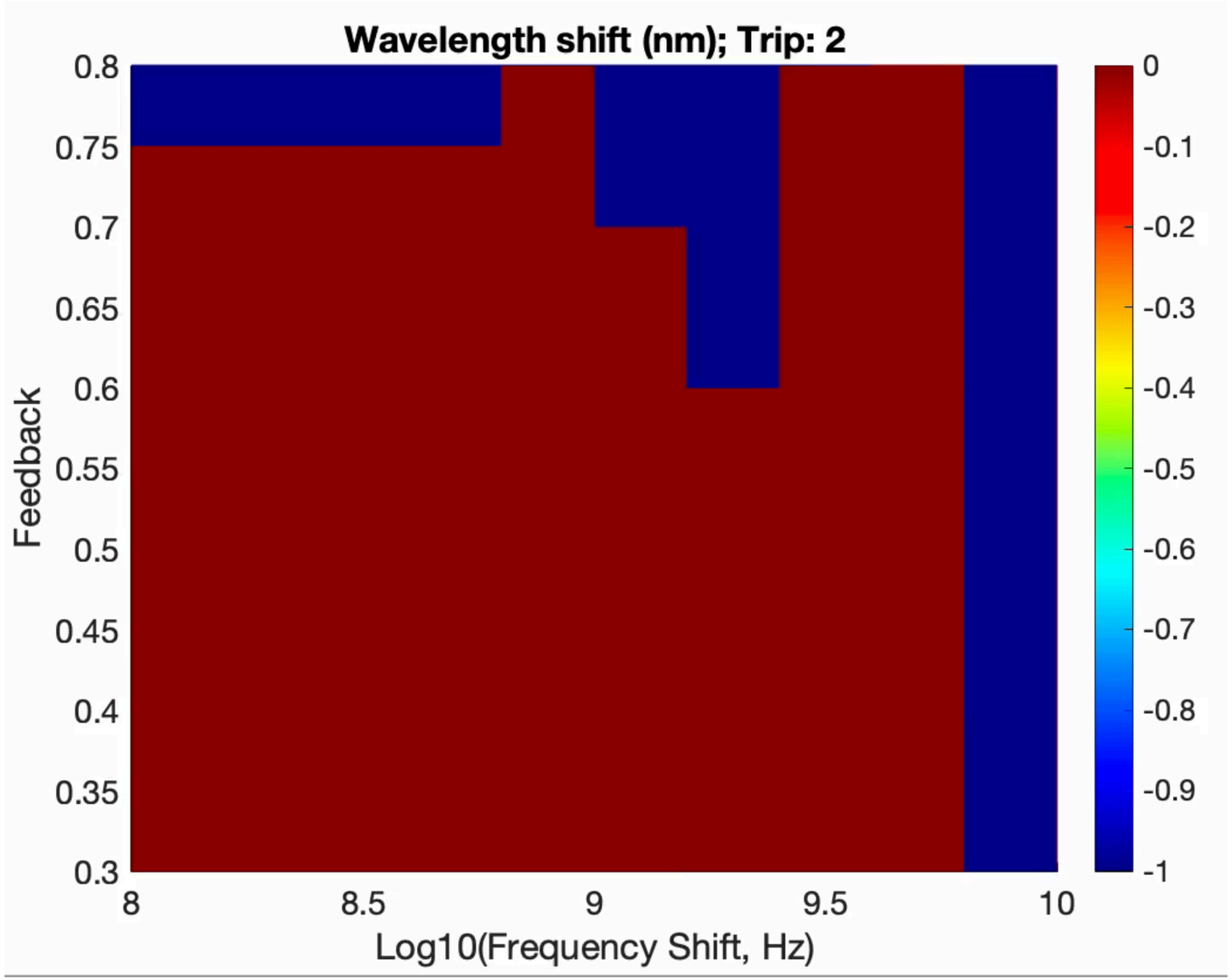
Numeric


Wavelength shift (nm); Trip: 1
Feedback
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
8
8.5
9
9.5
10
Log10(Frequency Shift)
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
-5

Numeric


Peak wavelength shift (nm) after 250 trips
White = did not saturate
02__output_effects__202202031206__grid
Feedback
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
8
8.5
9
9.5
10
Log10(Frequency Shift, Hz)
0
-0.5
-1
-1.5
-2
-2.5
-3

Numeric - Quartic dispersion



Numeric - Quartic dispersion