Tags: #logbook - Denison
Links:

Logbook_09_220215

A Numeric Project

> **Aims**
>
> - Examine the instantaneous frequency and the fourier transform of the soliton field

A.1 Notes

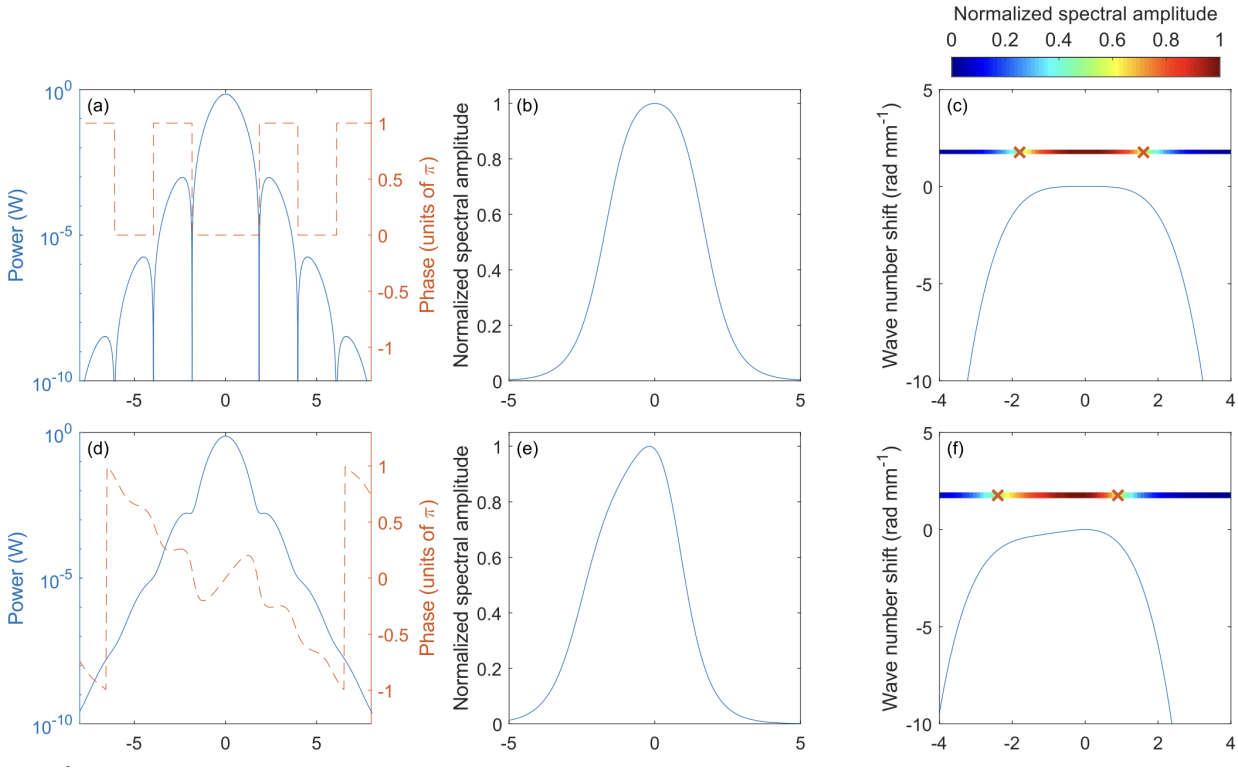
The instantaneous frequency is defined as

$$\omega_i = -\frac{\mathrm{d}\phi}{\mathrm{d}t}$$

where ϕ is the complex phase of the electric field amplitude, E.

We are looking for asymmetries in the instantaneous frequency and the spectrum, since this indicates that the soliton has shifted into a different form (as we are trying to do by using the frequency shifter).

From Widjaja et al (Absence of Galilean invariance for pure-quartic solitons), we want the second row of plots where the spectrum is asymmetric.

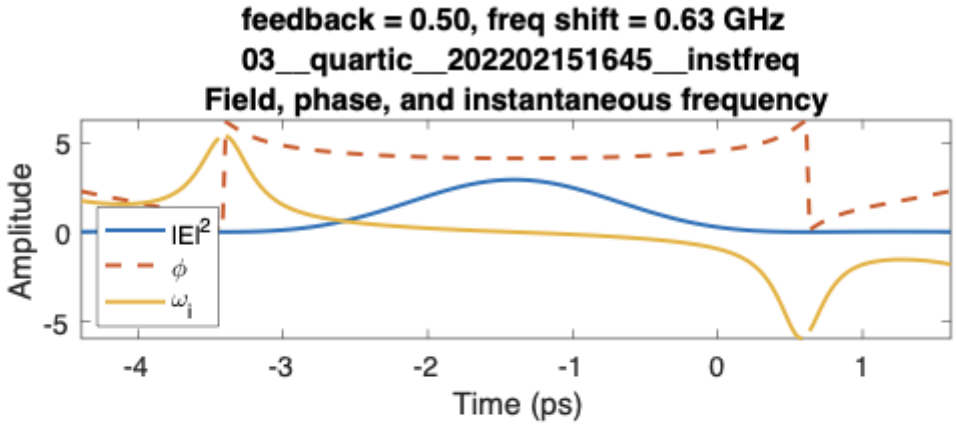


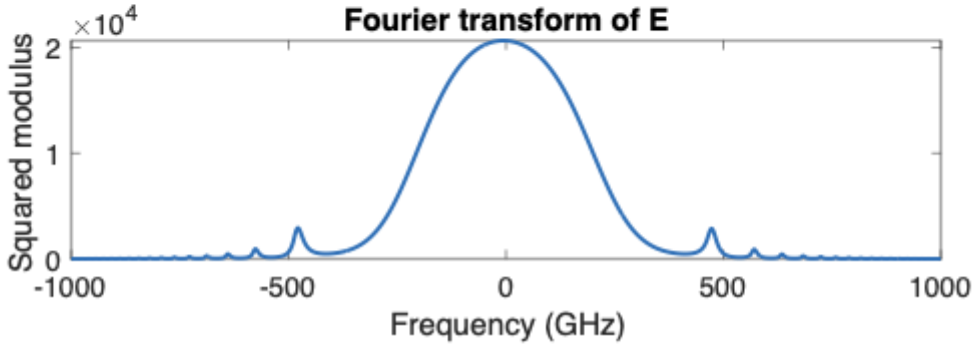
A.2 Results

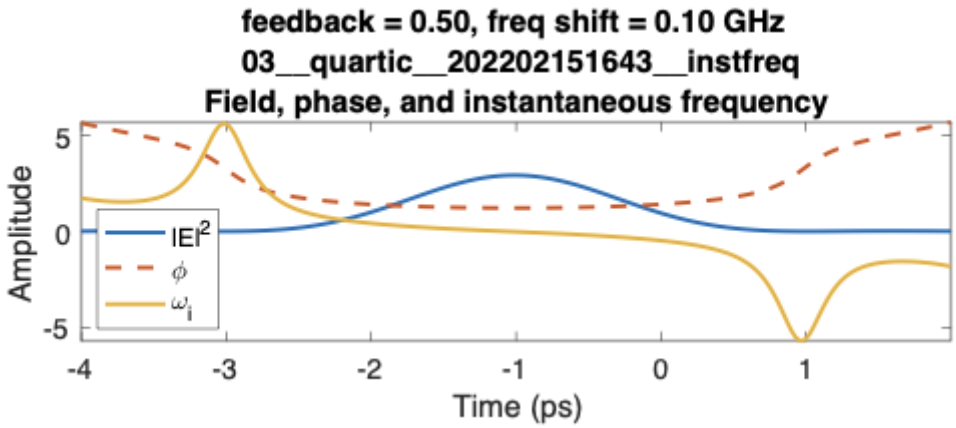
A.2.1 Initial

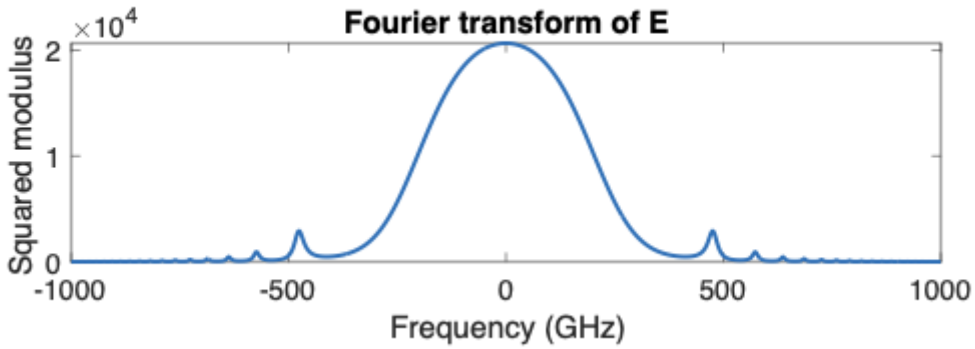
These have been superseded by the plots below.

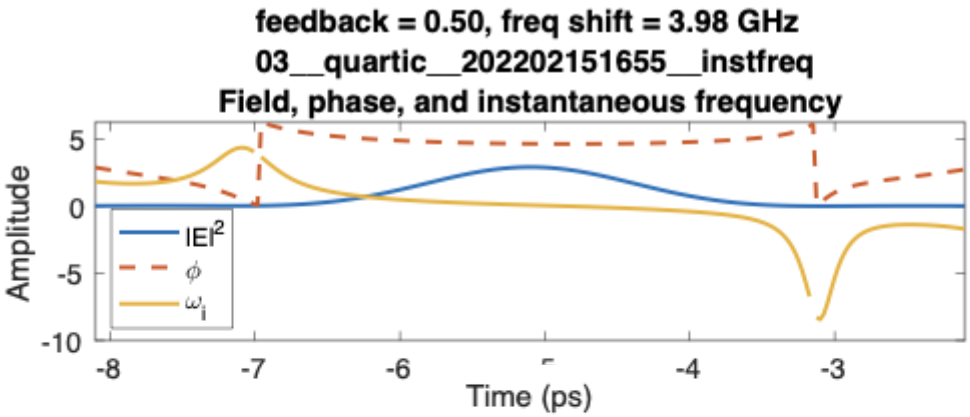
Using `quartic_220215_instfreq.m`; Data: `03__quartic__202202151512__instfreq.mat`

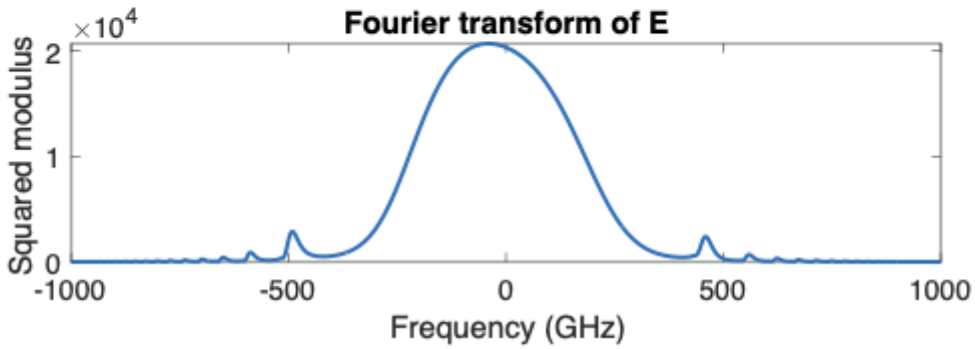

feedback = 0.50, freq shift = 0.63 GHz
03__quartic__202202151645__instfreq
Field, phase, and instantaneous frequency
Amplitude
Time (ps)
|E|²
φ
ω_i


Fourier transform of E
×10^4
Squared modulus
Frequency (GHz)


feedback = 0.50, freq shift = 0.10 GHz
03__quartic__202202151643__instfreq
Field, phase, and instantaneous frequency
Amplitude
Time (ps)
|E|²
φ
ω_i


Fourier transform of E
×10^4
Squared modulus
Frequency (GHz)





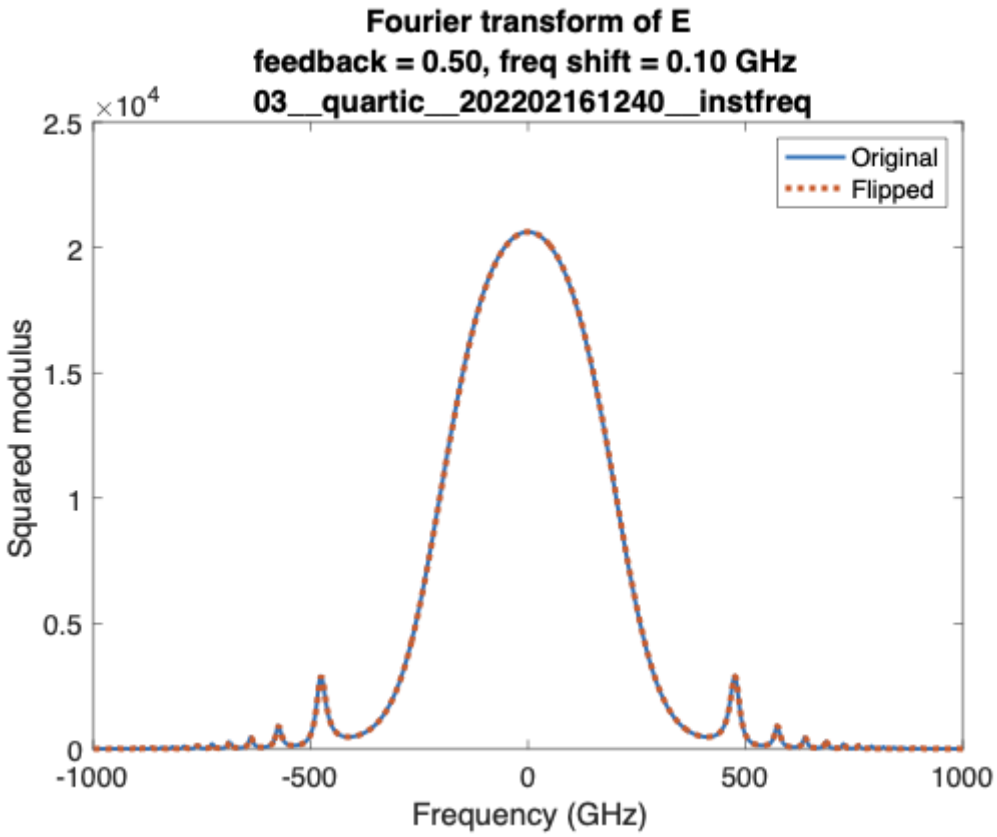
A.2.2 Improved Graphs

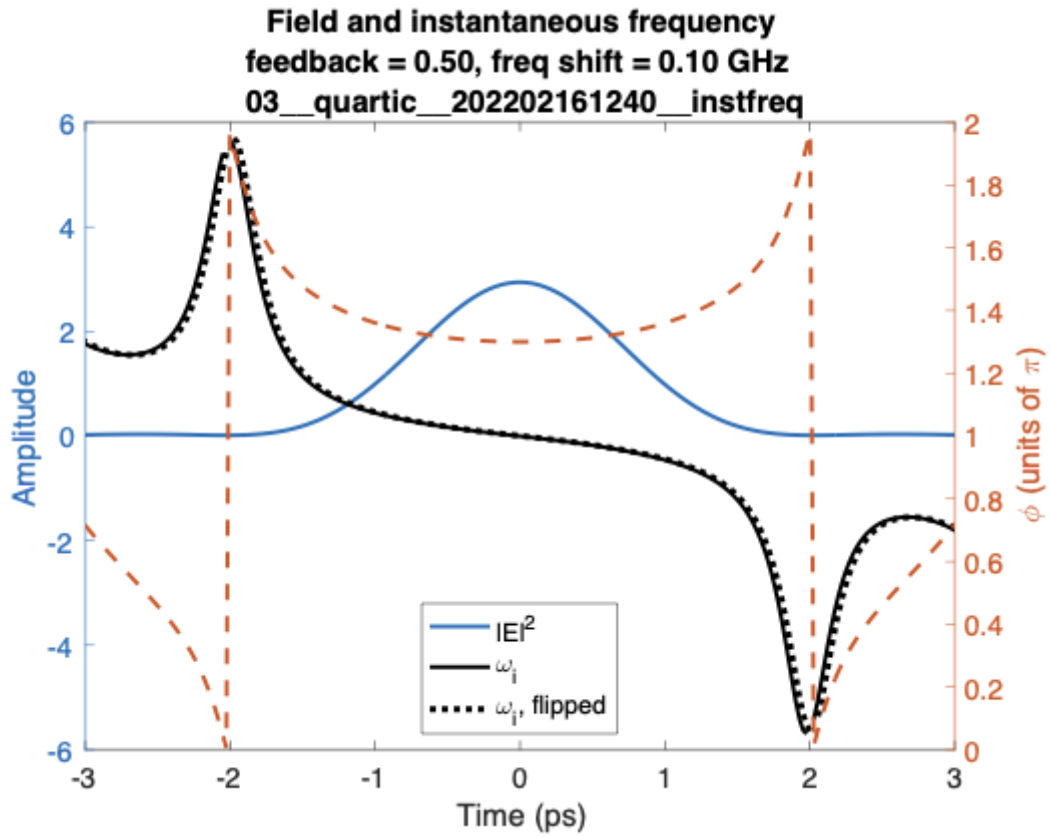
Re-running the simulations with more feedback values and improving the graphs to more easily show asymmetry.

Data: `03__quartic__202202151700__instfreq.mat`

A.2.2.1 Feedback = 0.5

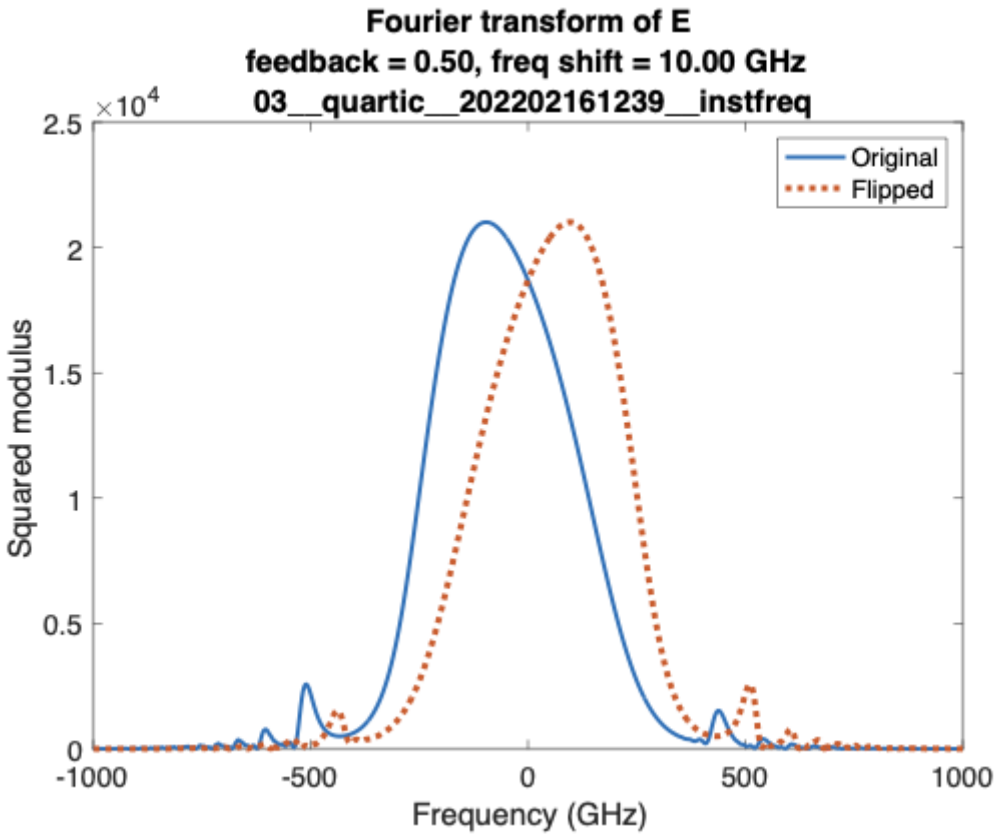
With a low frequency shift:

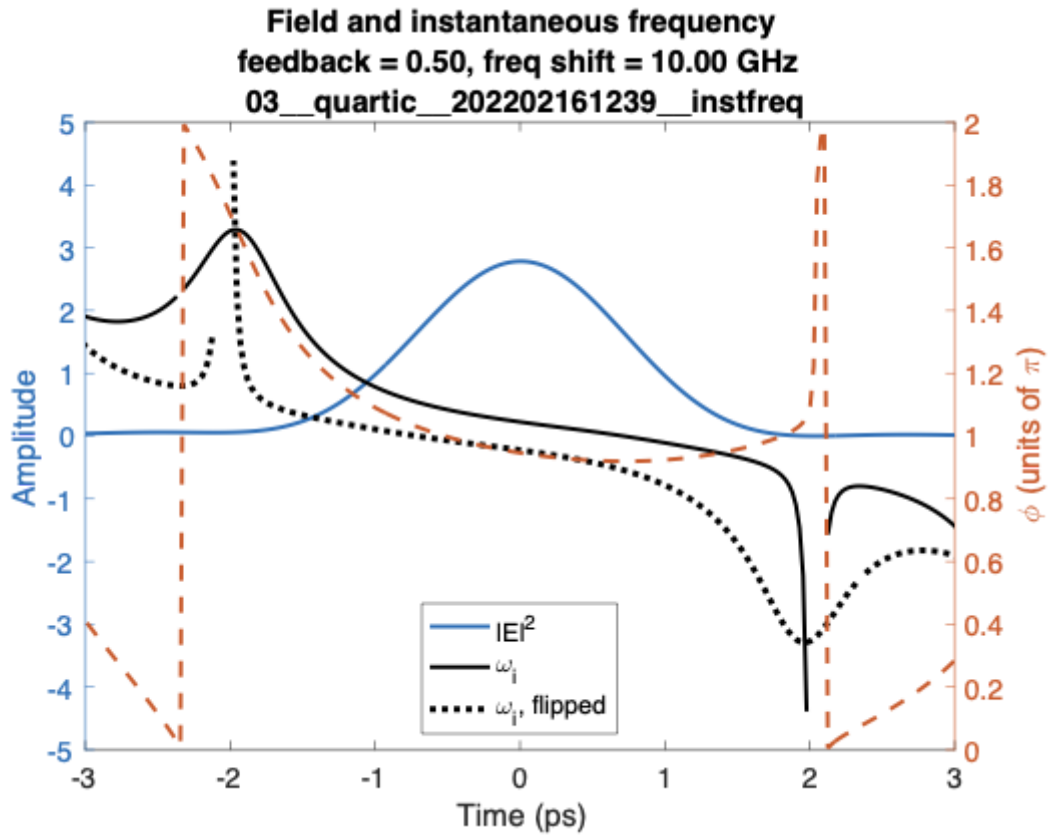




- There is no noticeable different in the spectrum, and the instantaneous frequency is mostly similar

With a larger frequency shift:

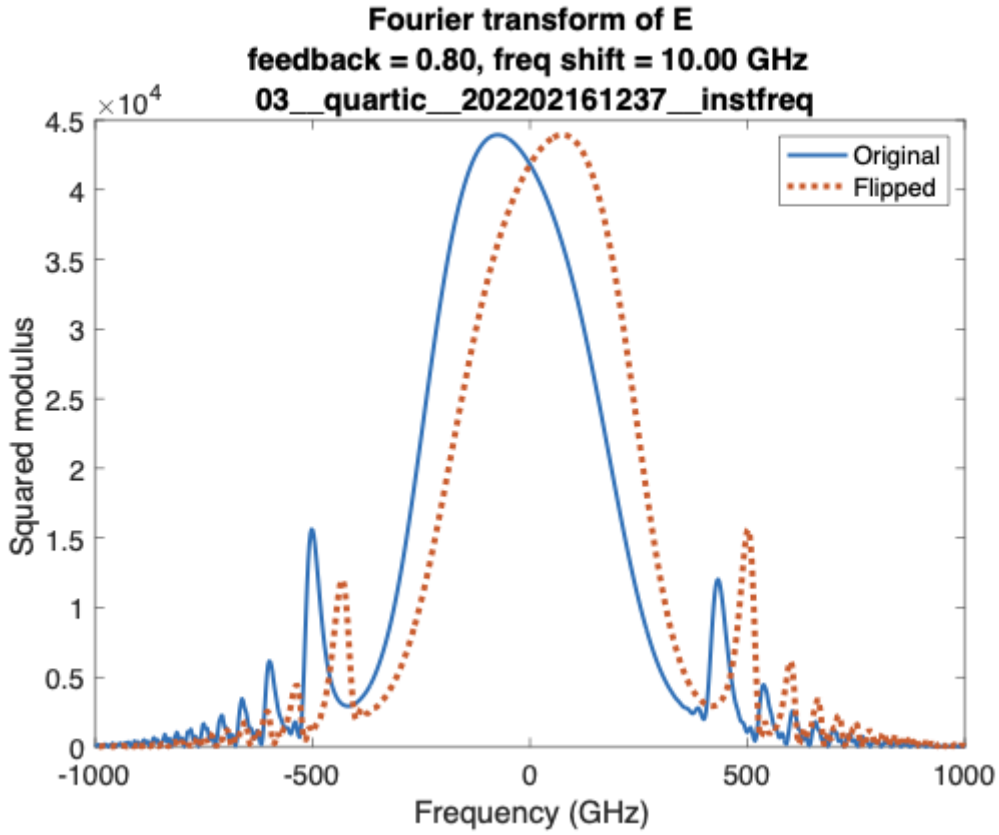


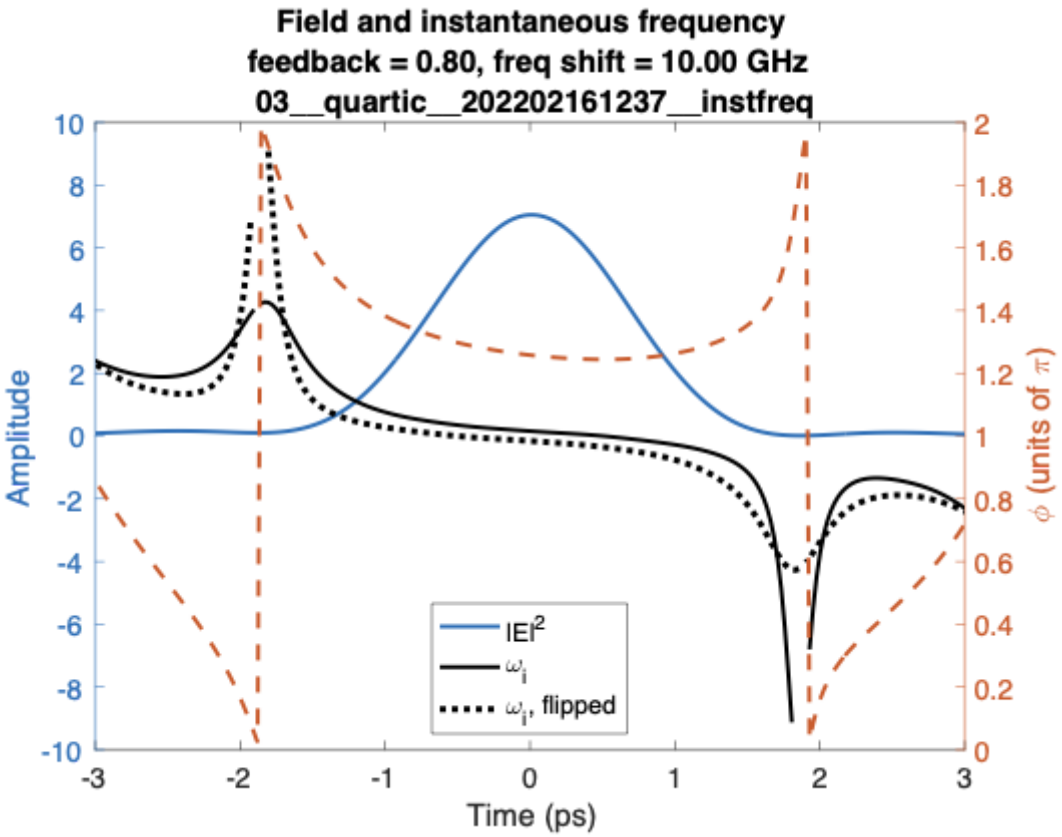


- We get a large asymmetry, as we expected

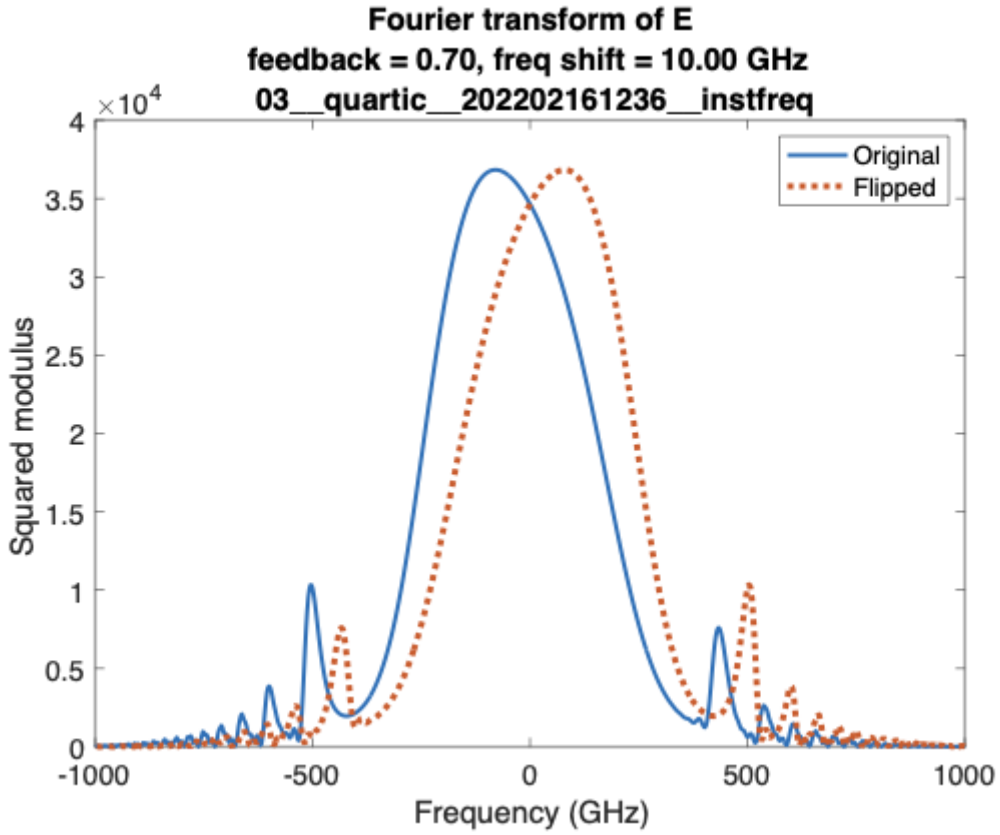
A.2.2.2 Feedback = 0.8

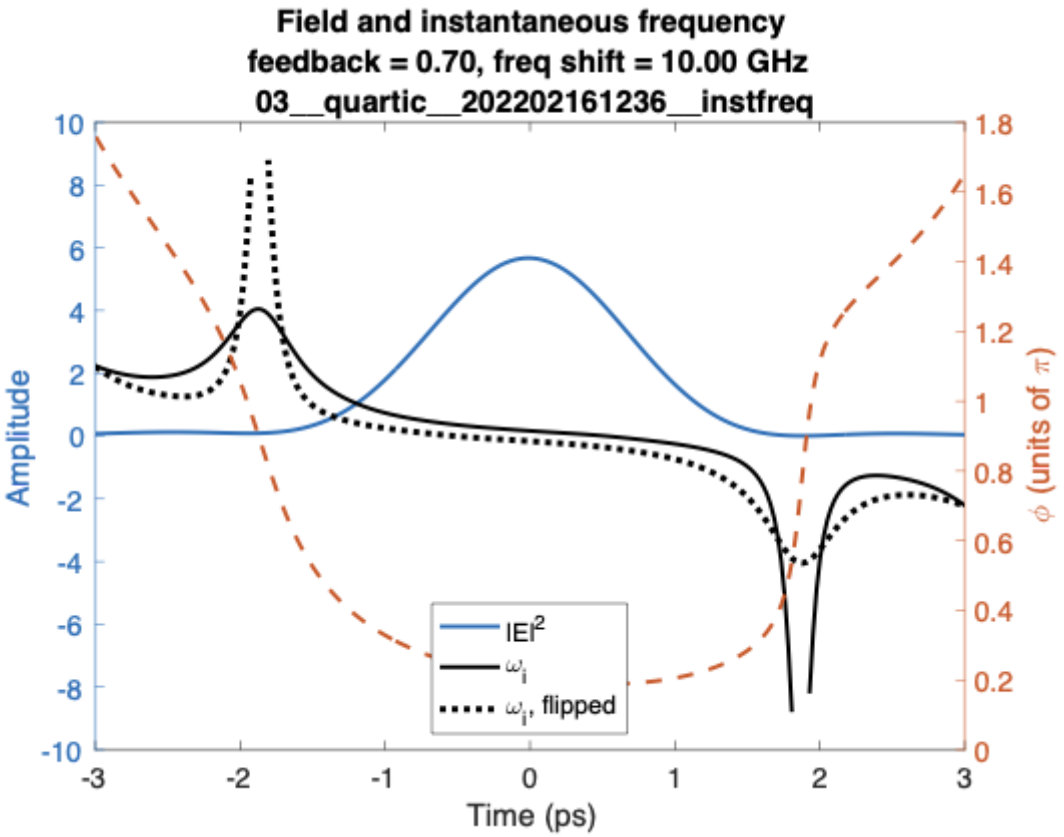
At a larger feedback, we get a smaller resultant shift:

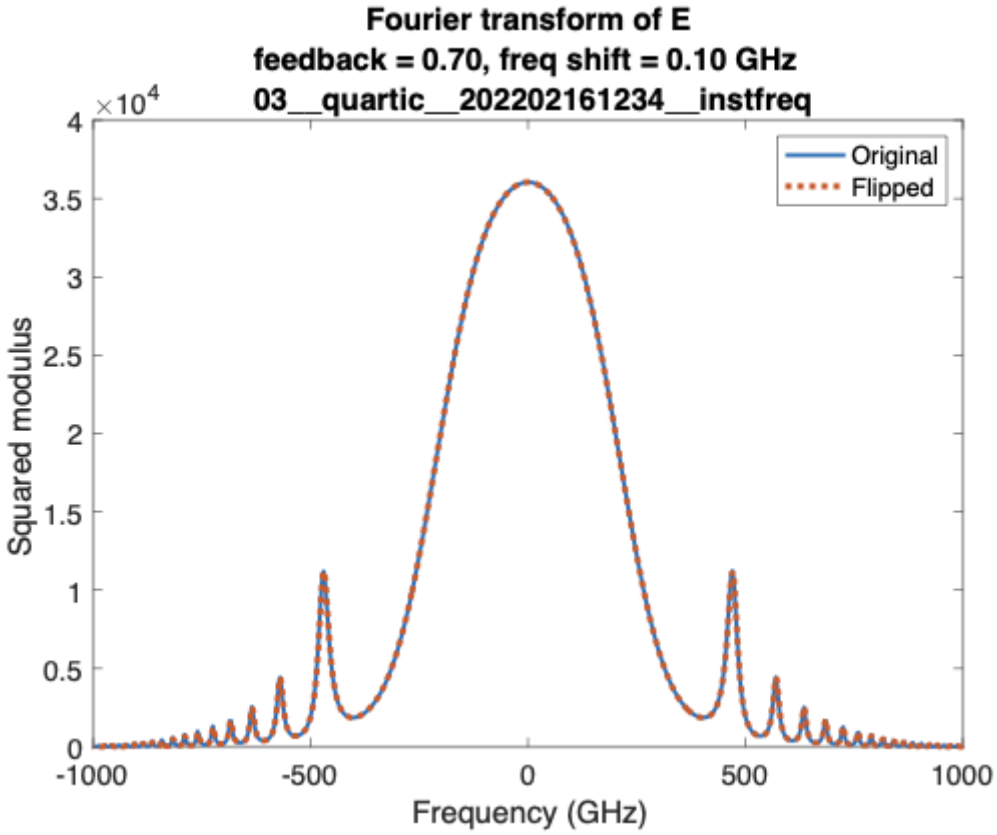


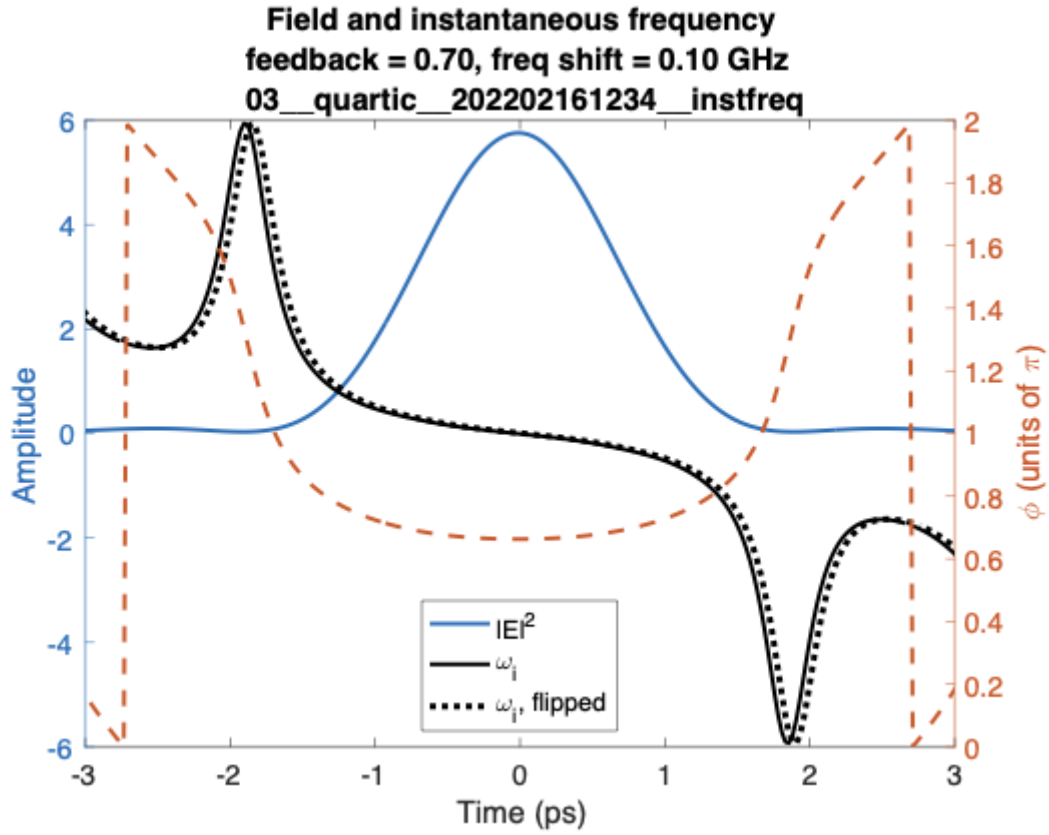


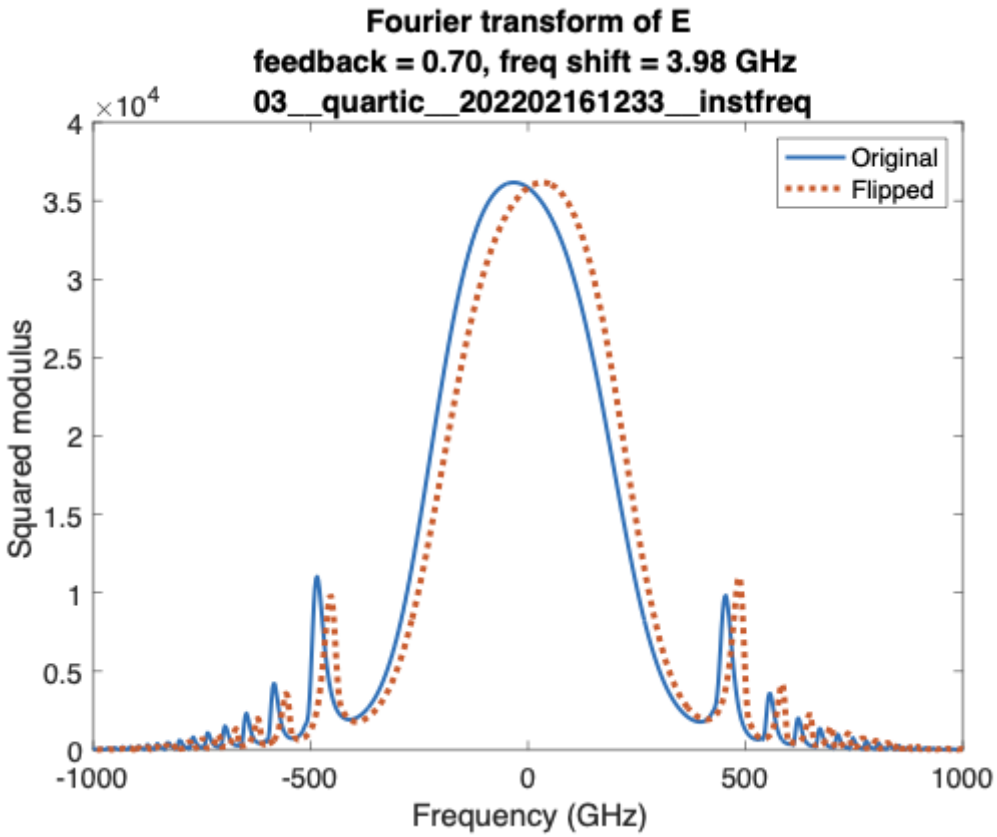
A.2.2.3 Feedback = 0.7

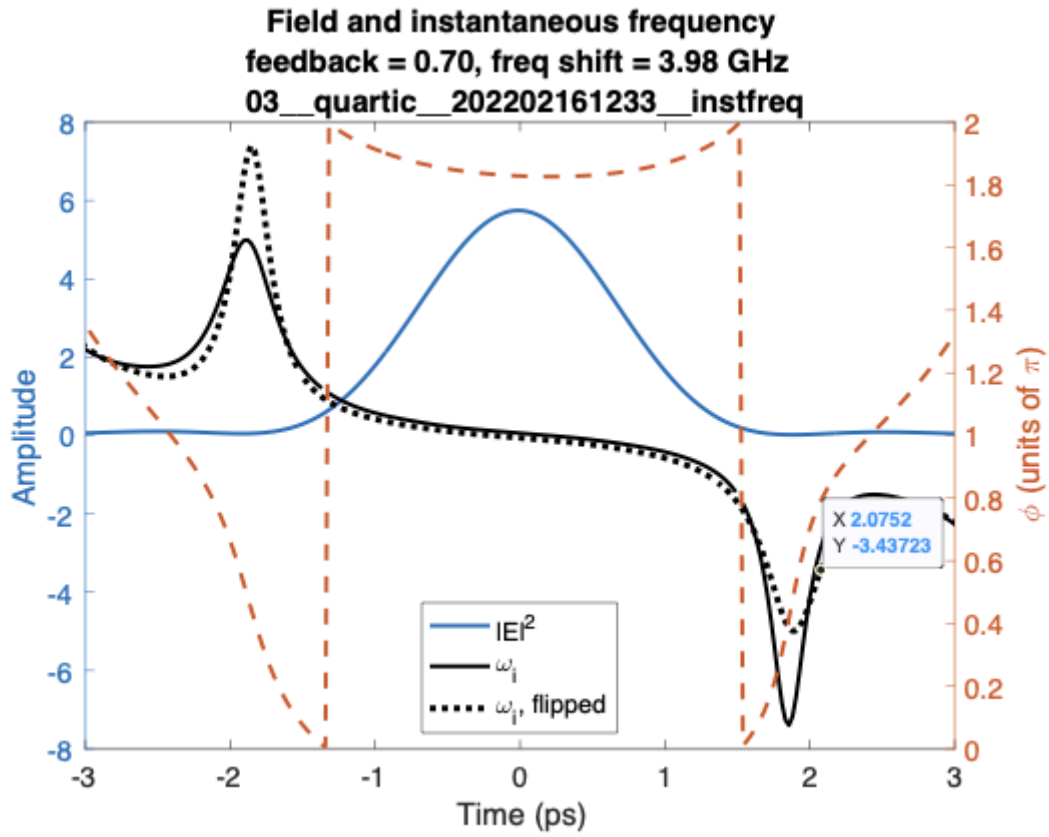

Fourier transform of E
feedback = 0.70, freq shift = 10.00 GHz
03__quartic__202202161236__instfreq
×10^4
Squared modulus
Frequency (GHz)
Original
Flipped


Field and instantaneous frequency
feedback = 0.70, freq shift = 10.00 GHz
03__quartic__202202161236__instfreq
Amplitude
ϕ (units of π)
Time (ps)
|E|^2
ω_i
ω_i, flipped

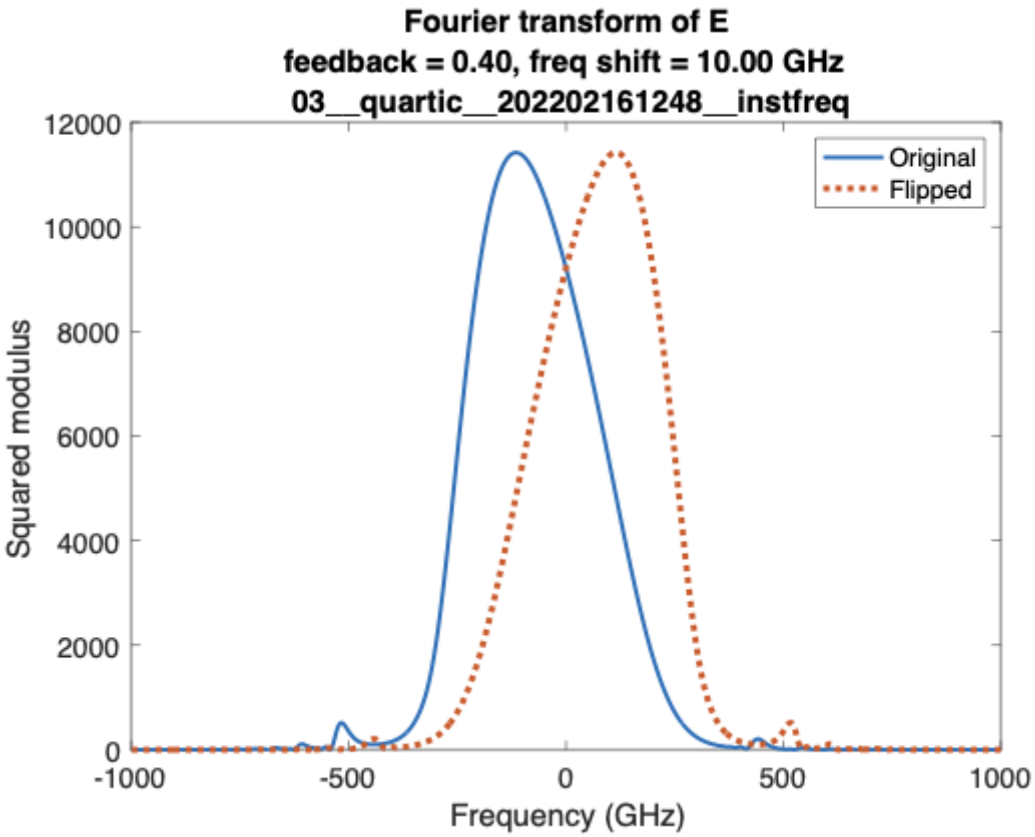

Fourier transform of E
feedback = 0.70, freq shift = 0.10 GHz
03__quartic__202202161234__instfreq
×10^4
4
3.5
3
2.5
2
1.5
1
0.5
0
Squared modulus
-1000
-500
0
500
1000
Frequency (GHz)
Original
Flipped

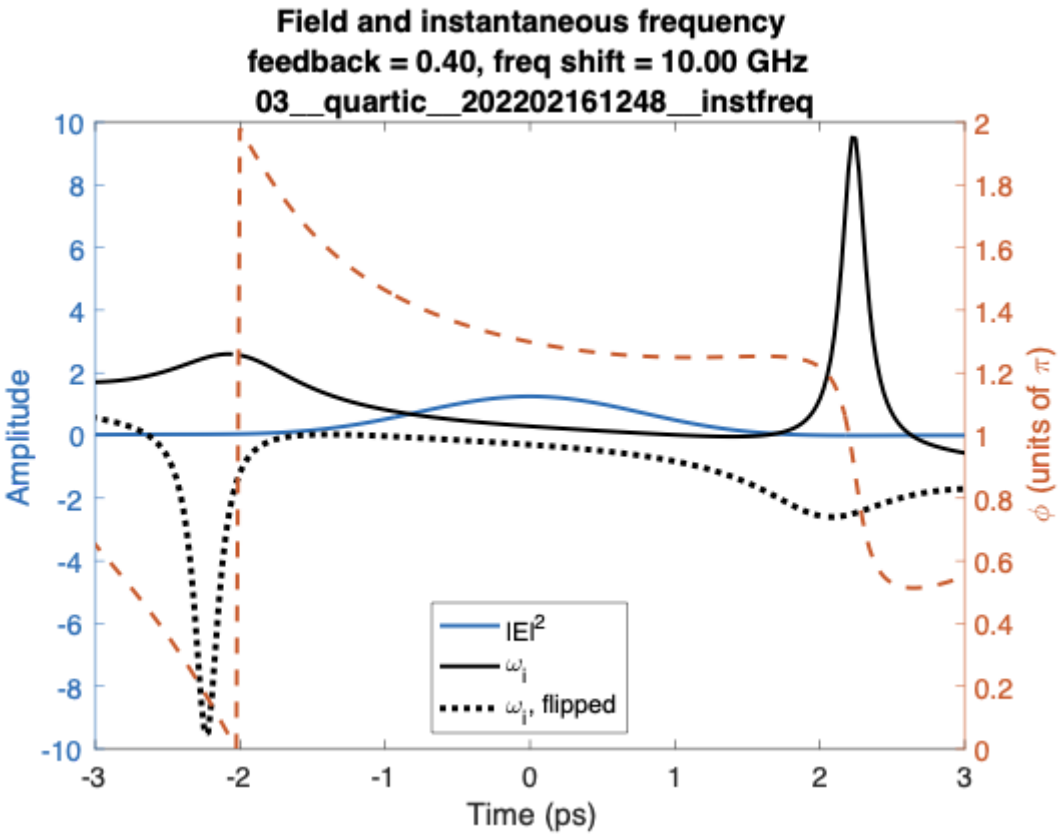

Field and instantaneous frequency
feedback = 0.70, freq shift = 0.10 GHz
03__quartic__202202161234__instfreq
Amplitude
ϕ (units of π)
Time (ps)
$|E|^2$
ω_i
ω_i, flipped


Fourier transform of E
feedback = 0.70, freq shift = 3.98 GHz
03__quartic__202202161233__instfreq
$\times 10^4$
Squared modulus
Frequency (GHz)
Original
Flipped



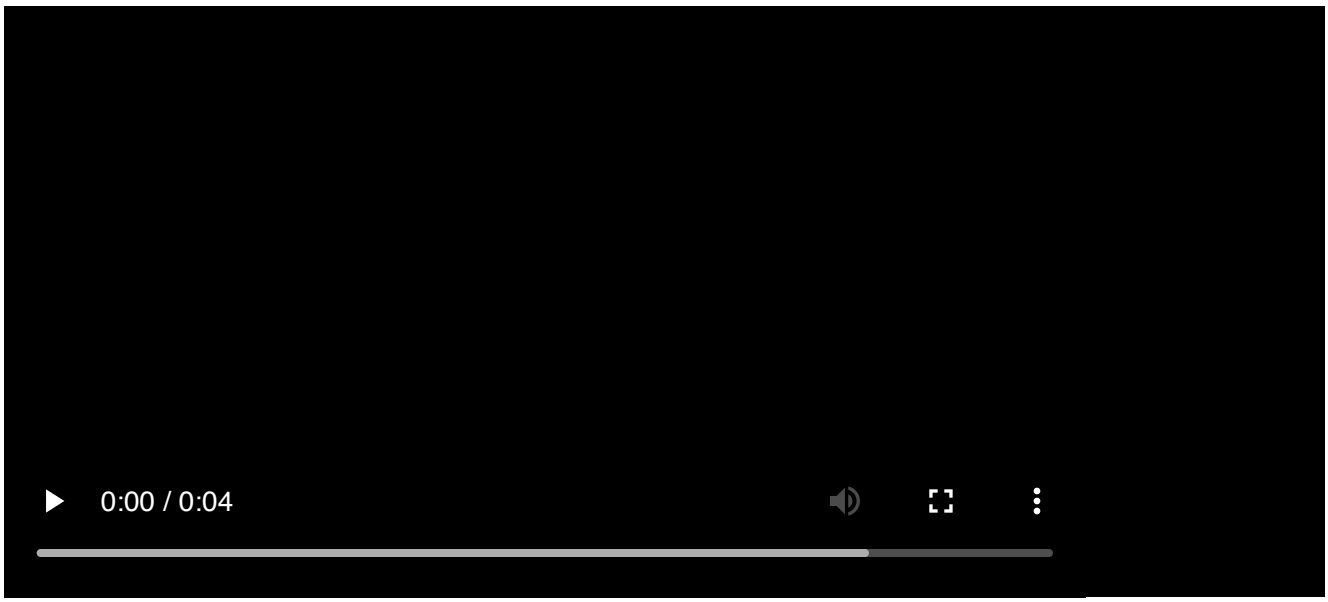
A.2.2.4 Feedback = 0.4

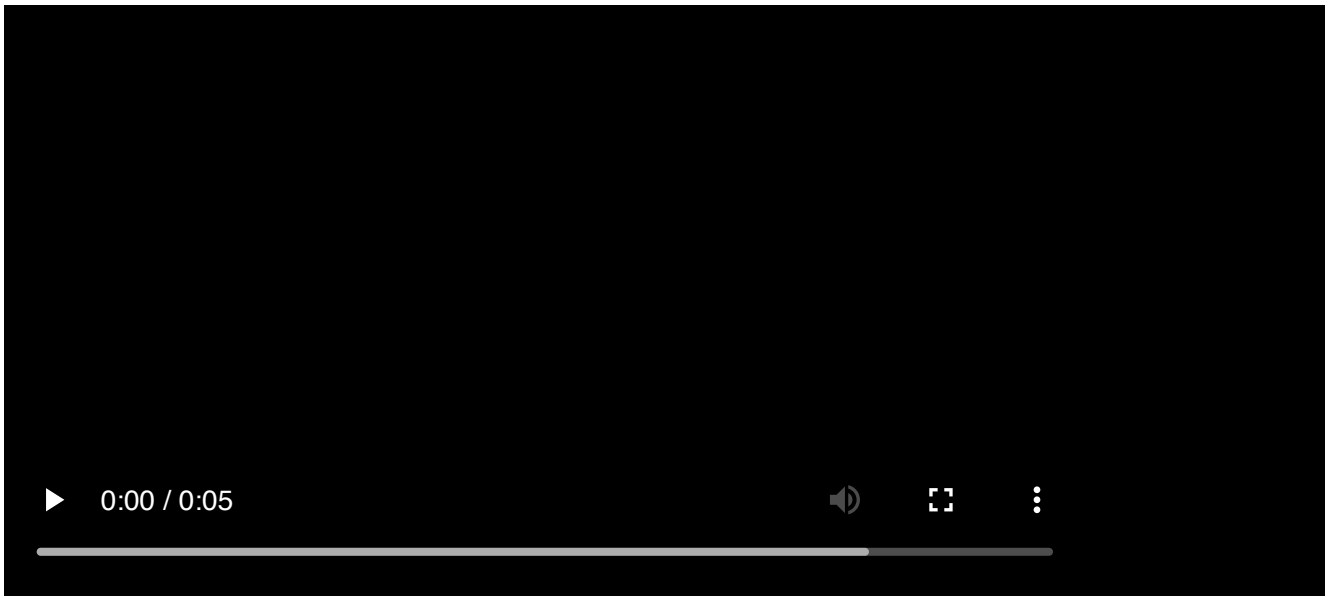




- The ω_i is now the same sign, rather than flipping

A.2.2.5 Animations





A.3 Outcomes

- It seems like we have been successful in creating the asymmetric phase profiles and spectra

A.4 To Do

- [x] ~~Repeat these plots~~

B Analytic Project

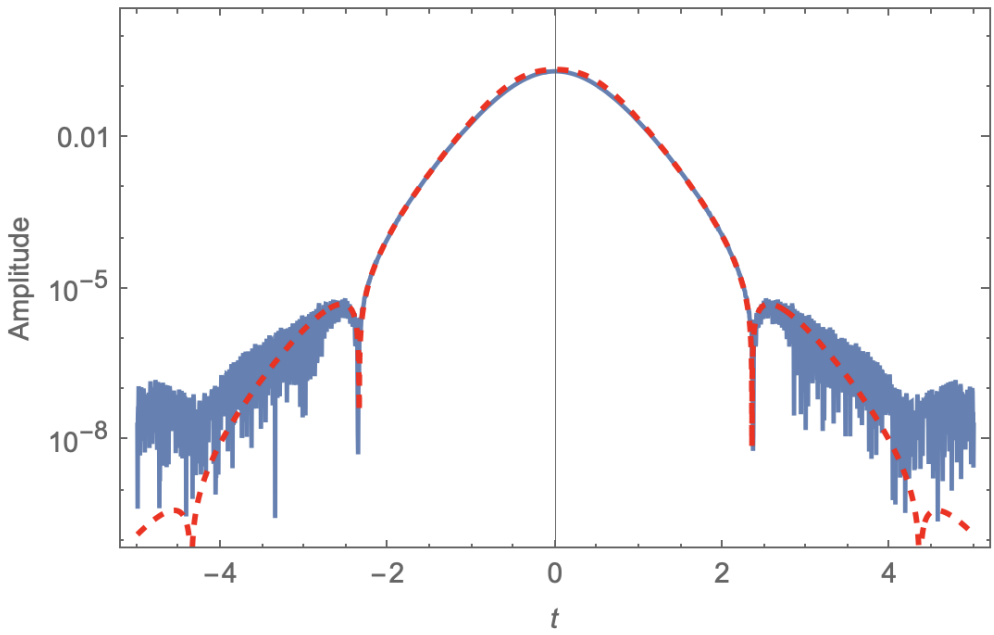
> **Aims**
>
> - [ ] Examine how the difference between the data and ansatz looks near the origin to try and determine the functional form

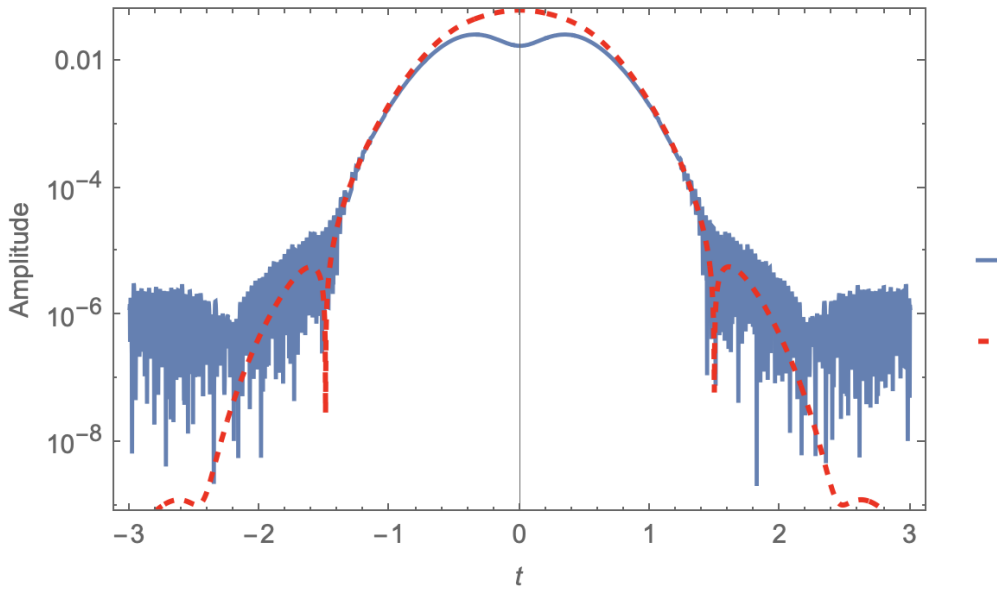
B.1 Notes

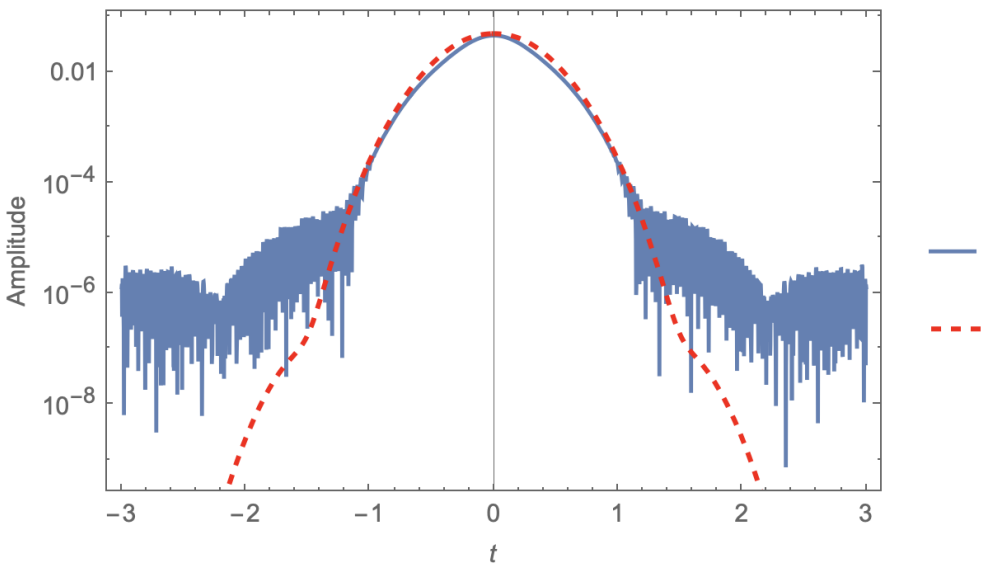
If my previous attempt at fitting a gaussian near the origin to supplement $u^{(0)}$ in the tails is valid, then plotting Long - $u^{(0)}$ should produce a Gaussian shape (or an upside down parabola on a log scale).

B.2 Results

Using `09_difference_220218.nb`:

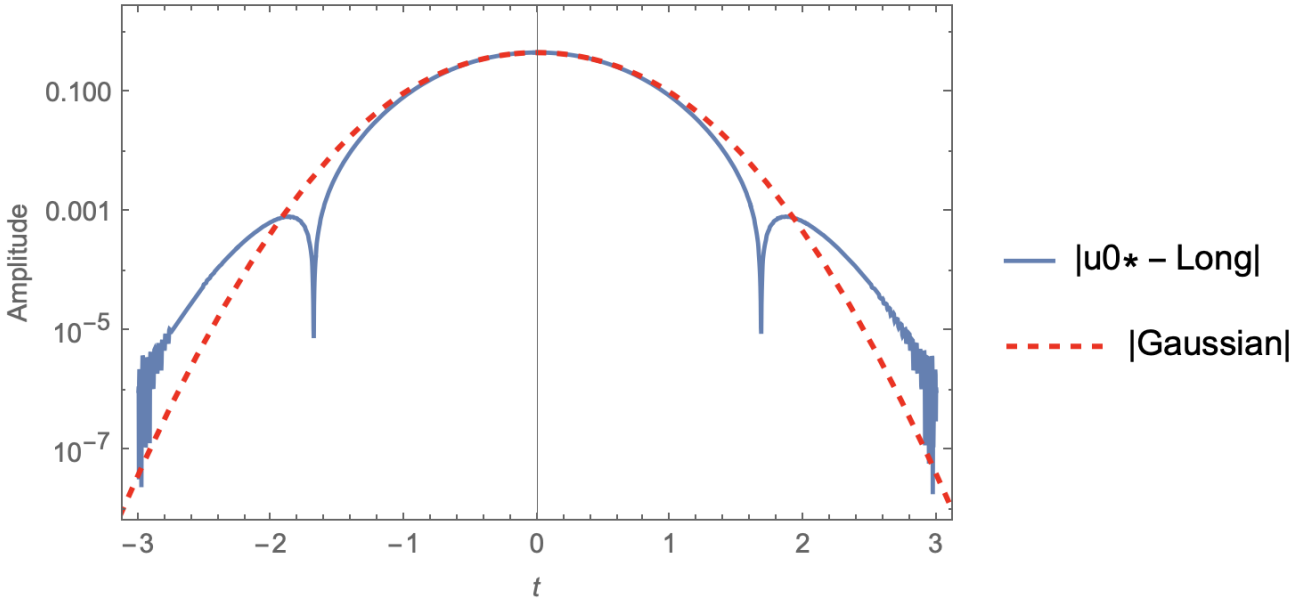






B.2.1 Gaussian

Using the functional from from Logbook_08_220207, we get



where $u^{(0)*}$ is the adjusted function

$$u^{(0)*} = \frac{u^{(0)}}{1 + \alpha e^{-x^2}}$$

B.3 Outcomes

B.4 To Do

- [x] ~~Look at the log shapes of the~~ $\mathrm{Long} - \mathrm{u}^{(\mathrm{k})}$
- [x] ~~Look at~~ $u^{(1)}$ ~~on the log scale~~