MRI Simulator Notes

Liam

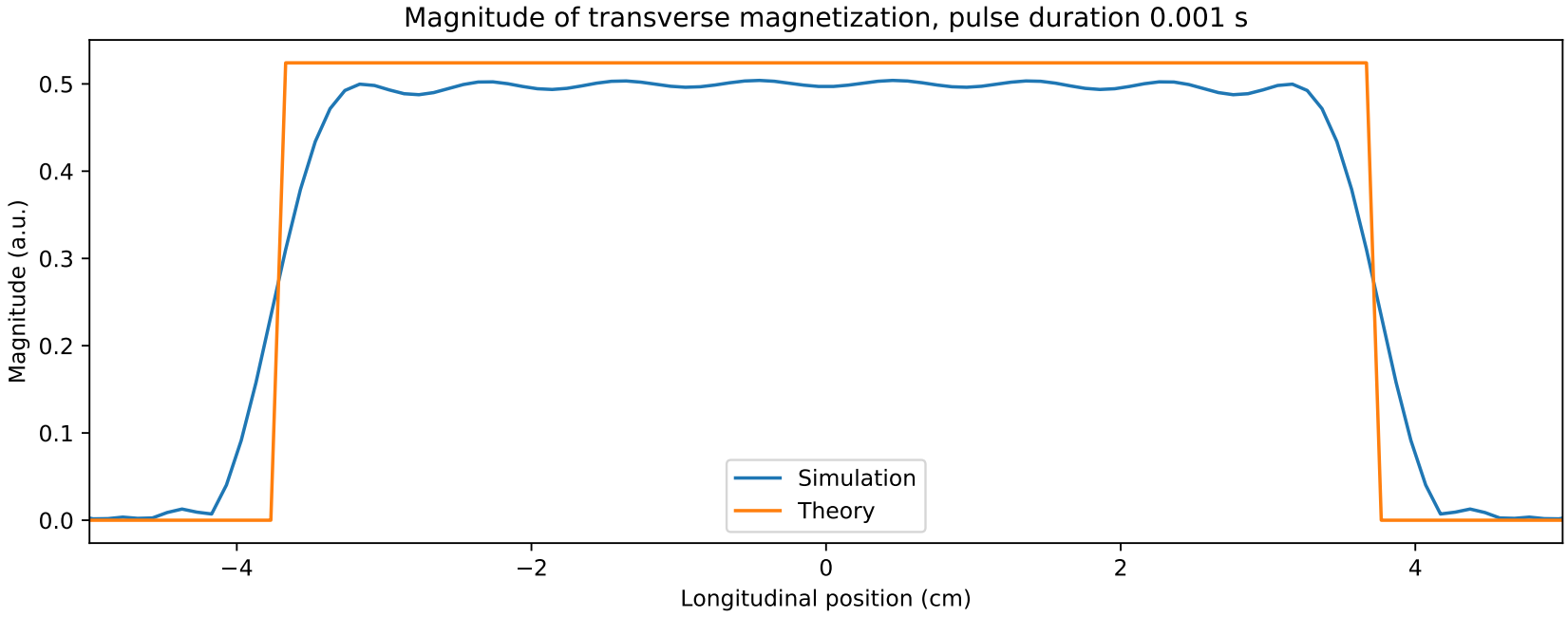
Tuesday 3rd December, 2019

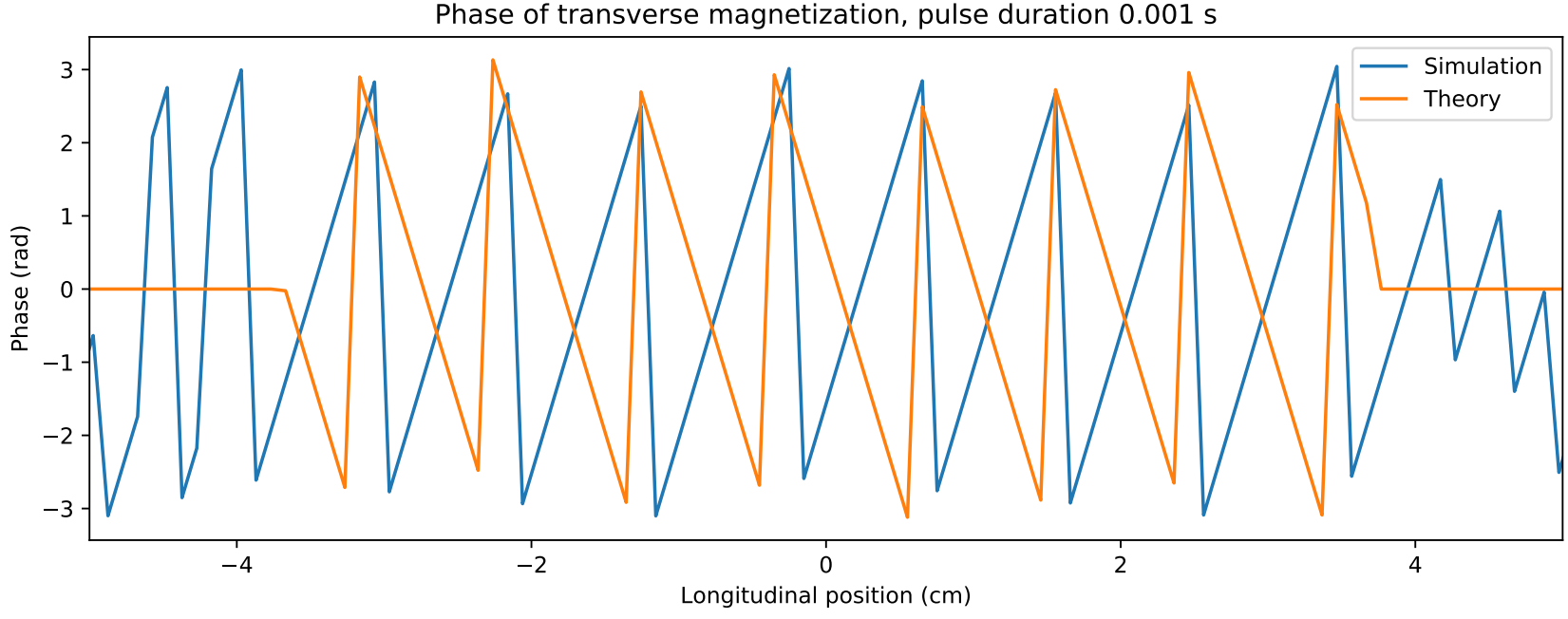
Tasks

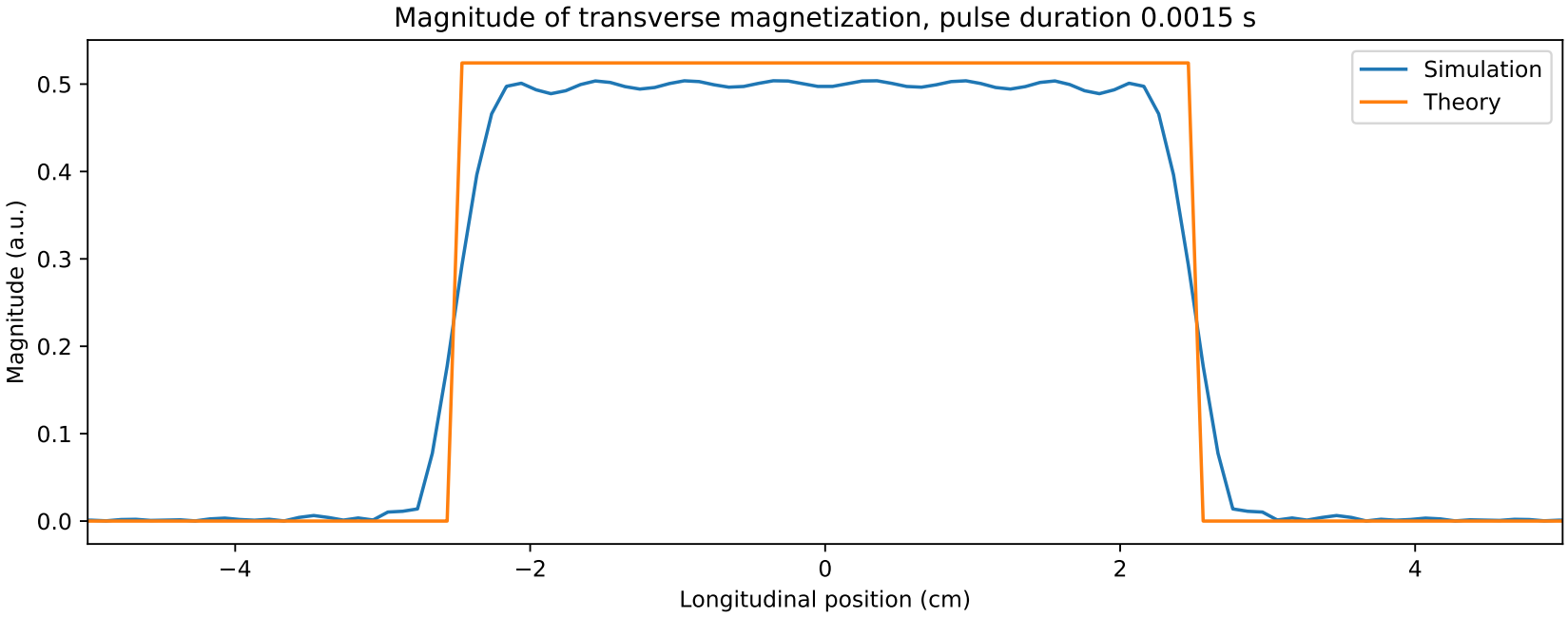
- I tried to verify my excitation routine by doing selective excitation of a slice. I verified the magnitude of the transverse magnetization profile previously; I had not verified the phase.

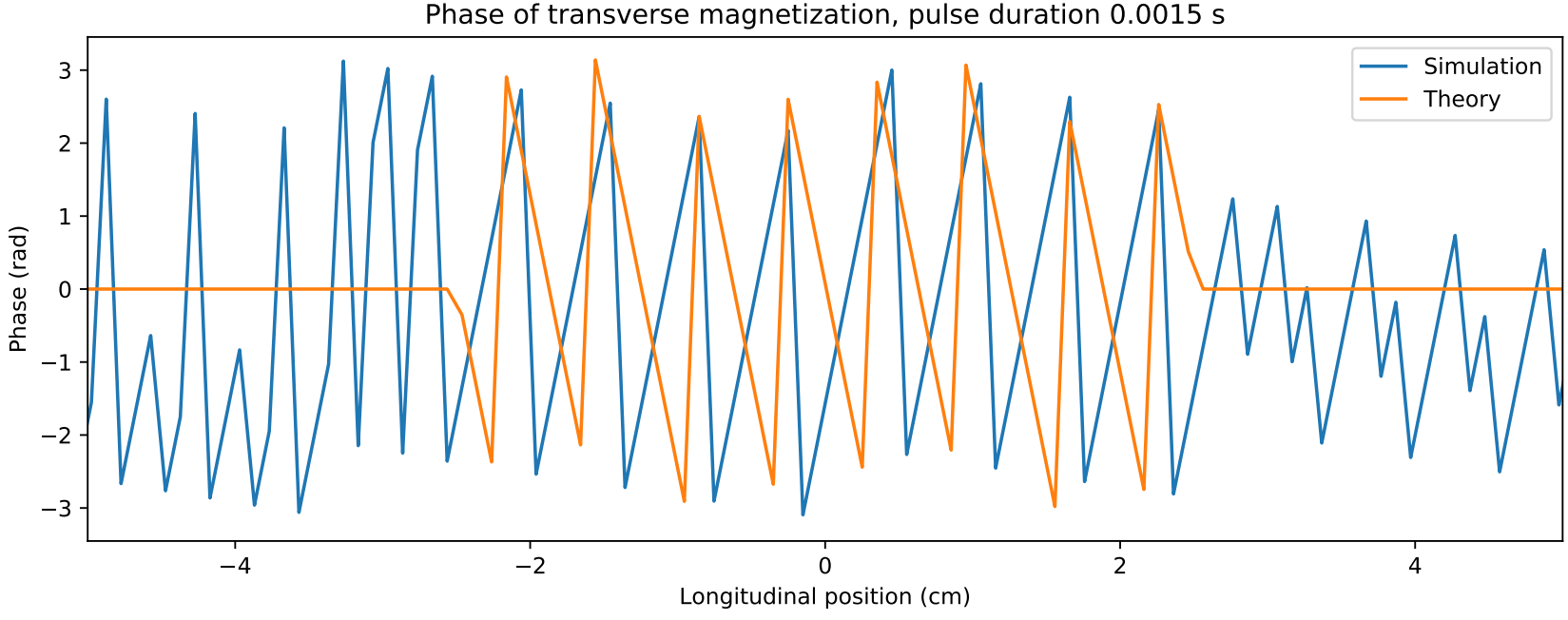
Verifying excitation

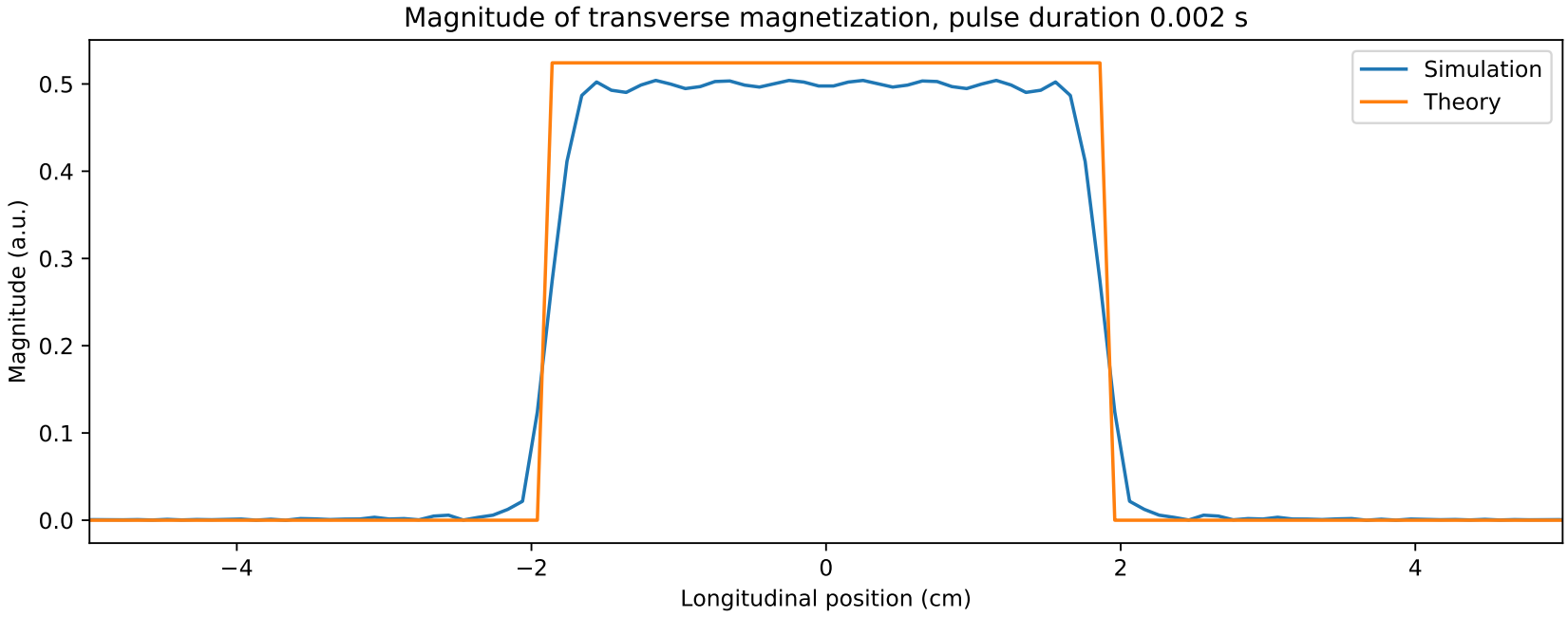
- I simulated selective slice excitation with more realistic parameters, e.g. using the actual gyromagnetic ratio of H-1.
- I set the amplitude of the excitation pulse to induce a tip angle of 30 degrees (0.52 radians).
- I changed the manner in which I computed the theory prediction from the small tip angle solution.
- The next three figures show the simulation and theory transverse magnetization profiles for a sinc pulse of duration 1.0 ms, 1.5 ms, and 2.0 ms.

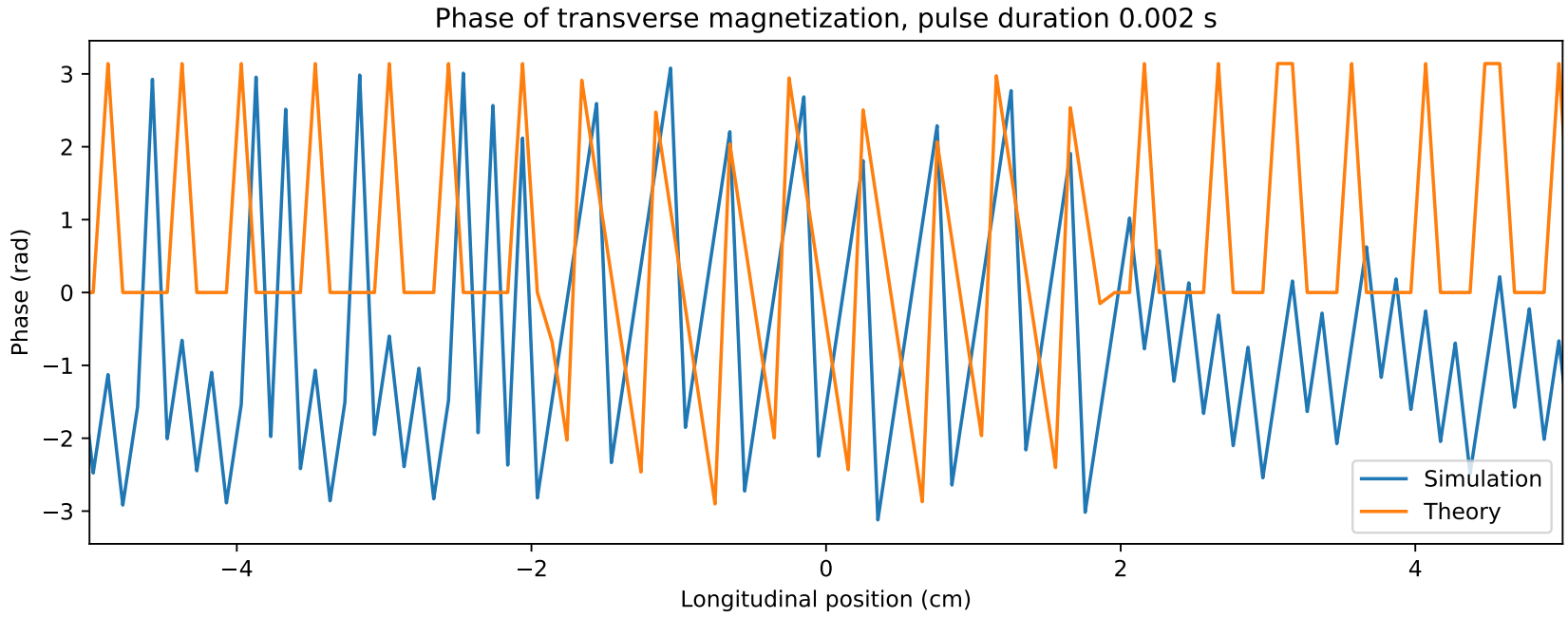

Magnitude of transverse magnetization, pulse duration 0.001 s
Magnitude (a.u.)
0.0
0.1
0.2
0.3
0.4
0.5
−4
−2
0
2
4
Longitudinal position (cm)
Simulation
Theory


Phase of transverse magnetization, pulse duration 0.001 s
Phase (rad)
−3
−2
−1
0
1
2
3
−4
−2
0
2
4
Longitudinal position (cm)
Simulation
Theory

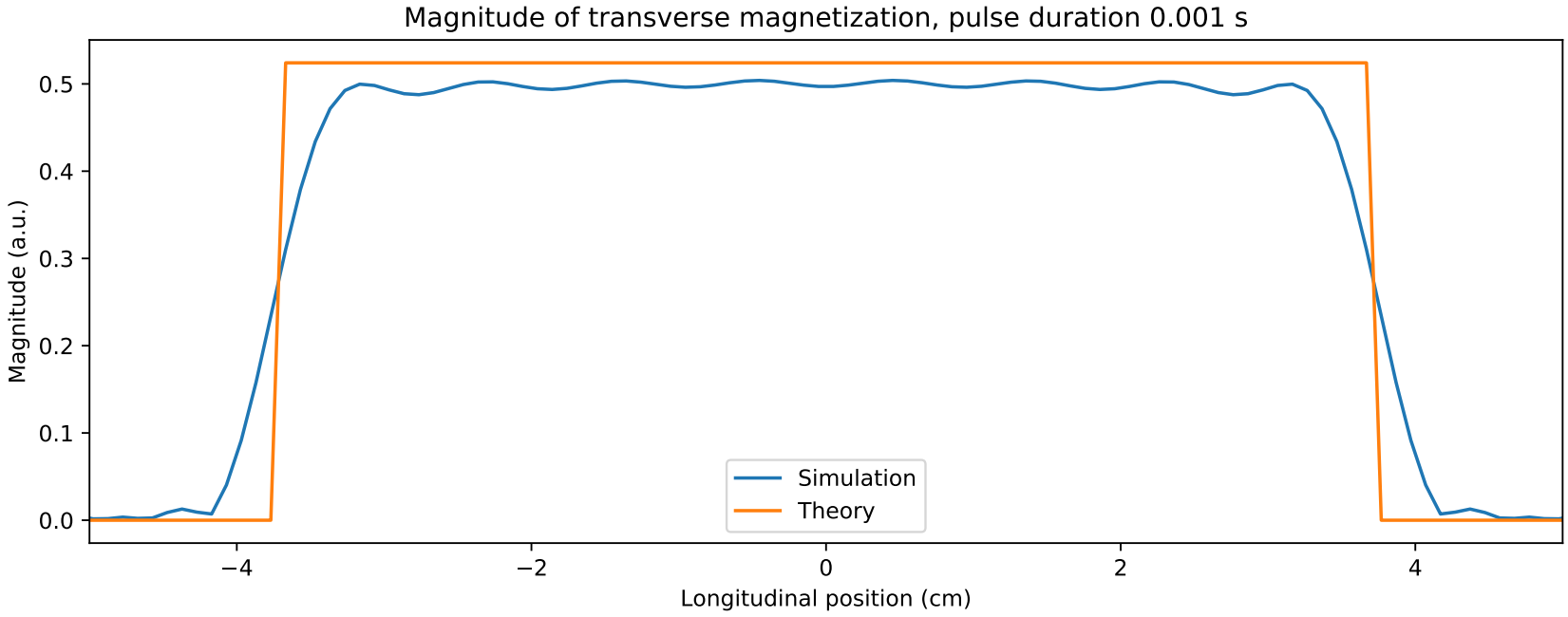

Magnitude of transverse magnetization, pulse duration 0.0015 s
Simulation
Theory
Magnitude (a.u.)
0.0
0.1
0.2
0.3
0.4
0.5
−4
−2
0
2
4
Longitudinal position (cm)


Phase of transverse magnetization, pulse duration 0.0015 s
Simulation
Theory
Phase (rad)
3
2
1
0
−1
−2
−3
−4
−2
0
2
4
Longitudinal position (cm)


Magnitude of transverse magnetization, pulse duration 0.002 s
Simulation
Theory
Magnitude (a.u.)
0.0
0.1
0.2
0.3
0.4
0.5
−4
−2
0
2
4
Longitudinal position (cm)


Phase of transverse magnetization, pulse duration 0.002 s
Simulation
Theory
Phase (rad)
−3
−2
−1
0
1
2
3
−4
−2
0
2
4
Longitudinal position (cm)

- The phase between theory and simulation disagrees. I do not know why.
- Multiplying the theory phase curves by -1 yields better agreement for the short pulses, but not the longer ones (see figures following).
- I might try verifying my excitation routine in a different manner to see if the problem is with the simulation or my computation of the theory profile.
- It's good to see agreement again in the magnitude profile, at least.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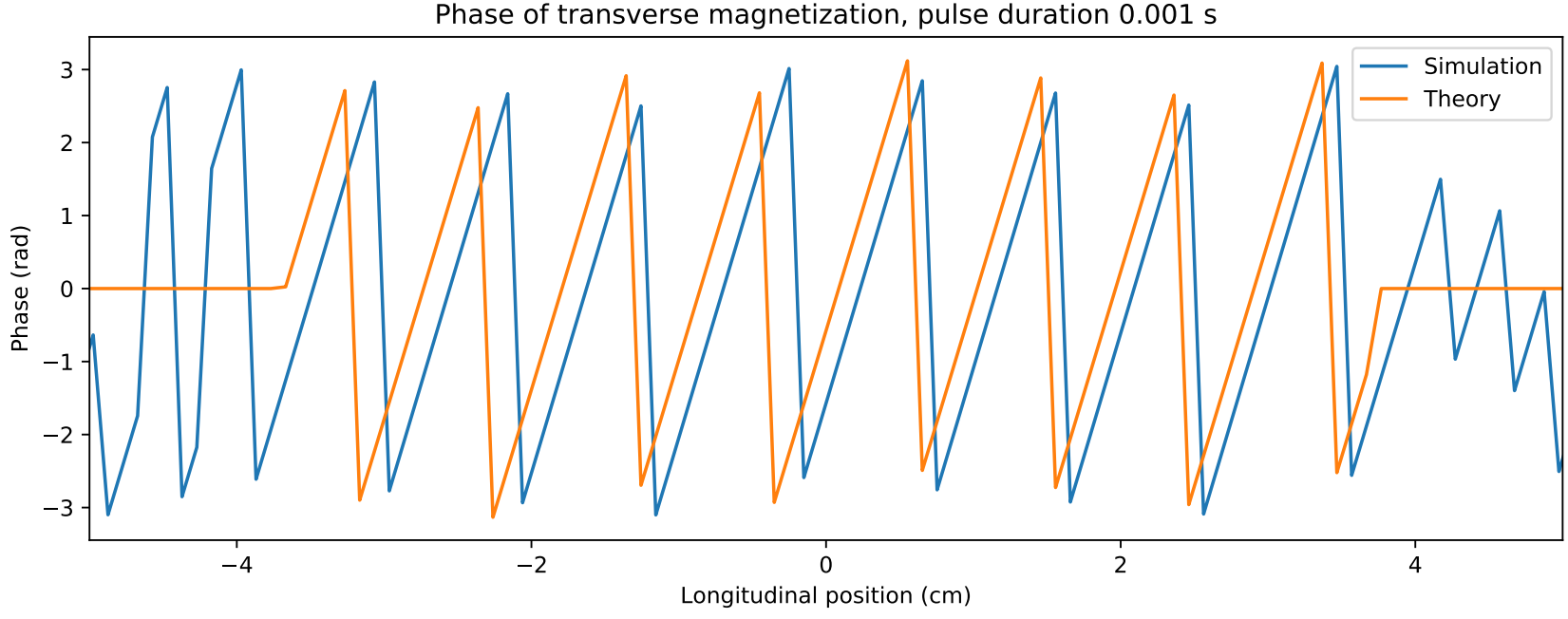
−4
−2
0
2
4
Longitudinal position (cm)
Simulation
Theory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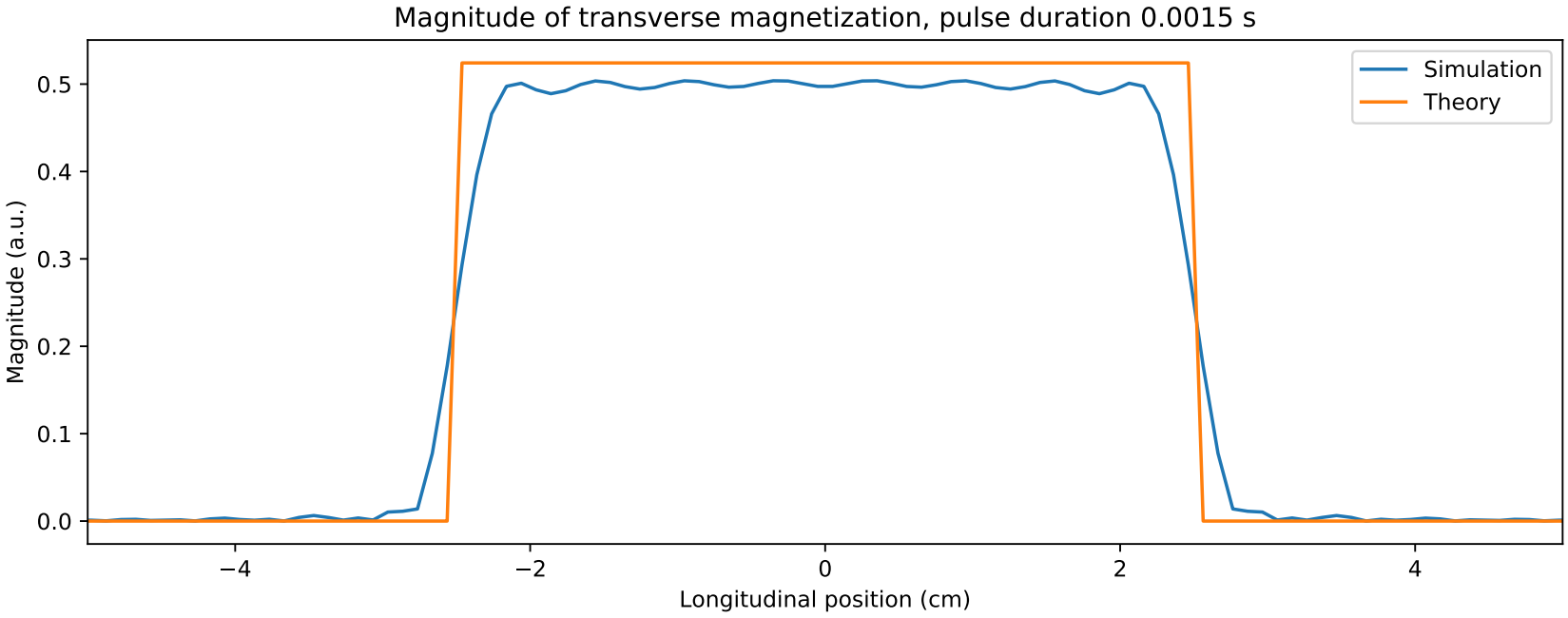
Longitudinal position (cm)
Simulation
Theory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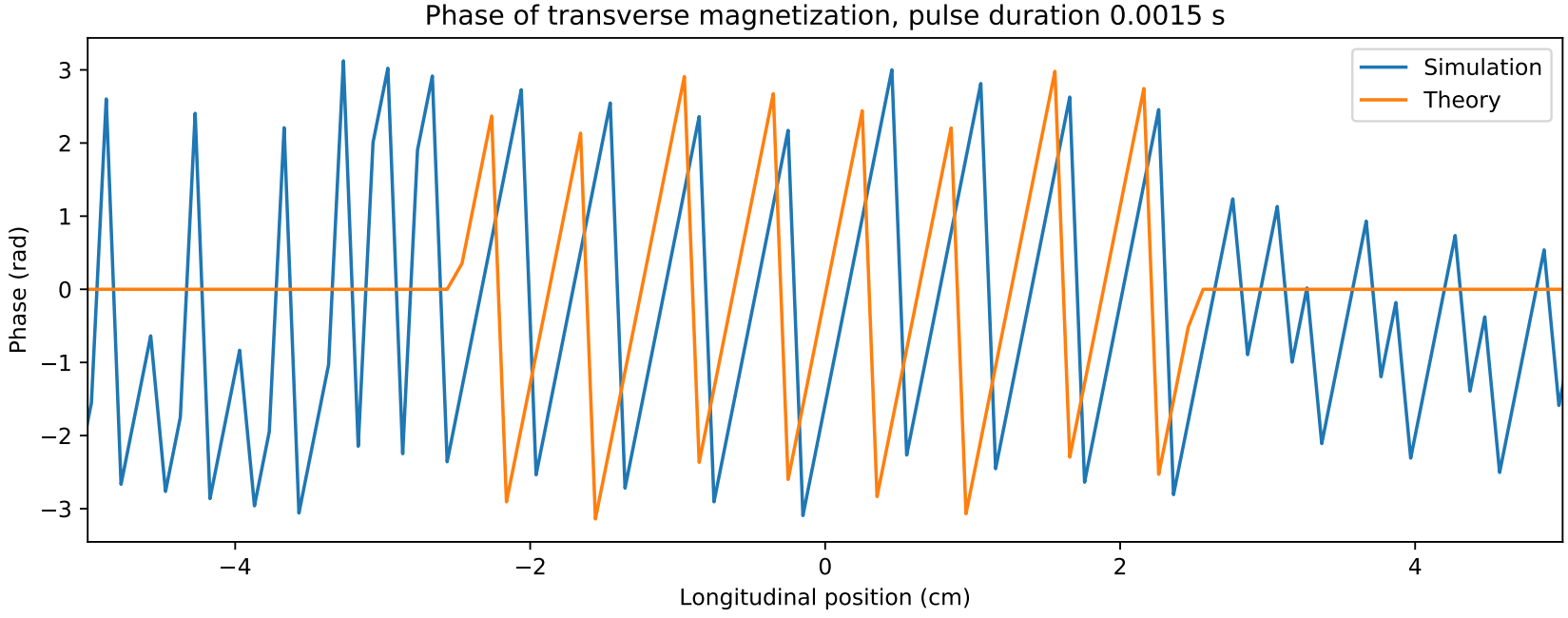
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Theory
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3
2
1
0
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−4
−2
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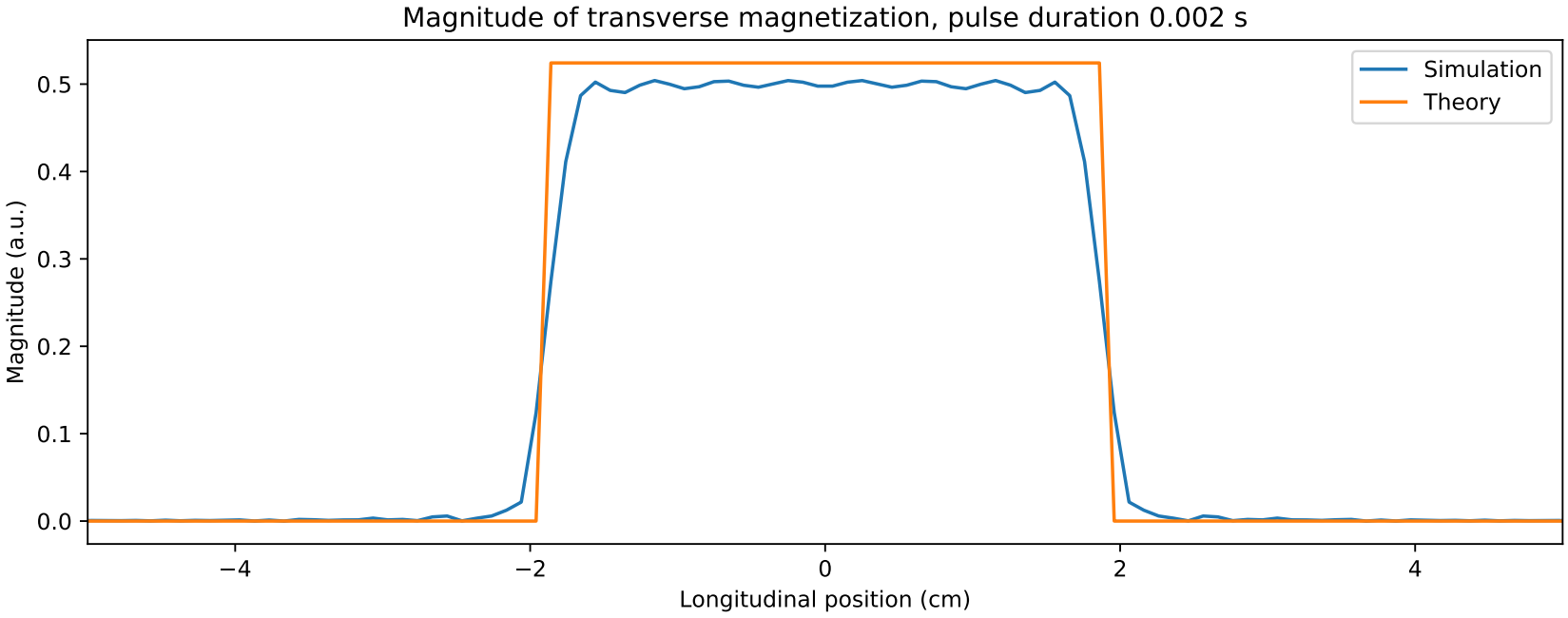
Longitudinal position (cm)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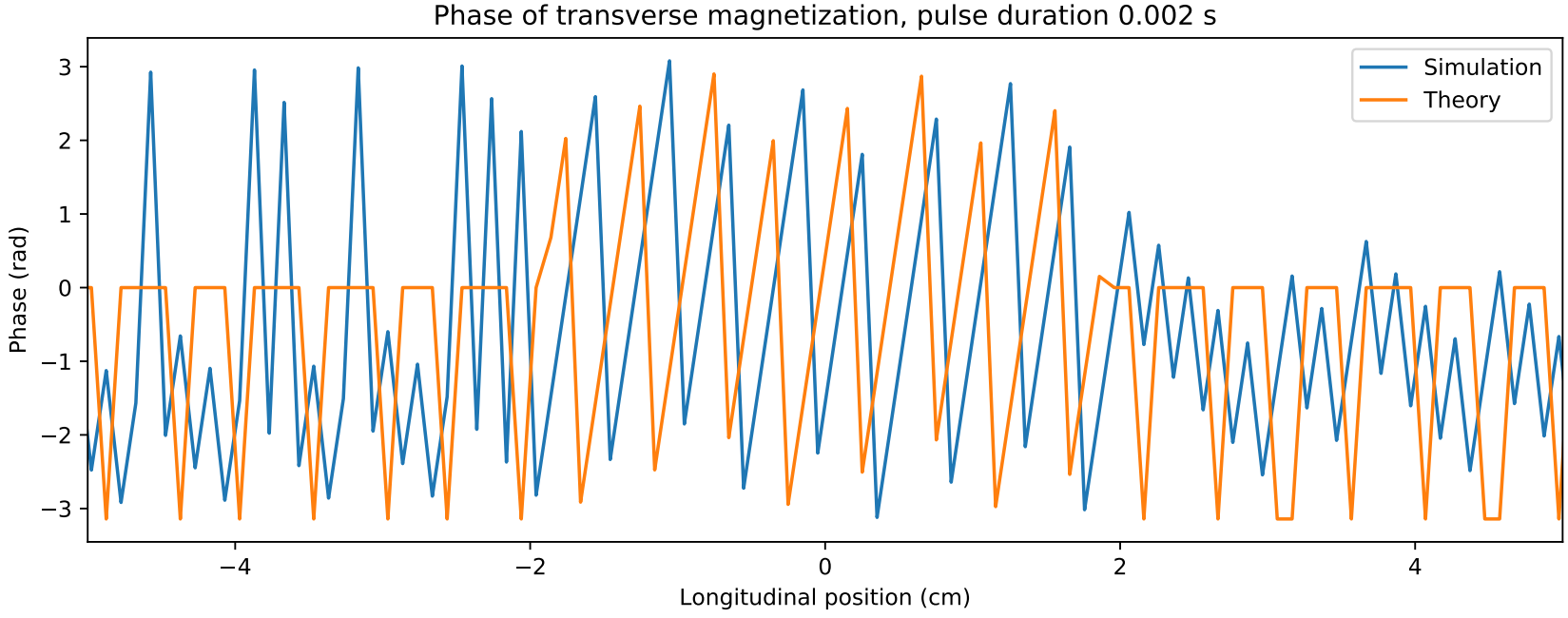
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