As presented at Euro DesignCon 2004 Channel Compliance Testing Utilizing Novel Statistical Eye Methodology

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Presented by
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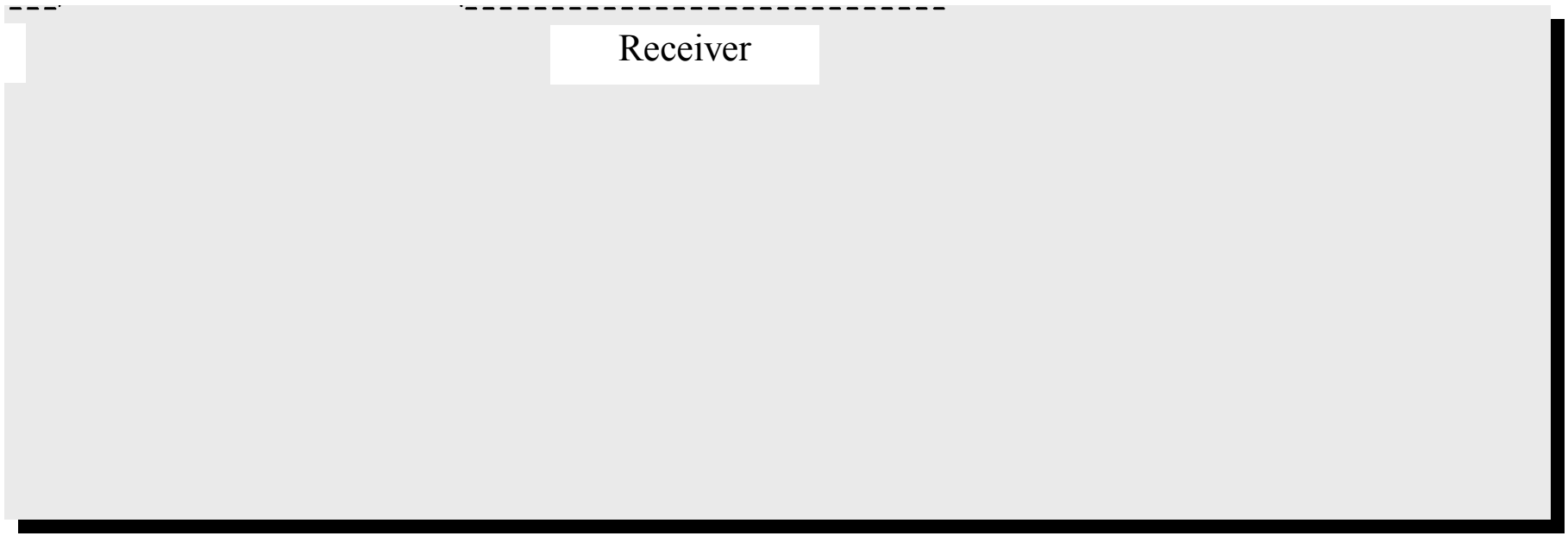
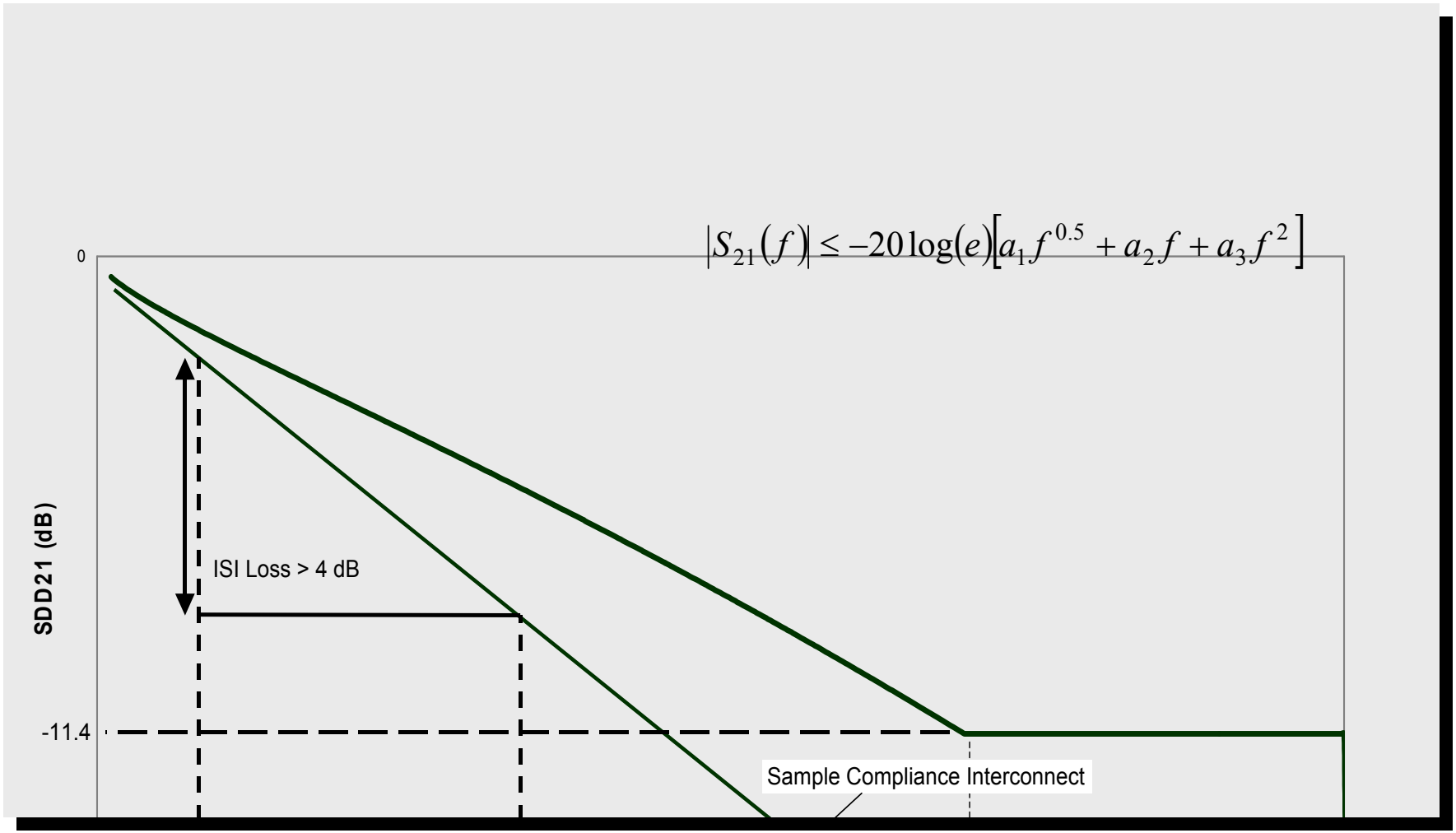
Infineon Technologies

To SAS-2 6Gbps physical WG May 25, 2005

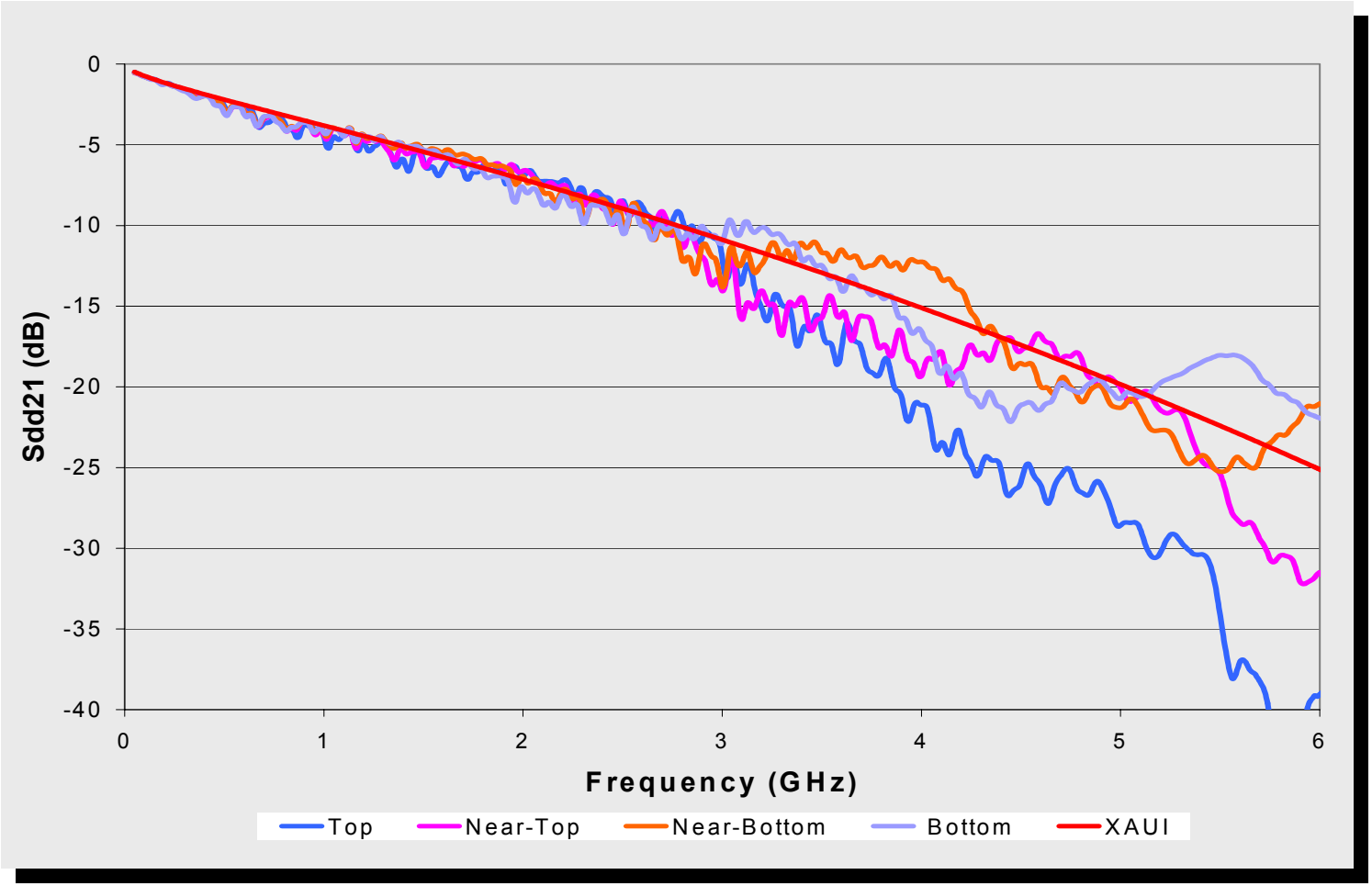
A Simple System Perspective



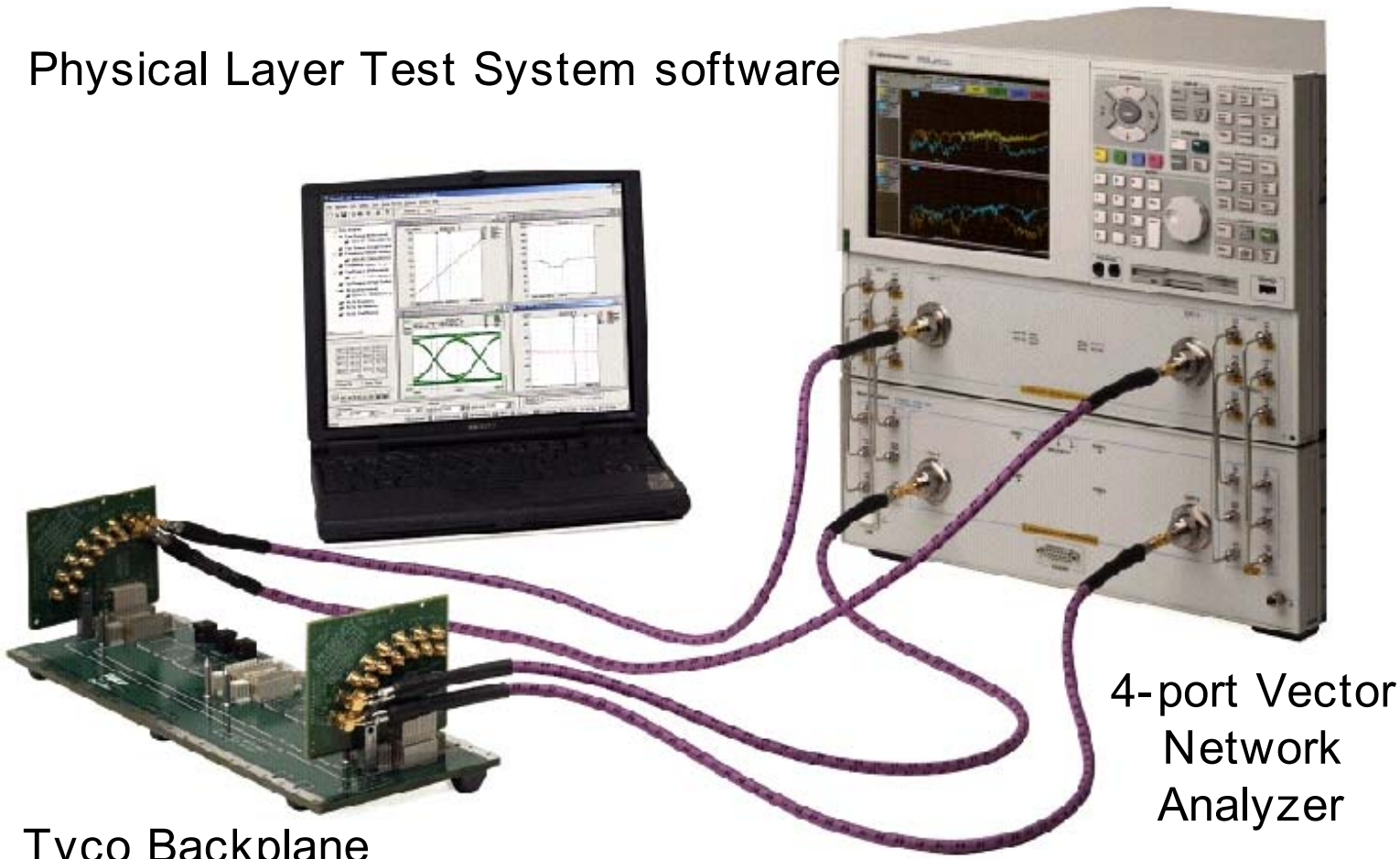
Current Methods



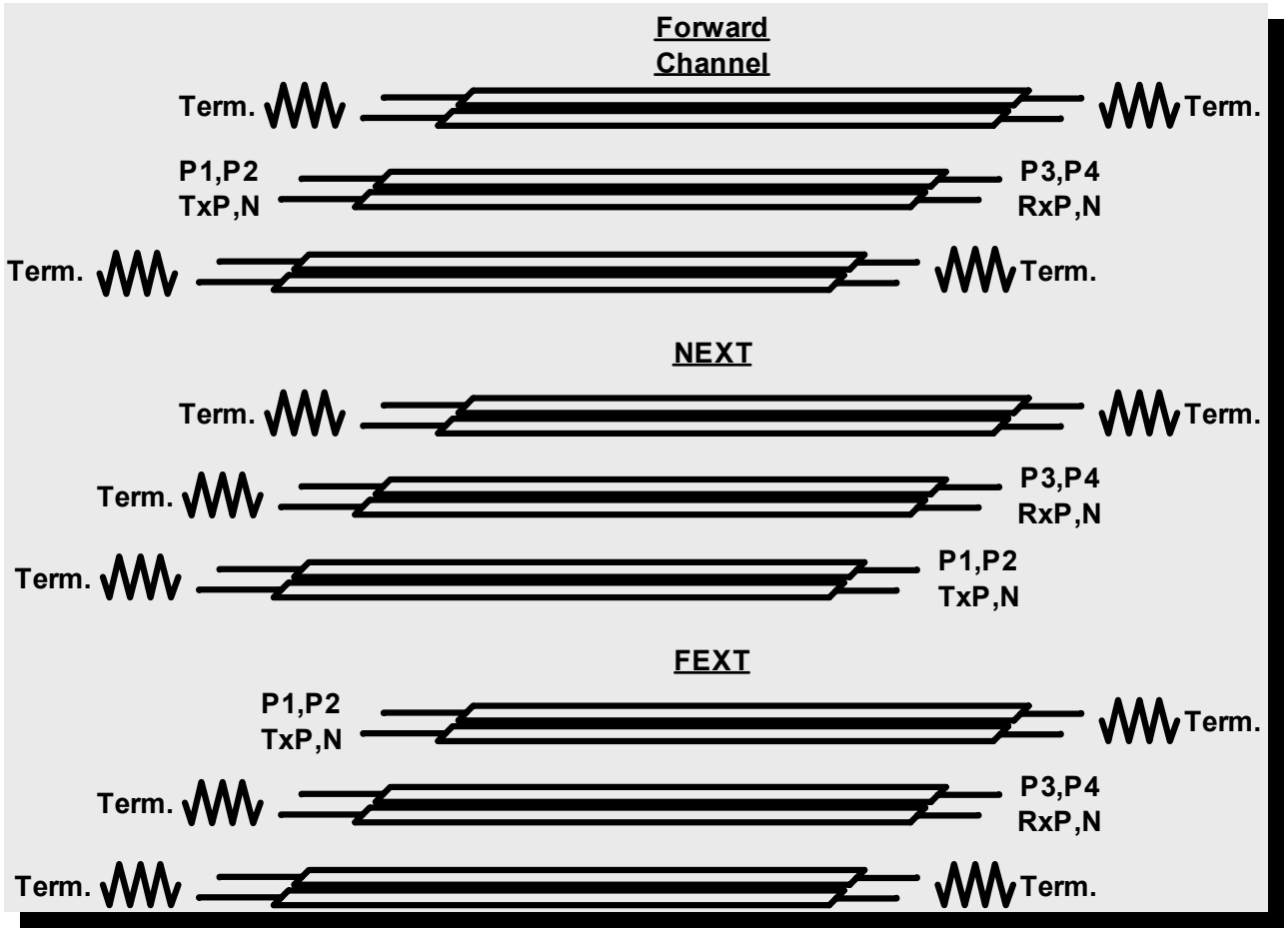
The Real Problem



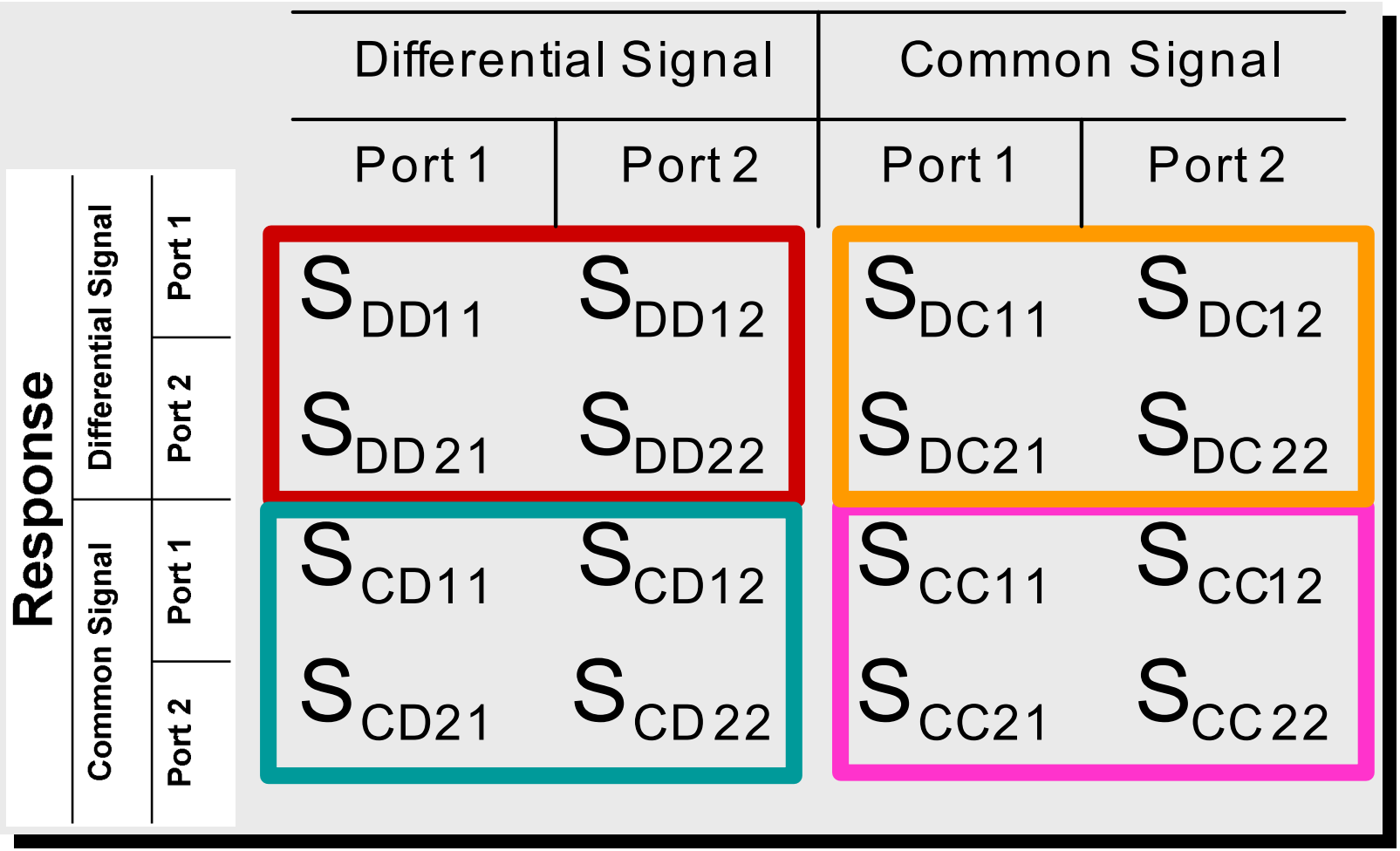
How to Measure The Channel



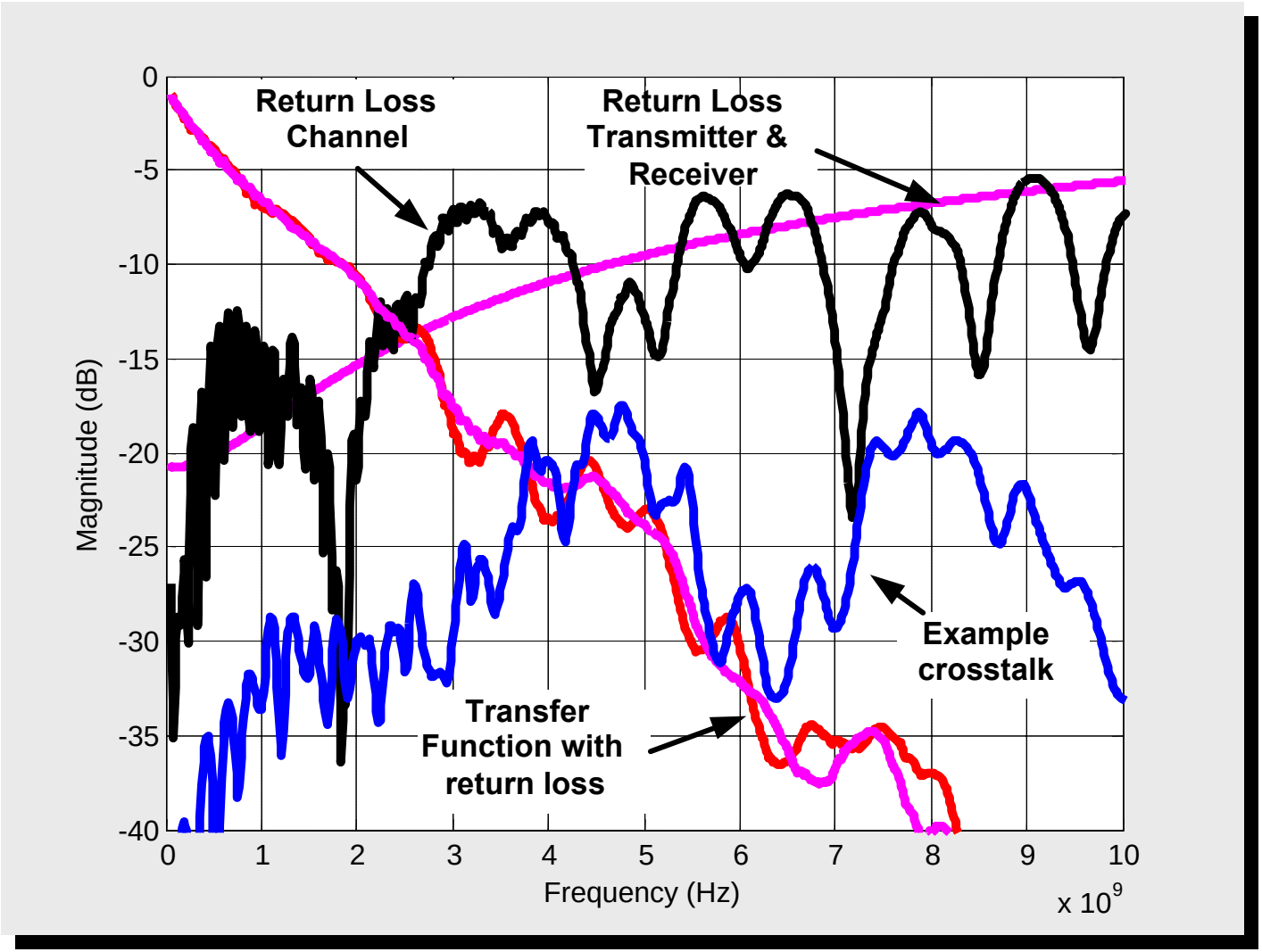
Measuring the whole Channel



Differential Measurements



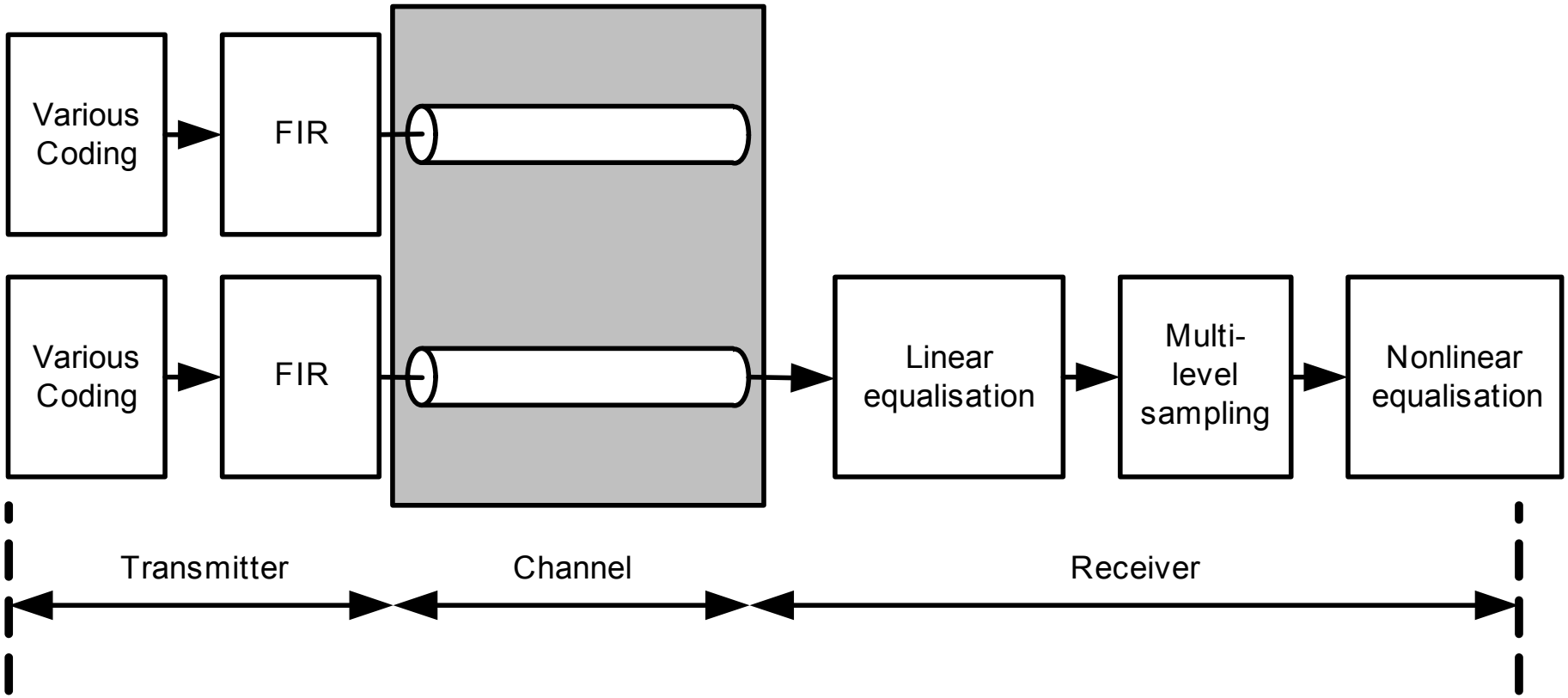
Frequency Response



Analysing Channels

- Must include all channel effects
  - Mode conversions
  - Channel and device return loss
  - Crosstalk
  - Magnitude and phase
  - Return Loss
  - Influence of the pattern/coding
- Must include all jitter and statistical effects

What is the real problem?

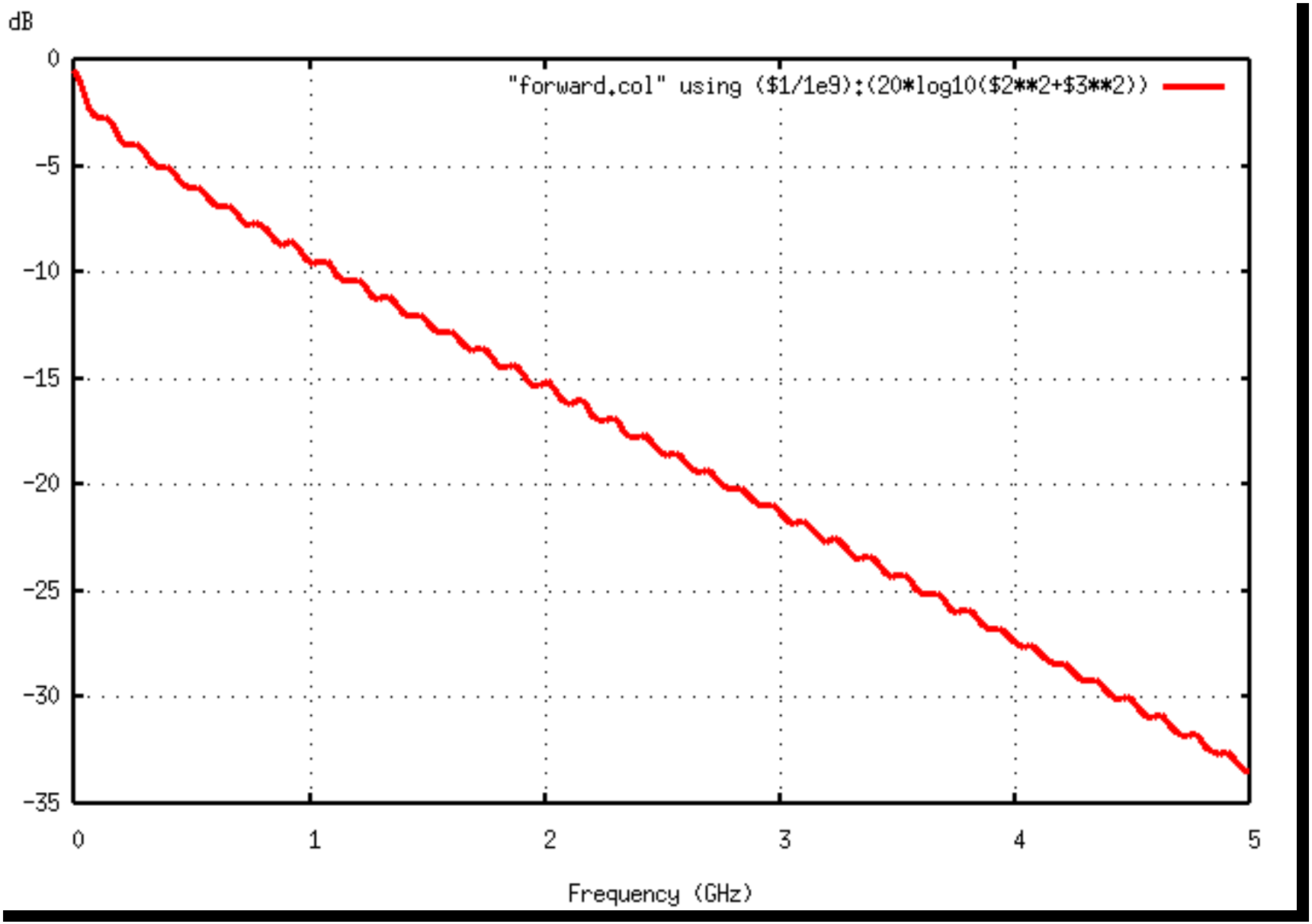


- Correlated and uncorrelated transmitters
- Various Channels incl. FEXT and NEXT
- Various jittered signalling types with common mode noise and return loss

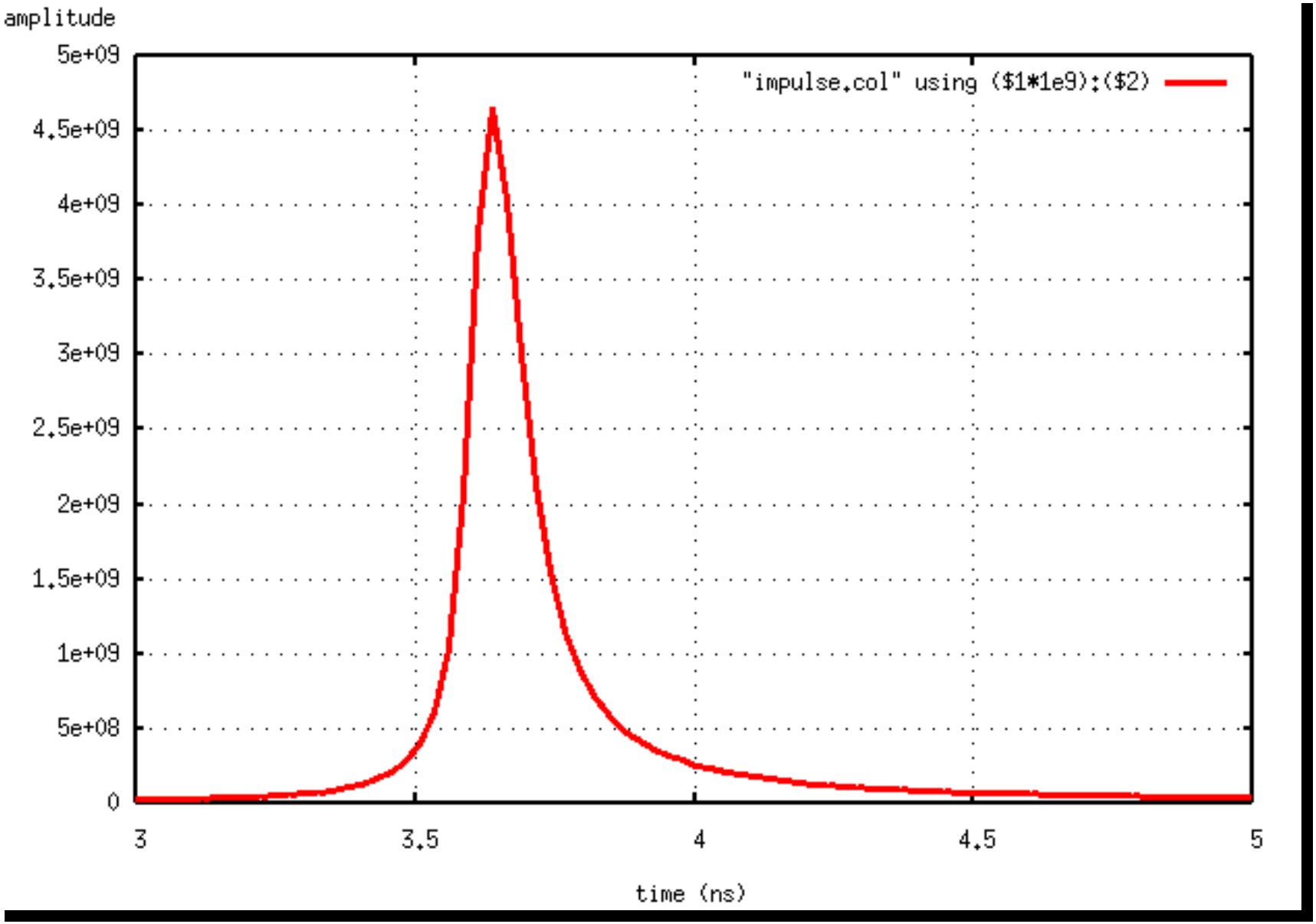
Introducing Stateye

- Following slides introduce the basic theory of stateye based on alpha c++ code and gnuplot running under Linux
- I would suggest that if there are questions, ask while I am presenting. It is important to understand each step

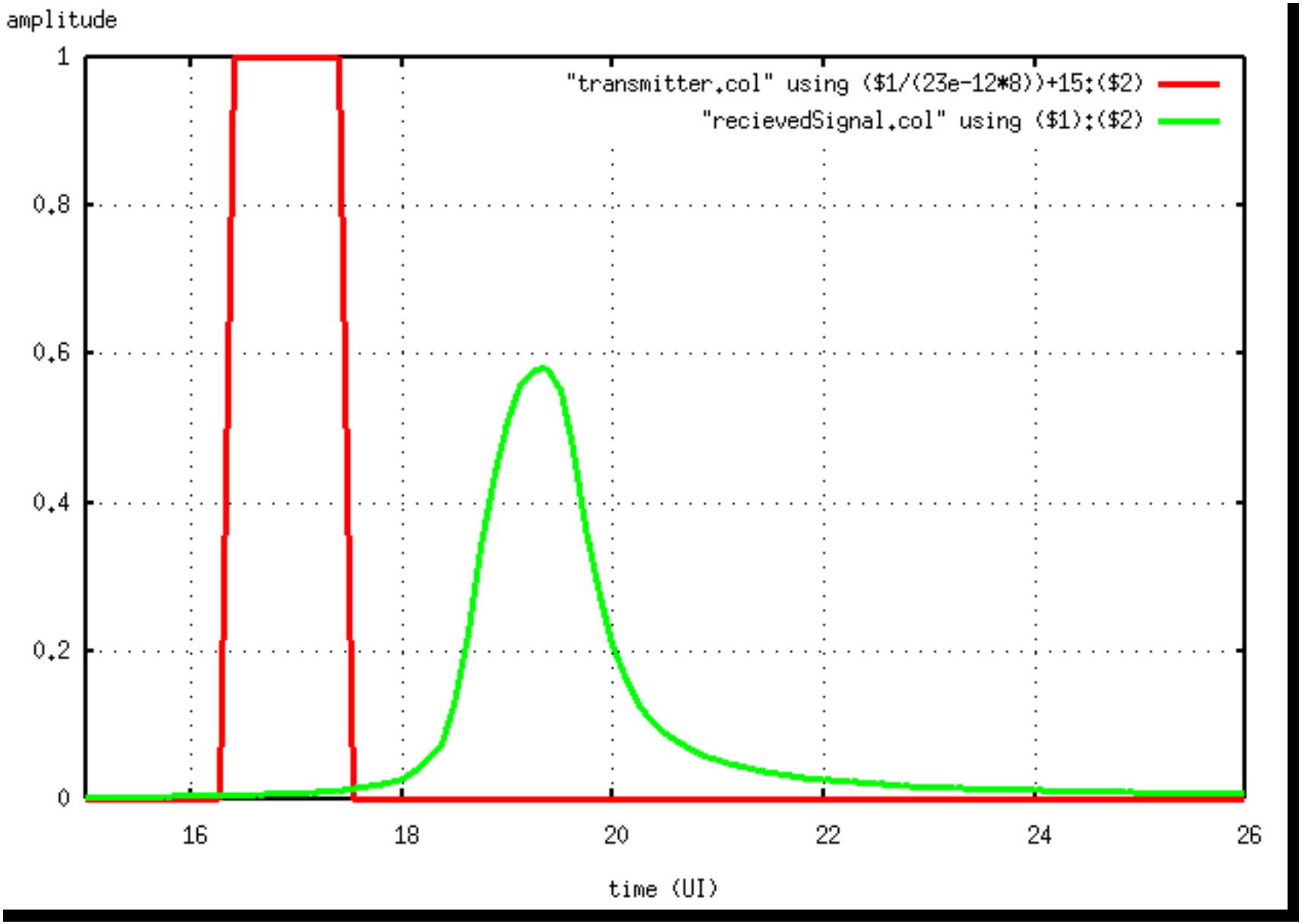
Simple Transfer Function



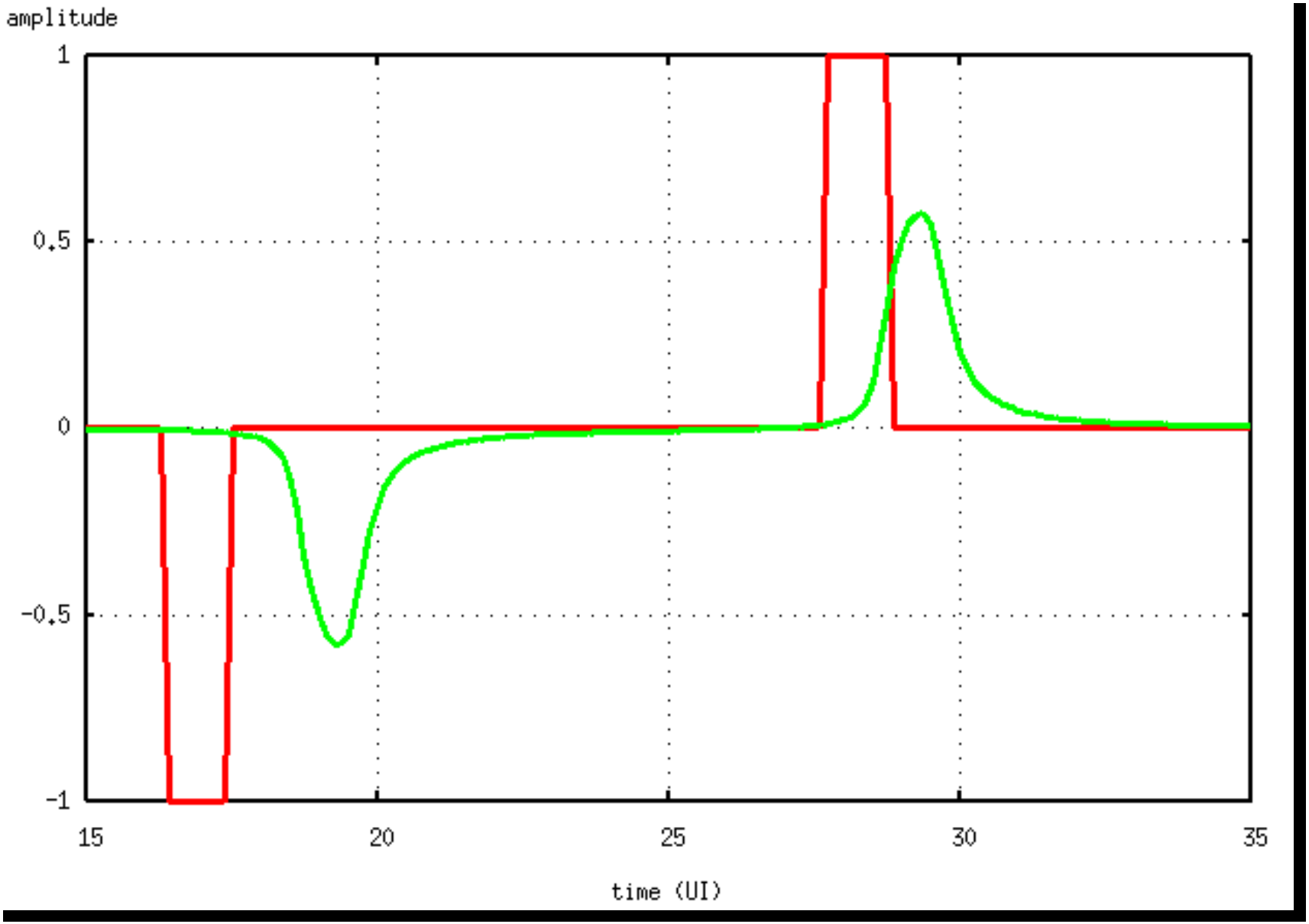
Impulse Response



Pulse Response



Symbols



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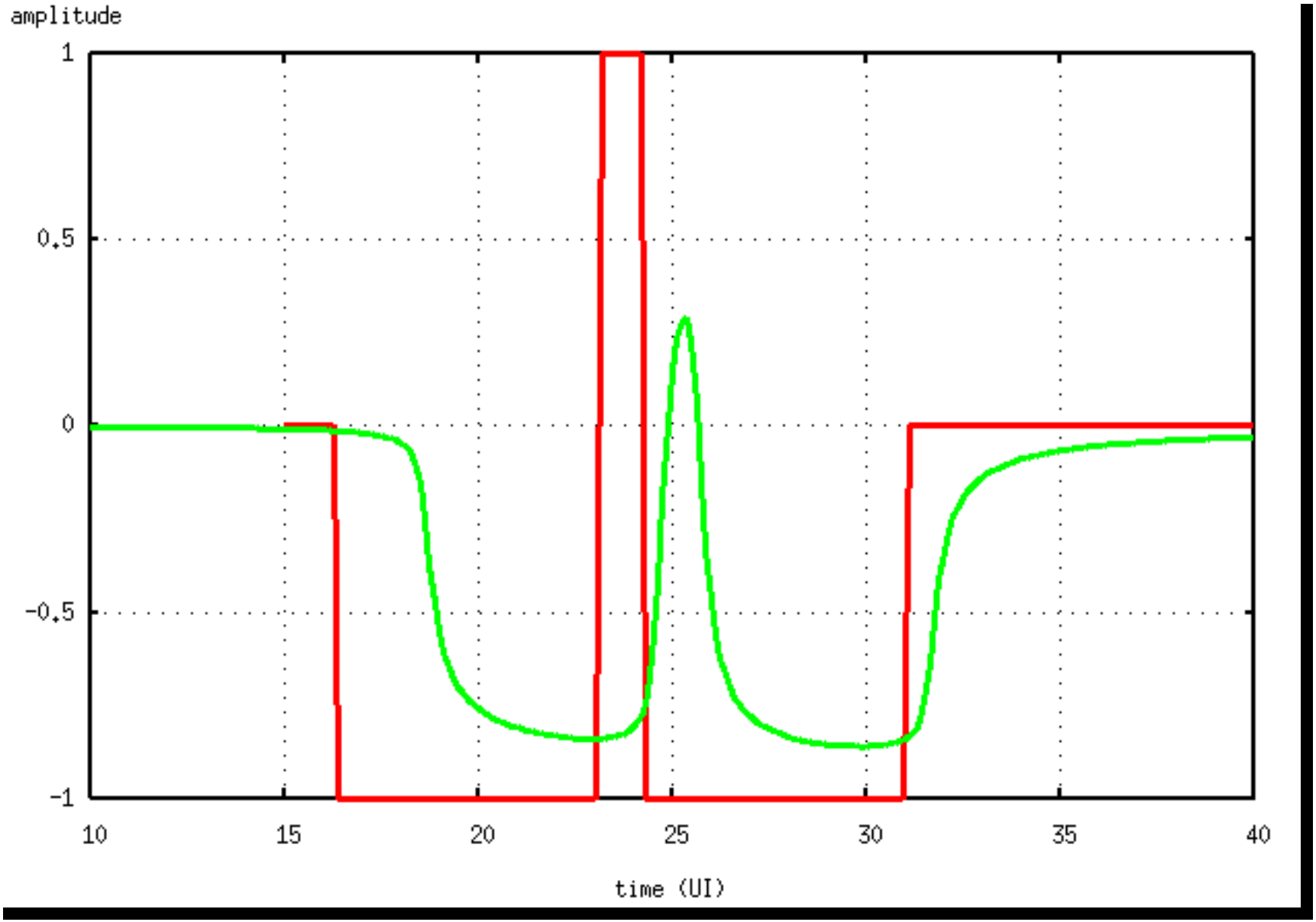
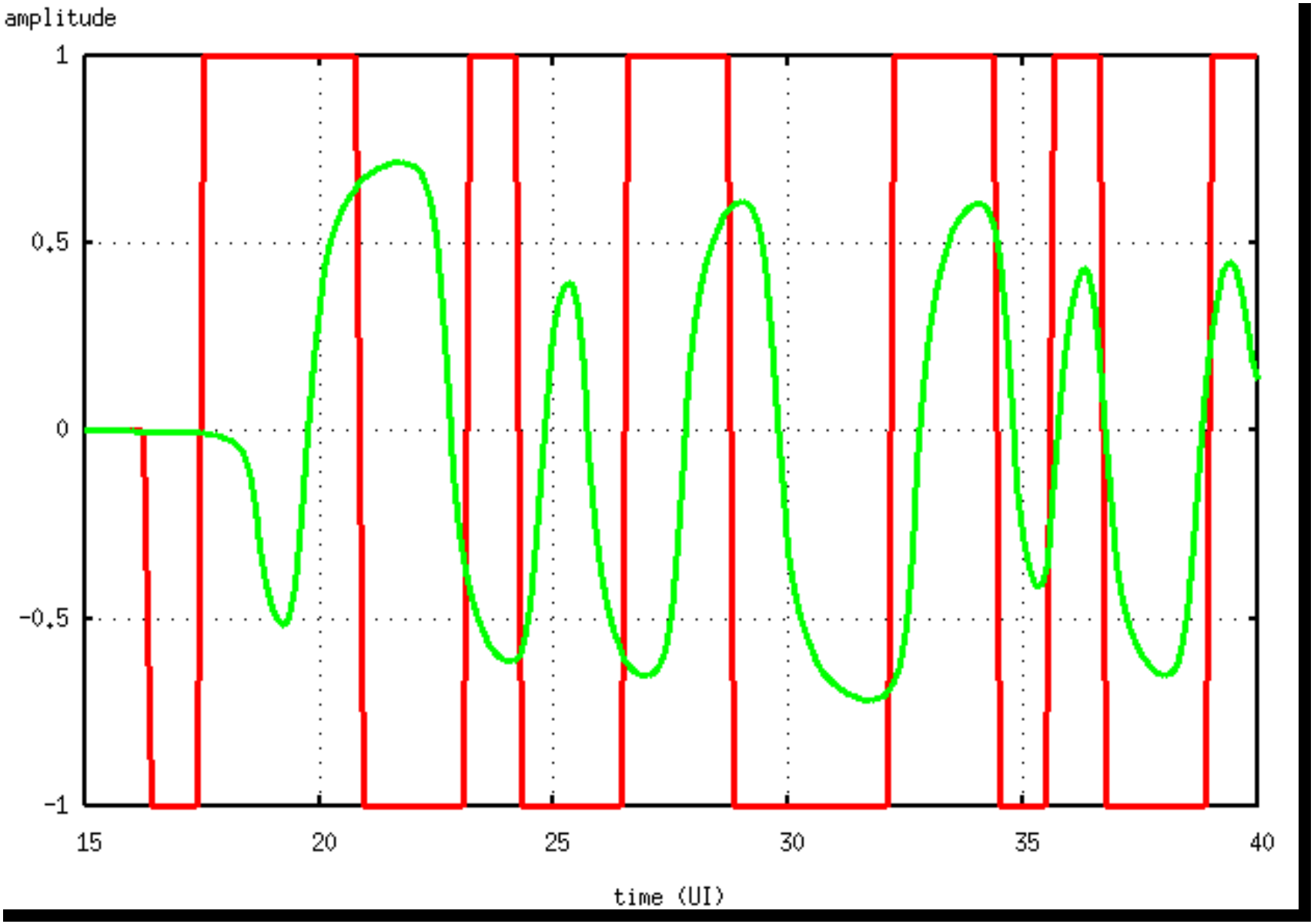
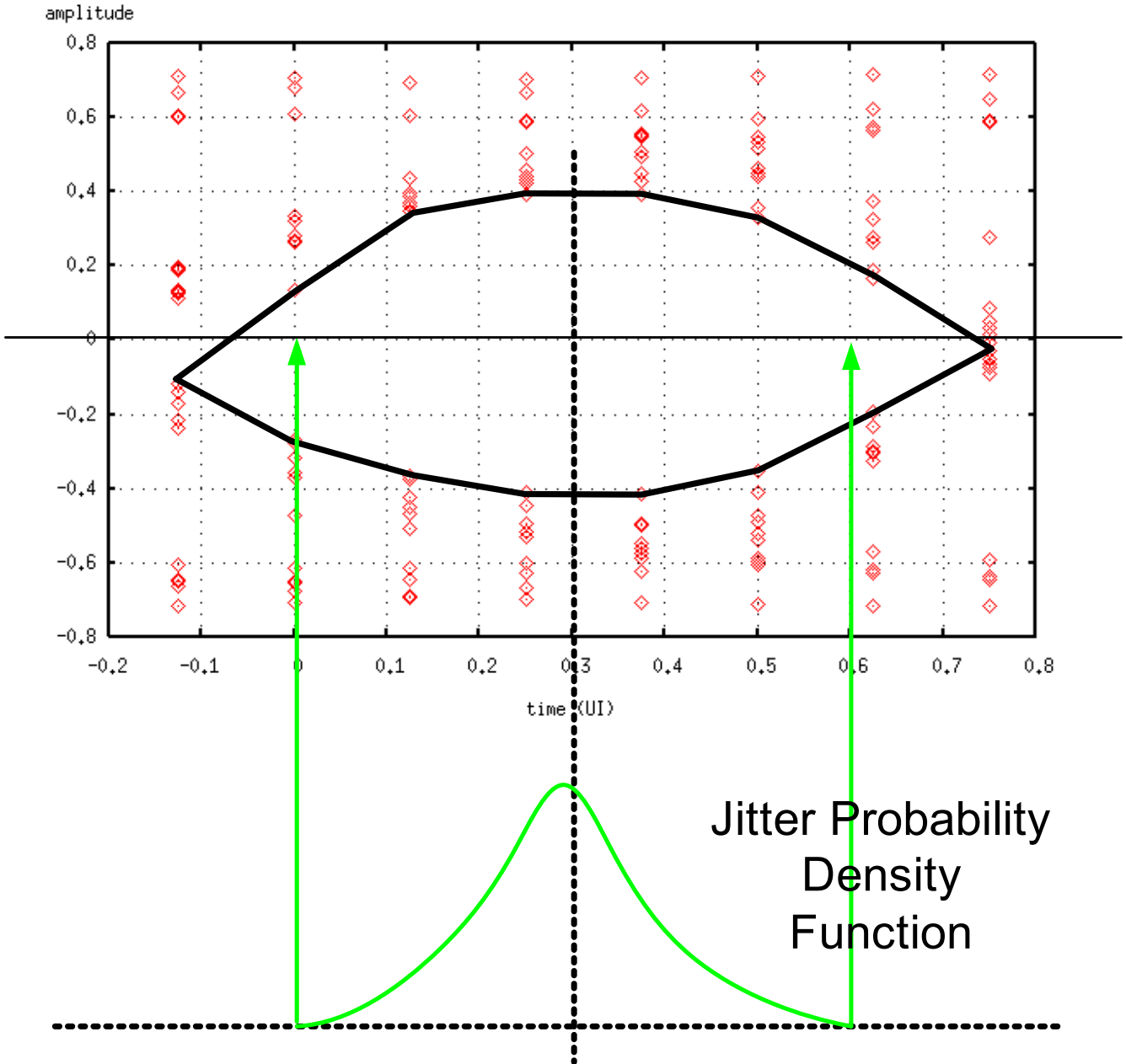


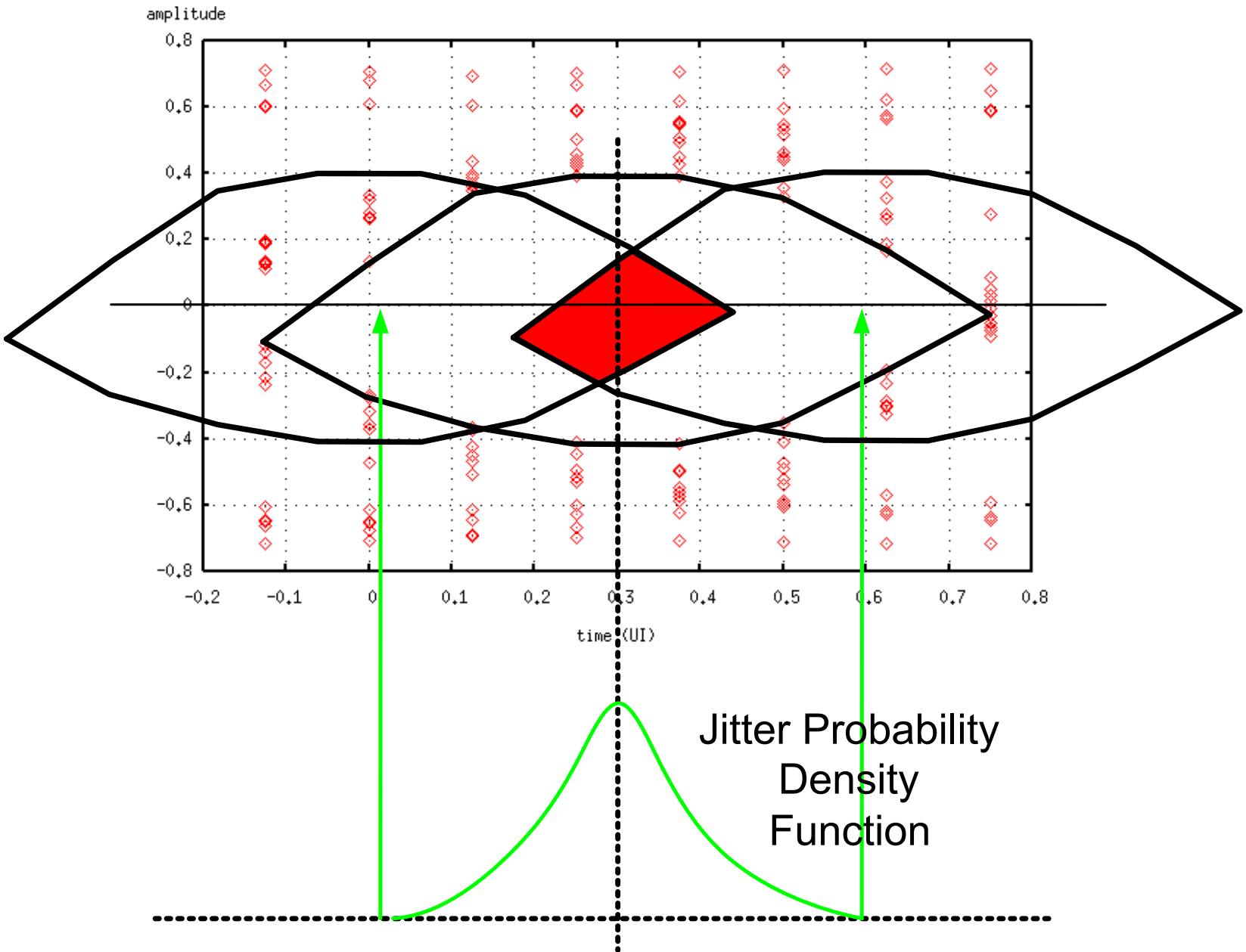
Worst case patterns



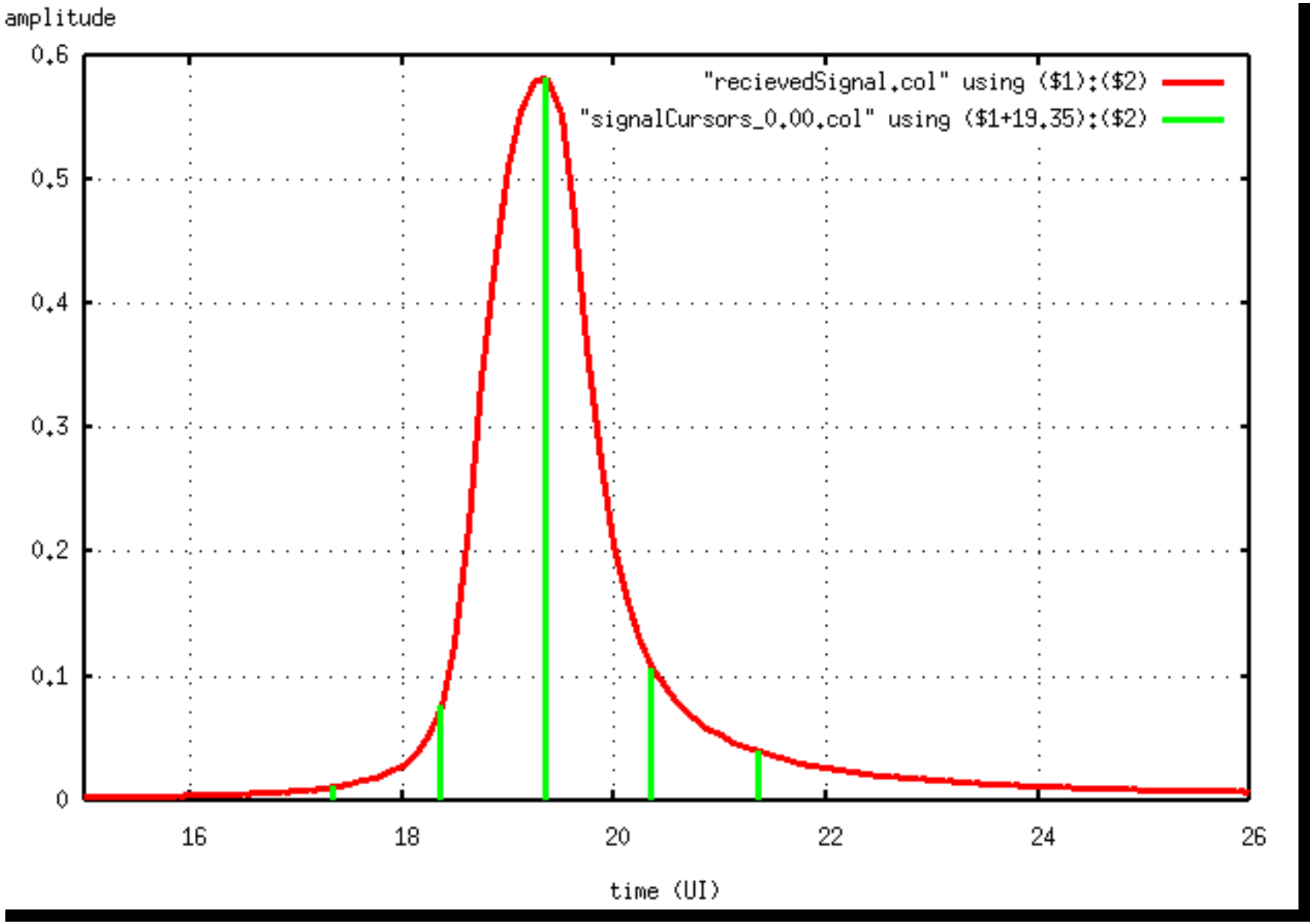
Worst Case Sampling Jitter



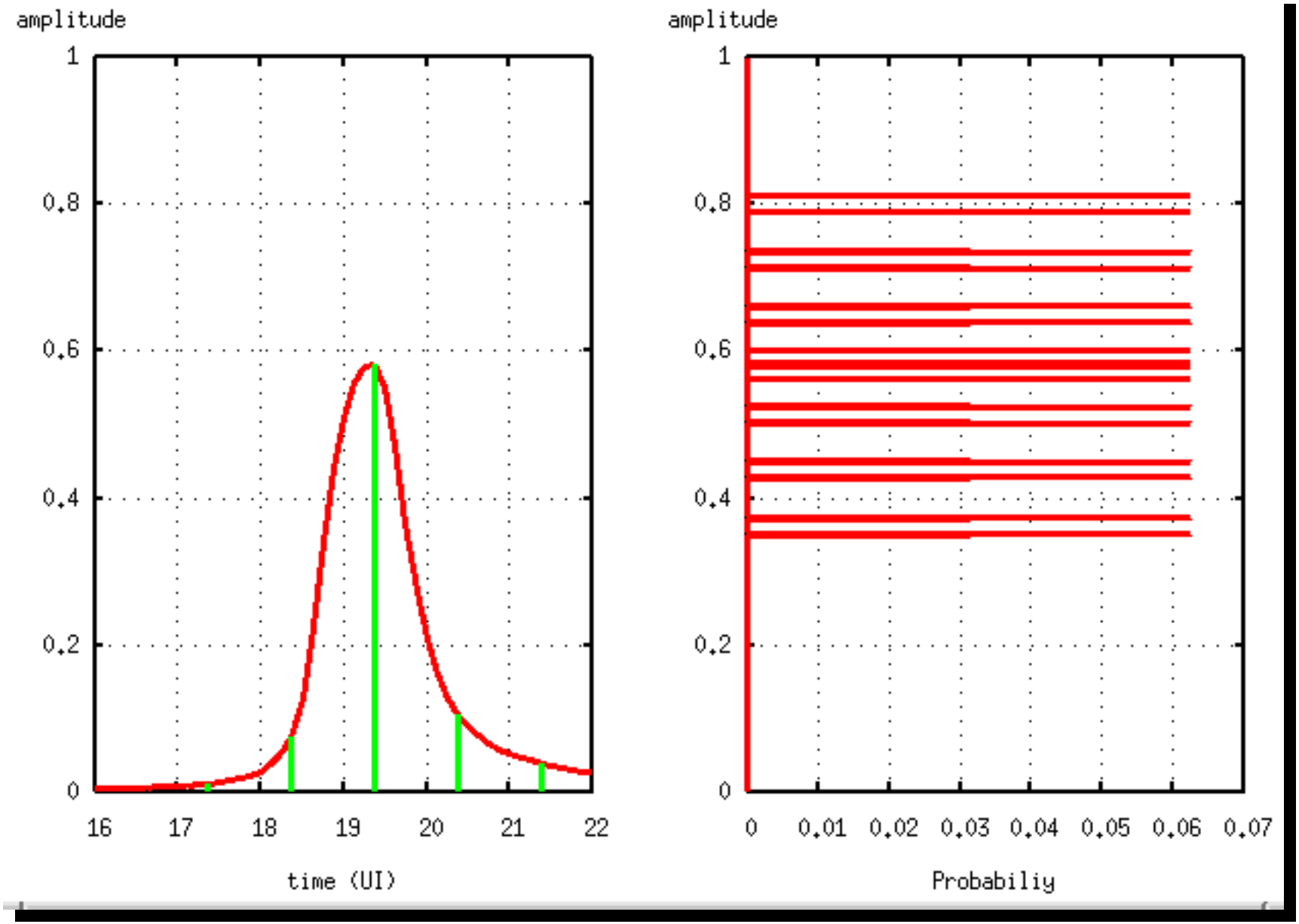
Worst Case Eye Opening



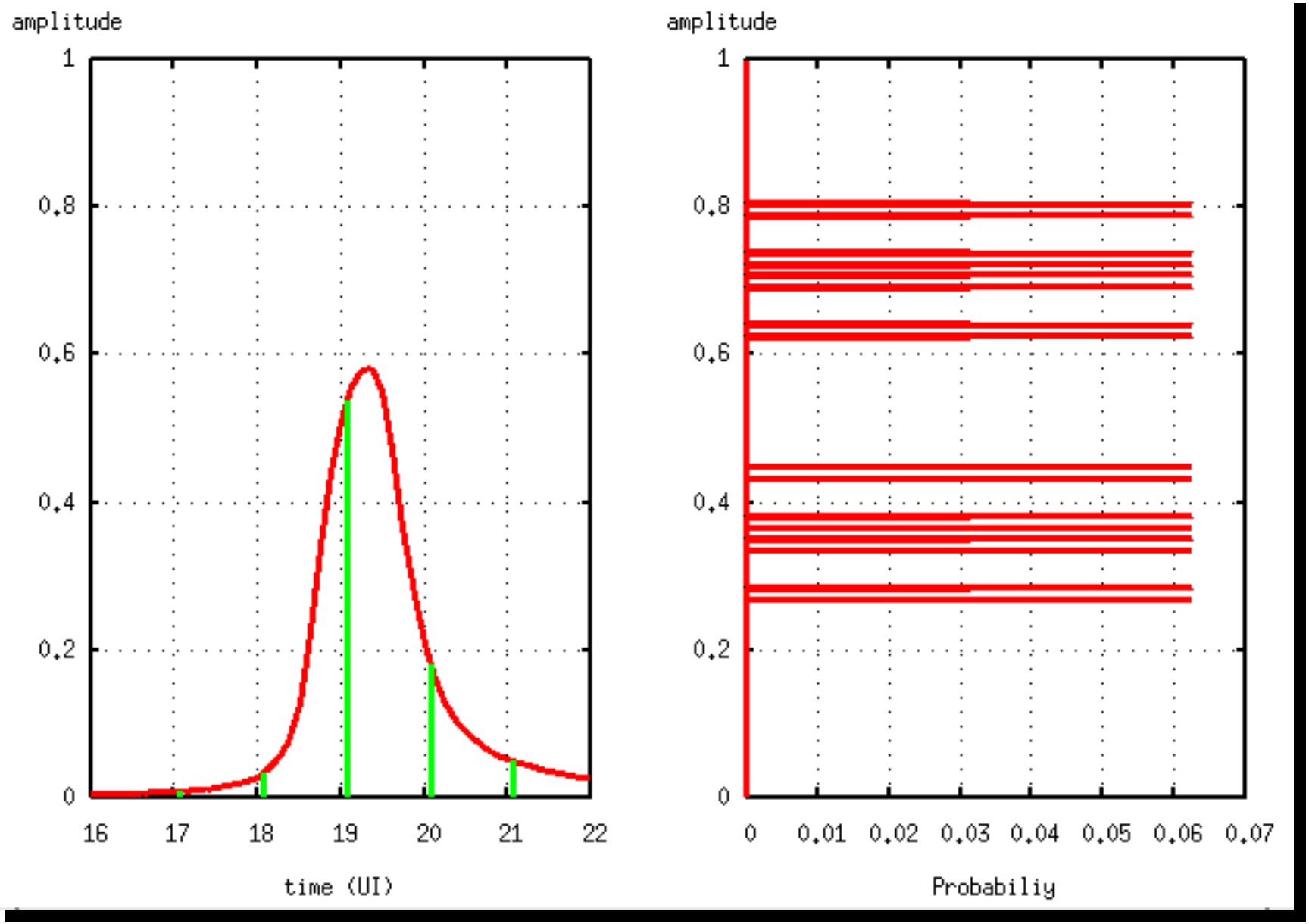
Cursor Extraction



Conditional pdf



Conditional pdf



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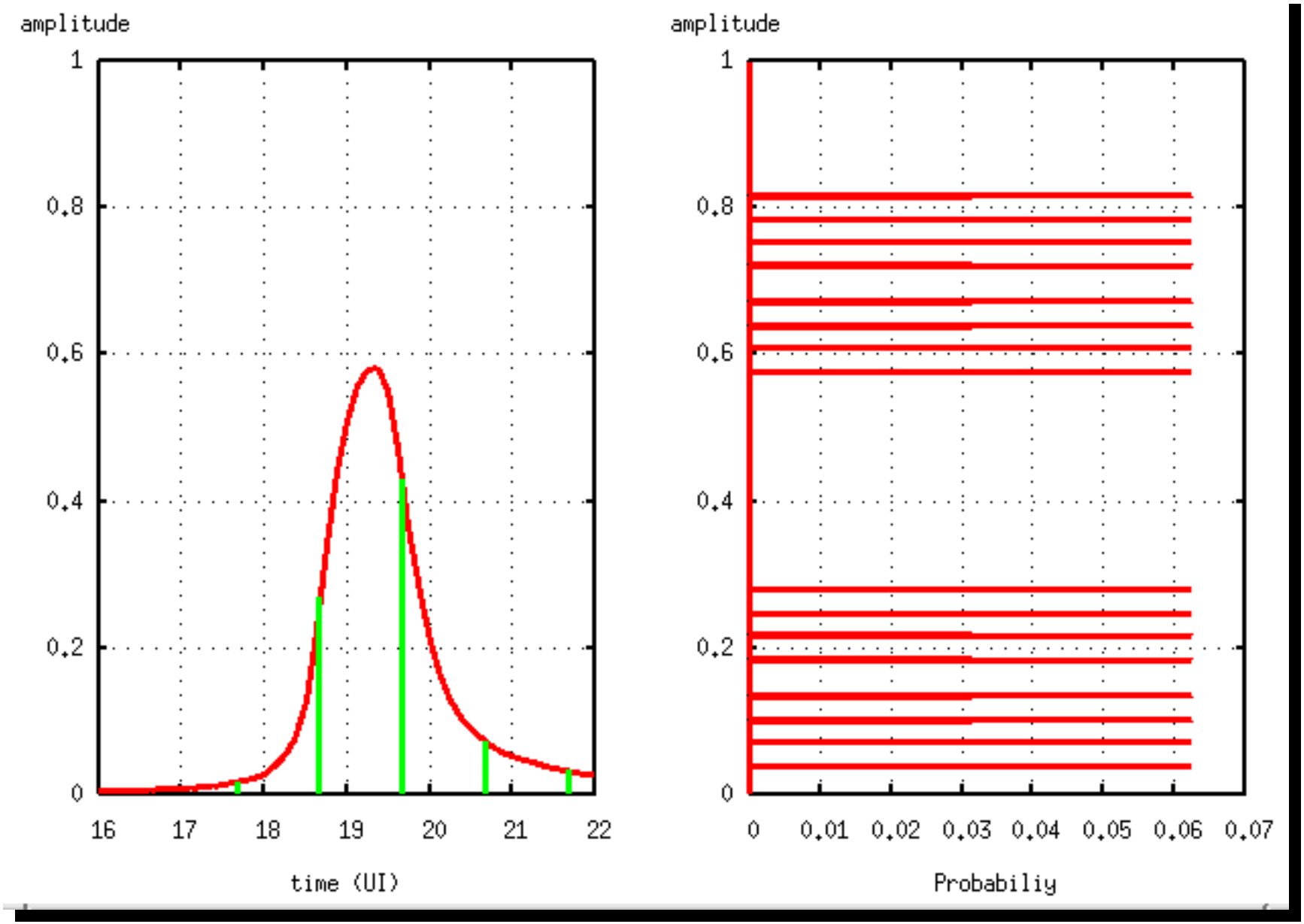
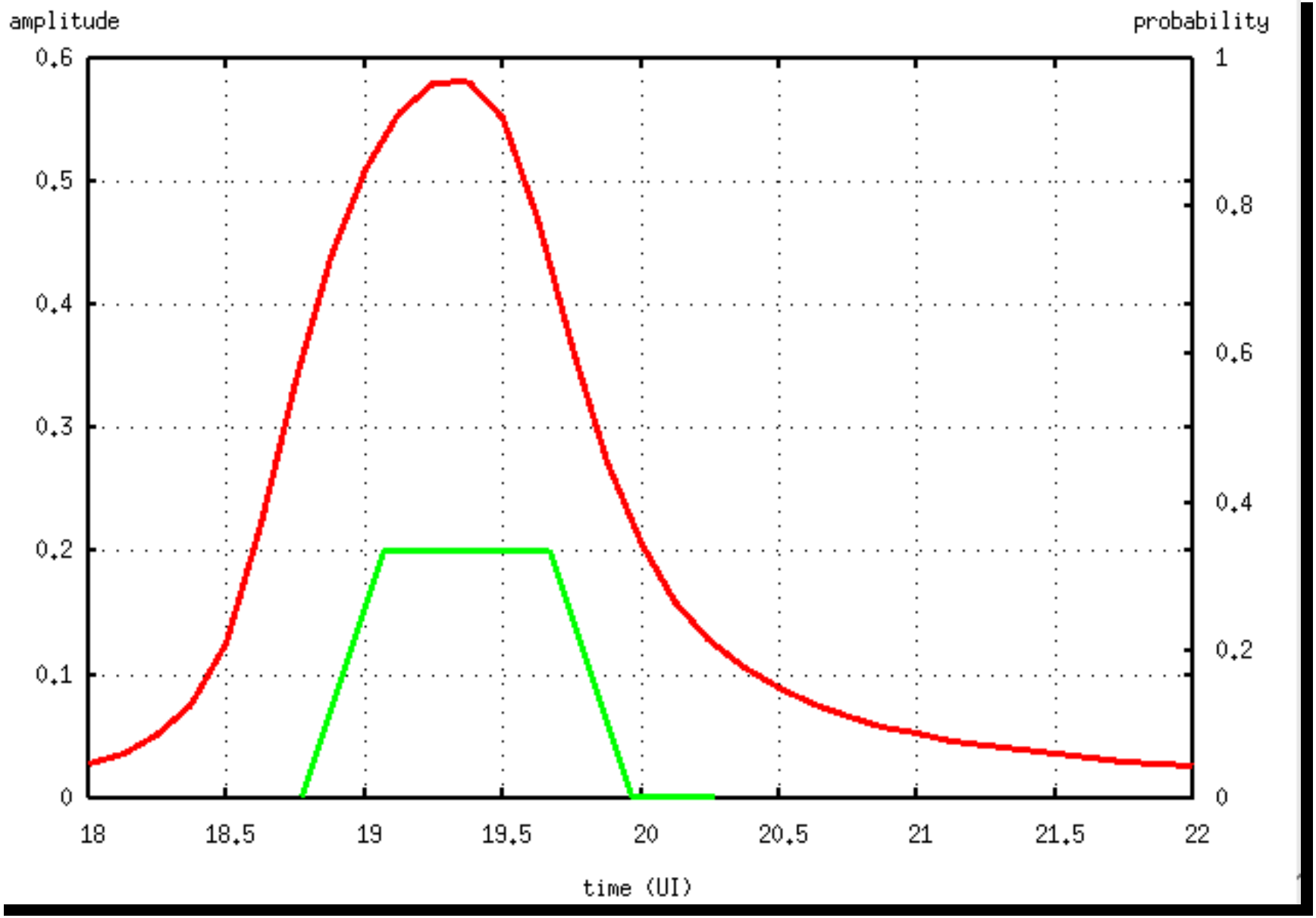
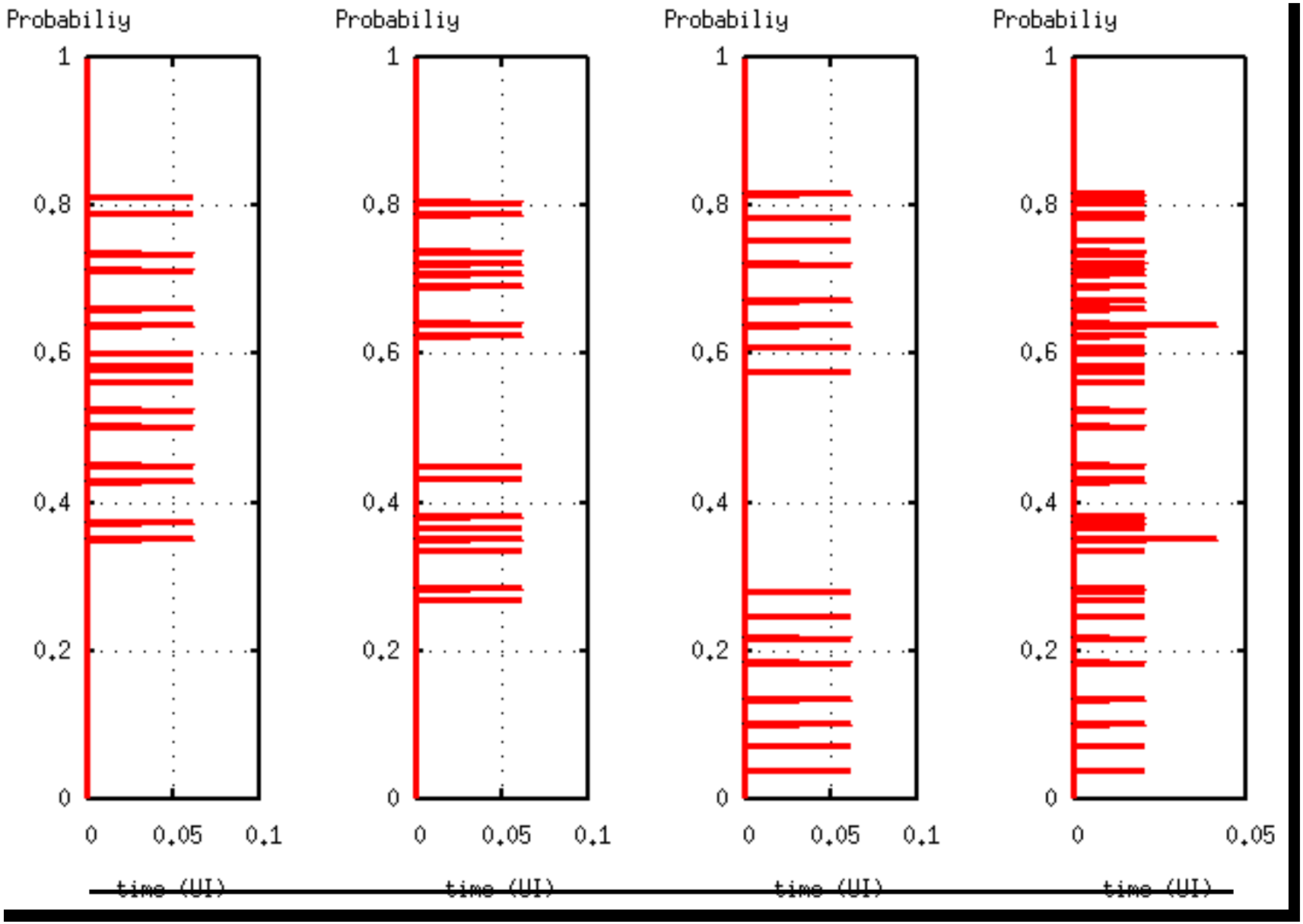


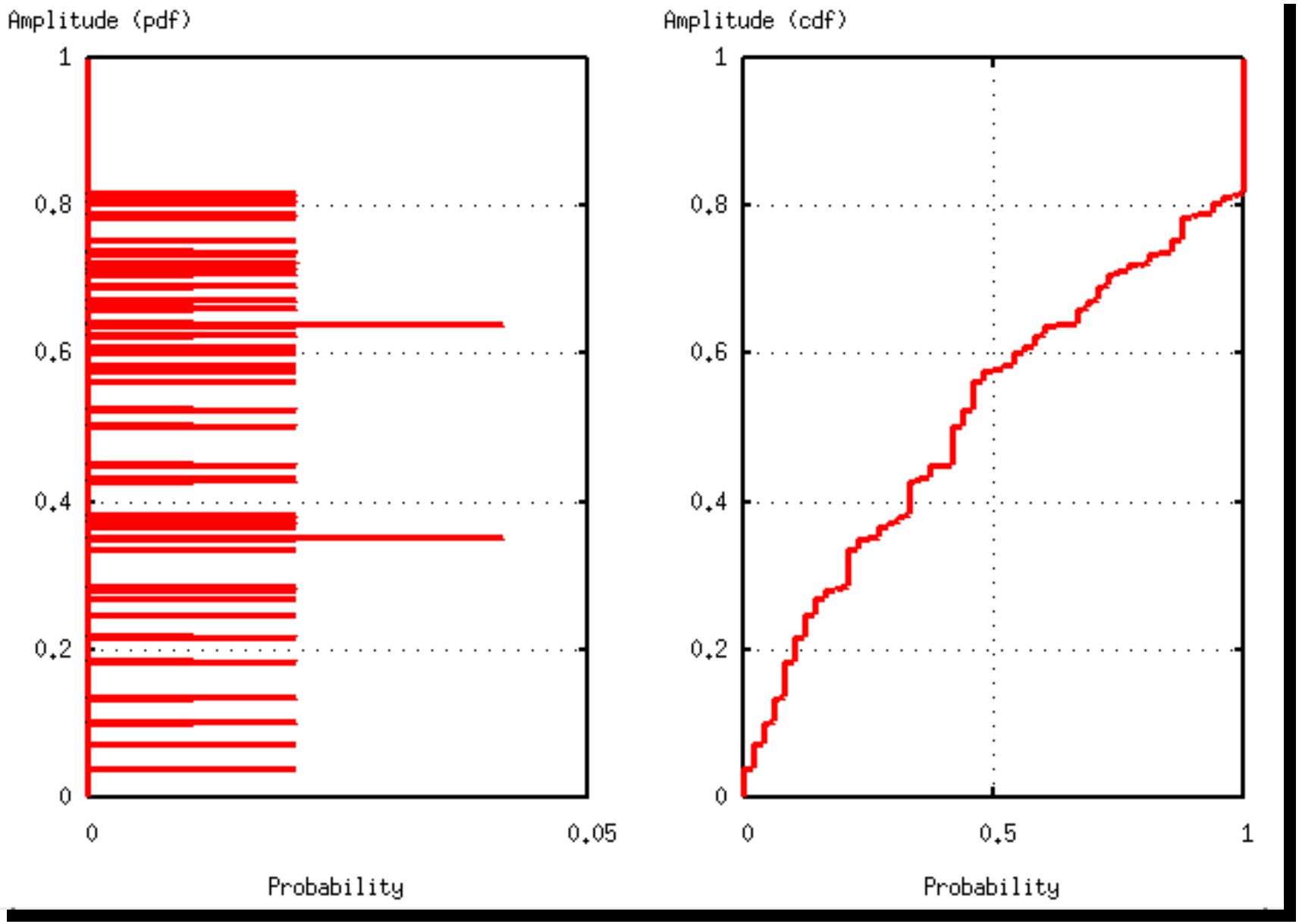
Sampling Jitter



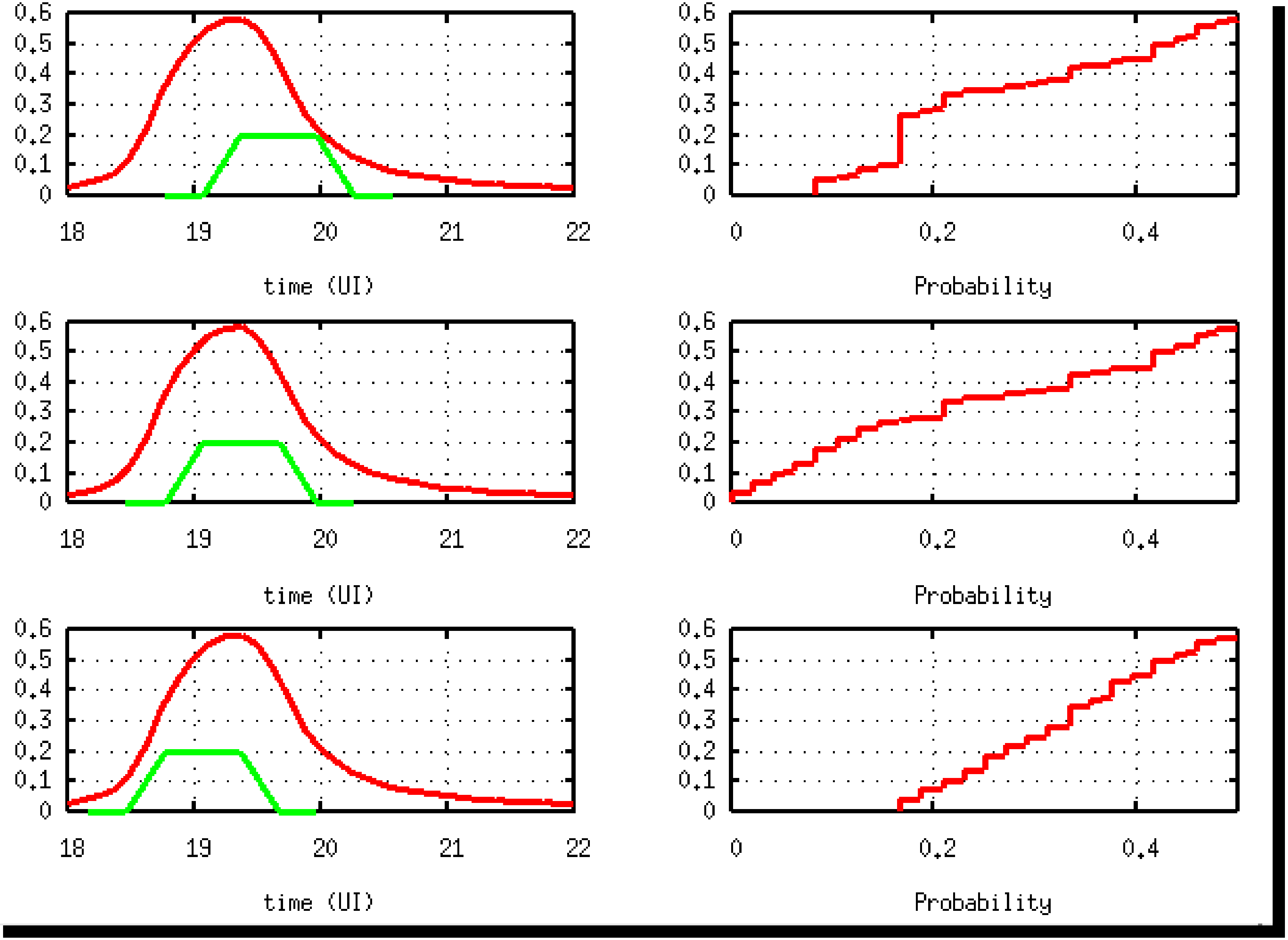
Average pdf over transmit jitter



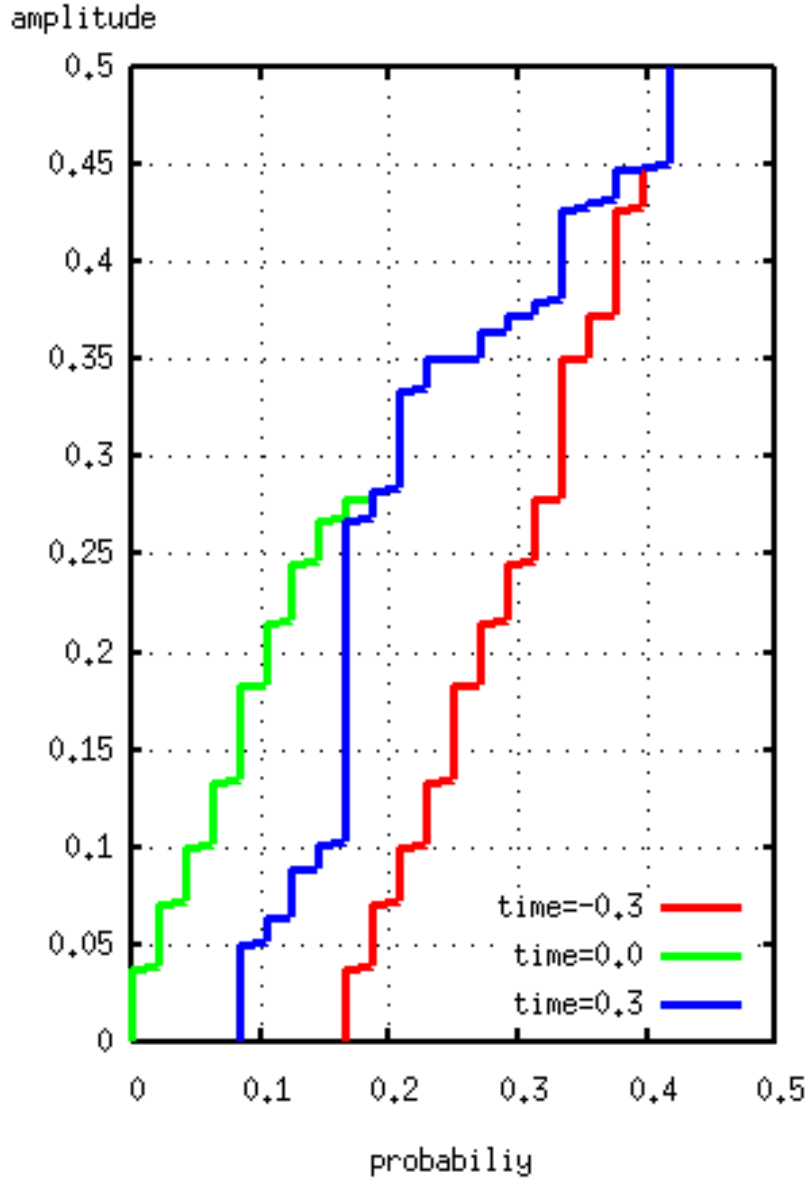
Pdf -> cdf


Amplitude (pdf)
1
0.8
0.6
0.4
0.2
0
0
0.05
Probability
Amplitude (cdf)
1
0.8
0.6
0.4
0.2
0
0
0.5
1
Probability

Conditional Average cdfs



Stateye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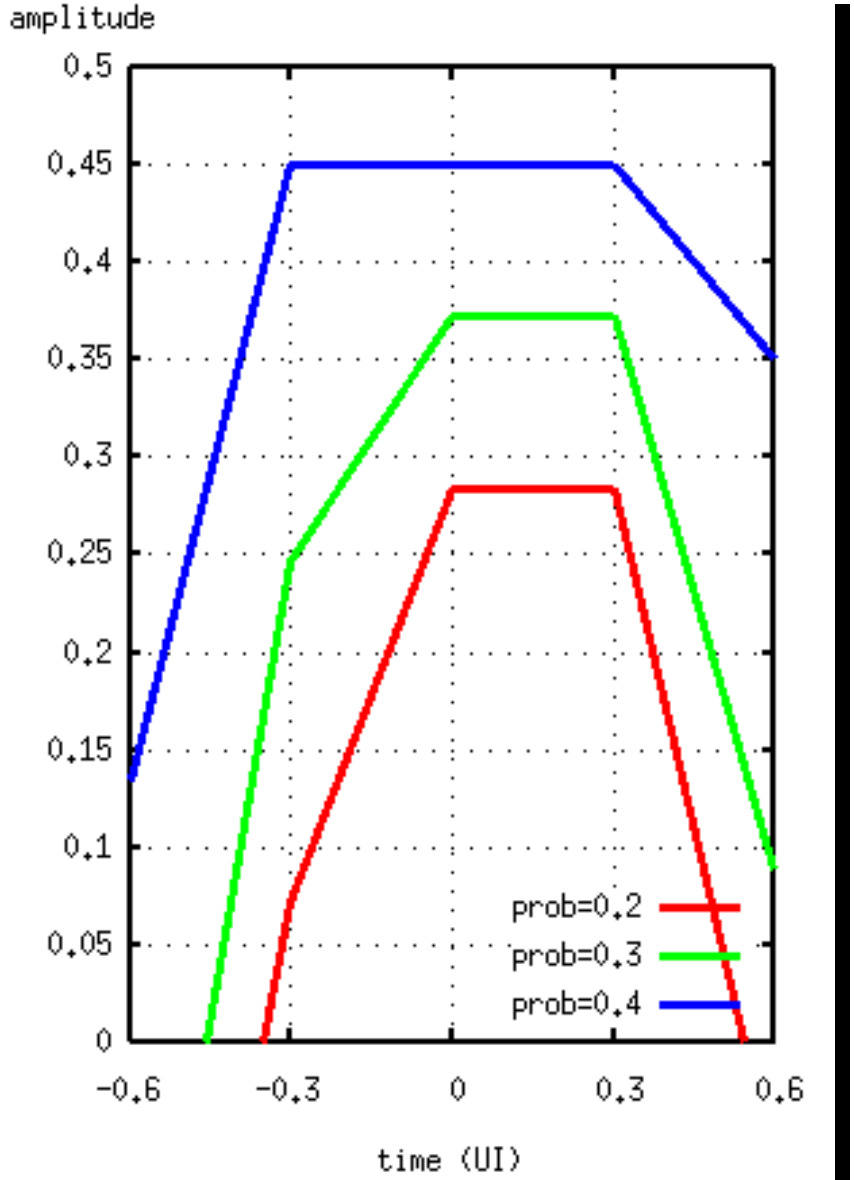
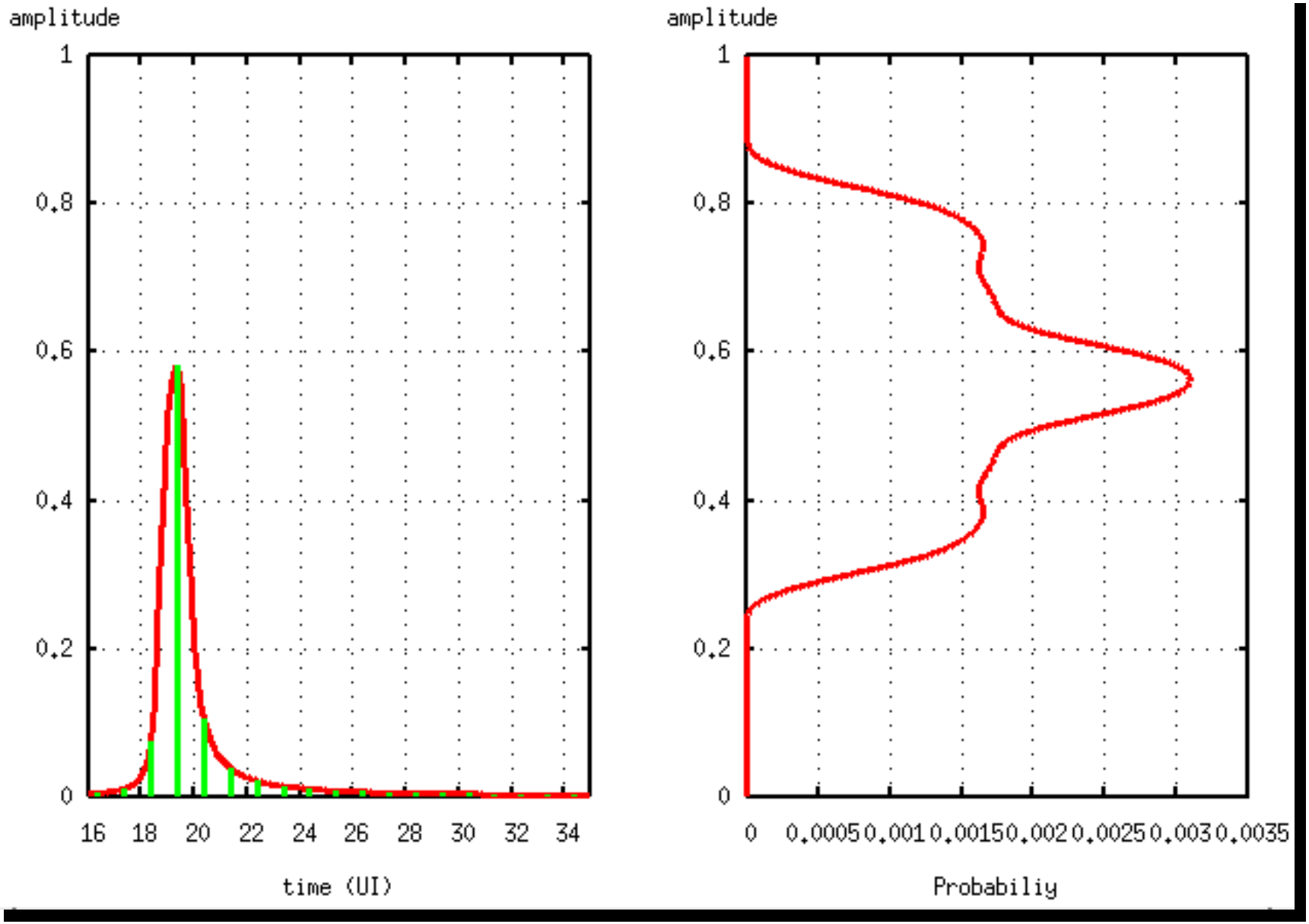
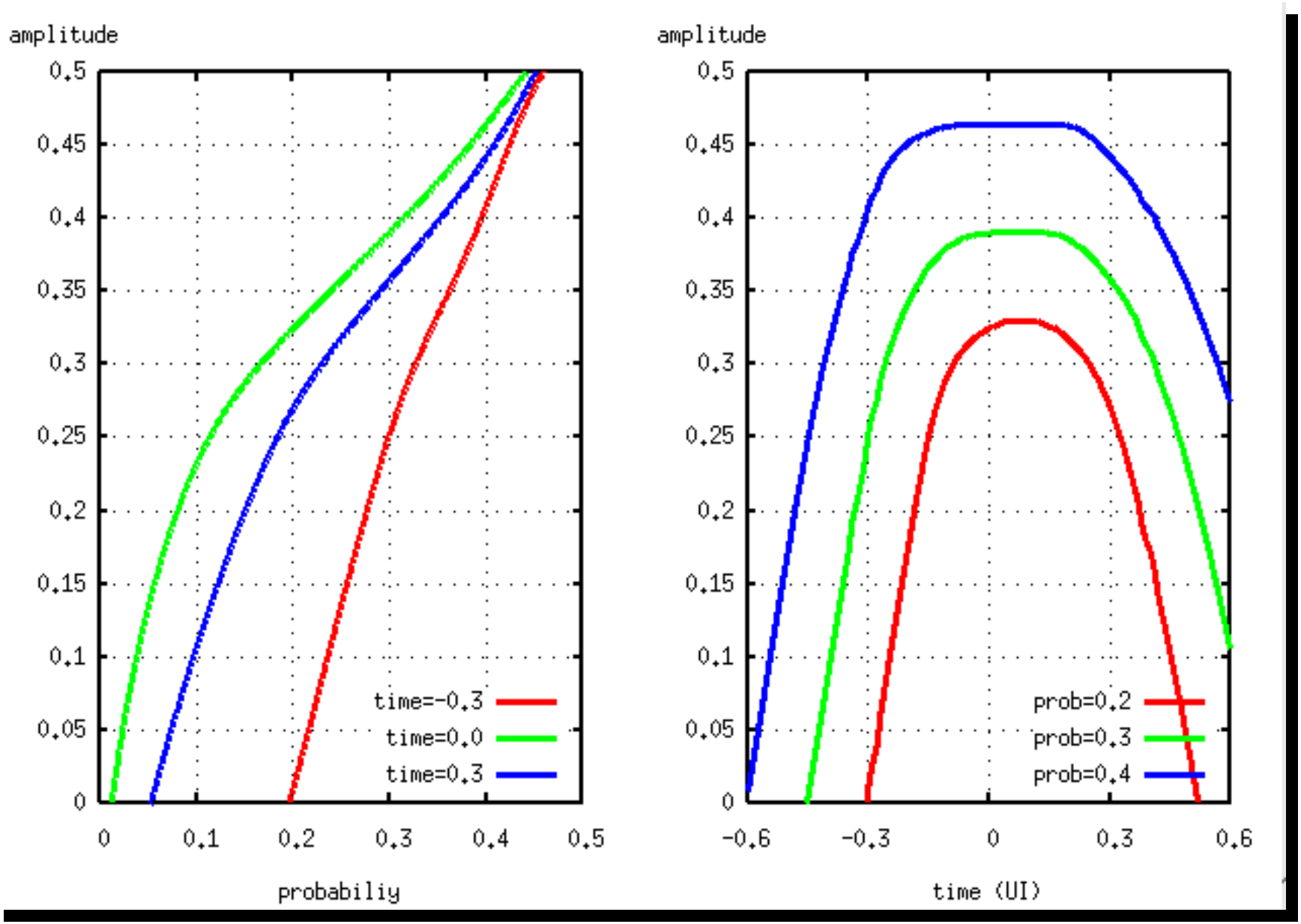
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.1
0.2
0.3
0.4
0.5
probabiliy
time=-0.3
time=0.0
time=0.3


amplitude
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.6
-0.3
0
0.3
0.6
time (UI)
prob=0.2
prob=0.3
prob=0.4

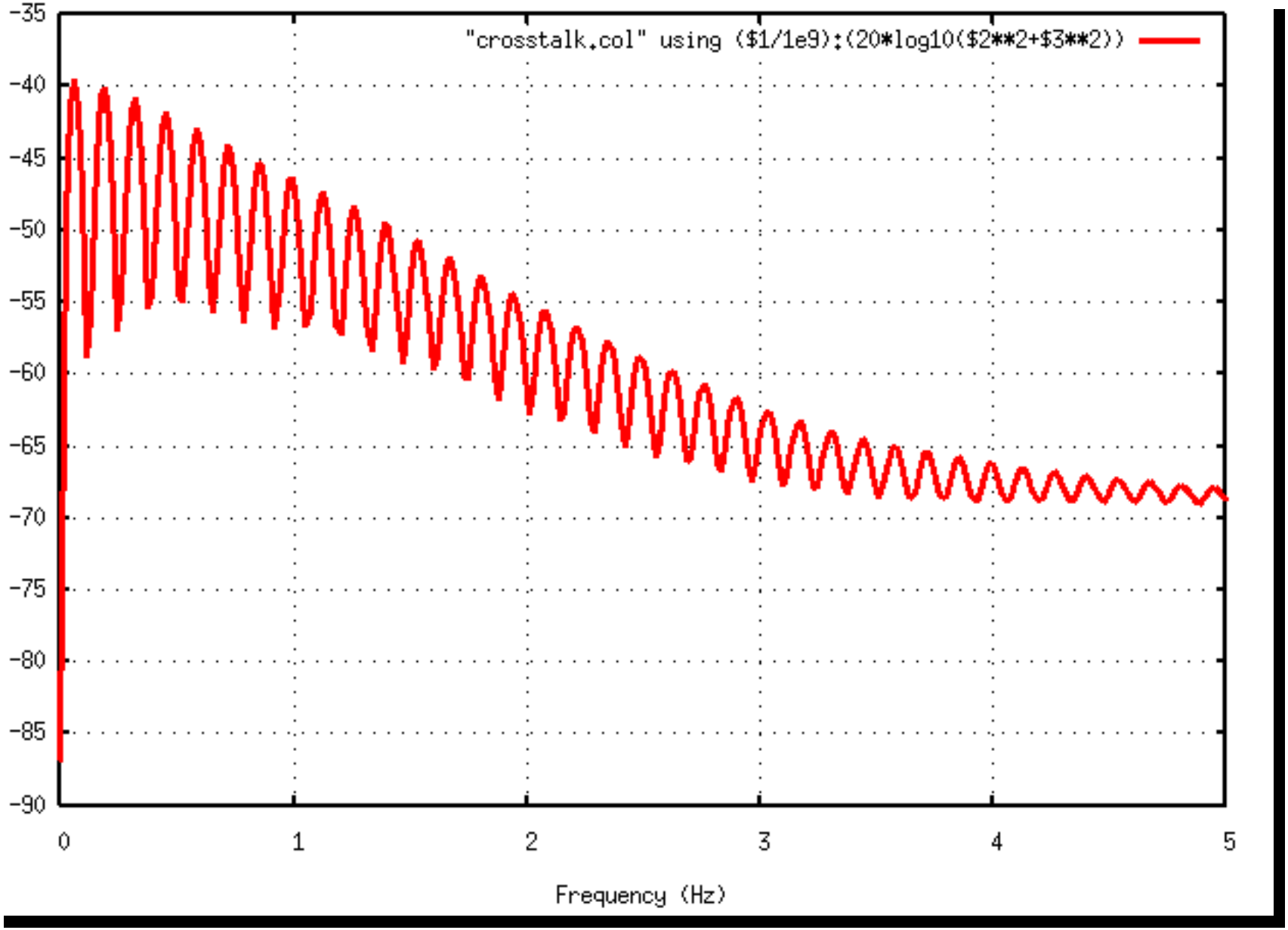
Taking more cursors



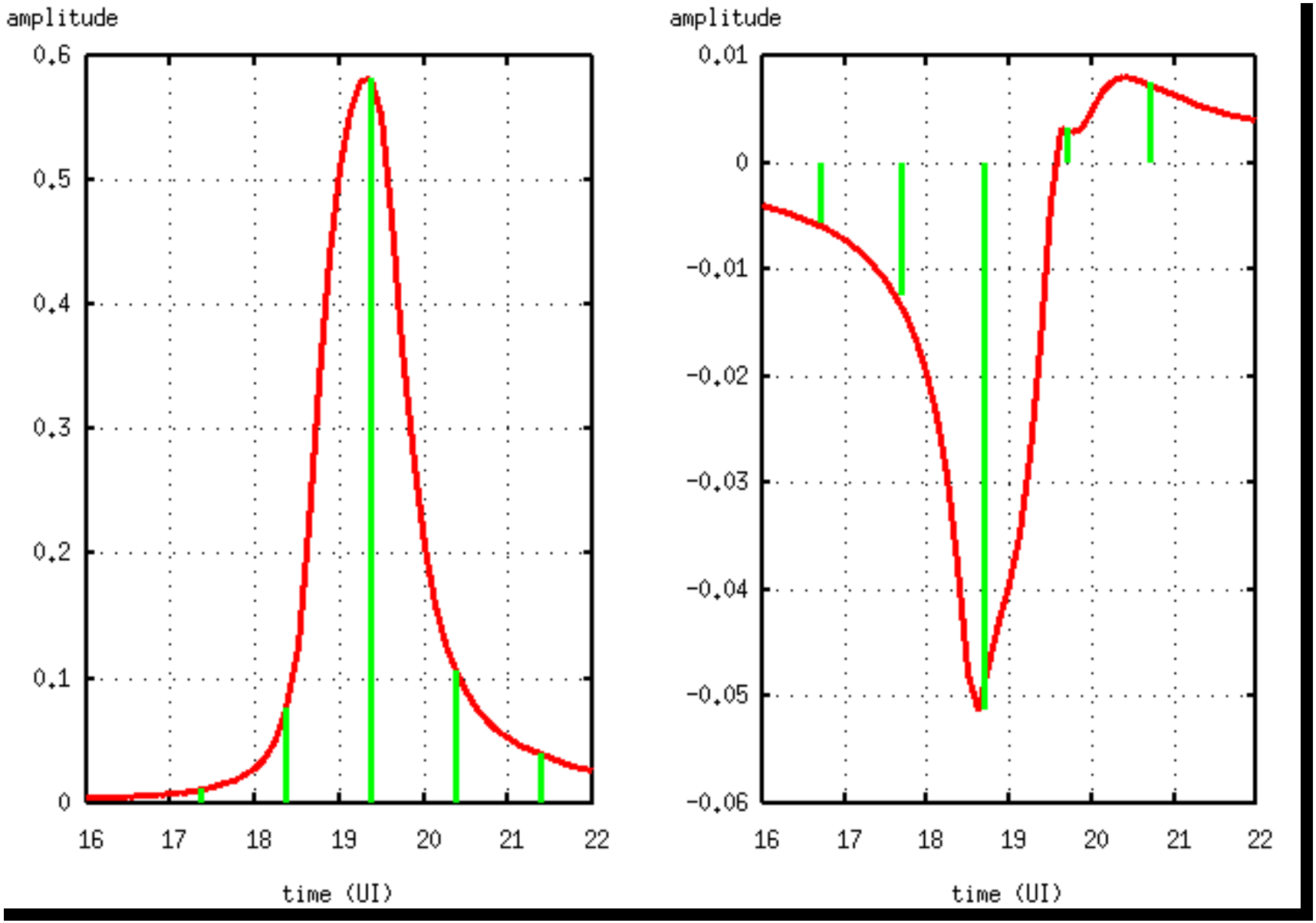
Taking more cursors



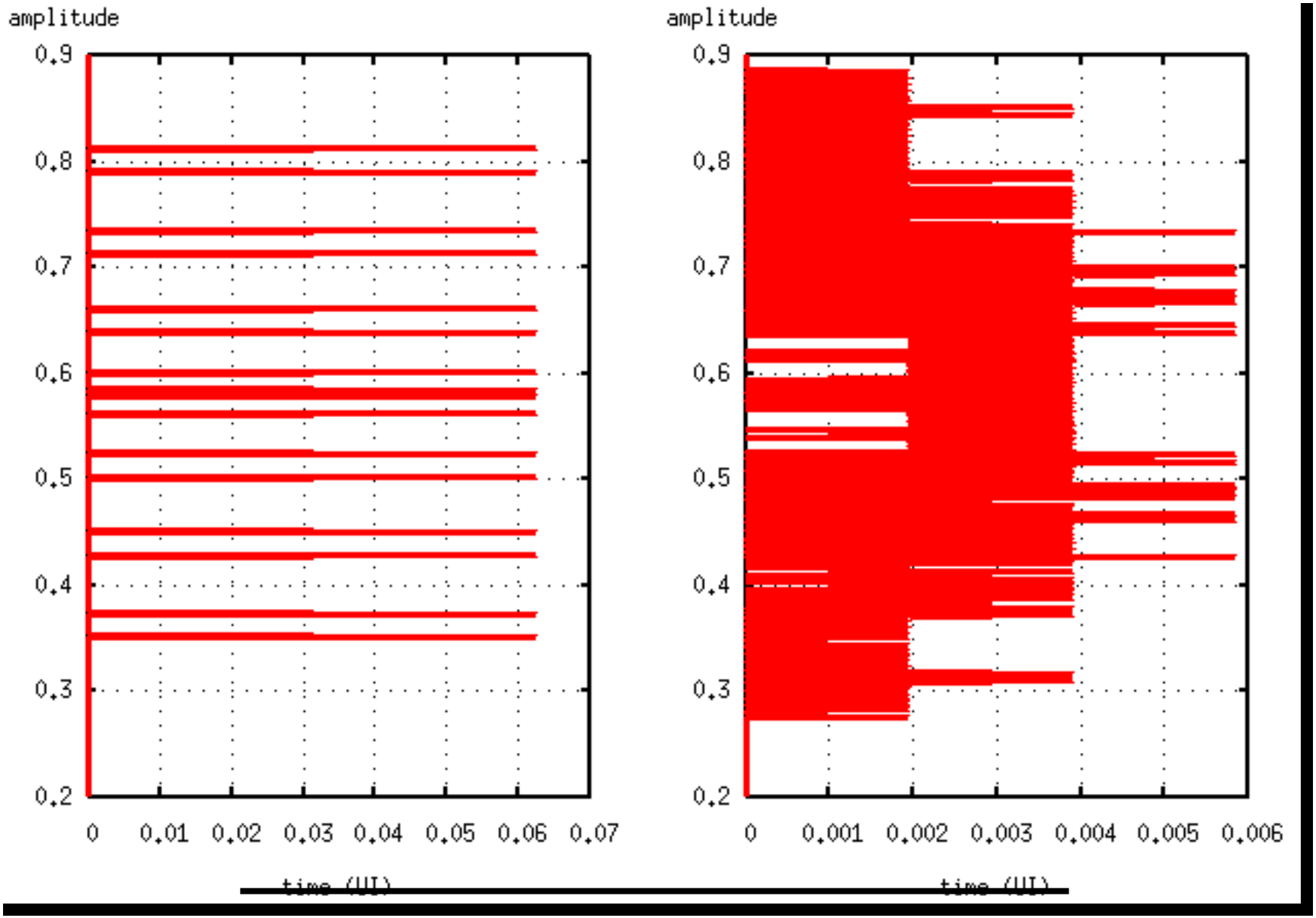
Simple Crosstalk



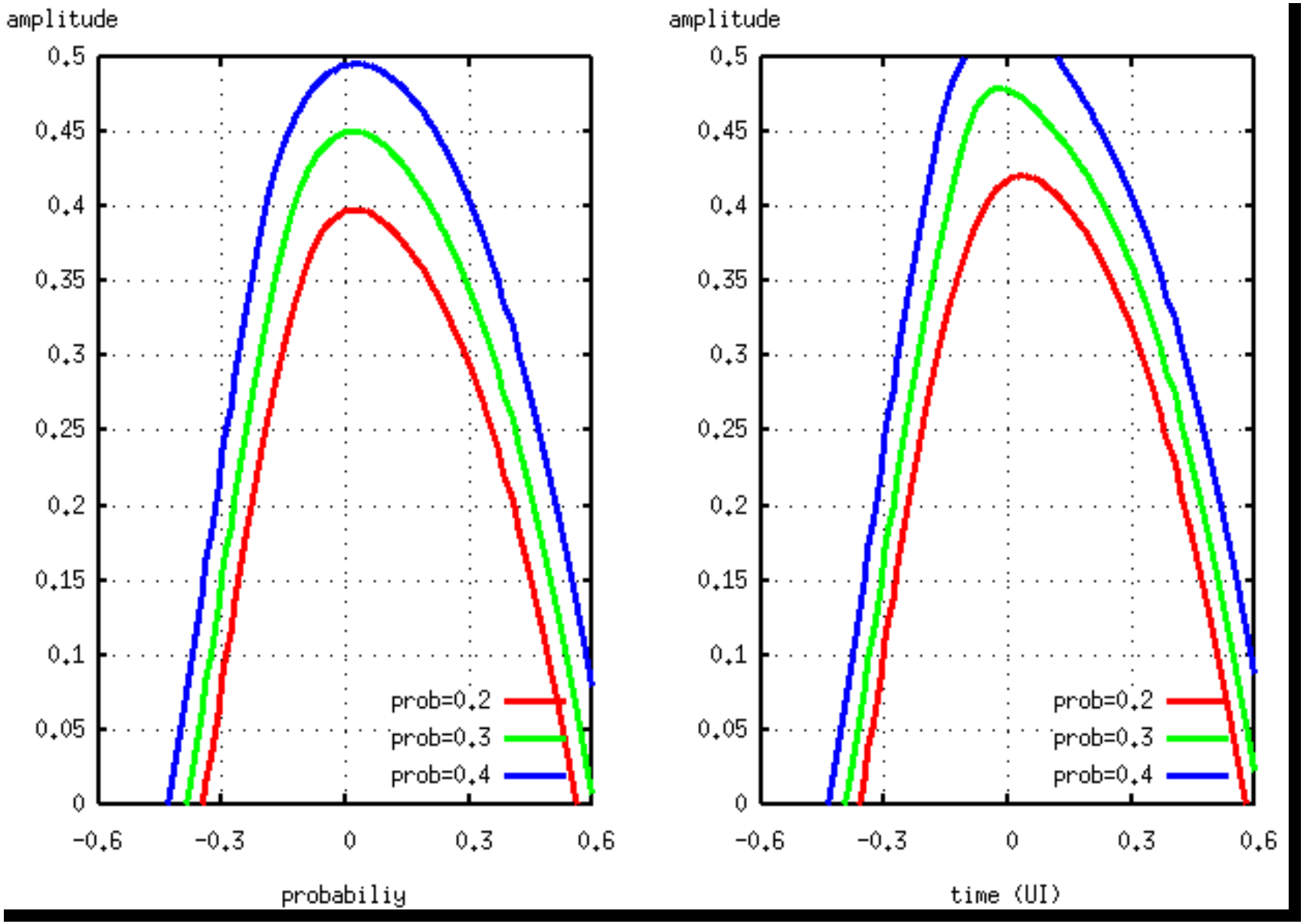
Pulse Response of Crosstalk



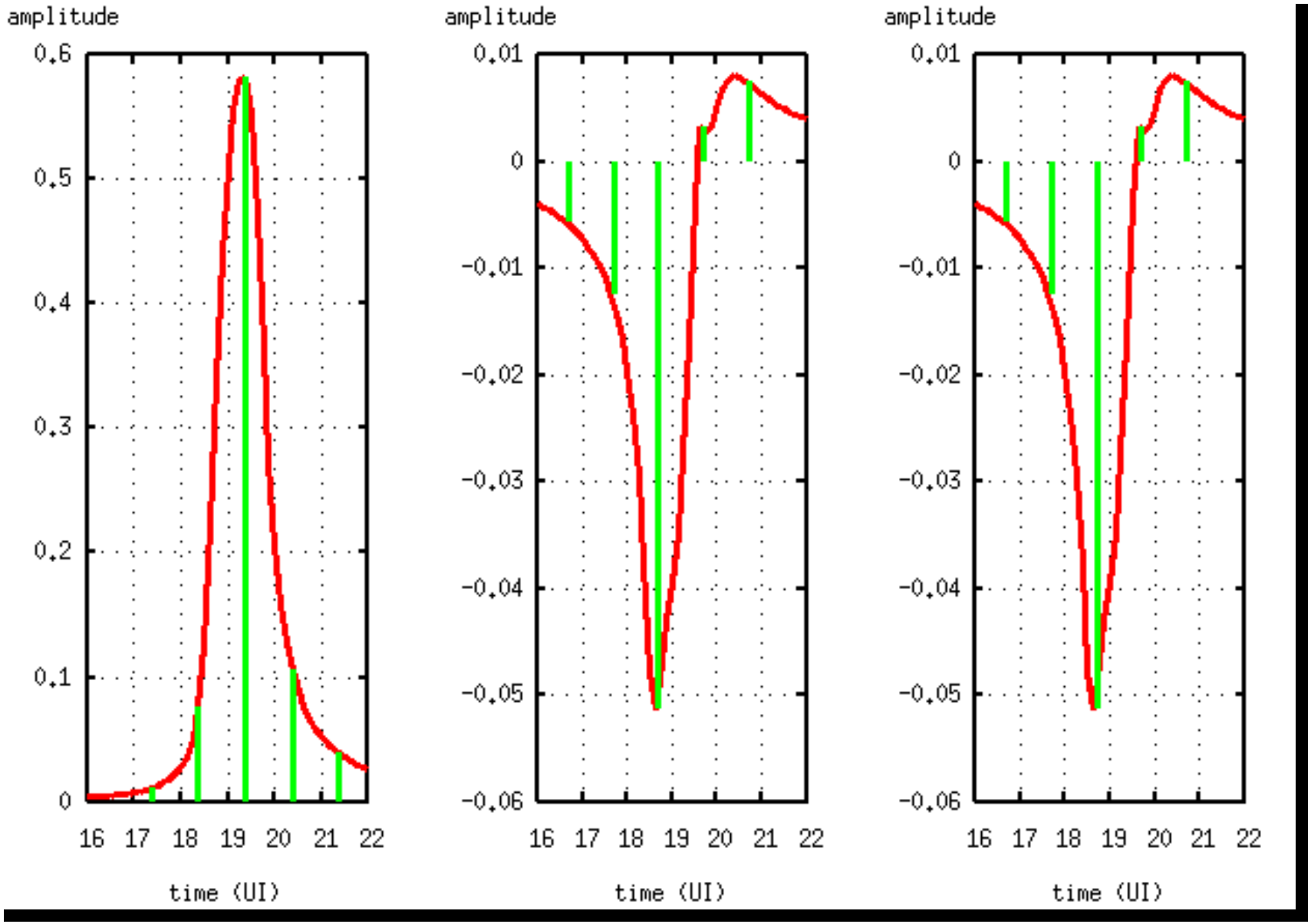
Effect of crosstalk on pdf



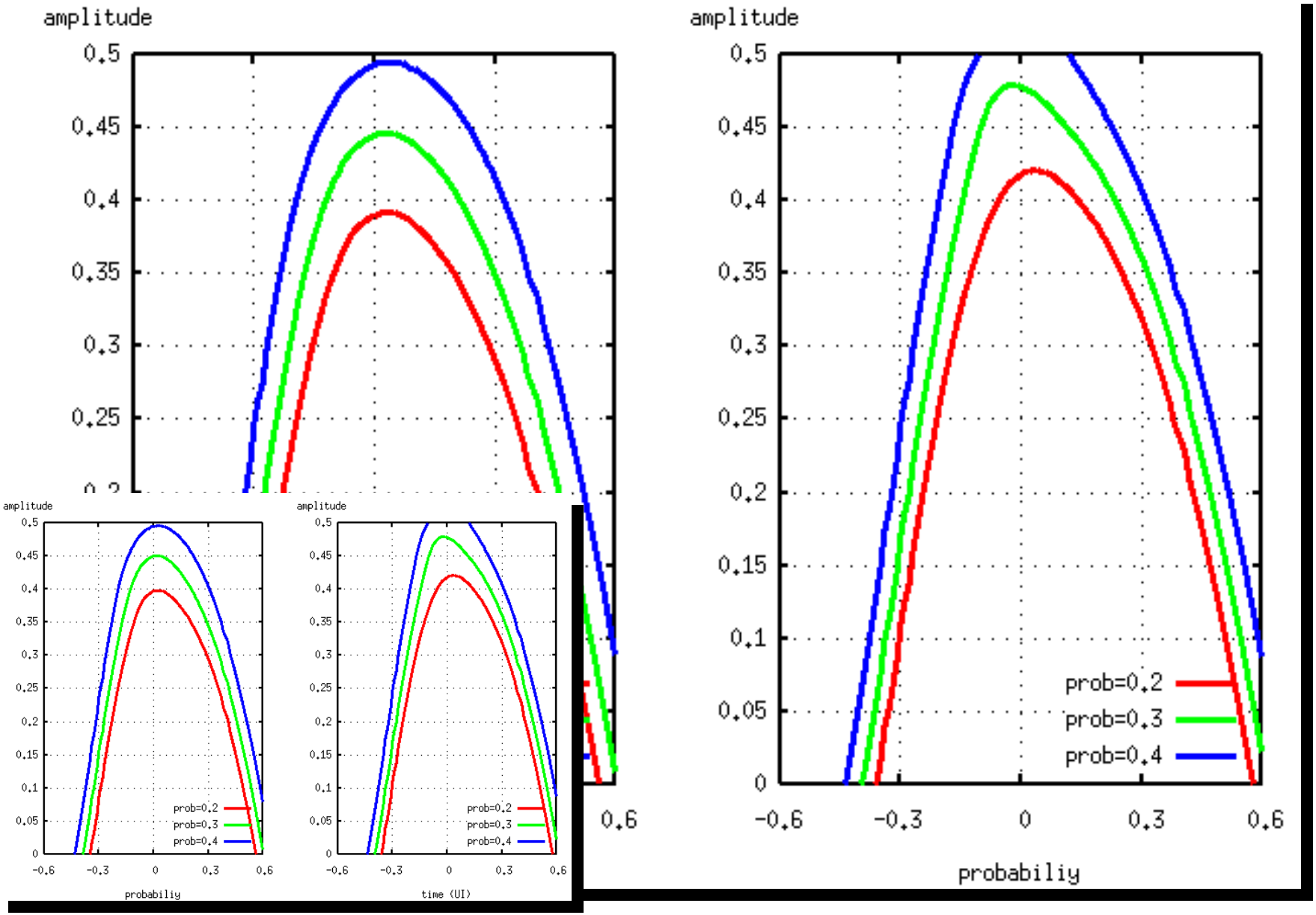
Effect of crosstalk on stateye



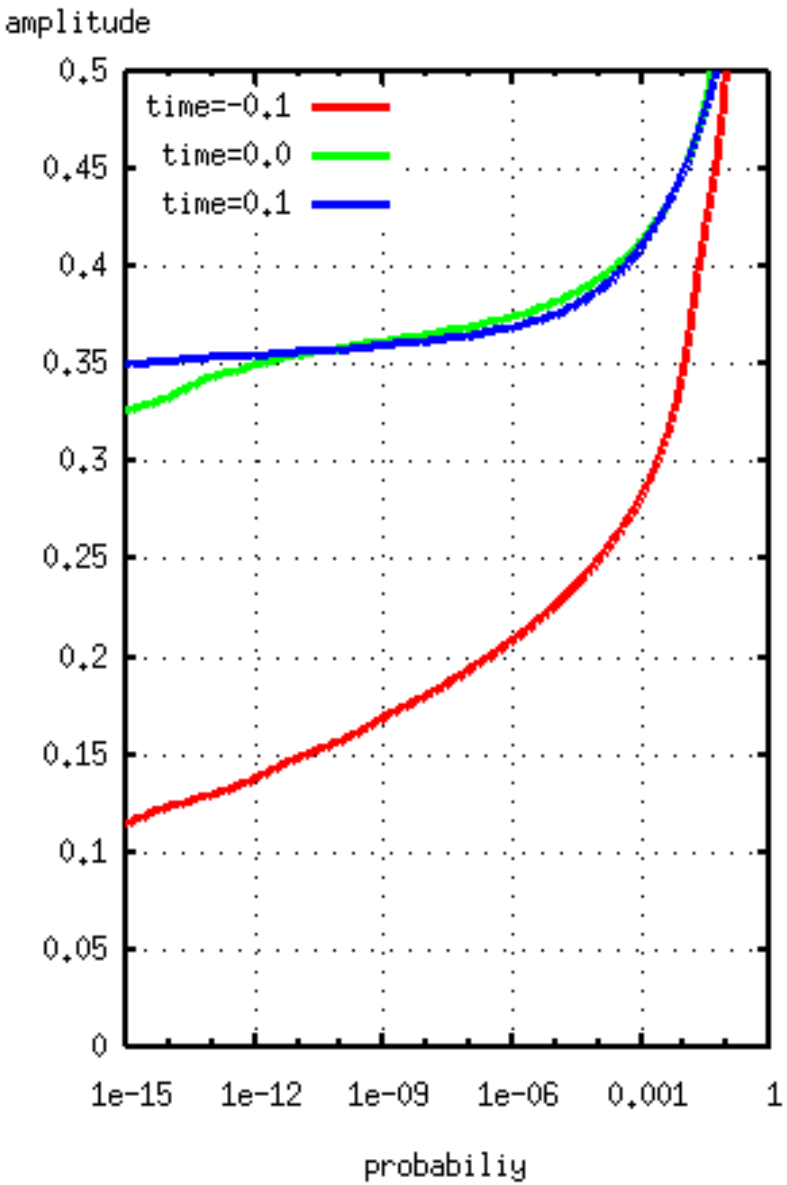
Multiple Crosstalk Aggressors

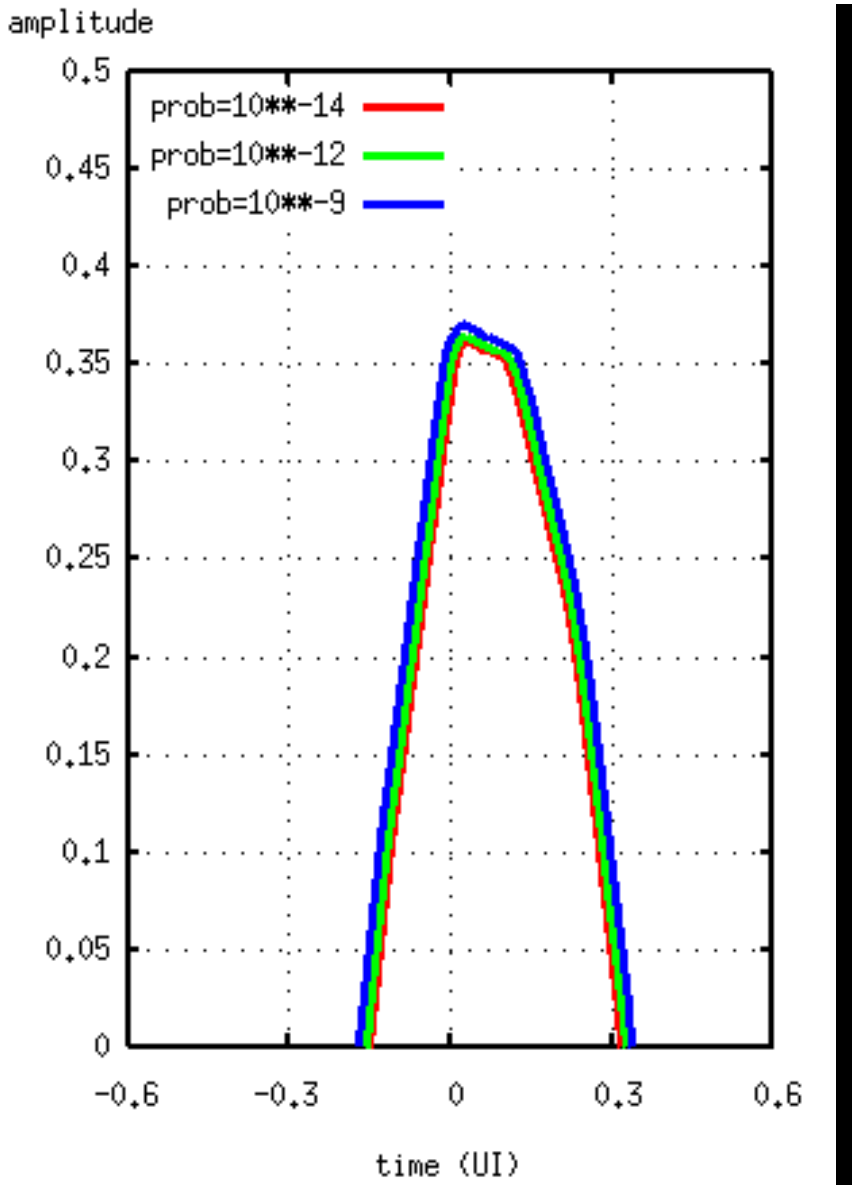


Multiple Crosstalk Aggressors



Real Probability

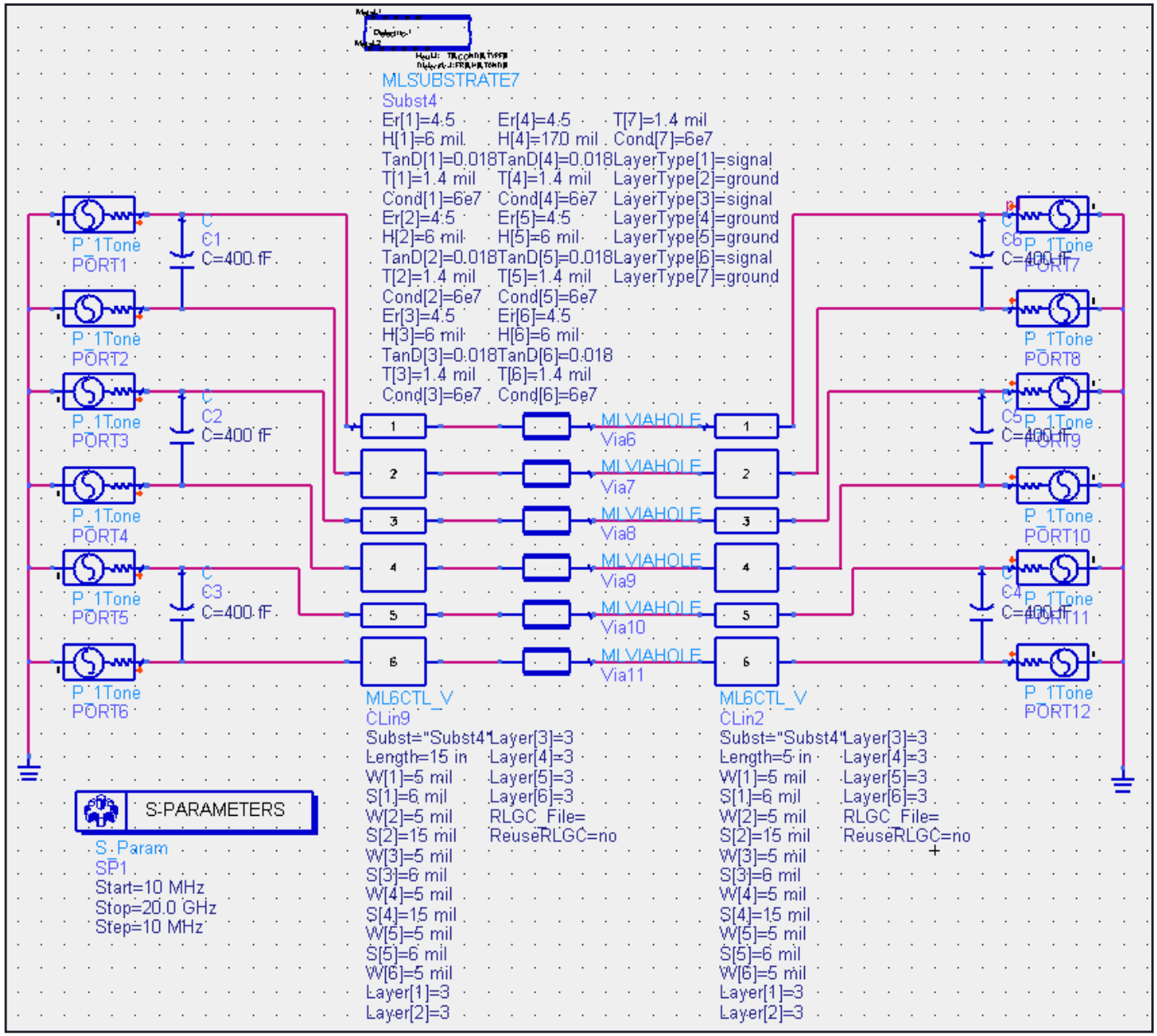




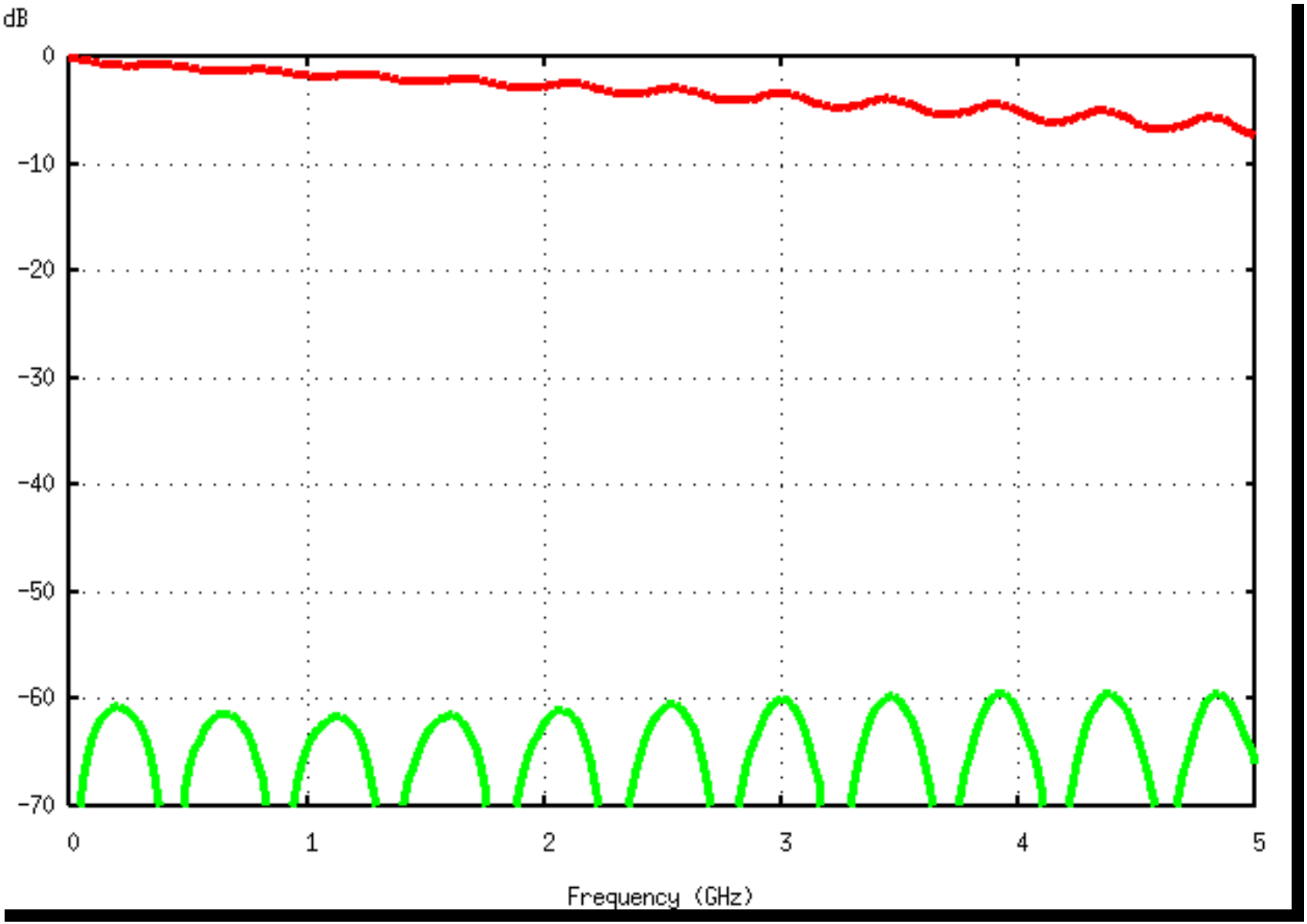
Pause for Breathe

(mine)

A Channel Example



Short Channel no via



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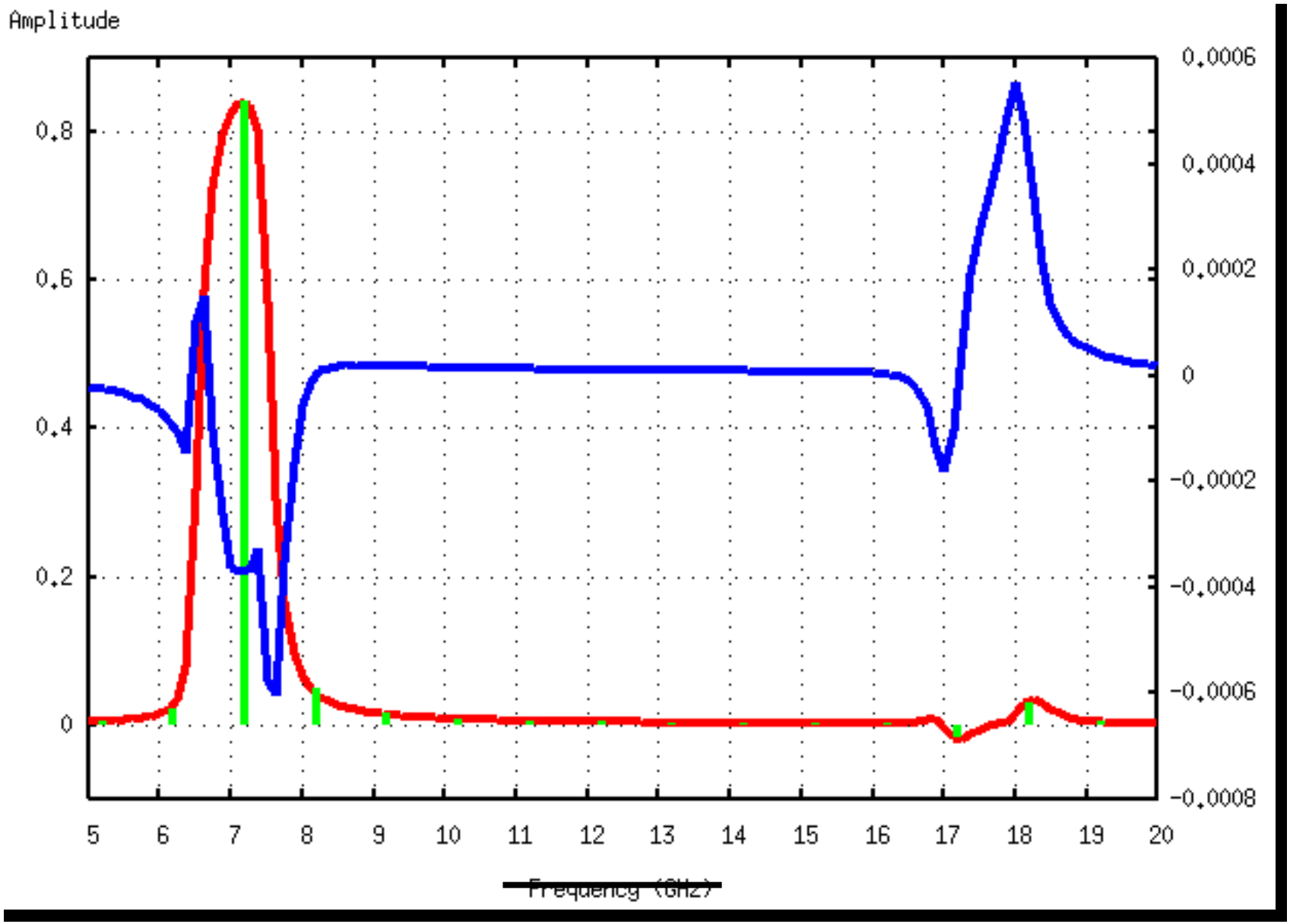

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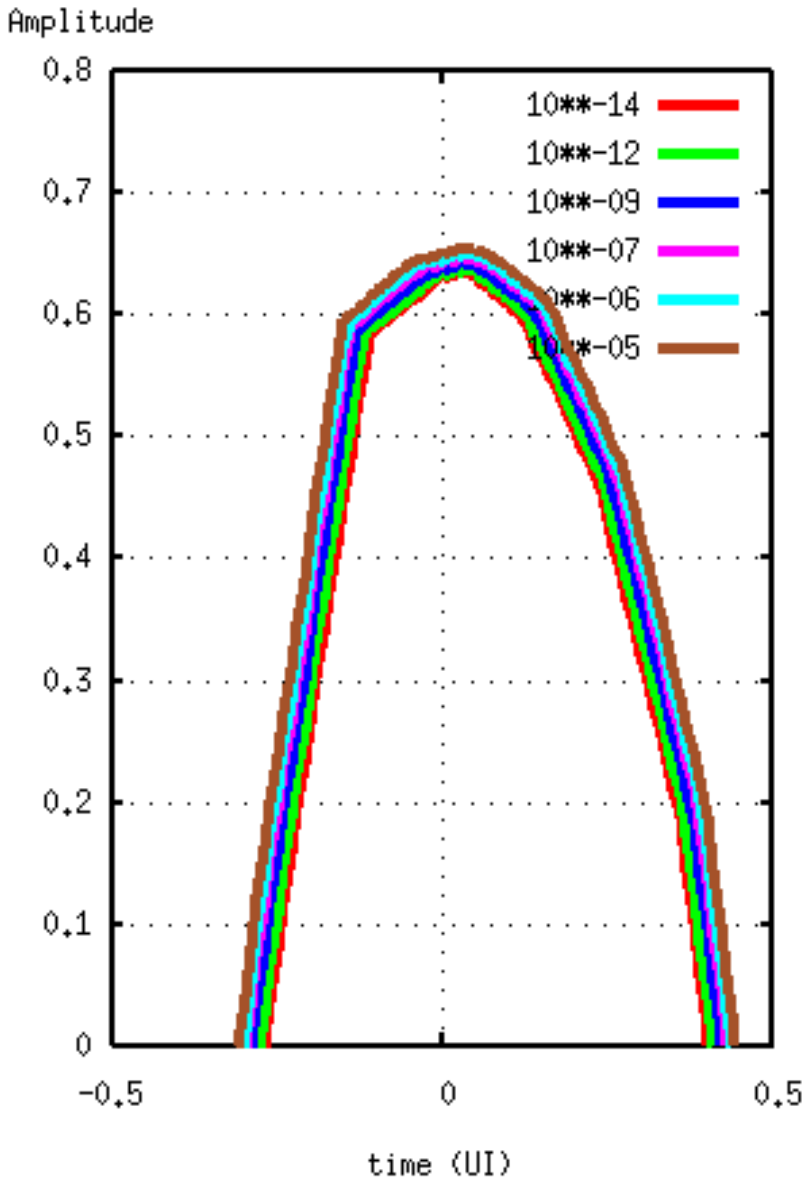
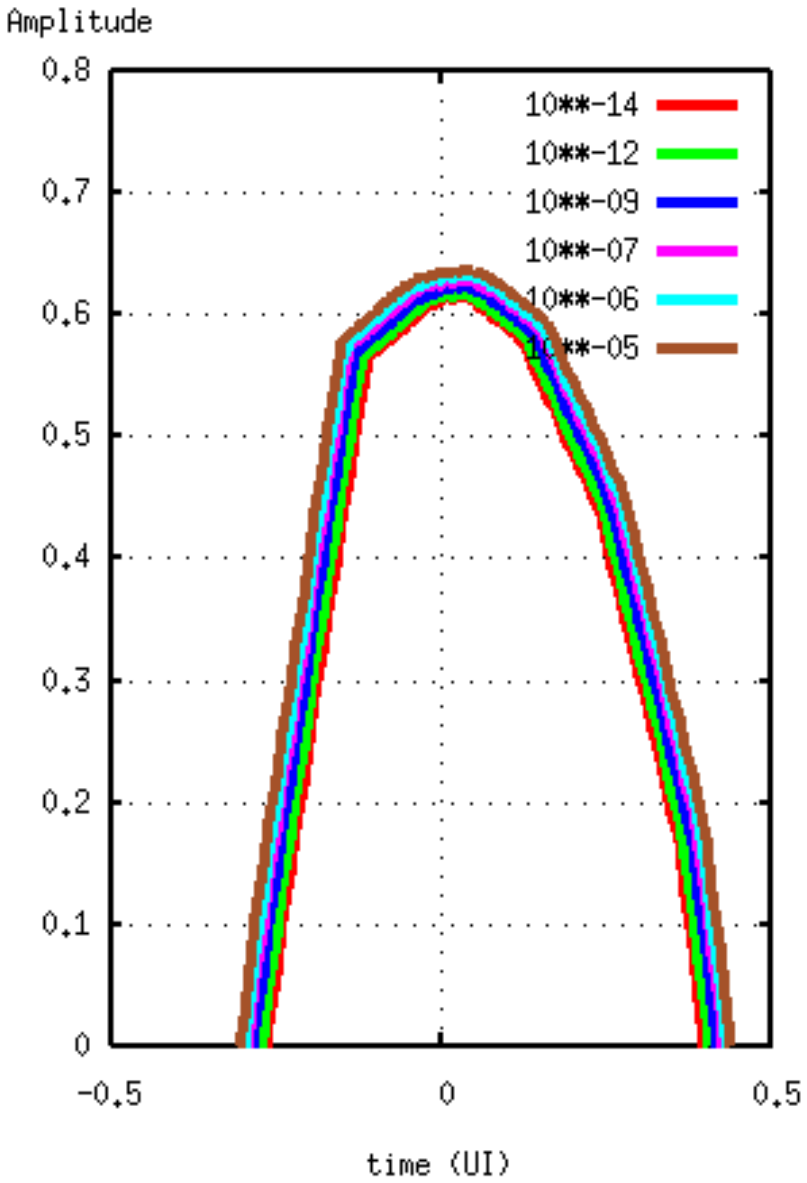
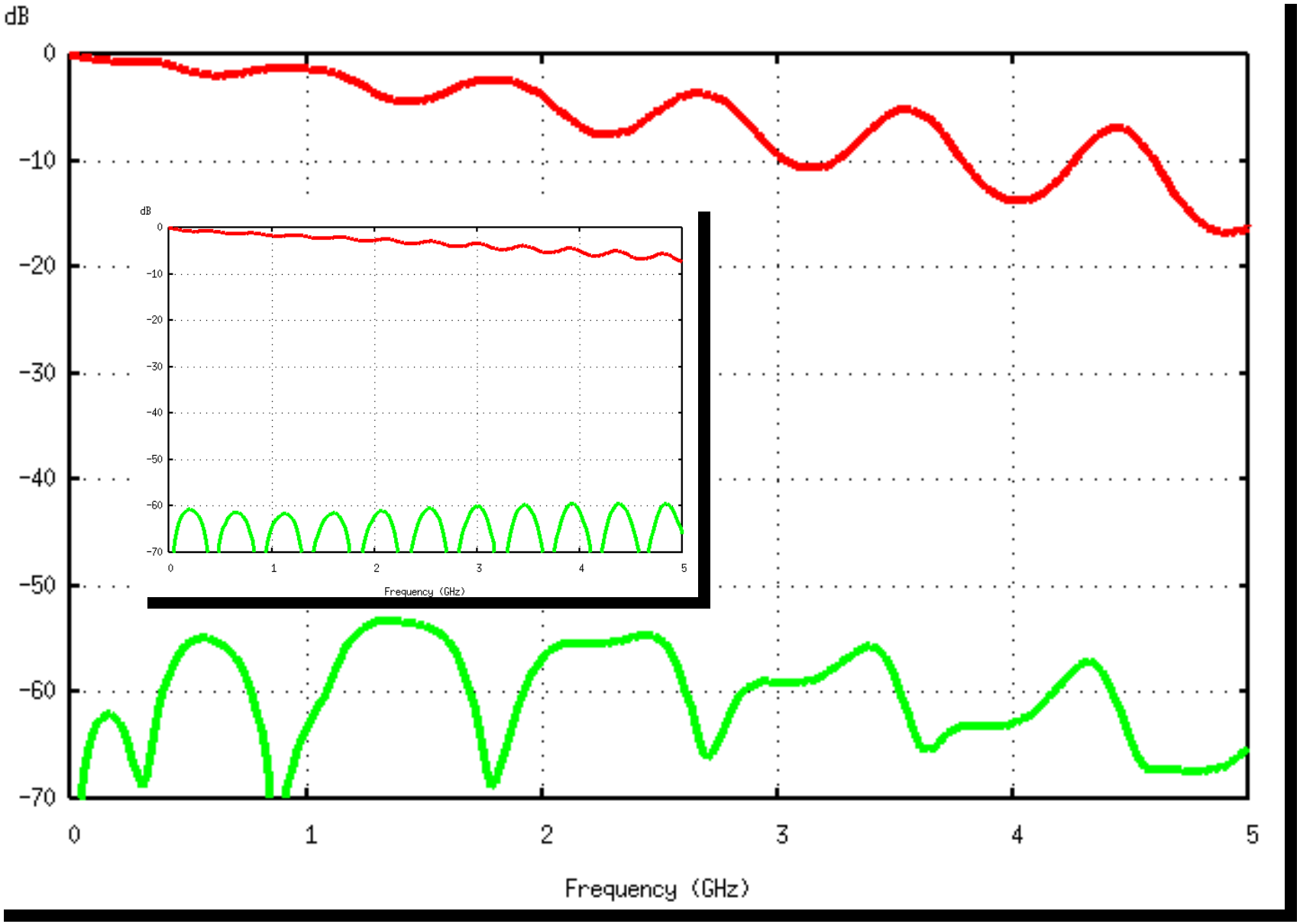
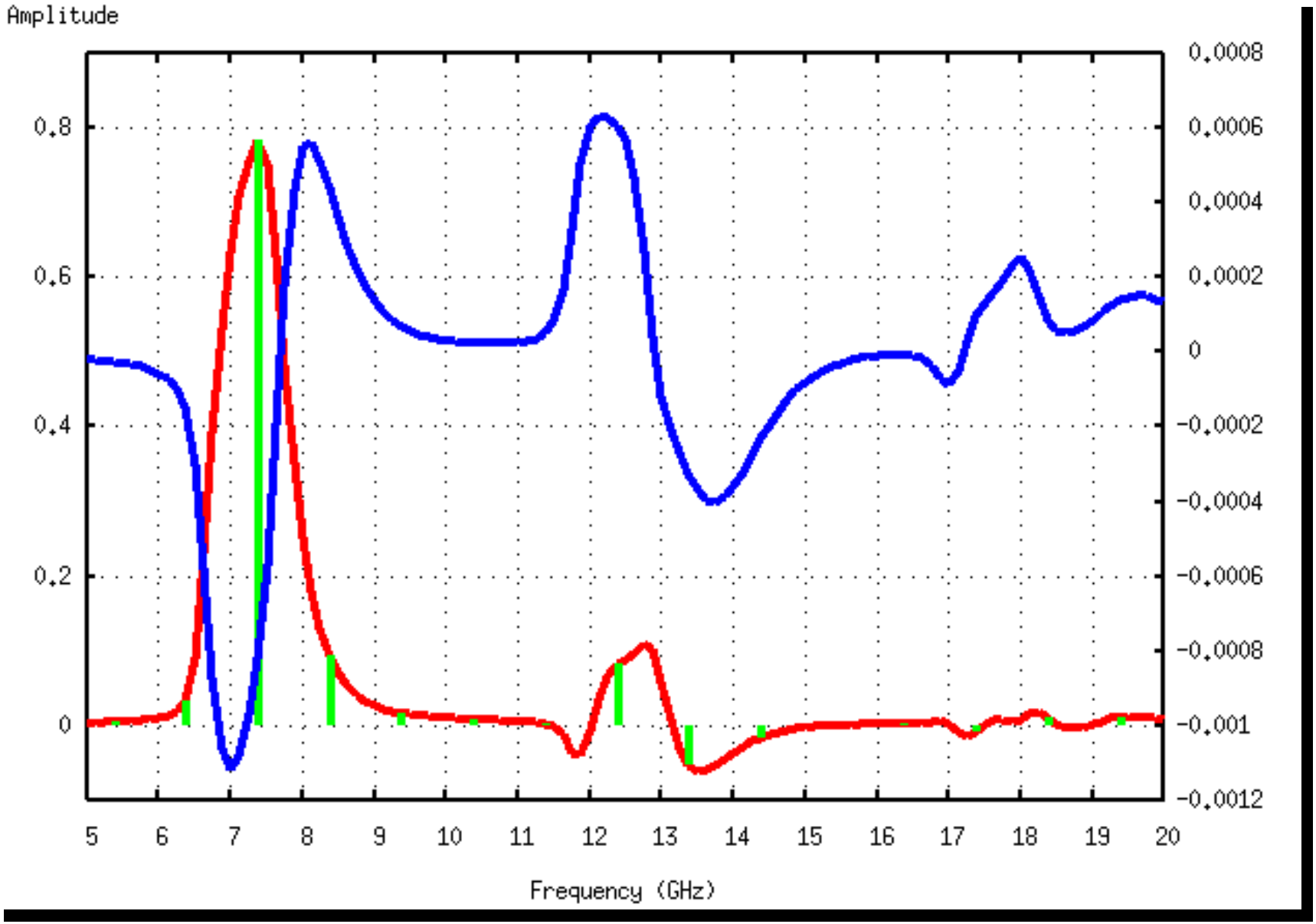




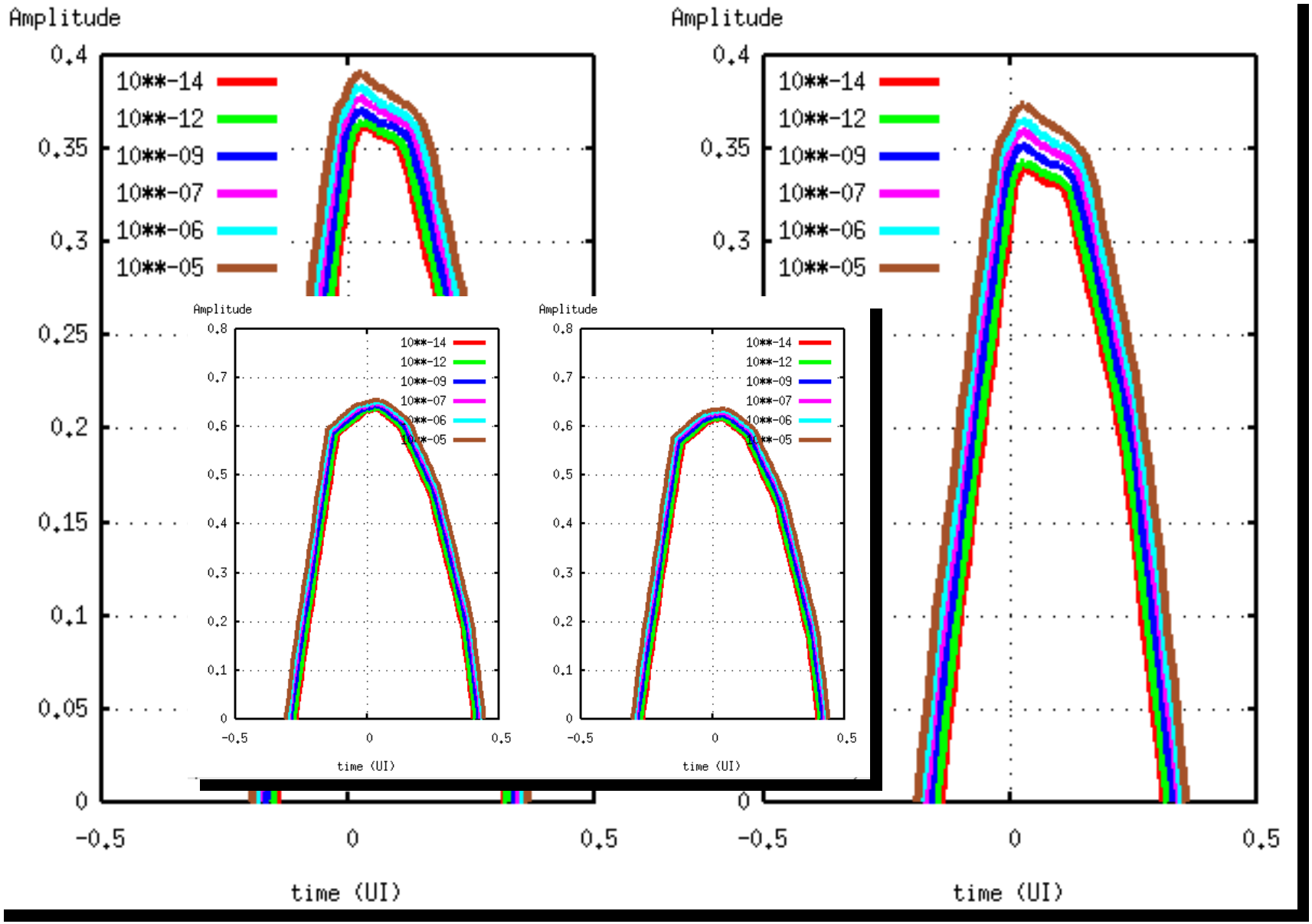
Short Channel with via



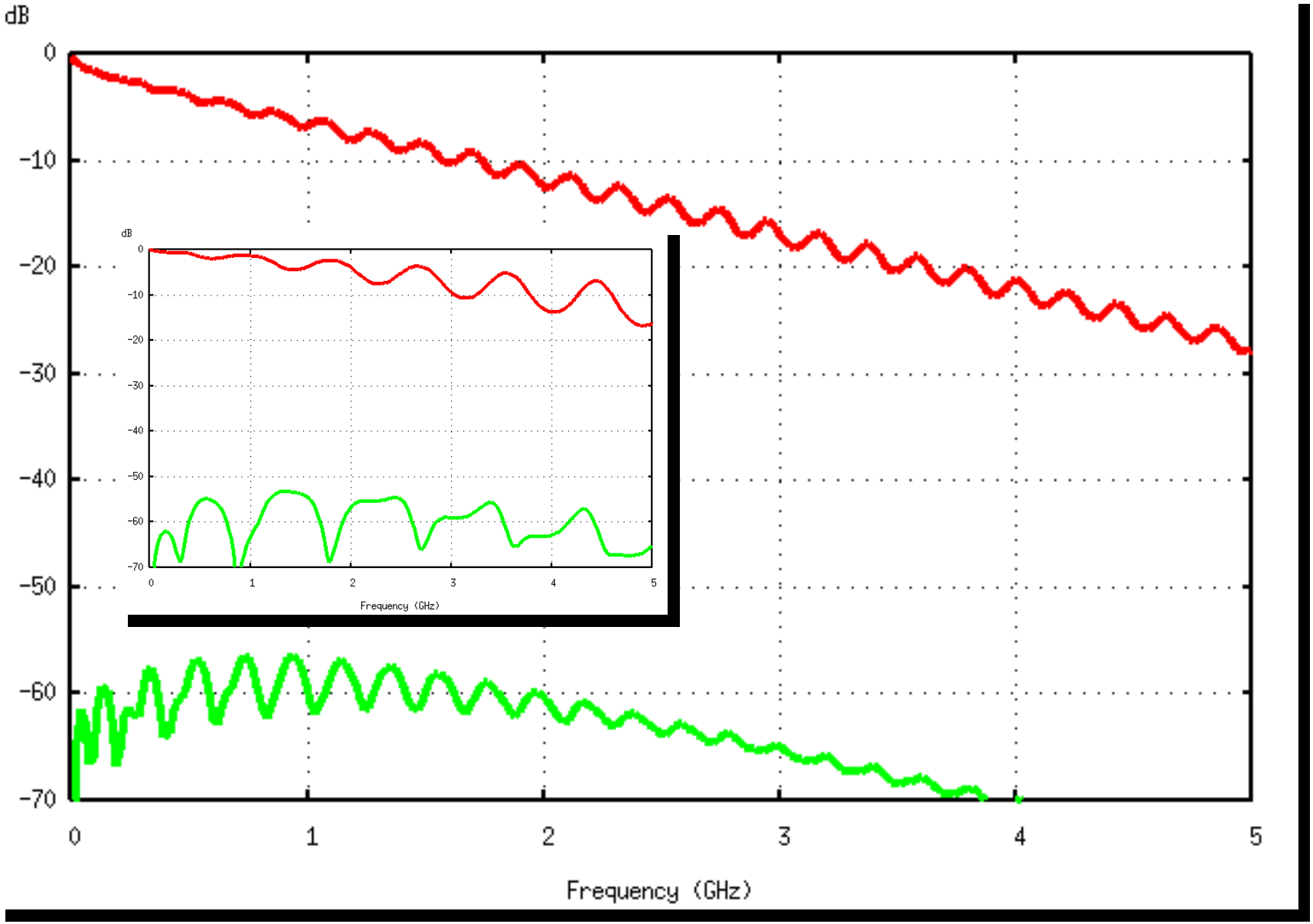
Short Channel with via



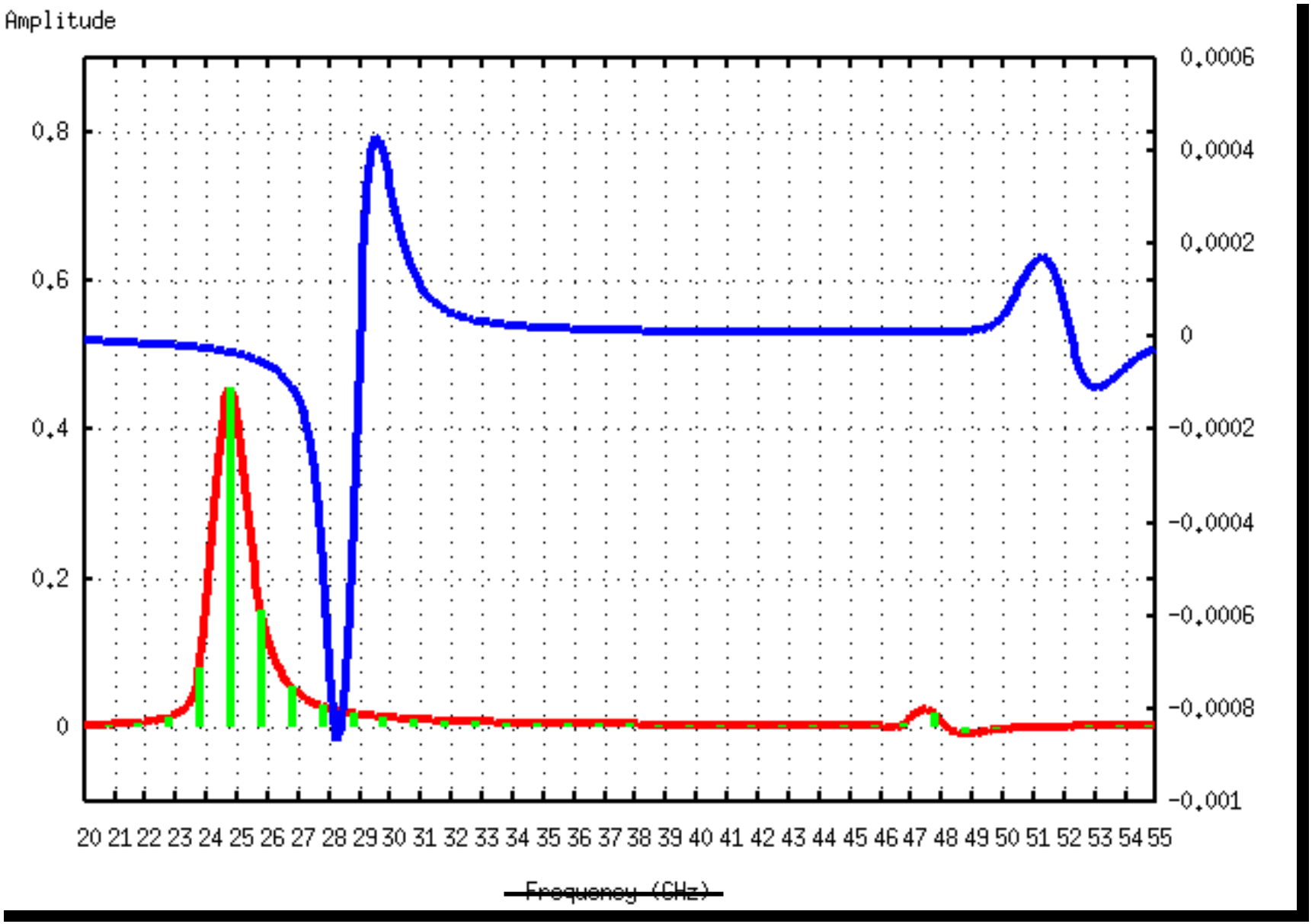
Short Channel with via



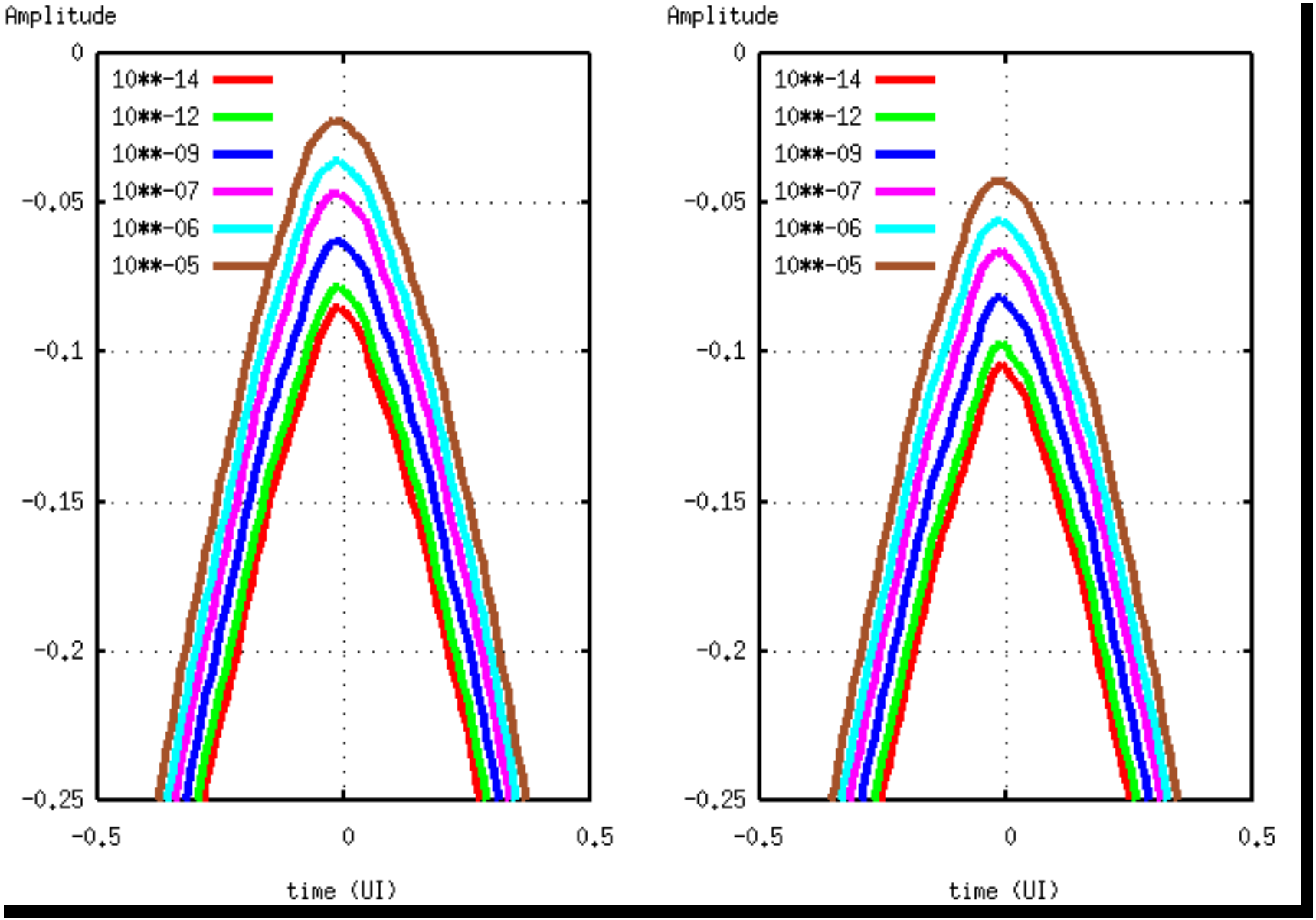
Longer Channel



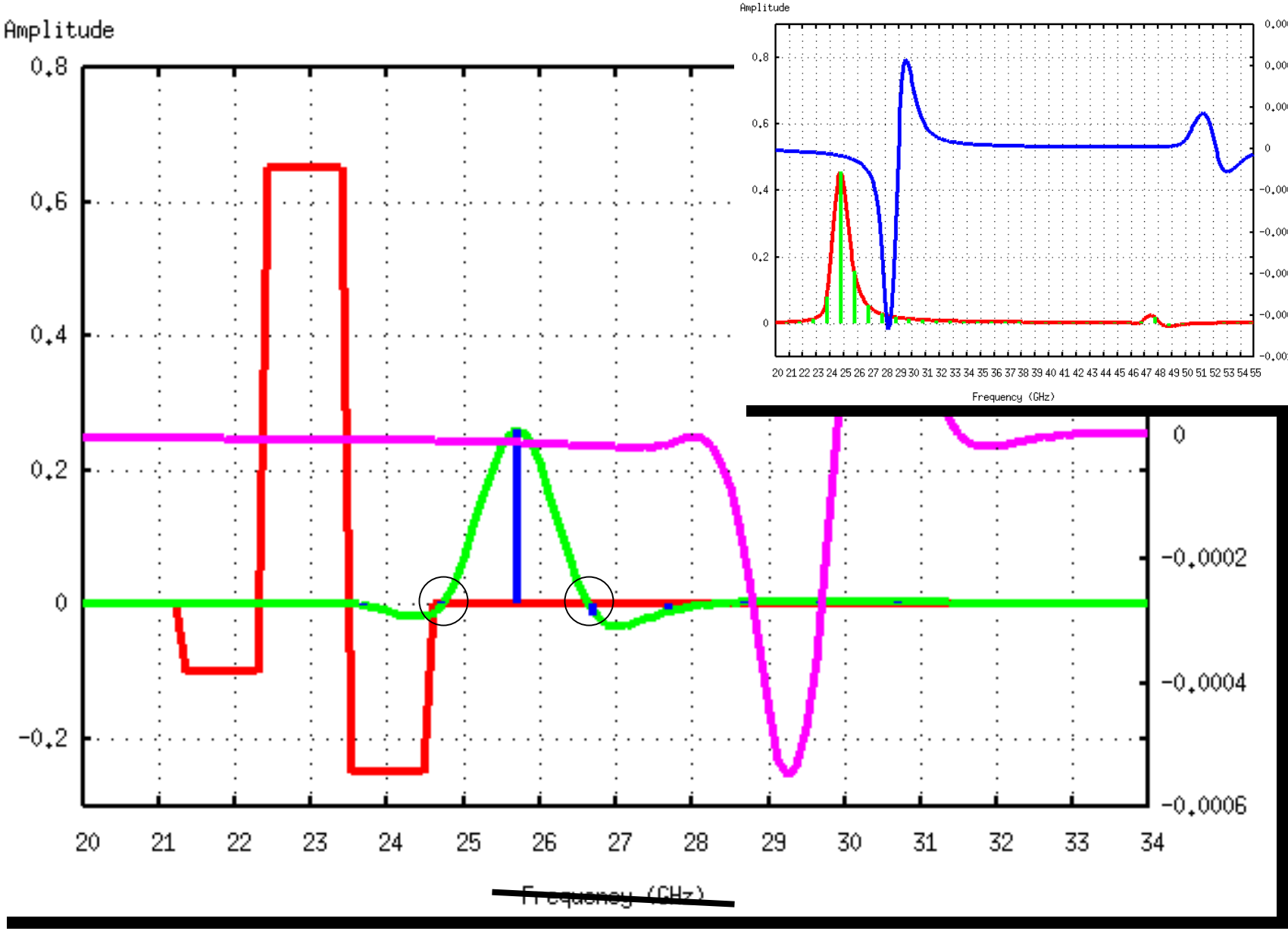
Longer Channel



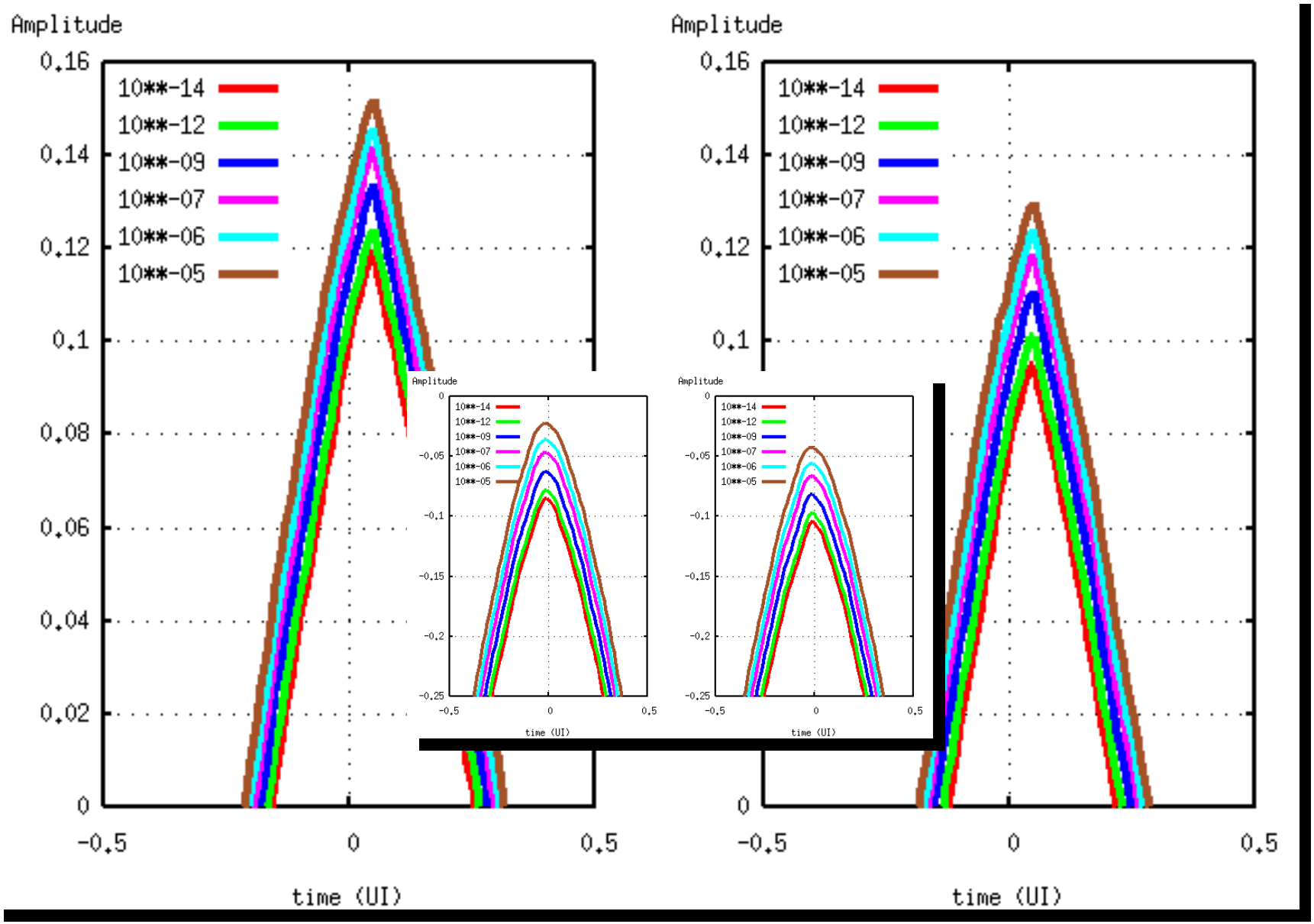
Longer Channel



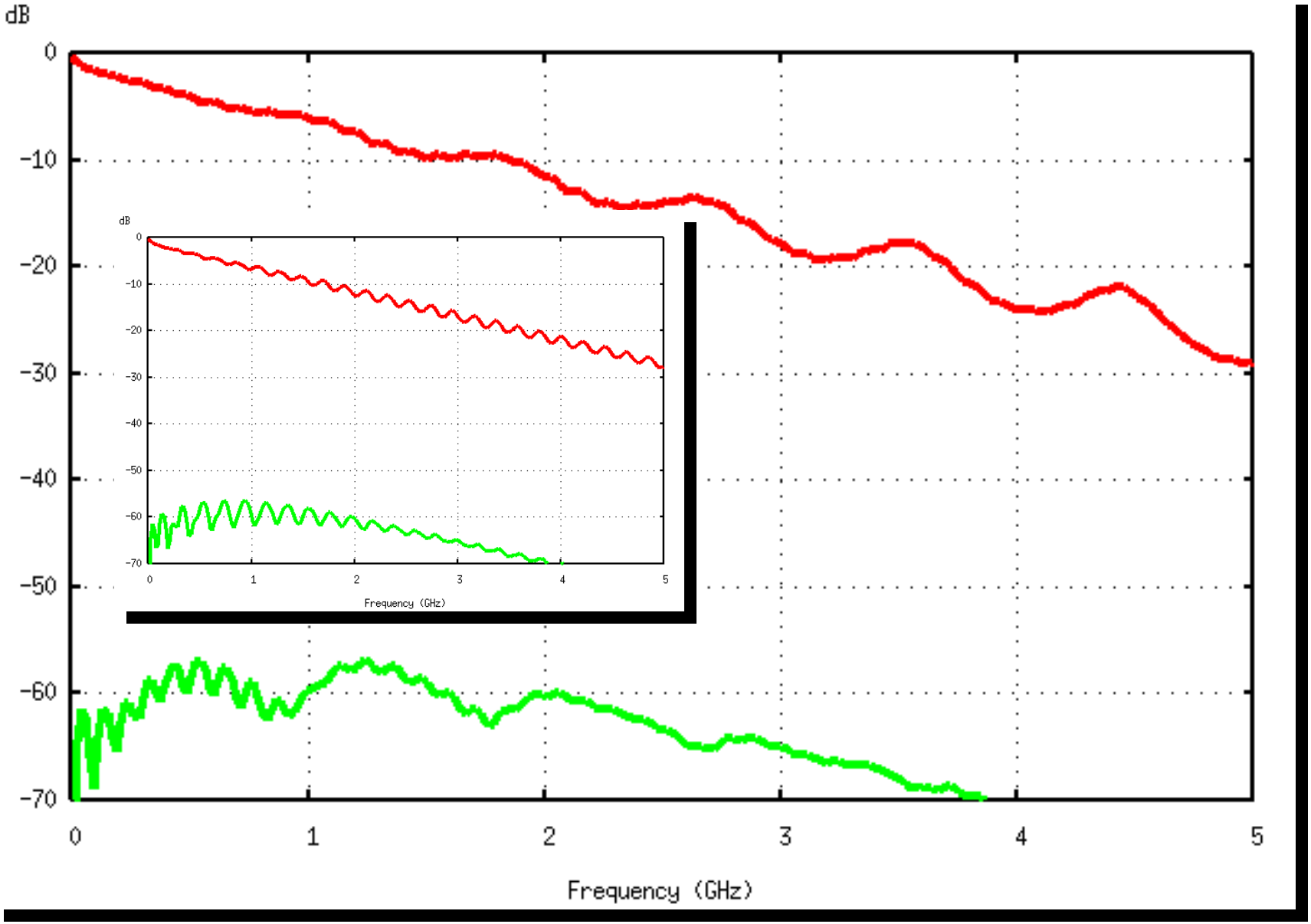
Longer Channel + deemphasis



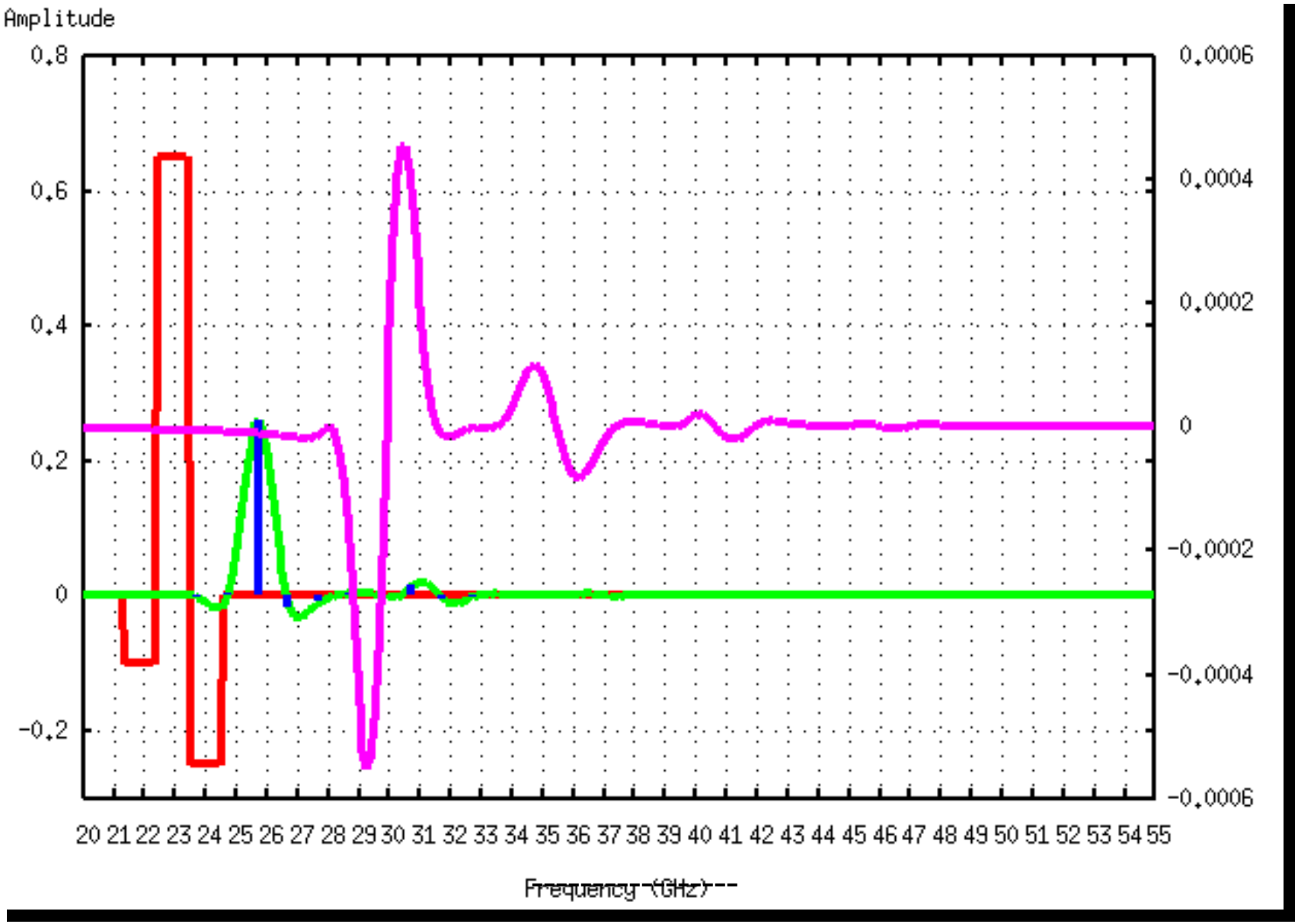
Longer Channel + deemphasis



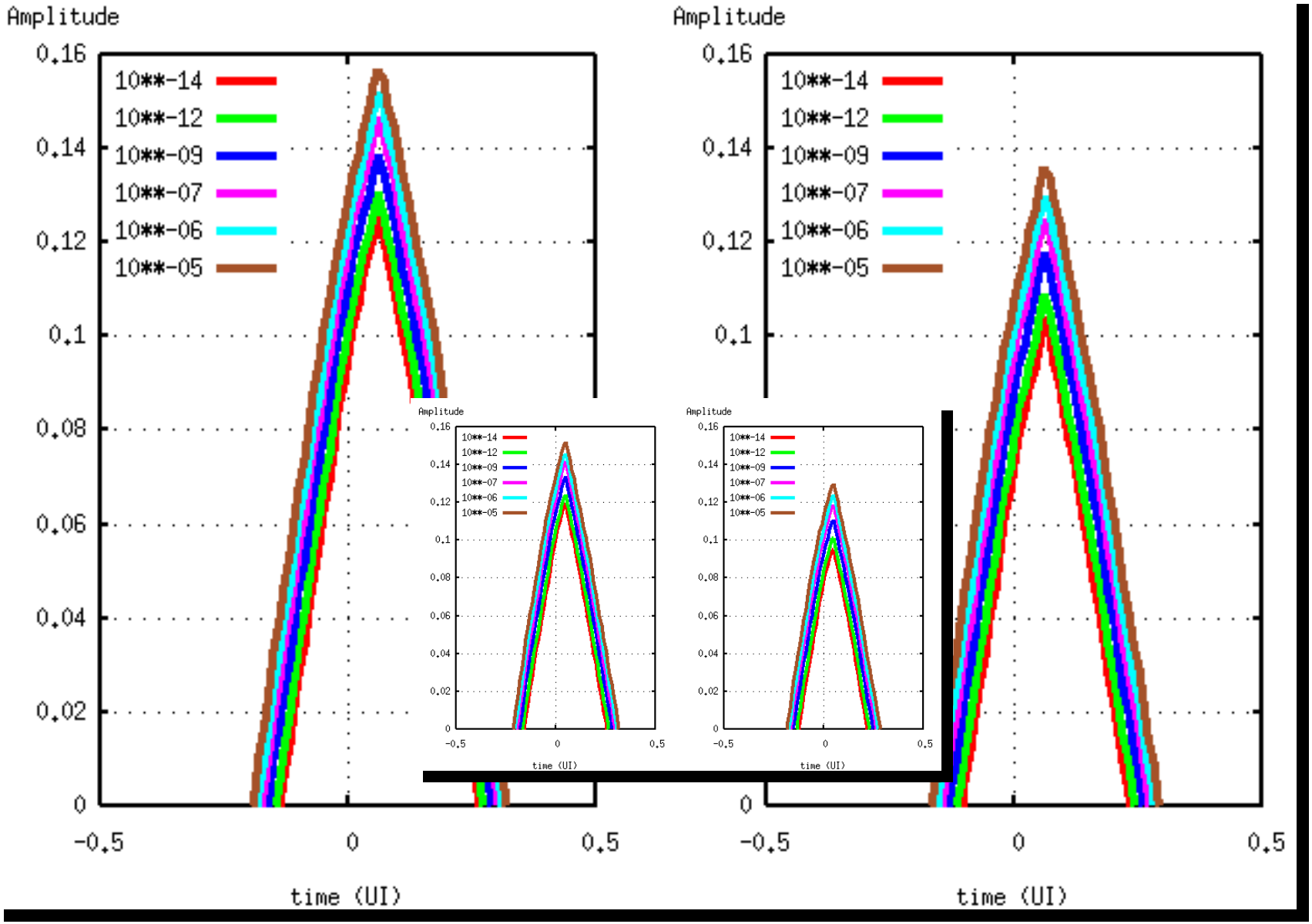
Long Channel with close rx via



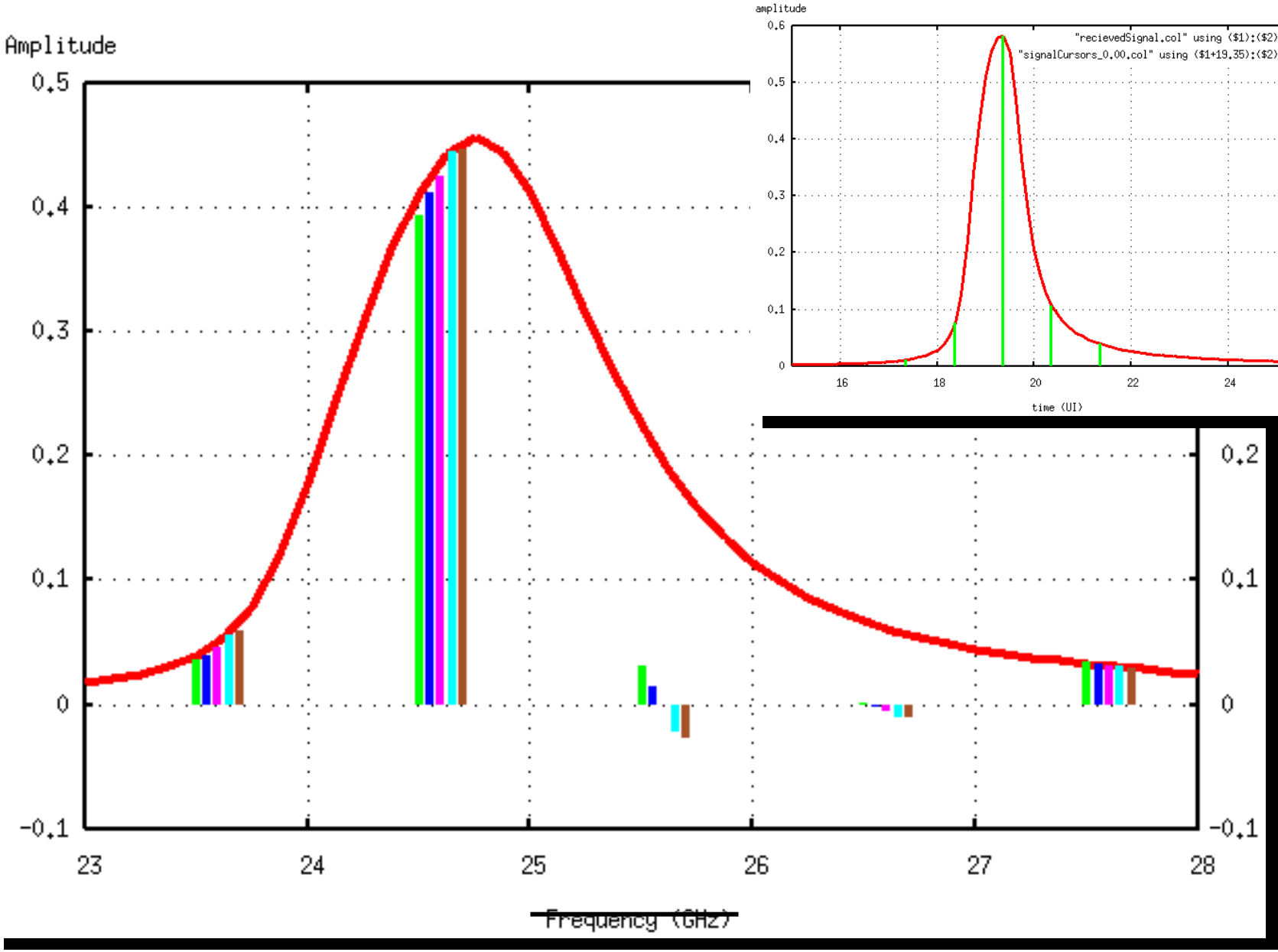
Long Channel with close rx via



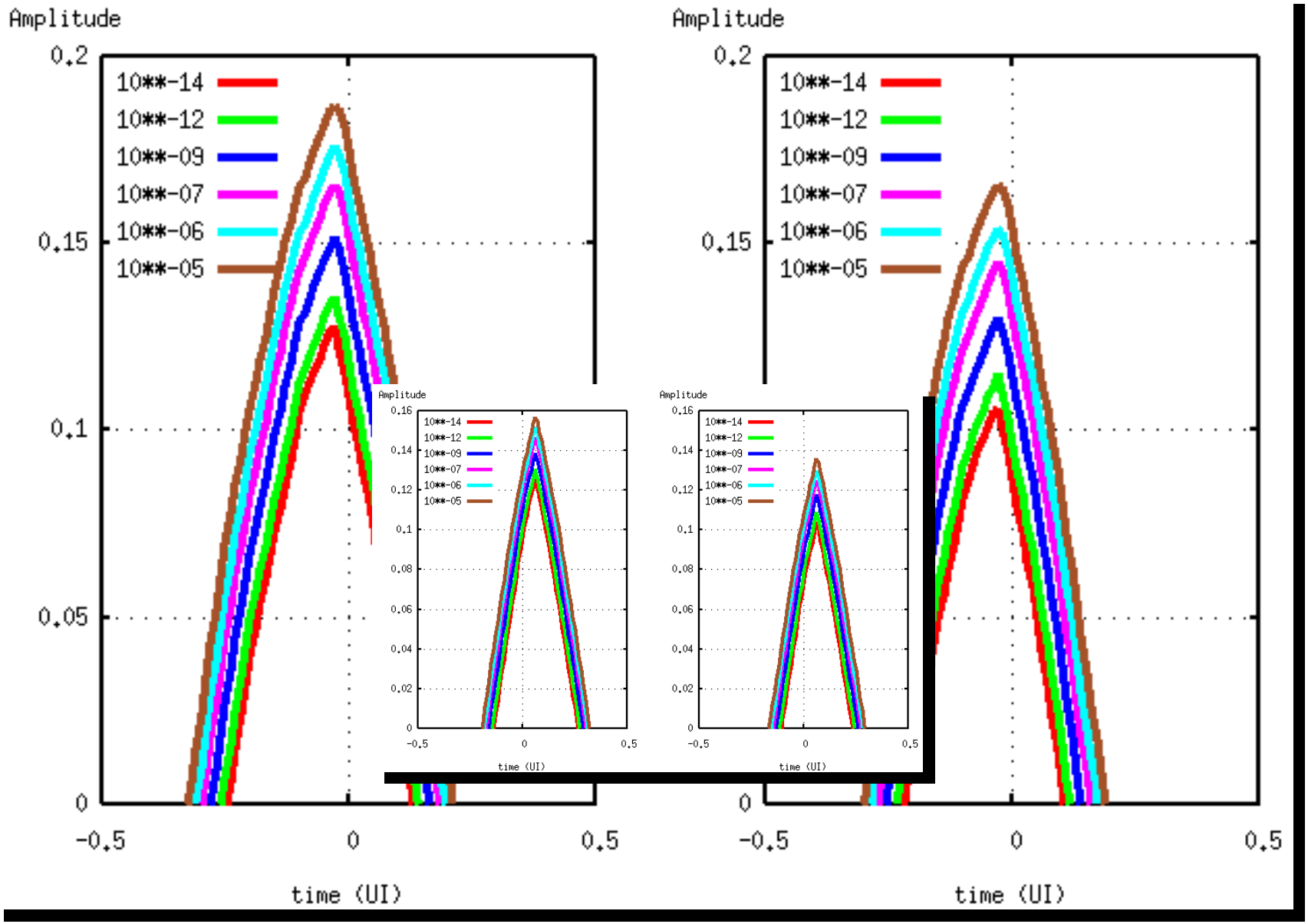
Long Channel with close rx via



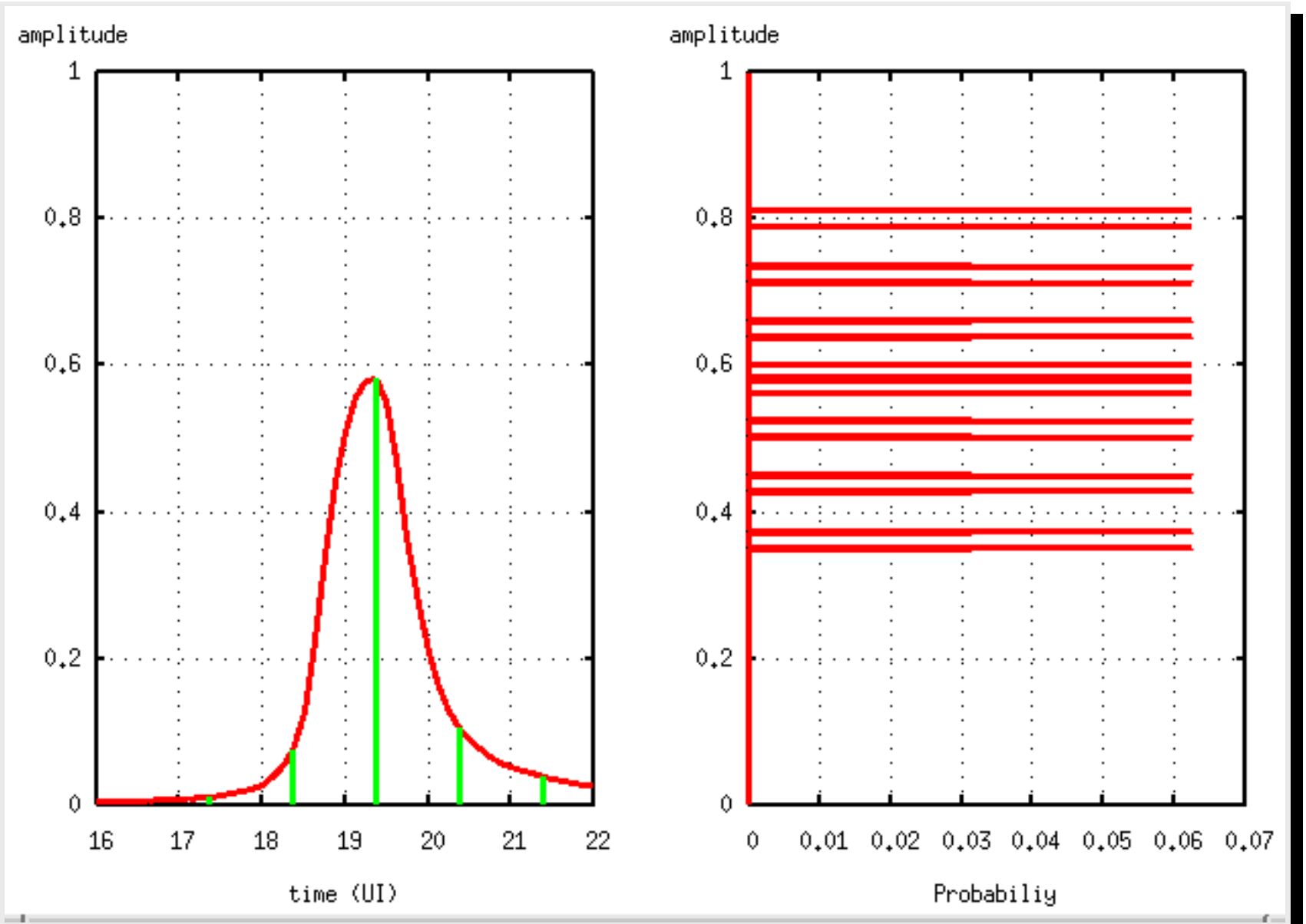
Longer Channel + DFE



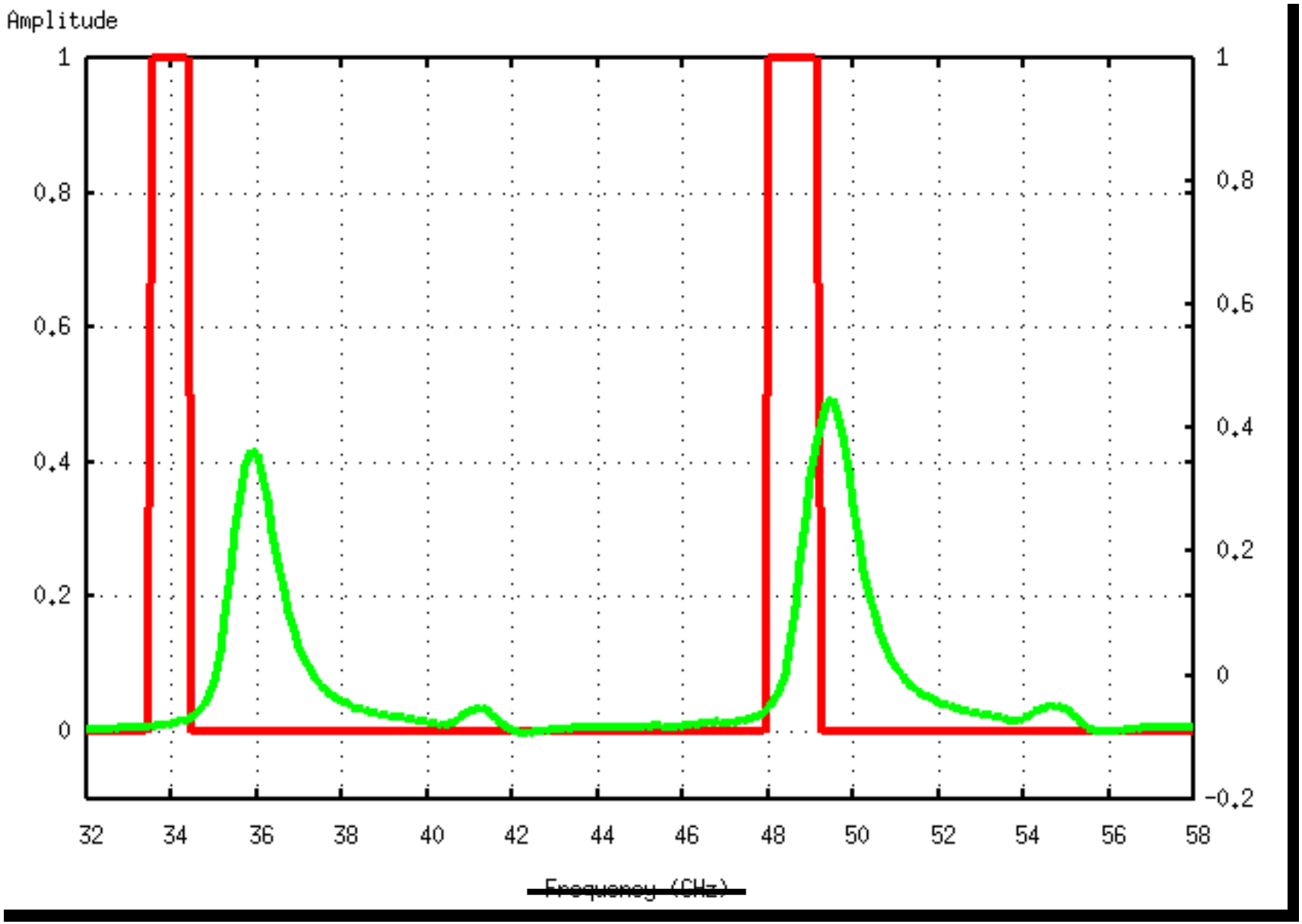
Longer Channel + DFE



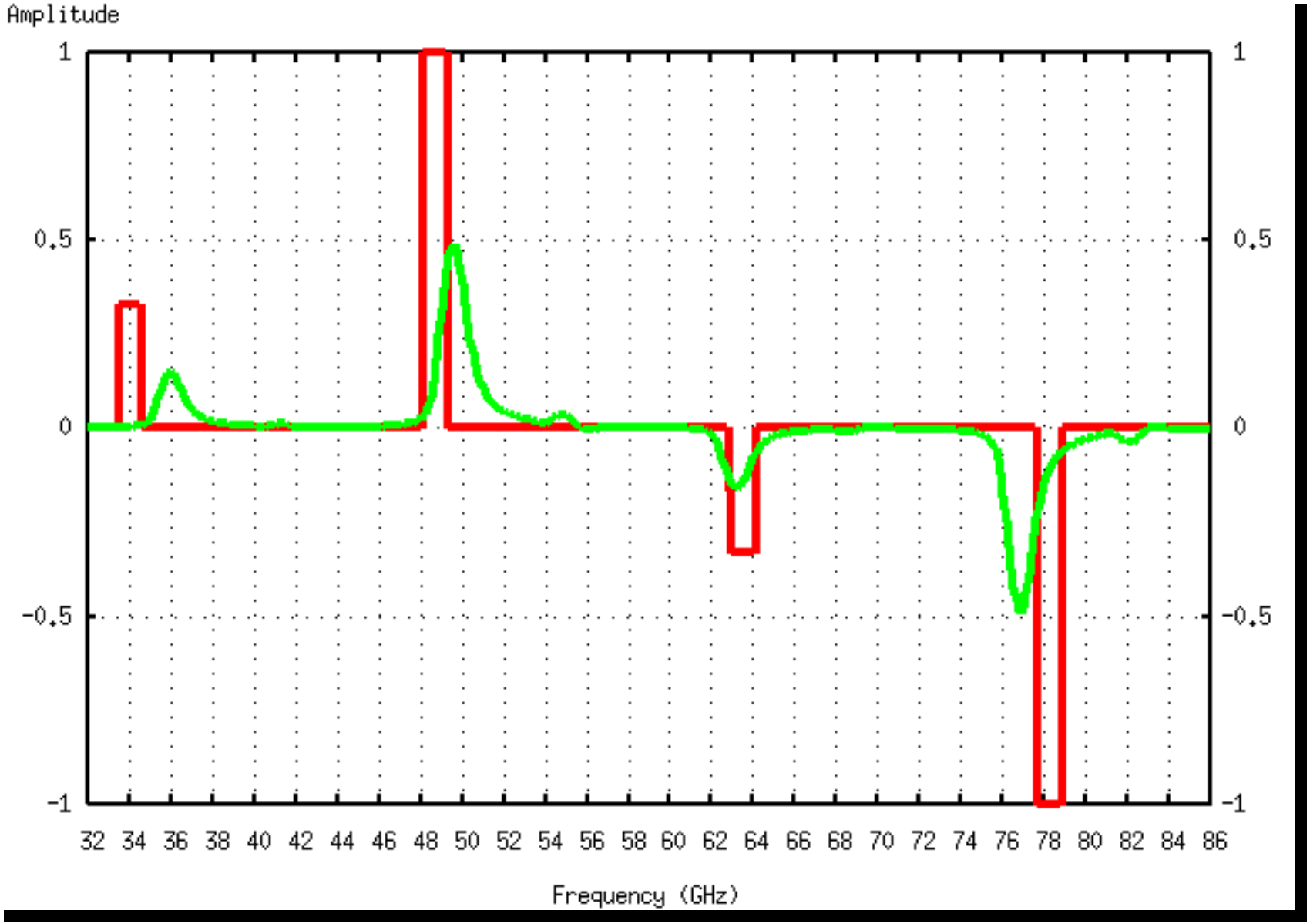
Dealing with Correlated Data



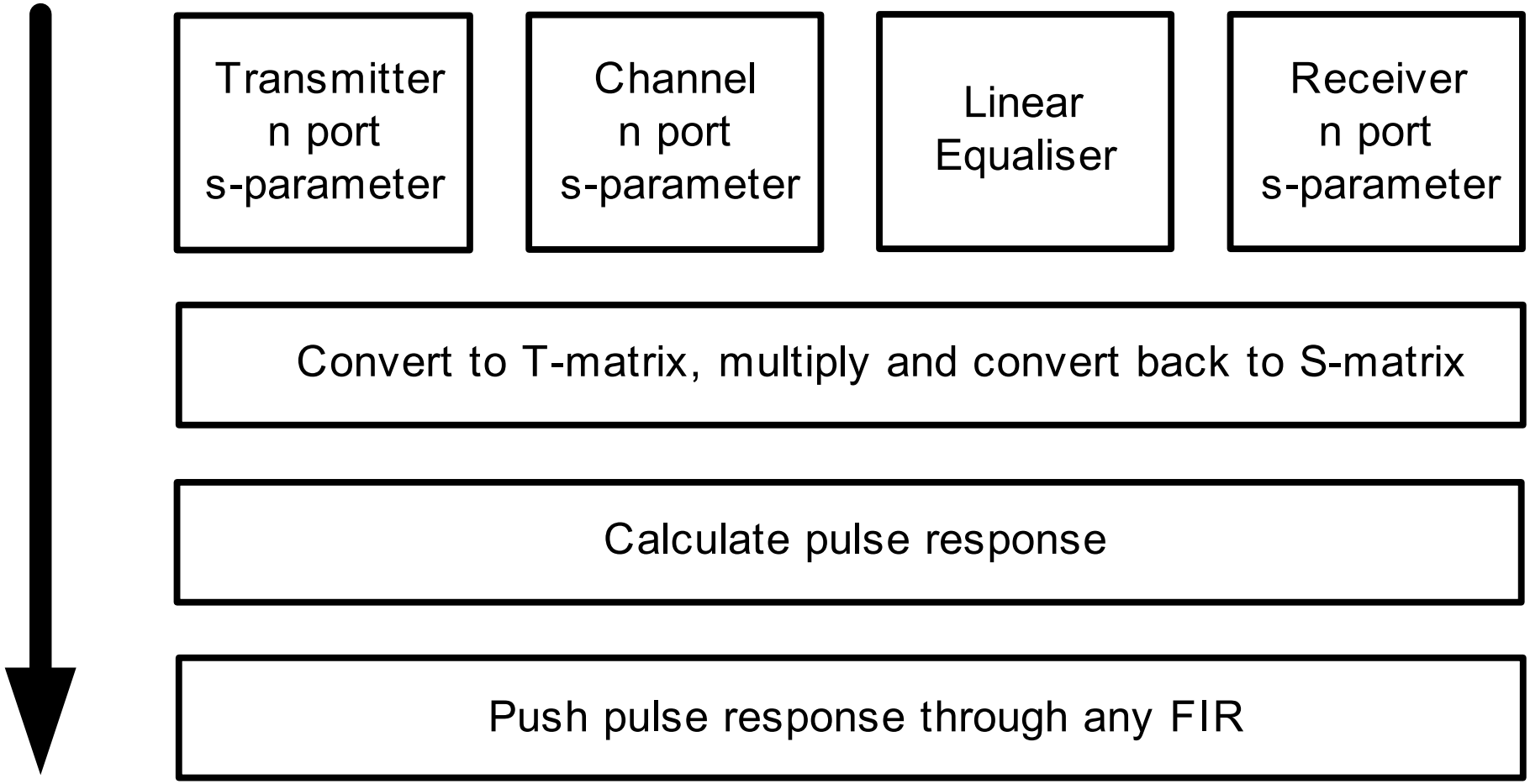
DCD or Pulse Shrinkage



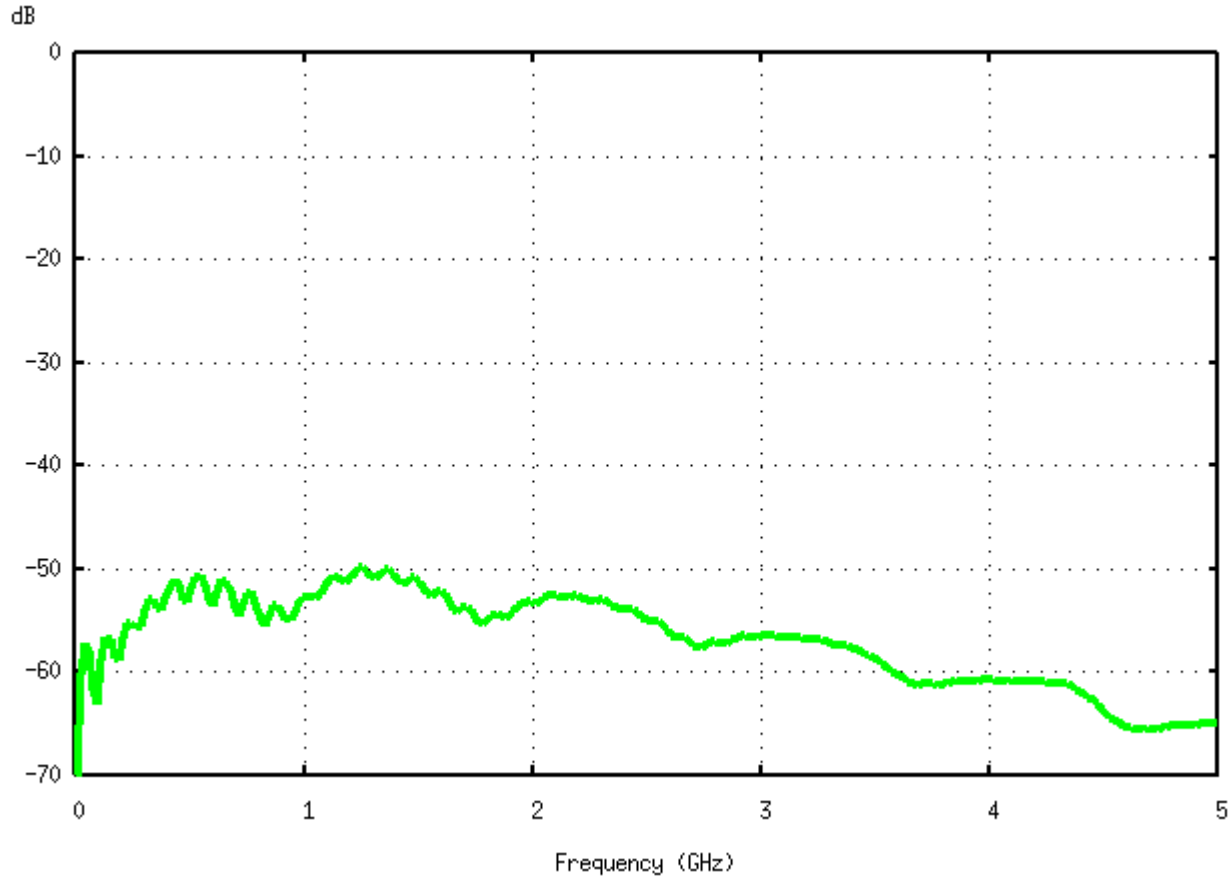
PAM


Amplitude
1
0.5
0
-0.5
-1
32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86
Frequency (GHz)

Return Loss, Boosting and FIRs



Dealing with common mode



- Calculate common mode transfer function
- Create the pulse response seen at the receiver
- Extract the cursors
- Additional use the cursors in the calculation of the conditional pdf, as for crosstalk

Stateye

- Stateye is a non-profit, open source, developers forum under www.stateye.org
- Currently stateye is being re-developed
- Stateye is being rewritten currently under c++ to allow easier contribution and exploration of differing technical opinions
  - The initial c++ class structure and initial functions will be made available at the above website.

Stateye

- Lab results concerning validation of this technique are also available from the website
- Stateye is under continuous development and improvement and encourages contribution
- This presentation is available from the T10 website. T10/05-198r0