Microlensing: Theory, Practice, Results, Future

Workshop 2

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Outline

In this workshop we will:

- Become familiar with relationship between caustic diagrams and light curve features
- Reproduce unseen planetary anomaly light curves

Motivation

Understanding the relationship between lens system parameters, caustic diagrams and lightcurve features is key to begin able to identify likely planetary anomalies and to begin to search for sensible models.

We start with looking at how lens parameters change caustic patterns and how lightcurve features correspond to the source star approaching or crossing these regions.

`coords`

The Matlab function `coords` can produce binary lens lightcurves for both point and finite sized source stars, for any sensible lens and source system values.

`coords` is called in Matlab from the command line and takes a (variable) number of input parameters.

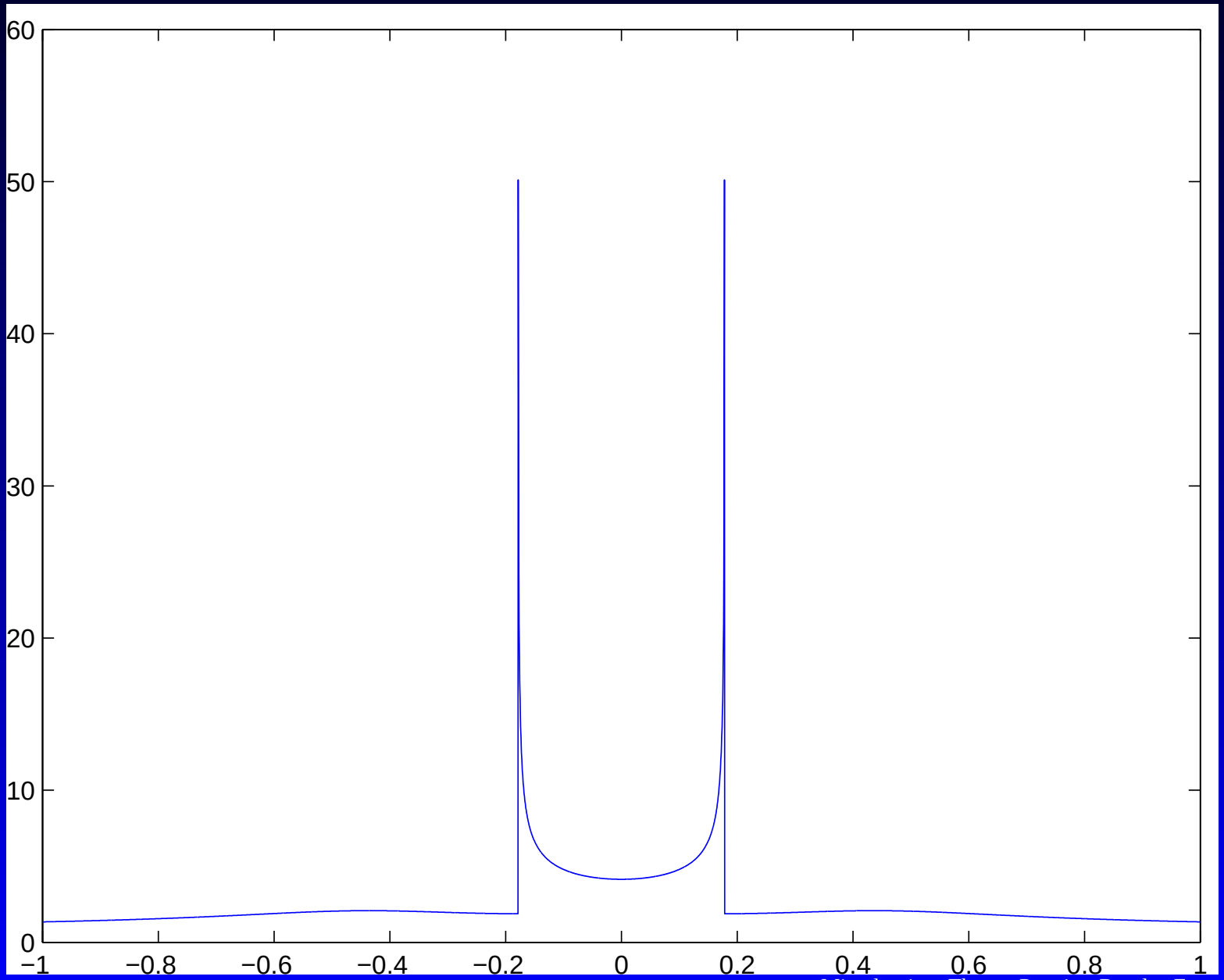
Type `help coords` at any time to get the help text.

coords

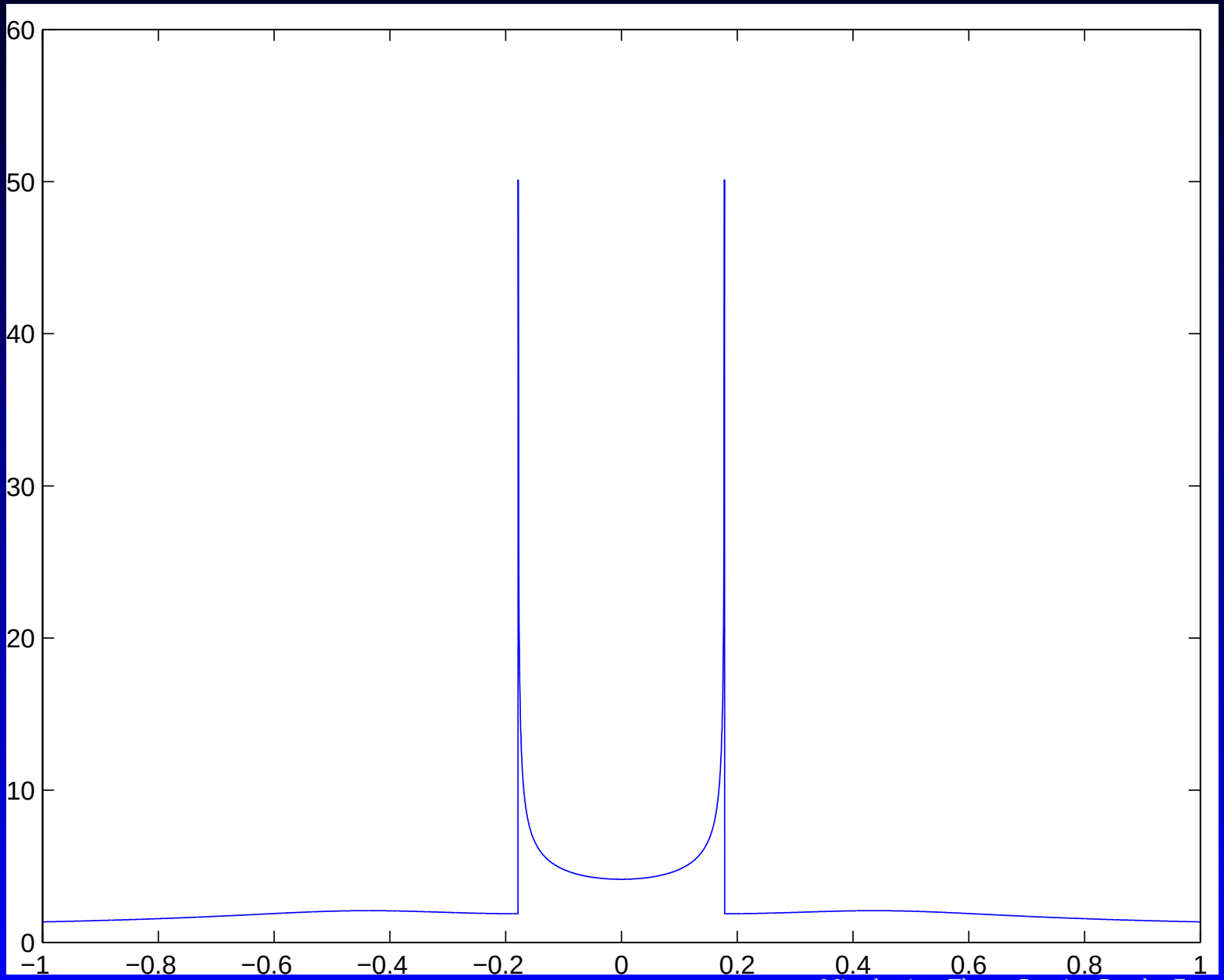
Experiment first with a point-source lightcurve, for various values of $q = \frac{m_1}{m_2}$, d, $u_{\rm min}$ and β.

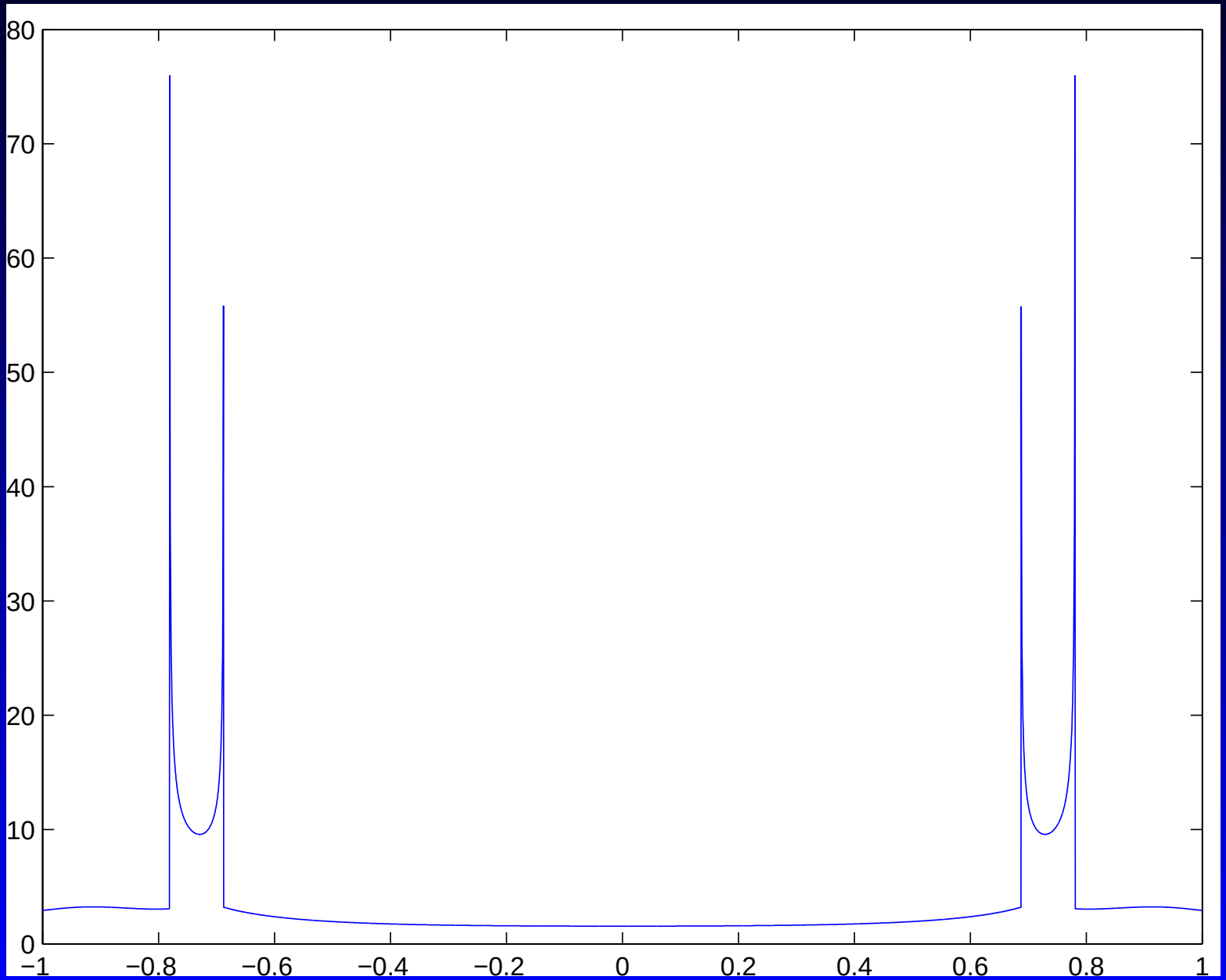
```
COORDS(Q,D,UMIN,BETA)
coords(0.1,1.5,0.01,pi/2)
```

- Q is the mass ratio of the binary lens: Q = M2/M1 (M1+M2=1)
- D is the projected binary lens separation in units of Re
- UMIN is the minimum impact parameter in units of Re
- BETA is the angle between com-tracknormal and binary axis in radians


60
50
40
30
20
10
0
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
1

coords(1,1.0,0.2,pi/2)

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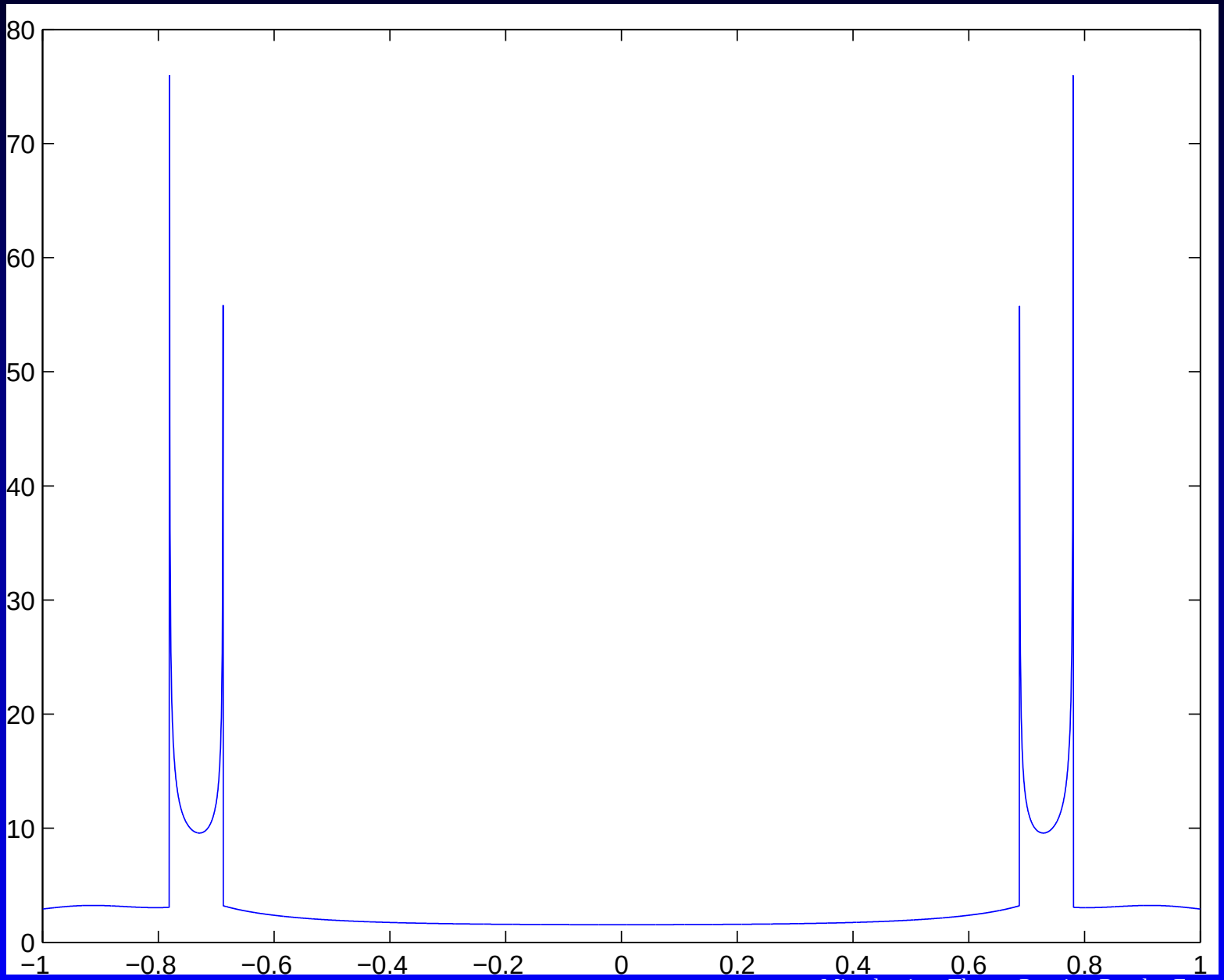
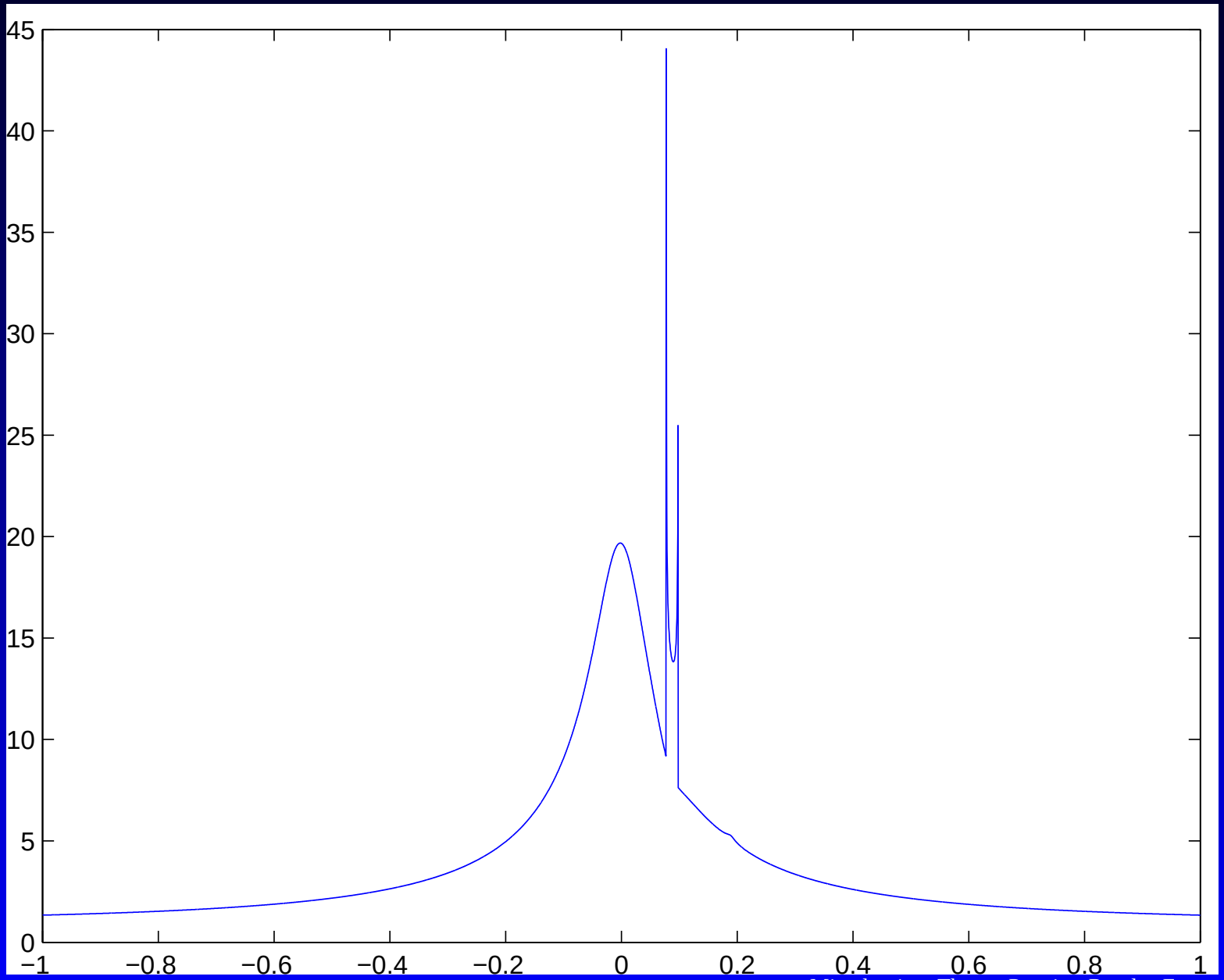
70
60
50
40
30
20
10
0
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
1

coords(1,2.0,0.1,pi/2)

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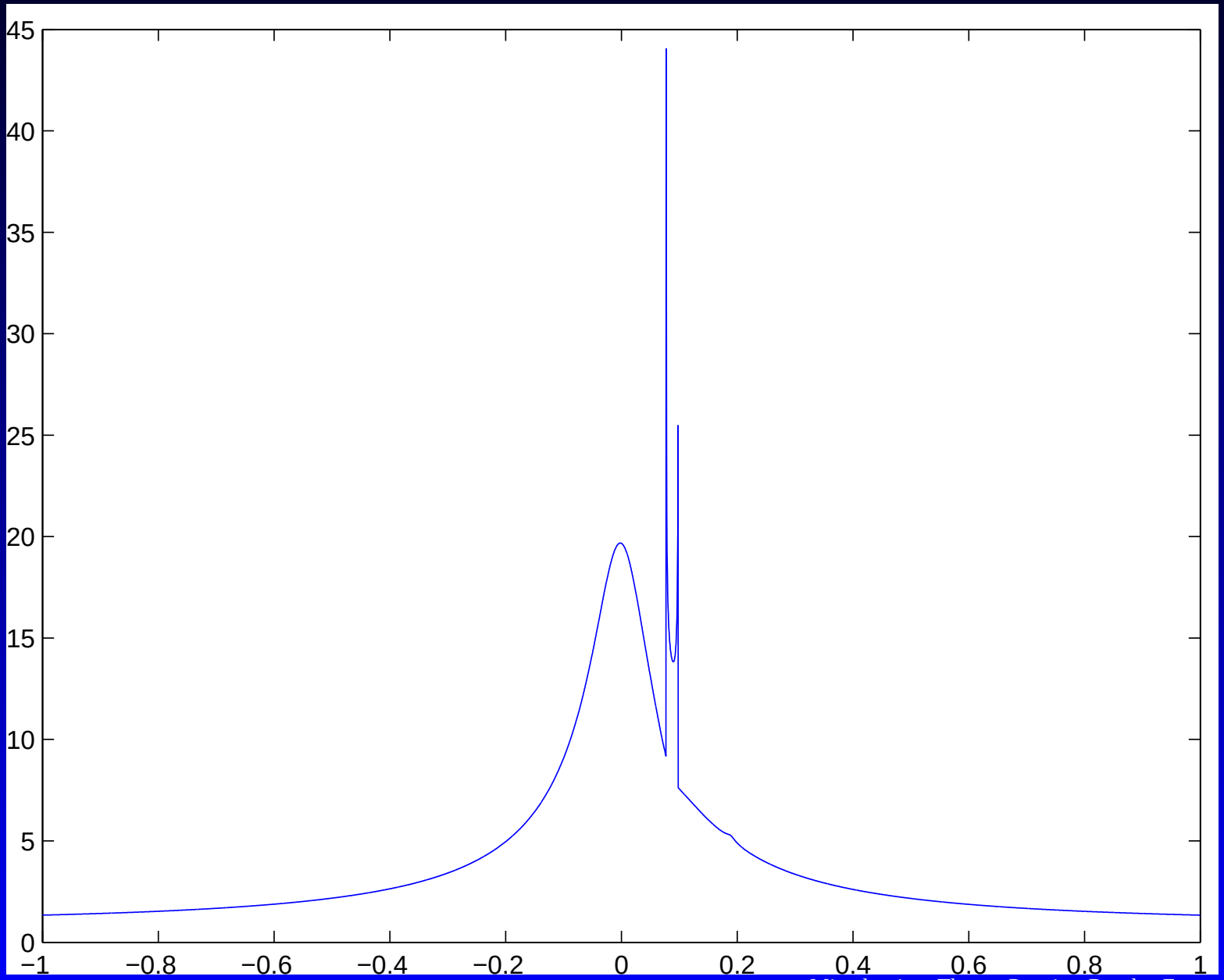
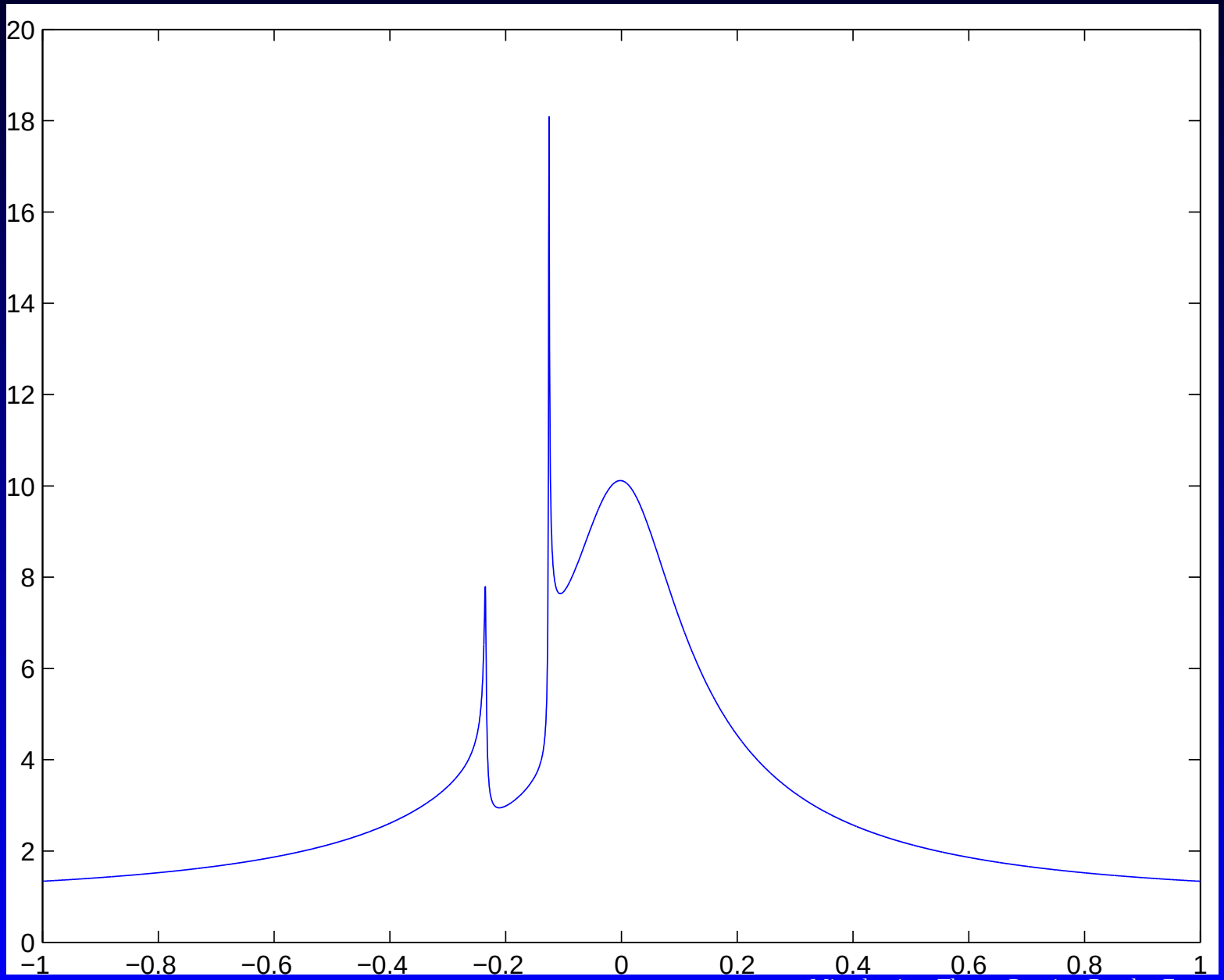
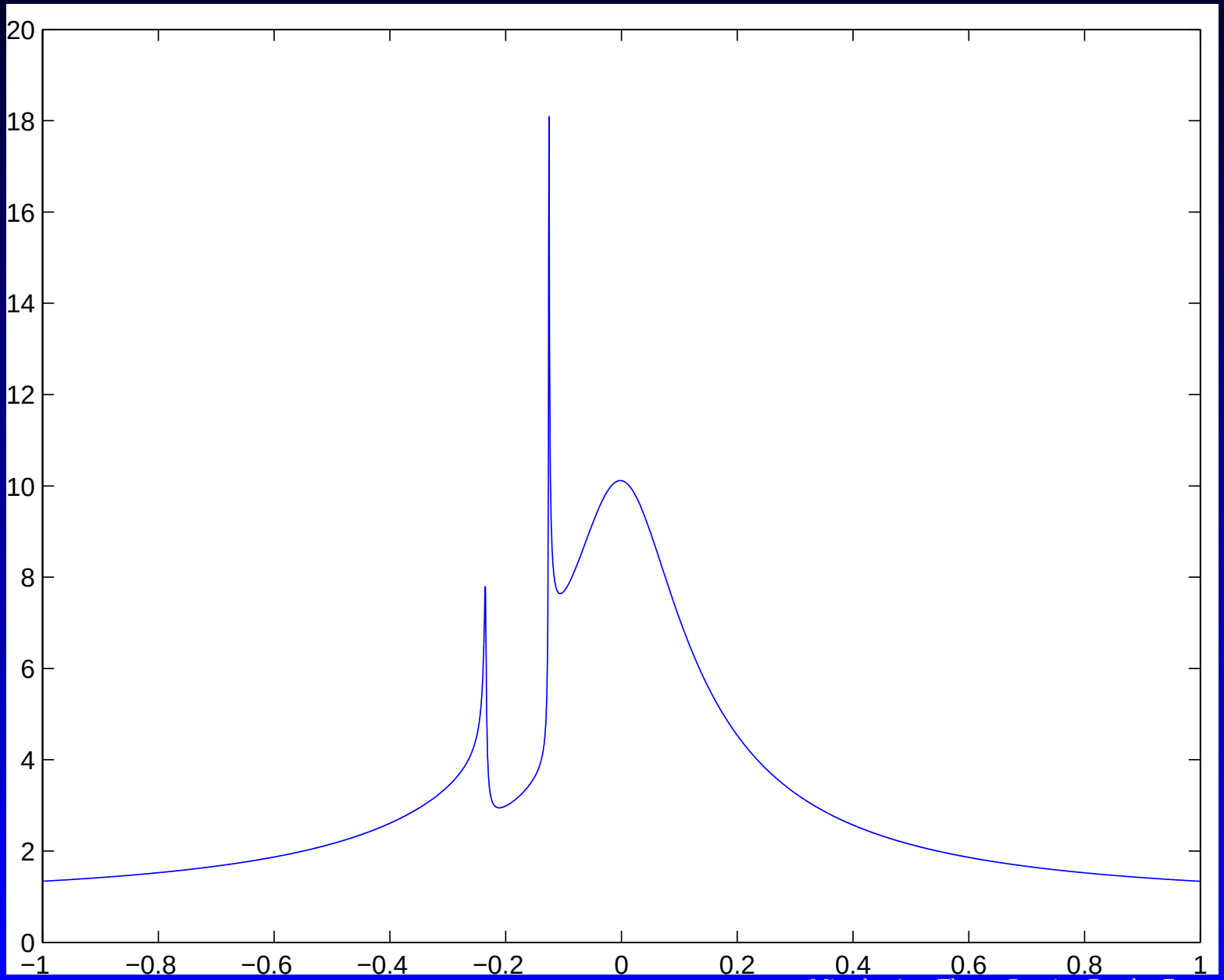
40
35
30
25
20
15
10
5
0
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
1

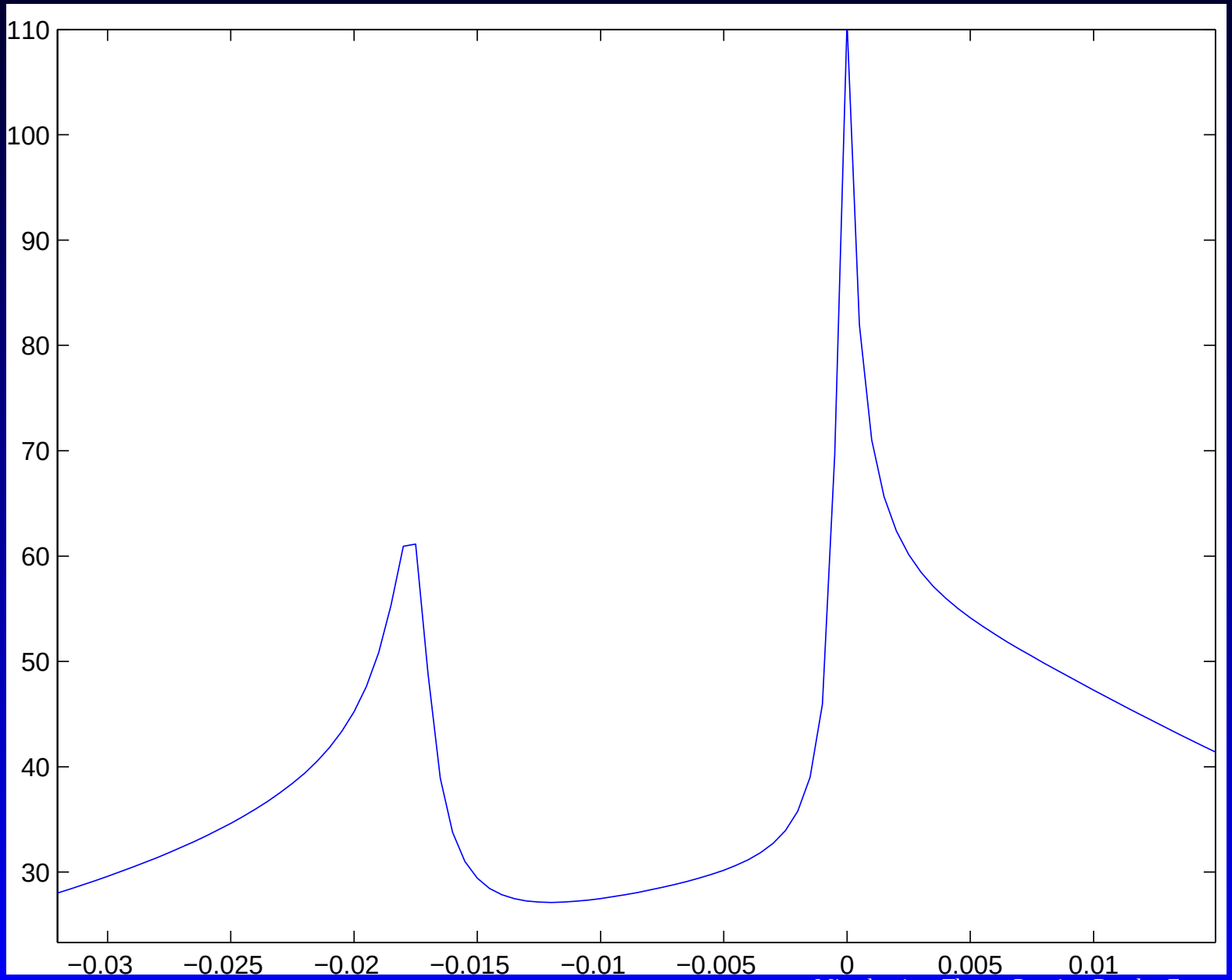
coords(1e-3,1.1,0.05,pi/3)



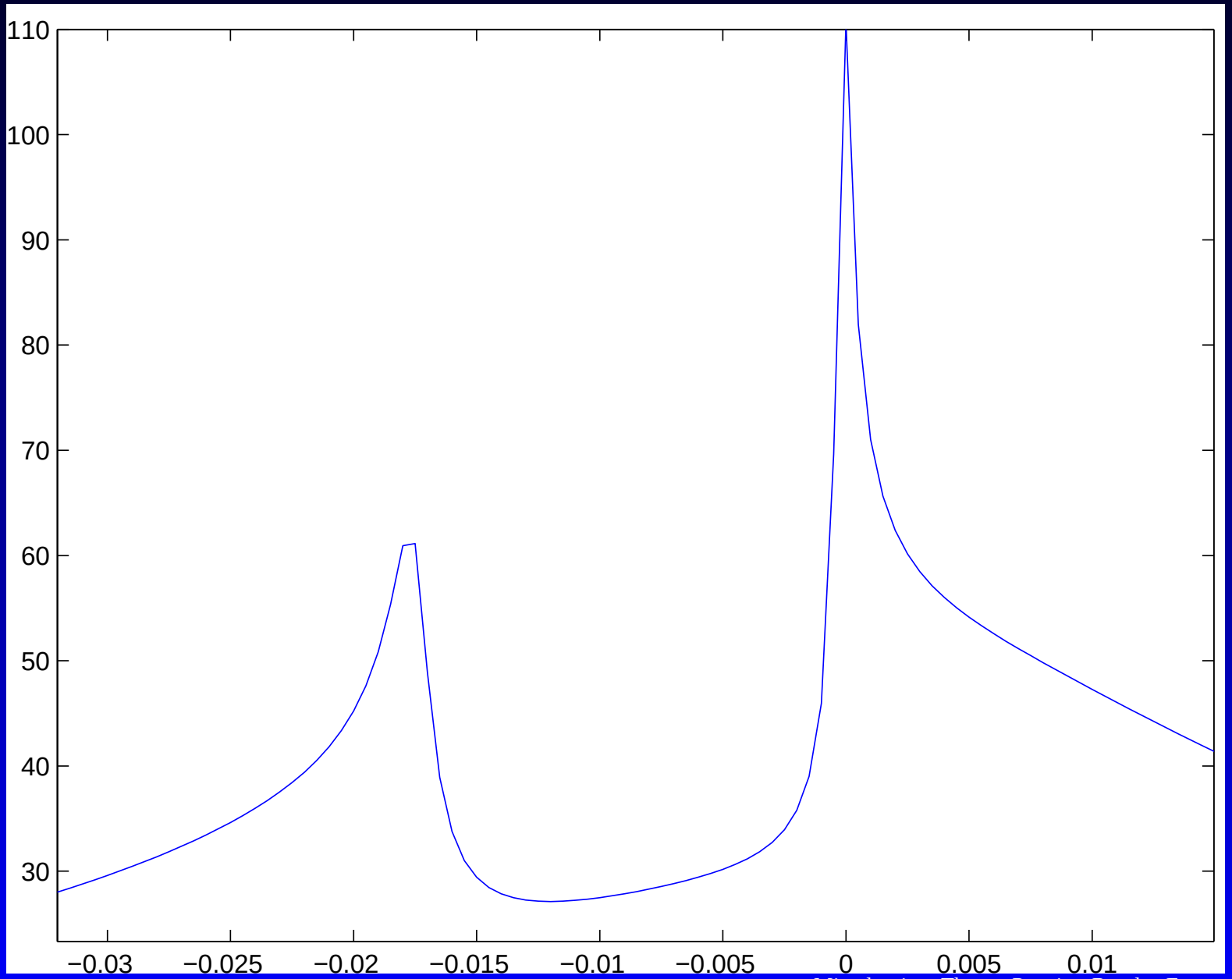

20
18
16
14
12
10
8
6
4
2
0
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
1

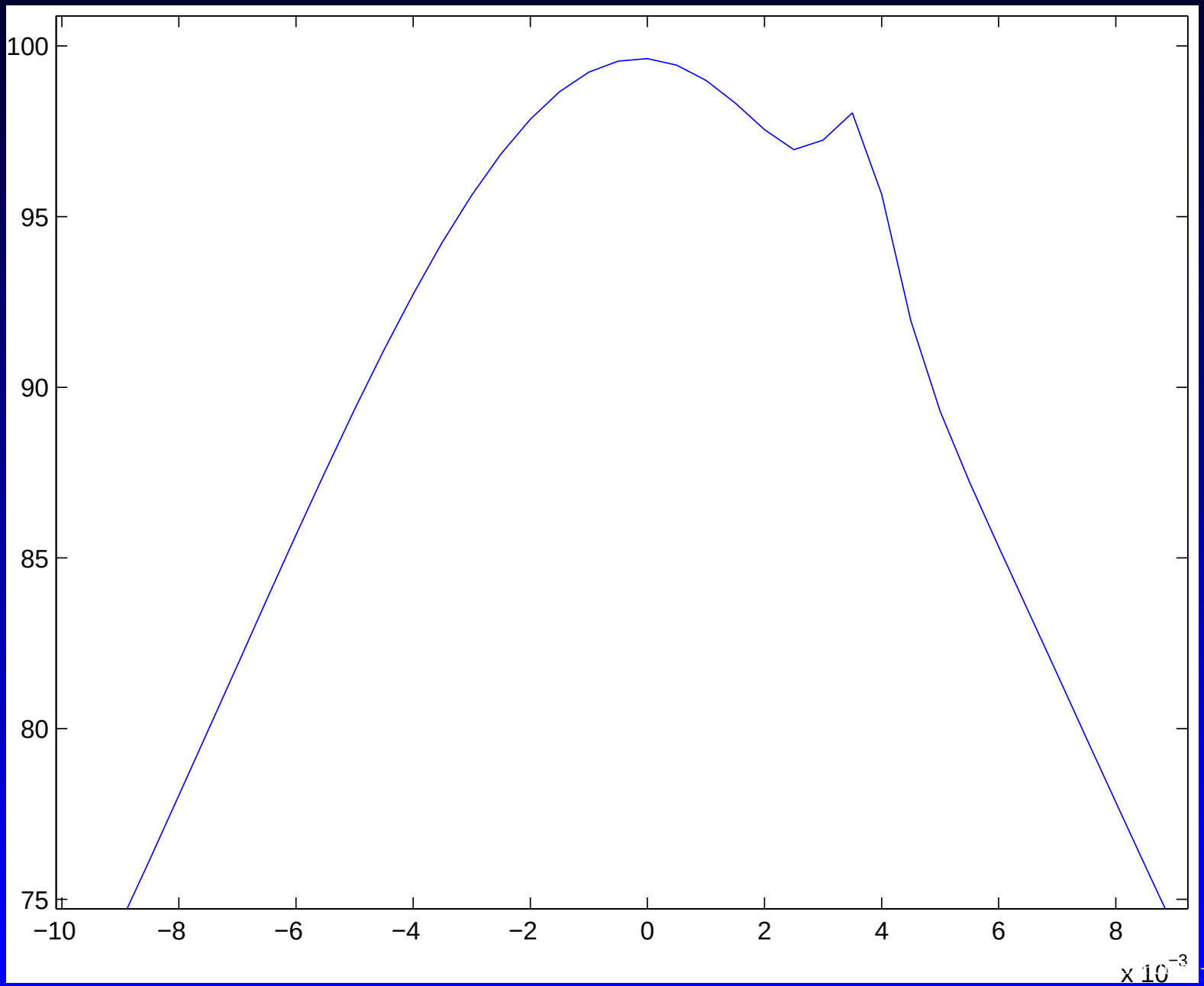
coords(1e-3,0.9,0.1,2*pi/3)



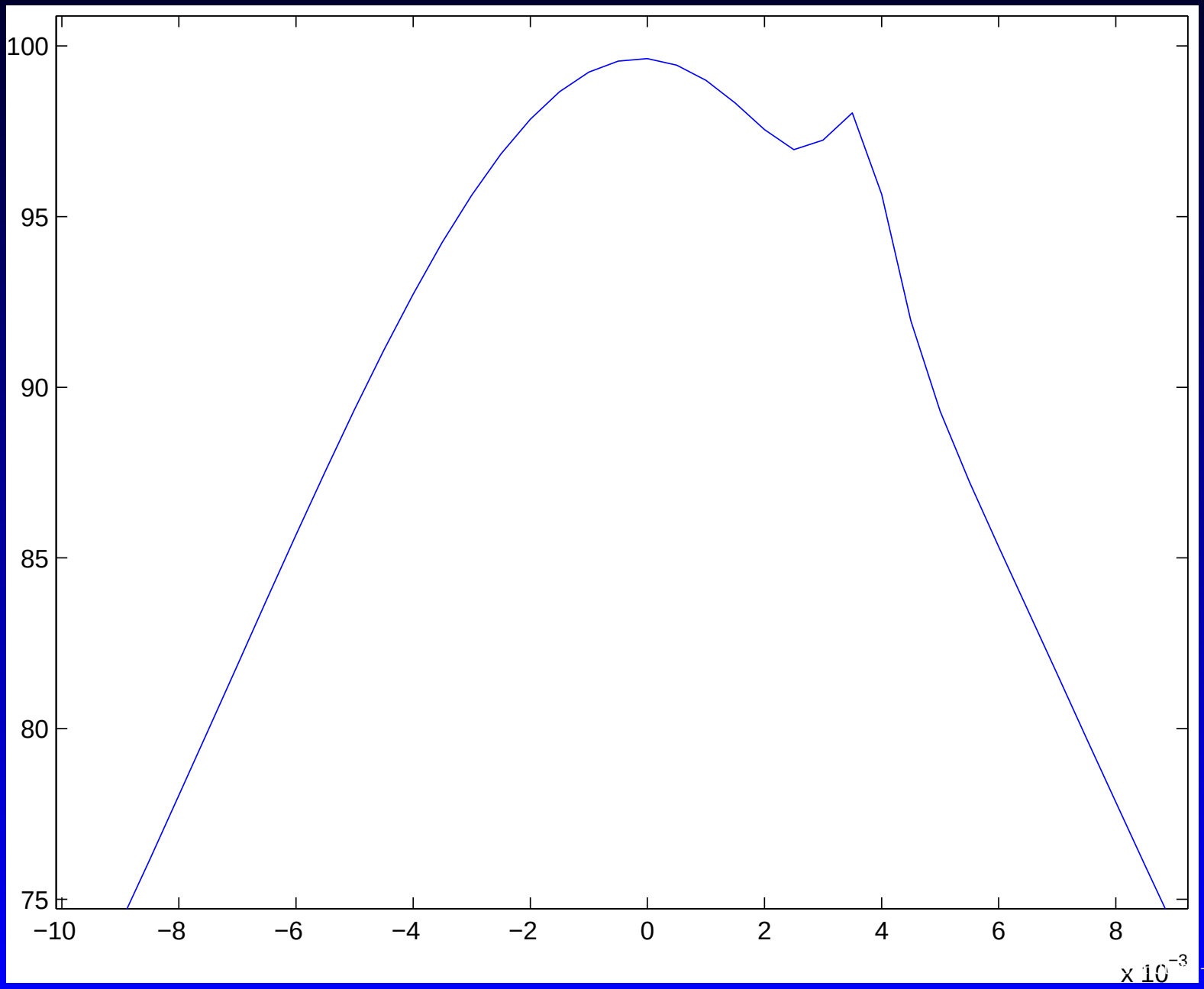

110
100
90
80
70
60
50
40
30
−0.03
−0.025
−0.02
−0.015
−0.01
−0.005
0
0.005
0.01

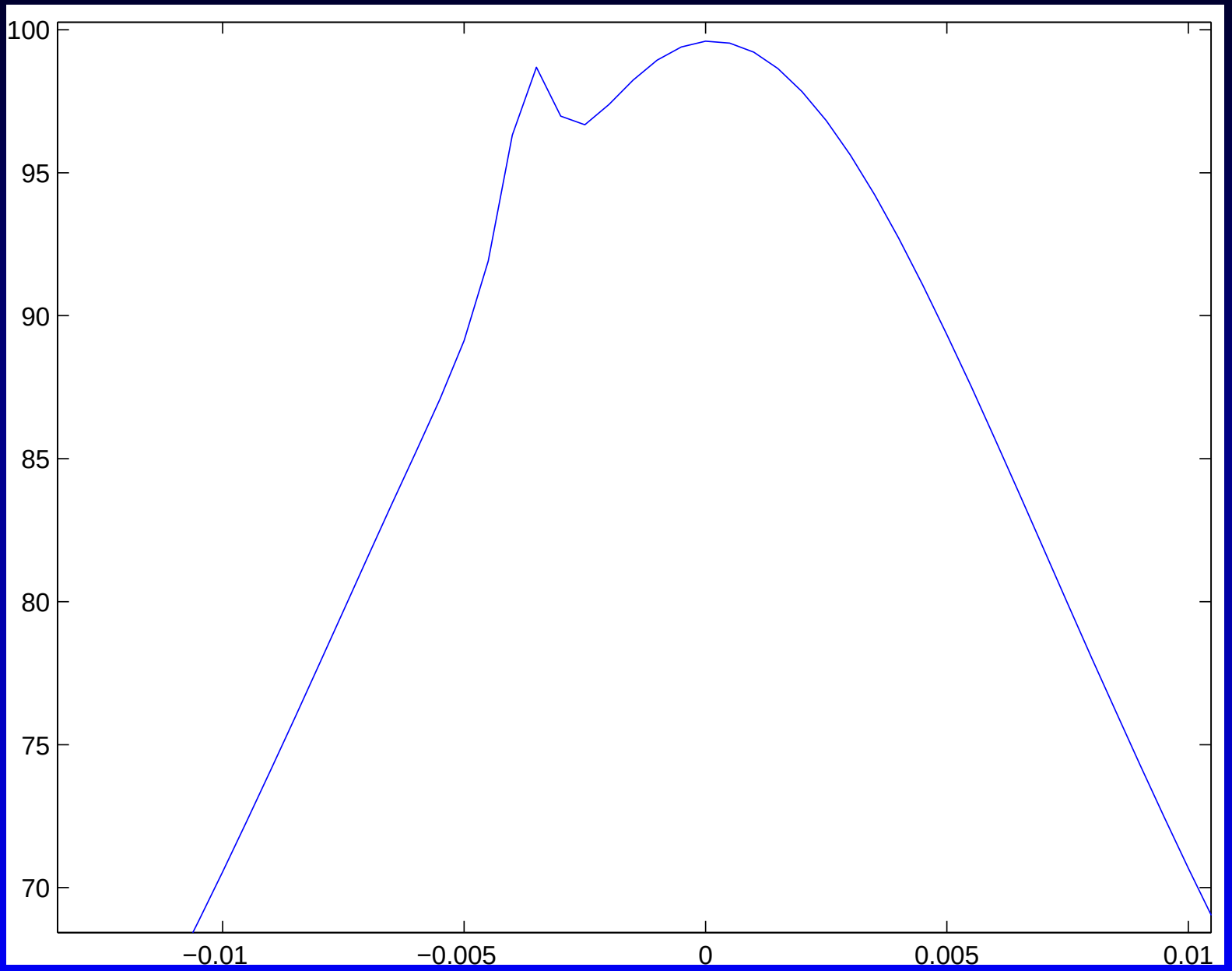
coords(1e-3,0.9,0.02,7*pi/8



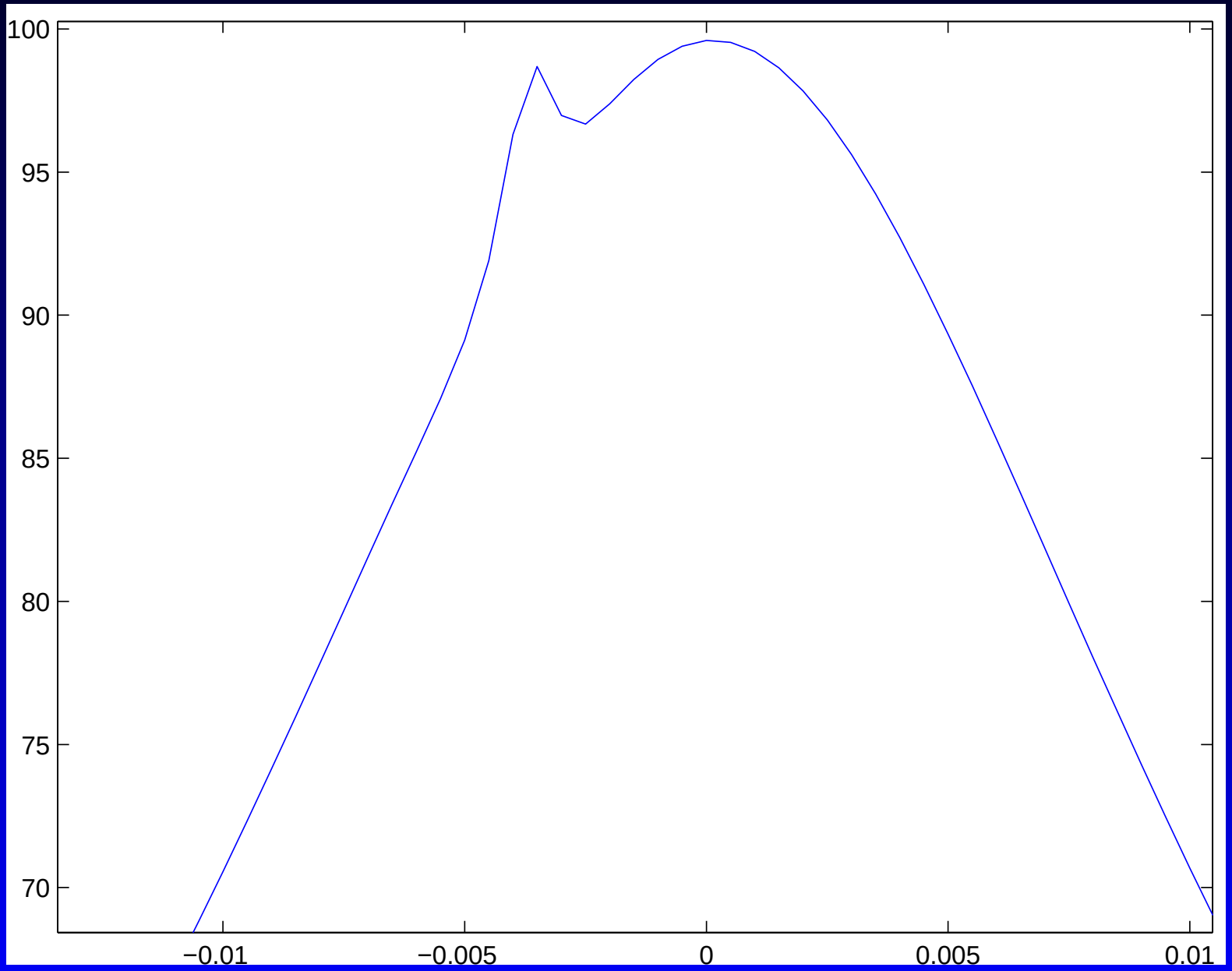

100
95
90
85
80
75
−10
−8
−6
−4
−2
0
2
4
6
8
x 10^−3

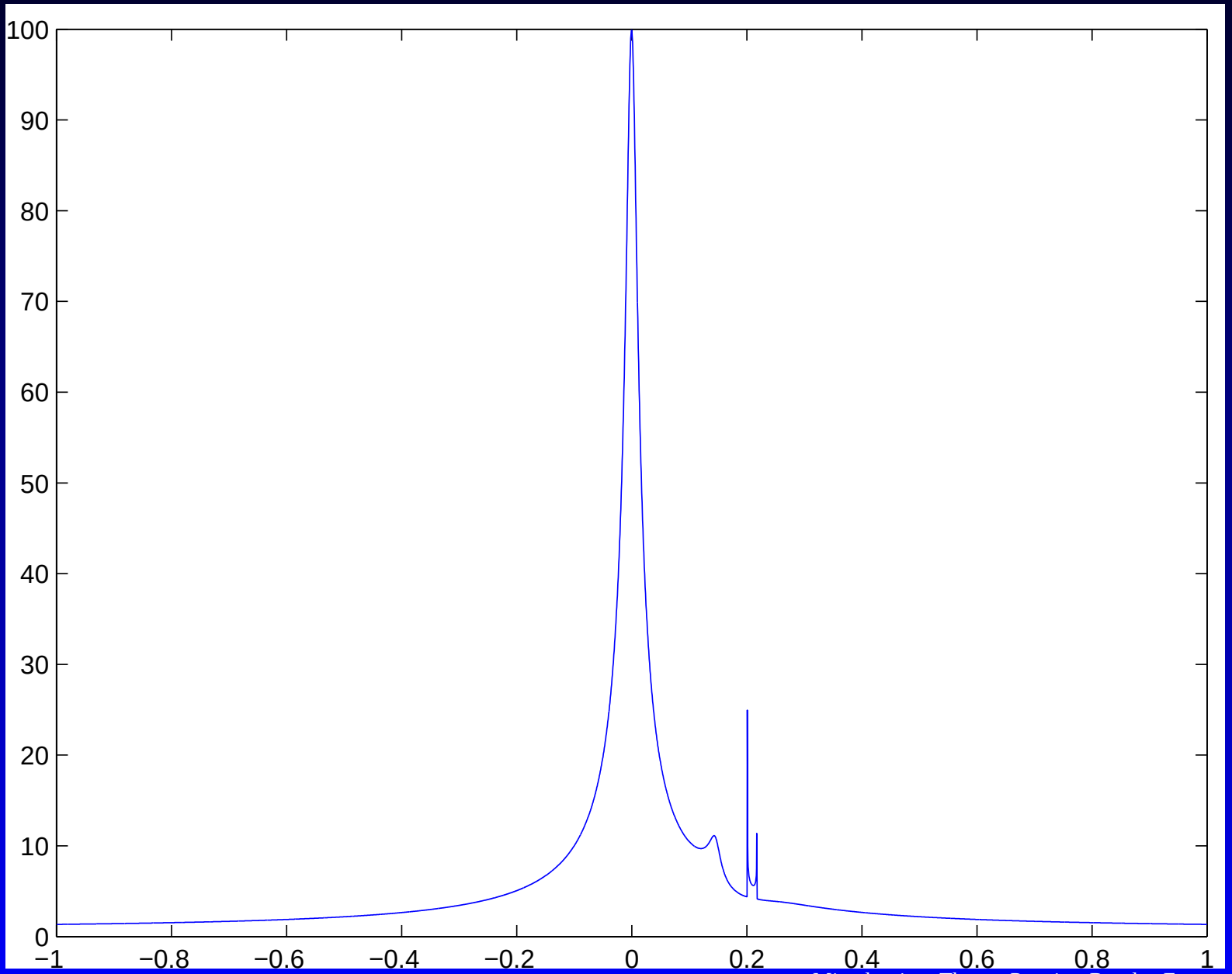
coords(1e-4,1/0.9,0.01,1.5



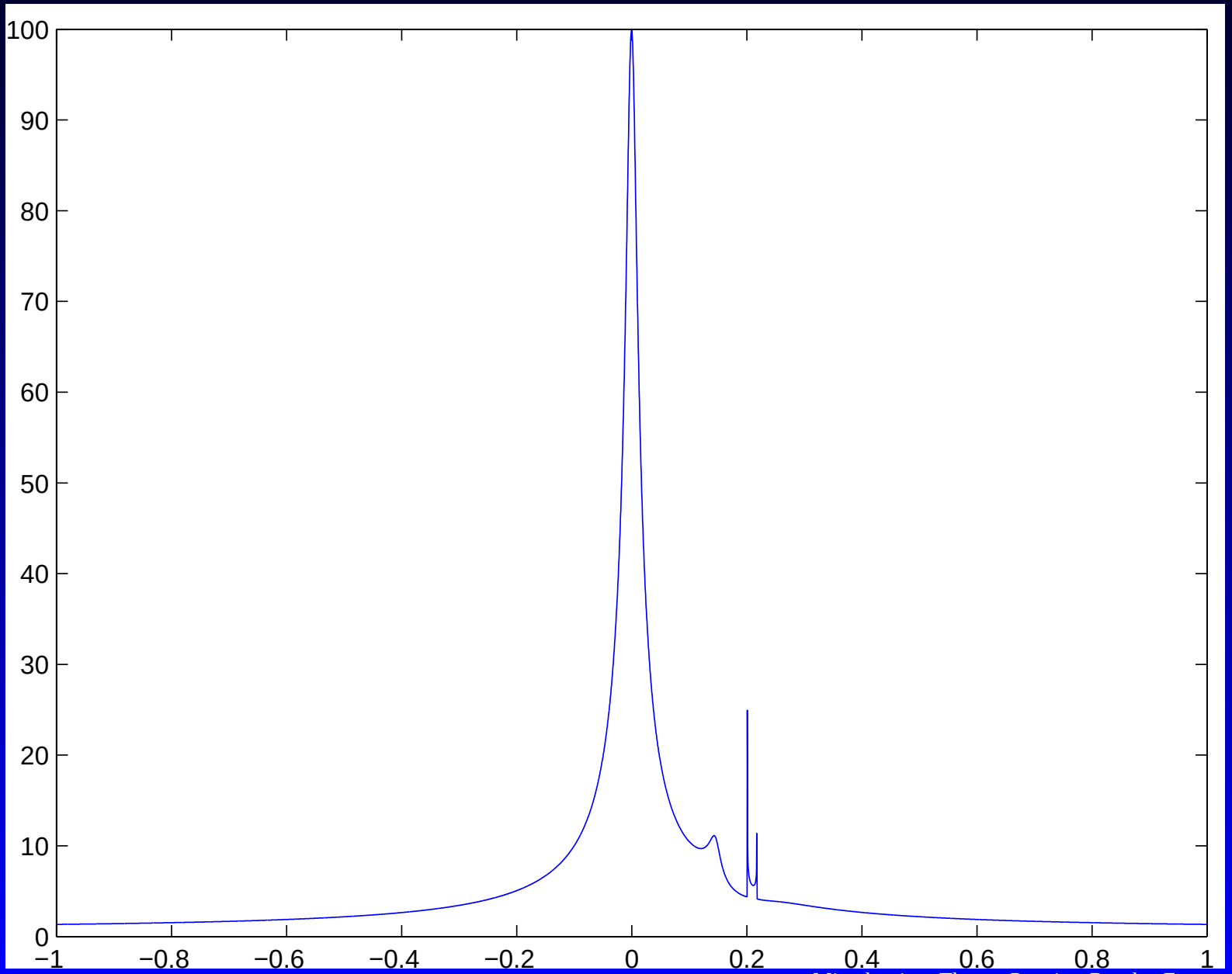

100
95
90
85
80
75
70
−0.01
−0.005
0
0.005
0.01

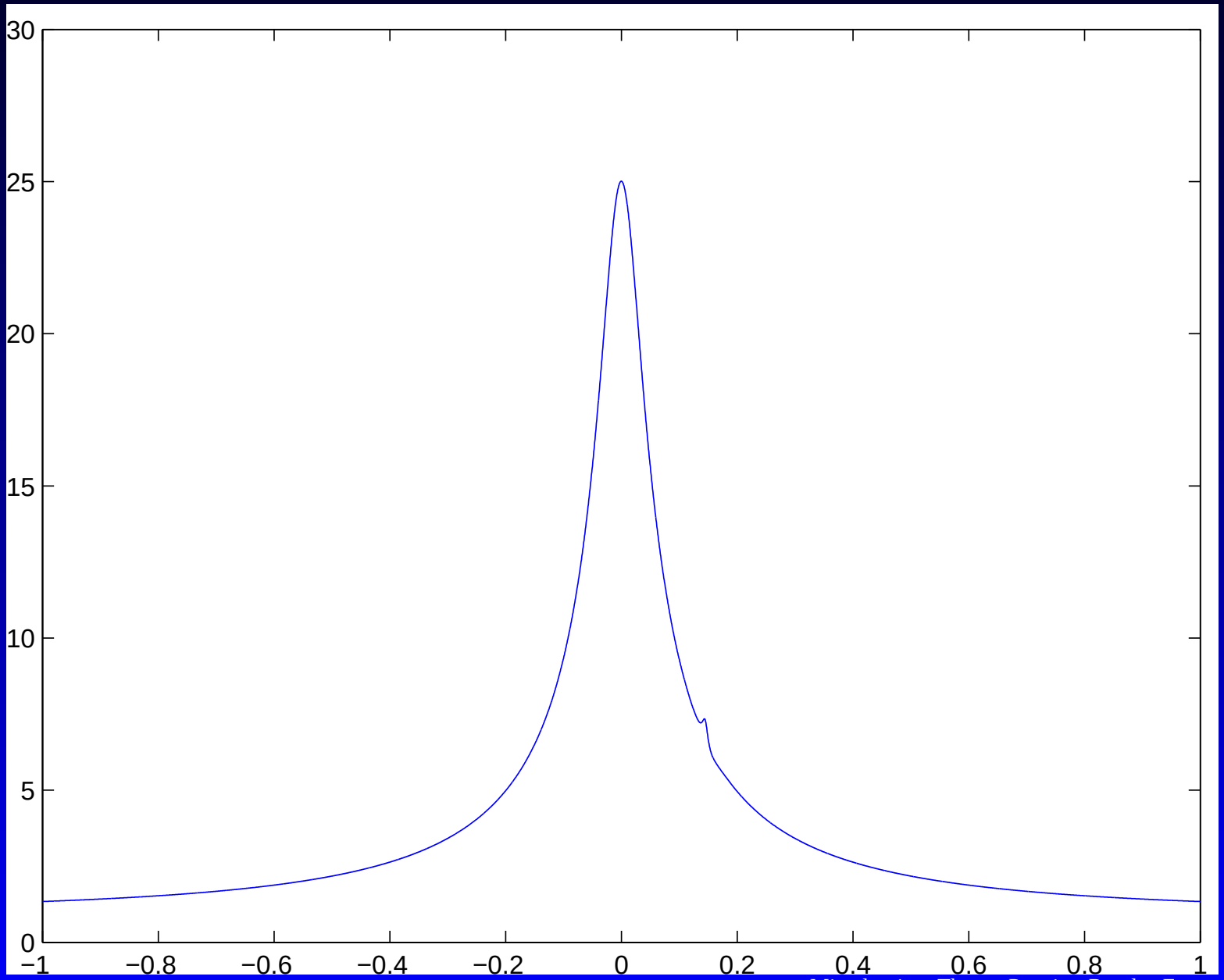
coords(1e-5,1.11,0.01,5.93



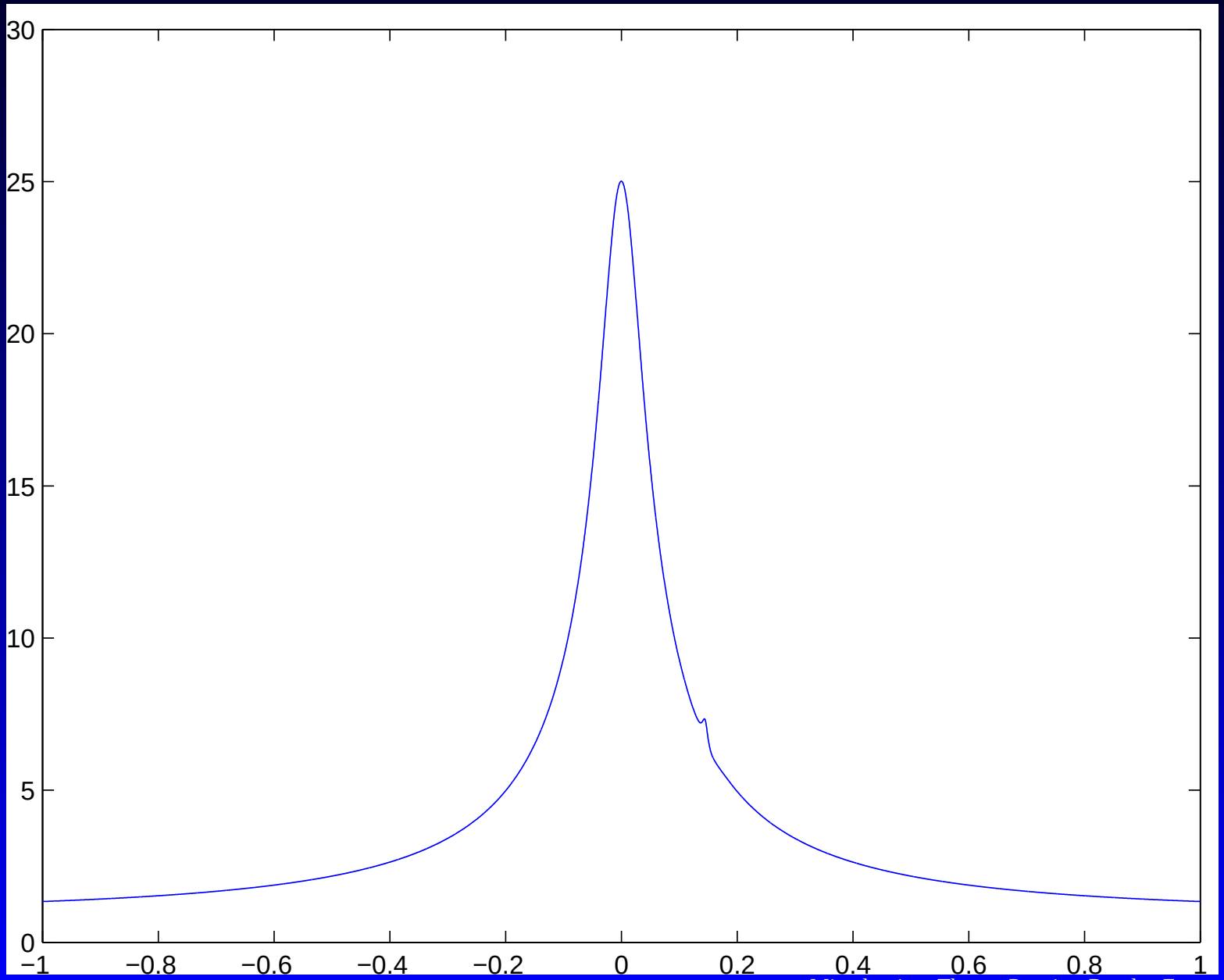

100
90
80
70
60
50
40
30
20
10
0
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
1

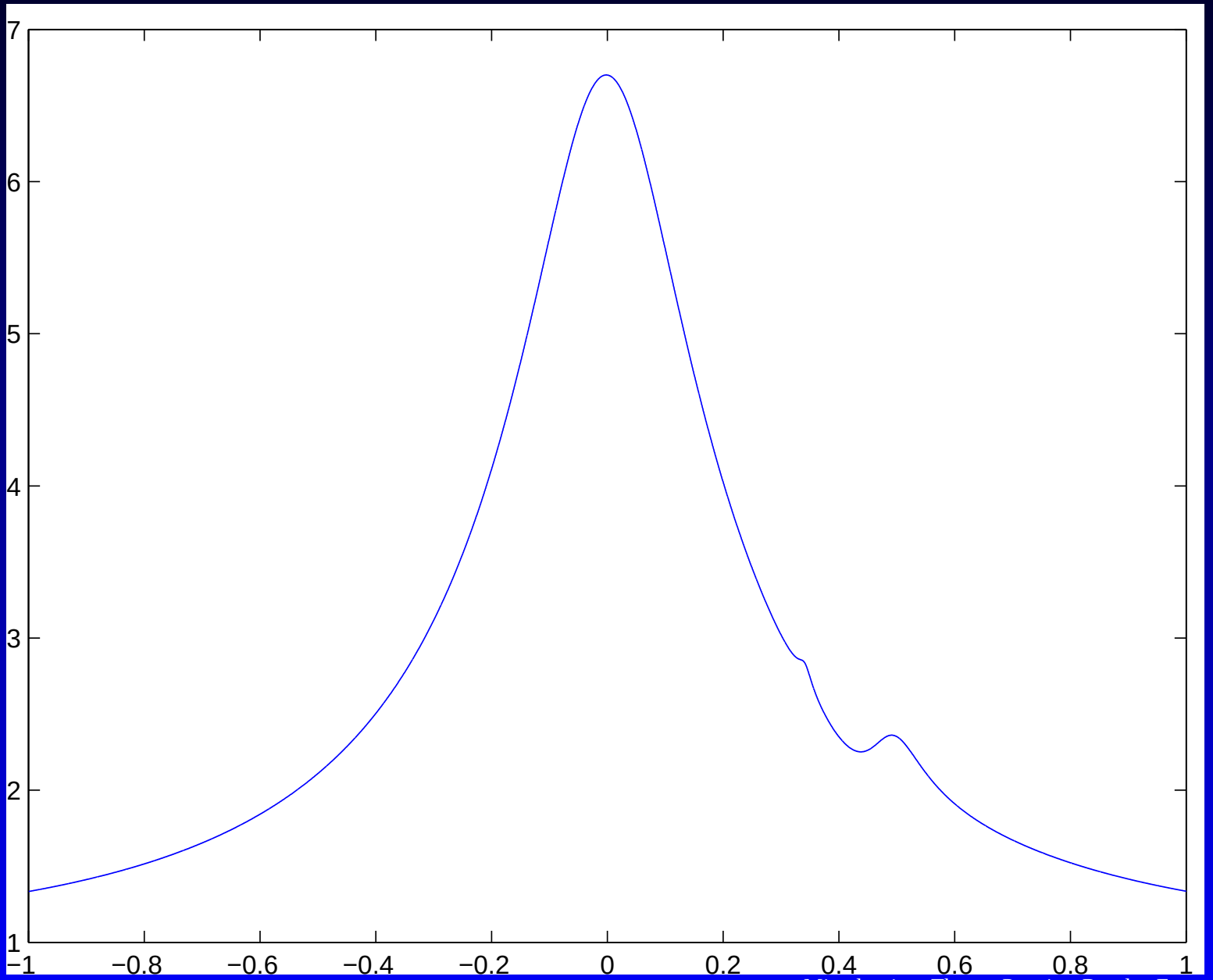
coords(1e-5,0.9,0.01,0.35)




30
25
20
15
10
5
0
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
1

coords(1e-5,1.1,0.04,1.3)




7
6
5
4
3
2
1
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
1

coords(1e-3,1.2,0.15,1.3)