Reconstructing Neutrino Interactions in Liquid Argon TPCs

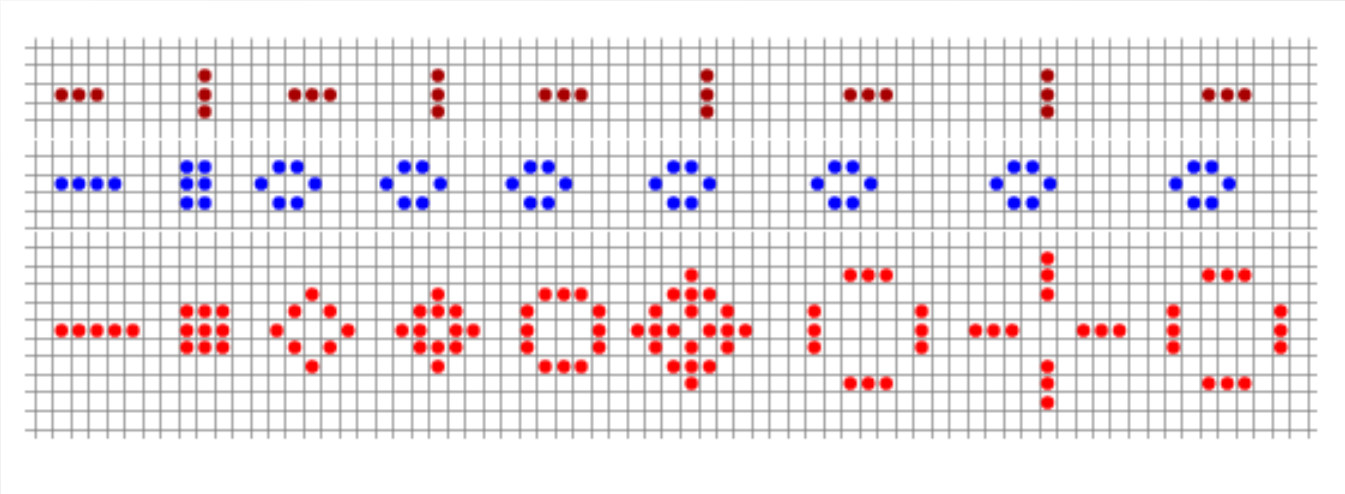
Ben Newell

Outline

- So far, data in Lar-TPCs has been reconstructed mostly 'by hand'
- Much more beneficial to have a fully automated process
- Algorithmic recognition of patterns – straight lines, curved tracks, etc...

Cellular Automata

- Conway's 'Game of Life'
- Local rules: behaviour of the cells determined purely by neighbours
- Discrete time: Cell states update simultaneously after passing through all cells



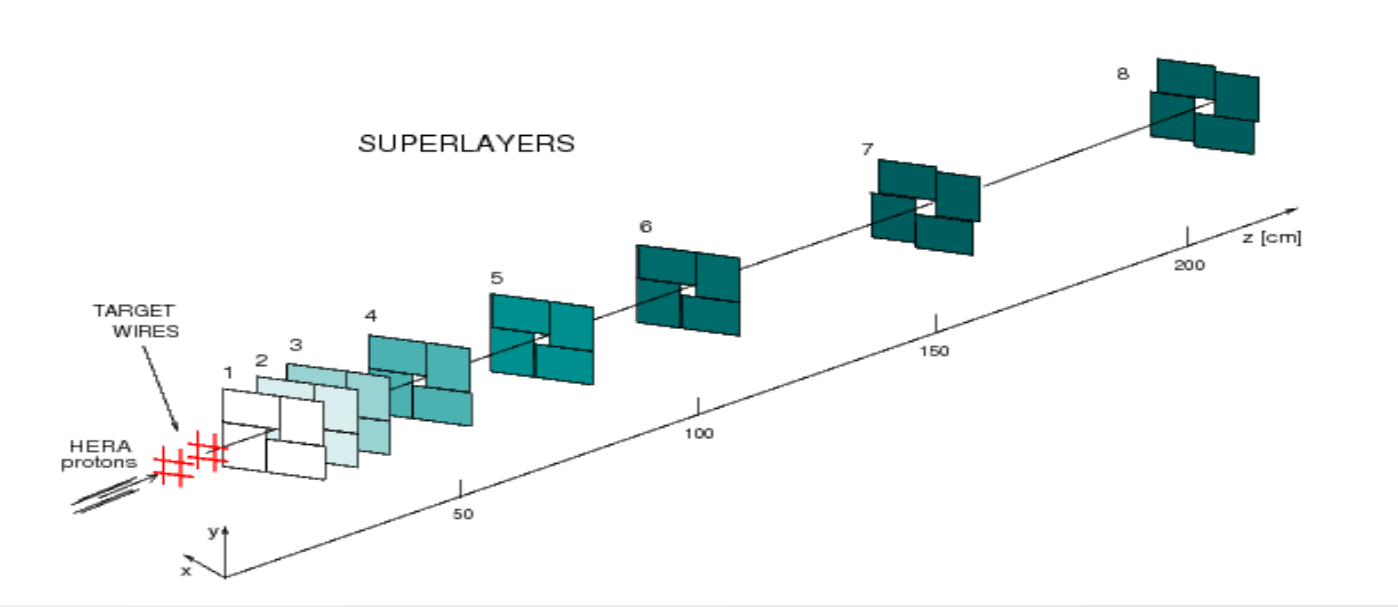
A Cellular Automata for Track Finding

- HERA-B experiment
- Segment based CA
- 2 stages – 'forward' and 'reverse' passes
- Forward: Assigns segment weights

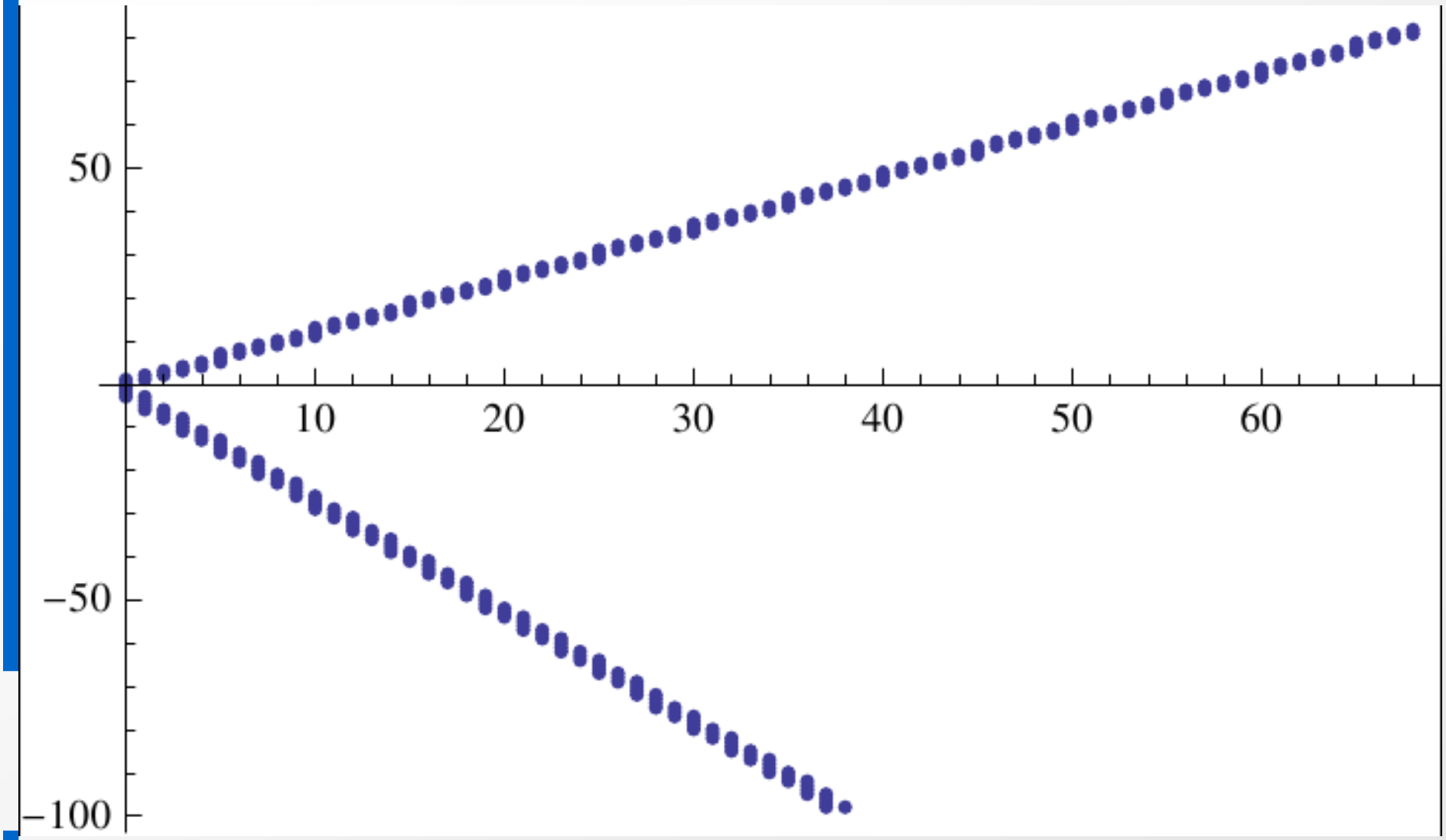
  Reverse: Collects segments into tracks

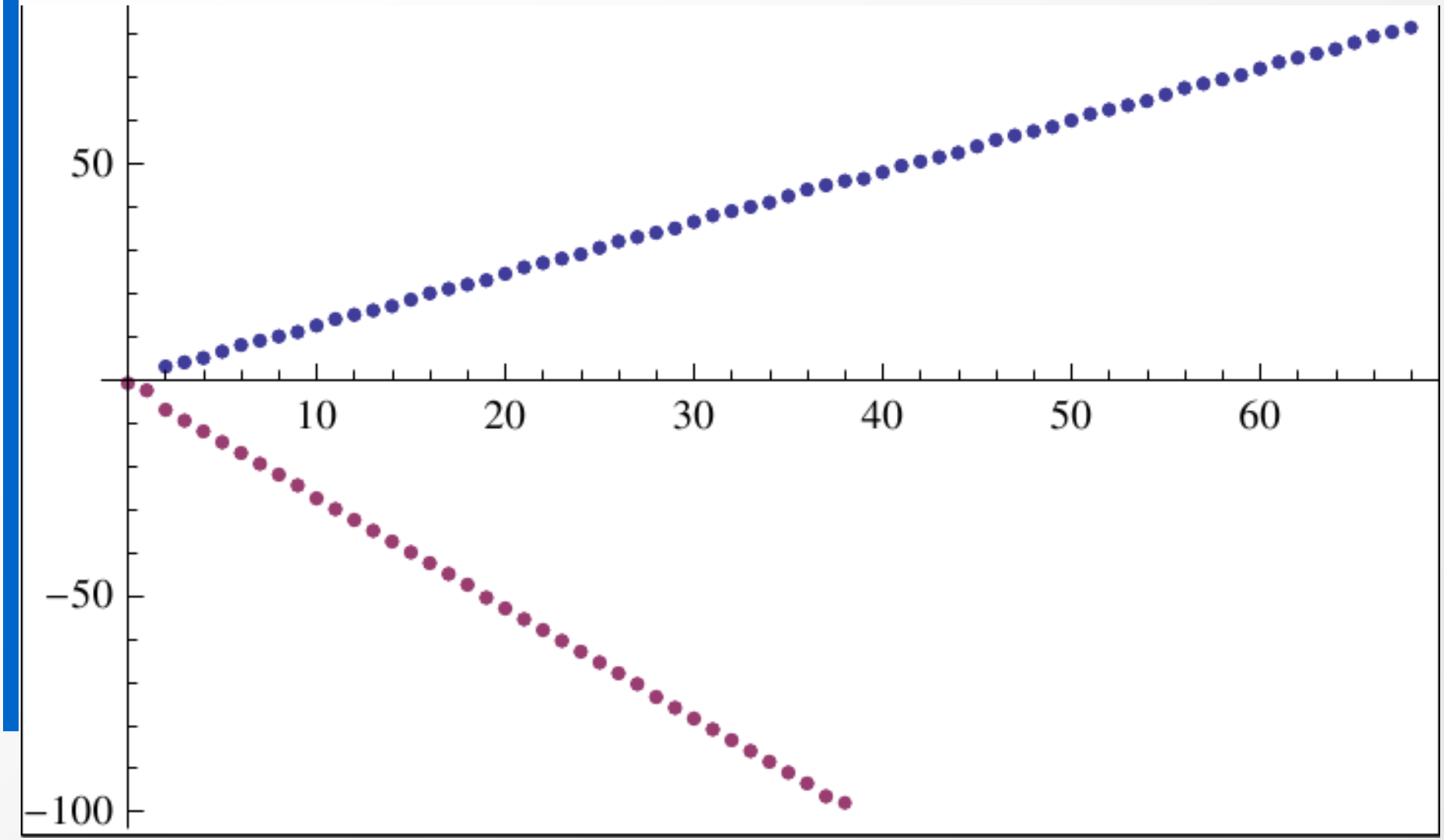
Comparison to HERA-B

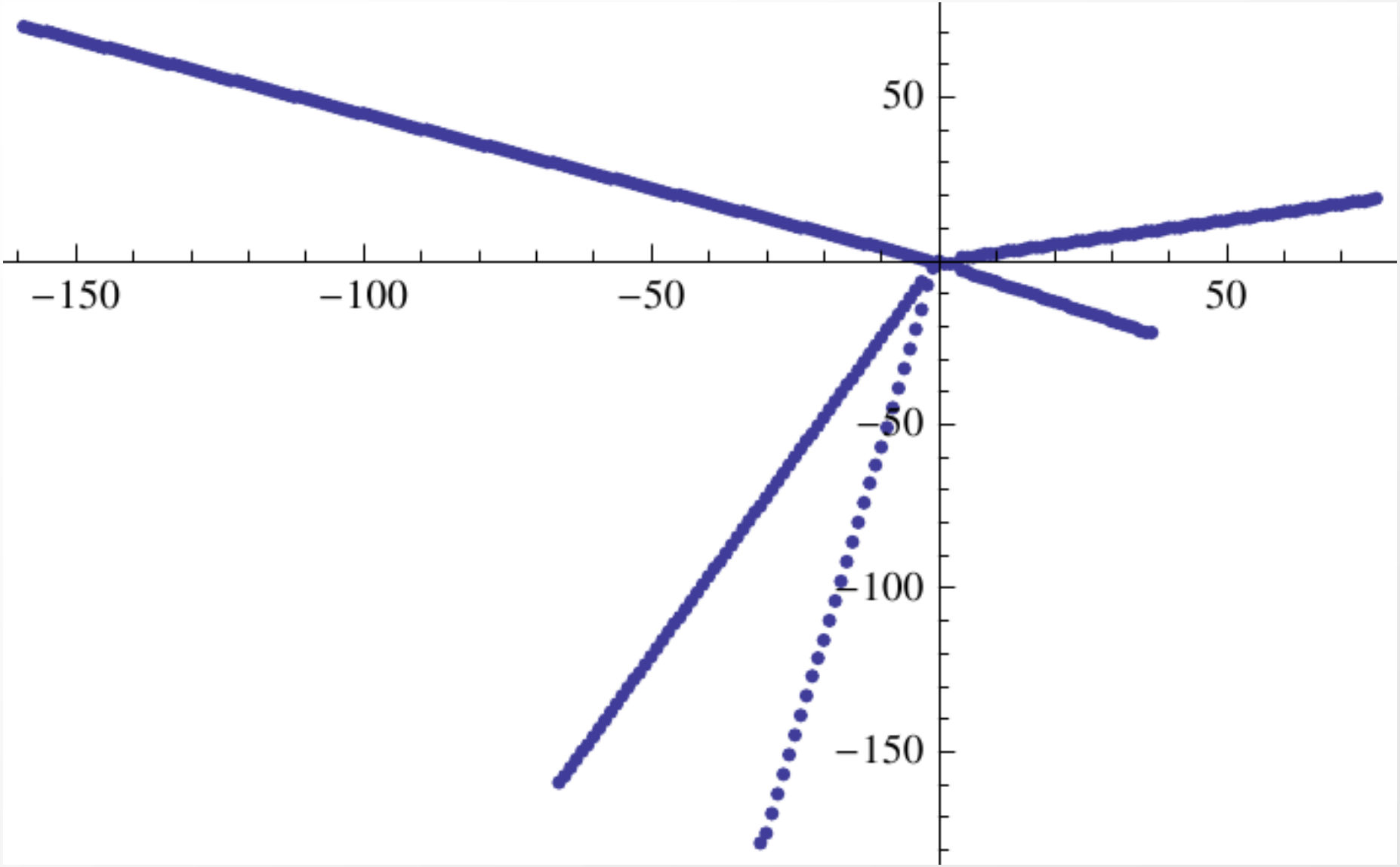
- HERA-B experiment uses eight 'superlayers'
- Nice small number
- Our detector uses voxels – 3D pixels
- Ridiculously large number of segments!

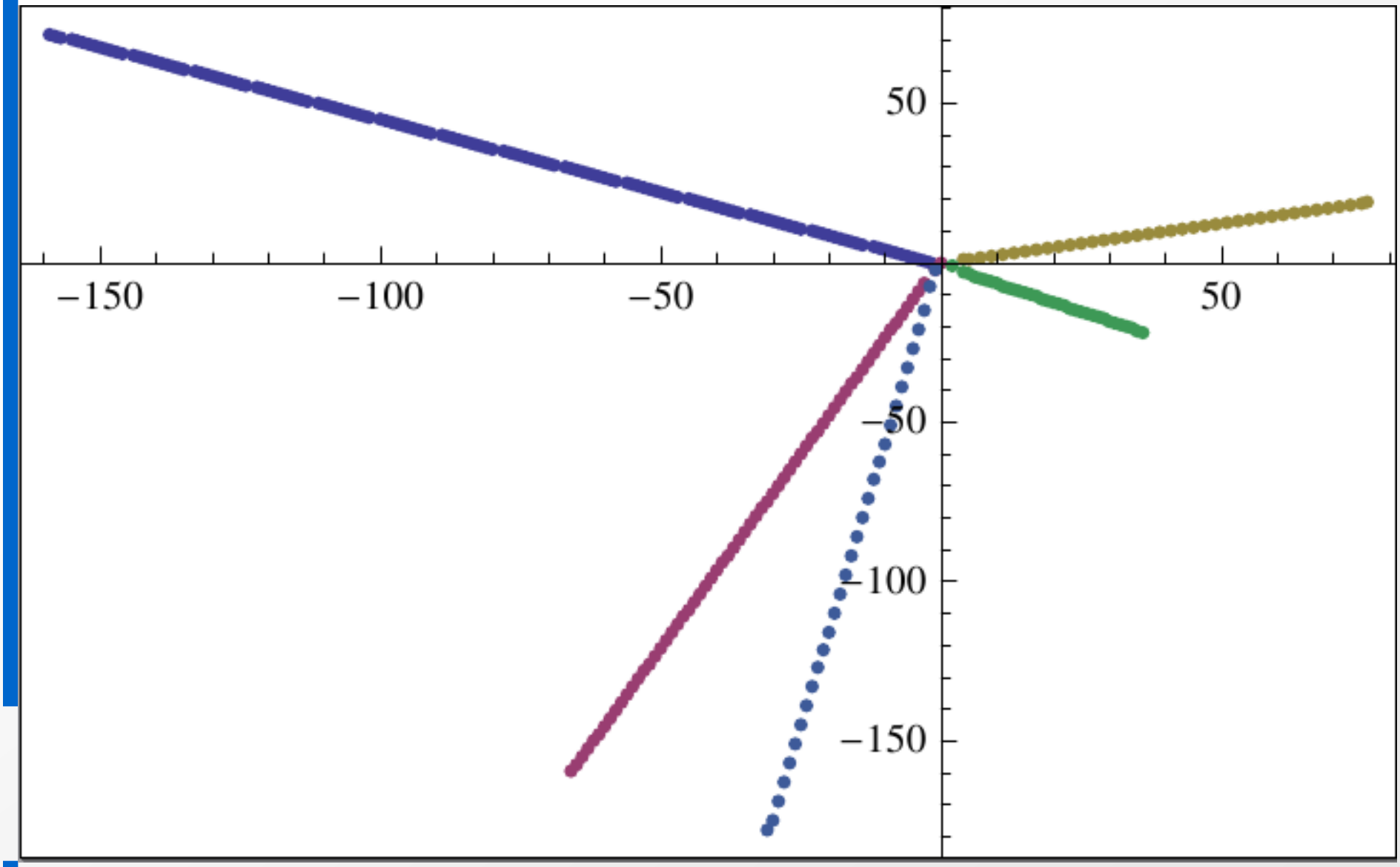


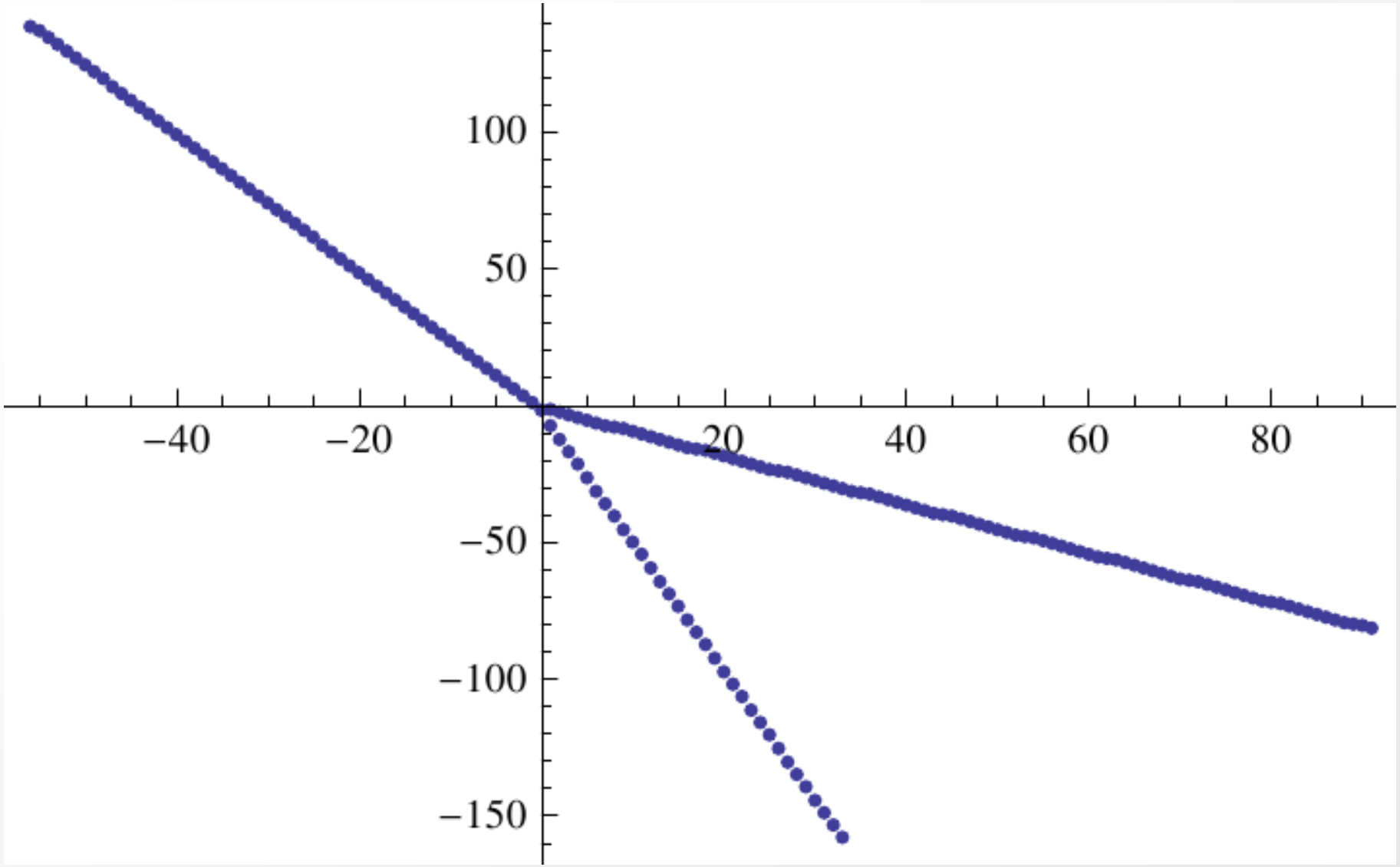
Early results

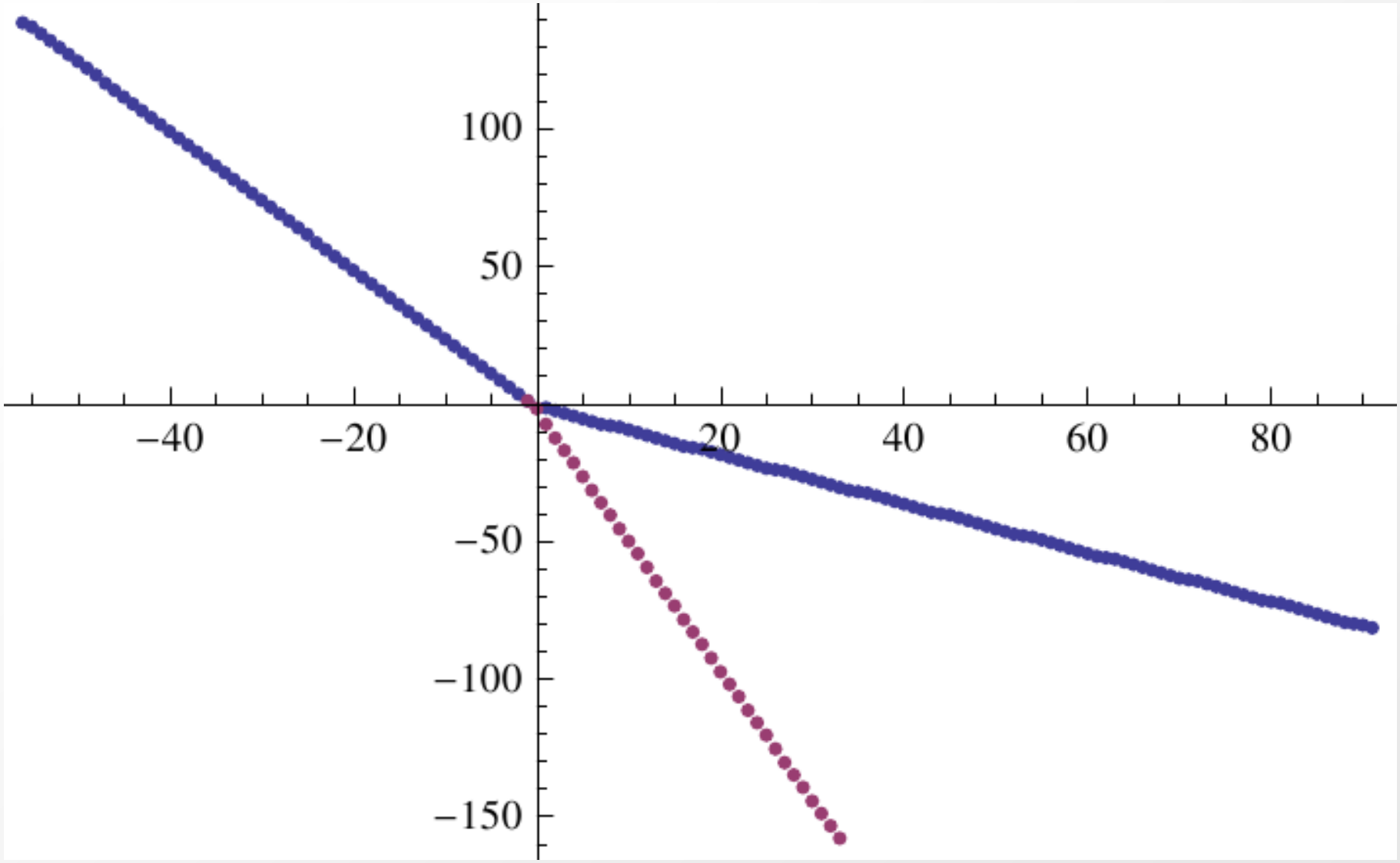


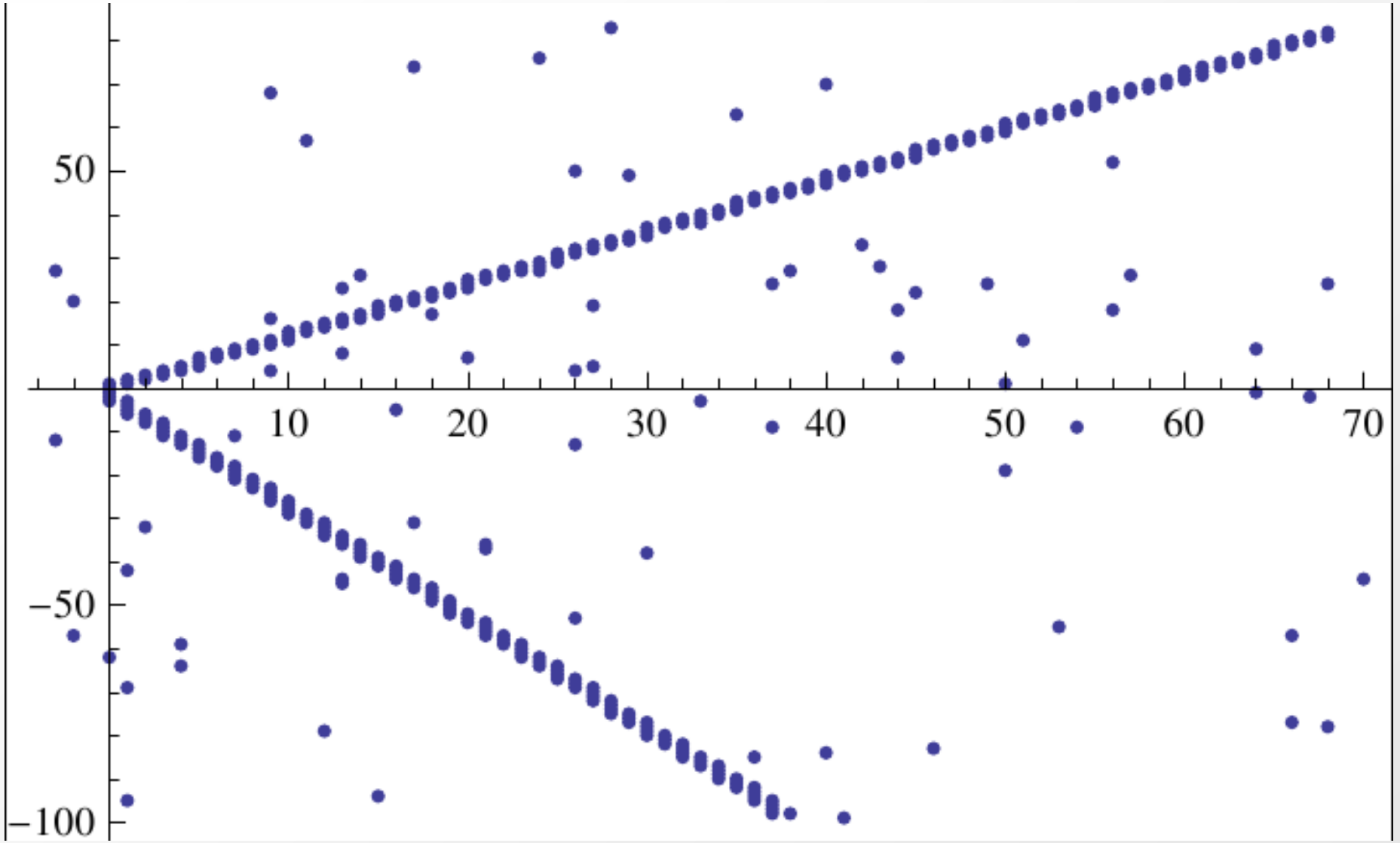

50
10
20
30
40
50
60
−50
−100

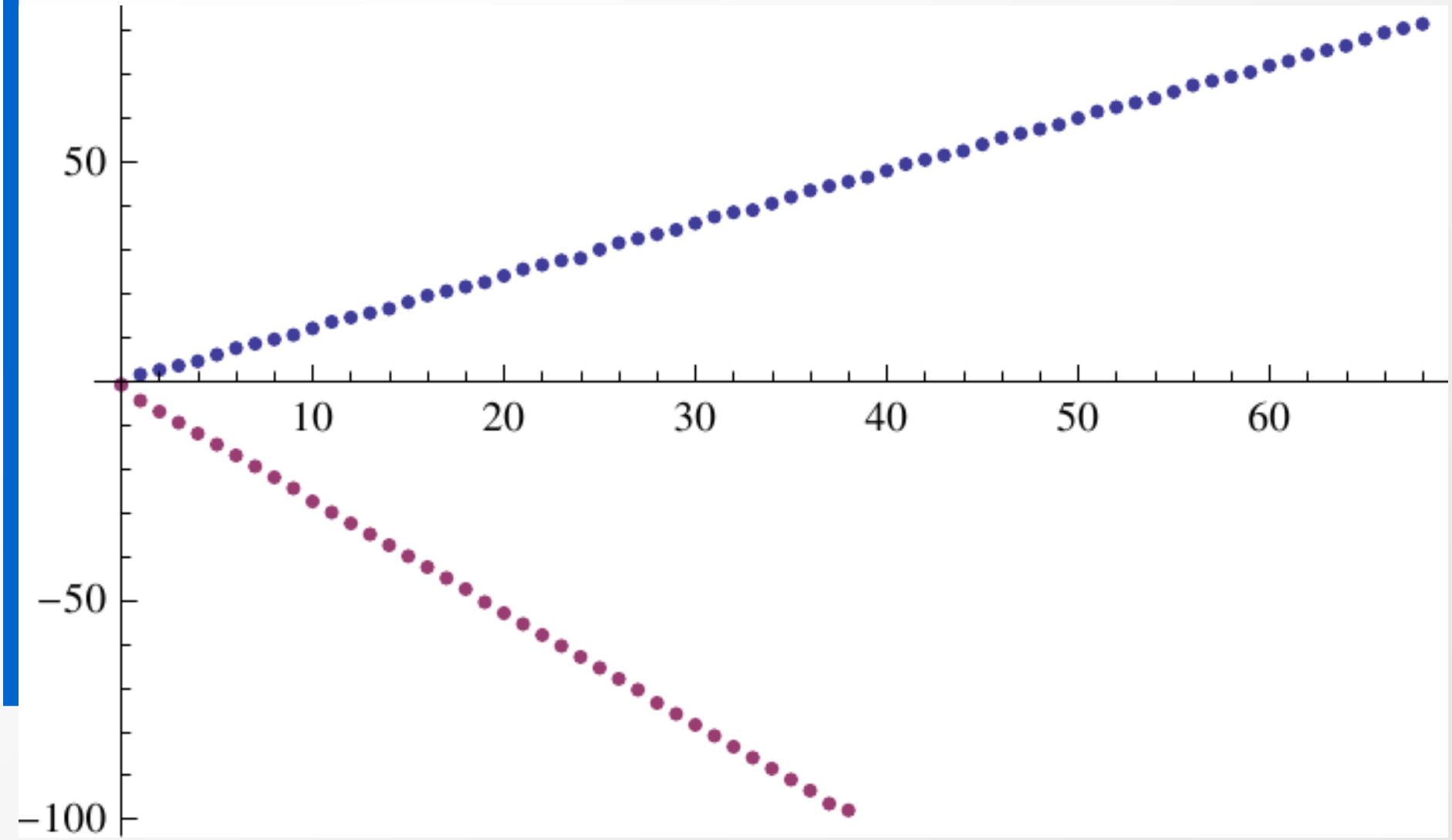

50
−150
−100
−50
50
−50
−100
−150

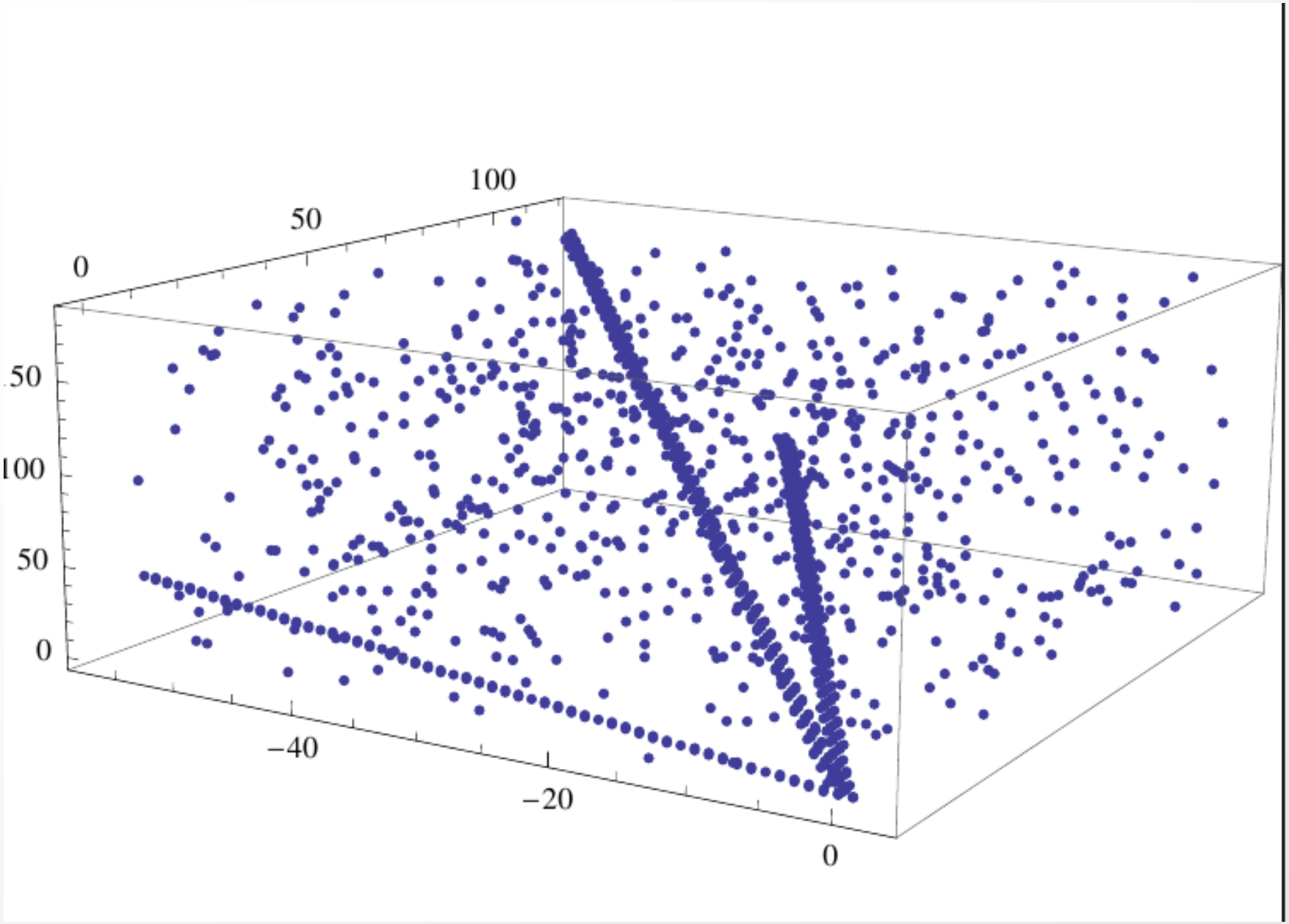

50
−150
−100
−50
50
−50
−100
−150

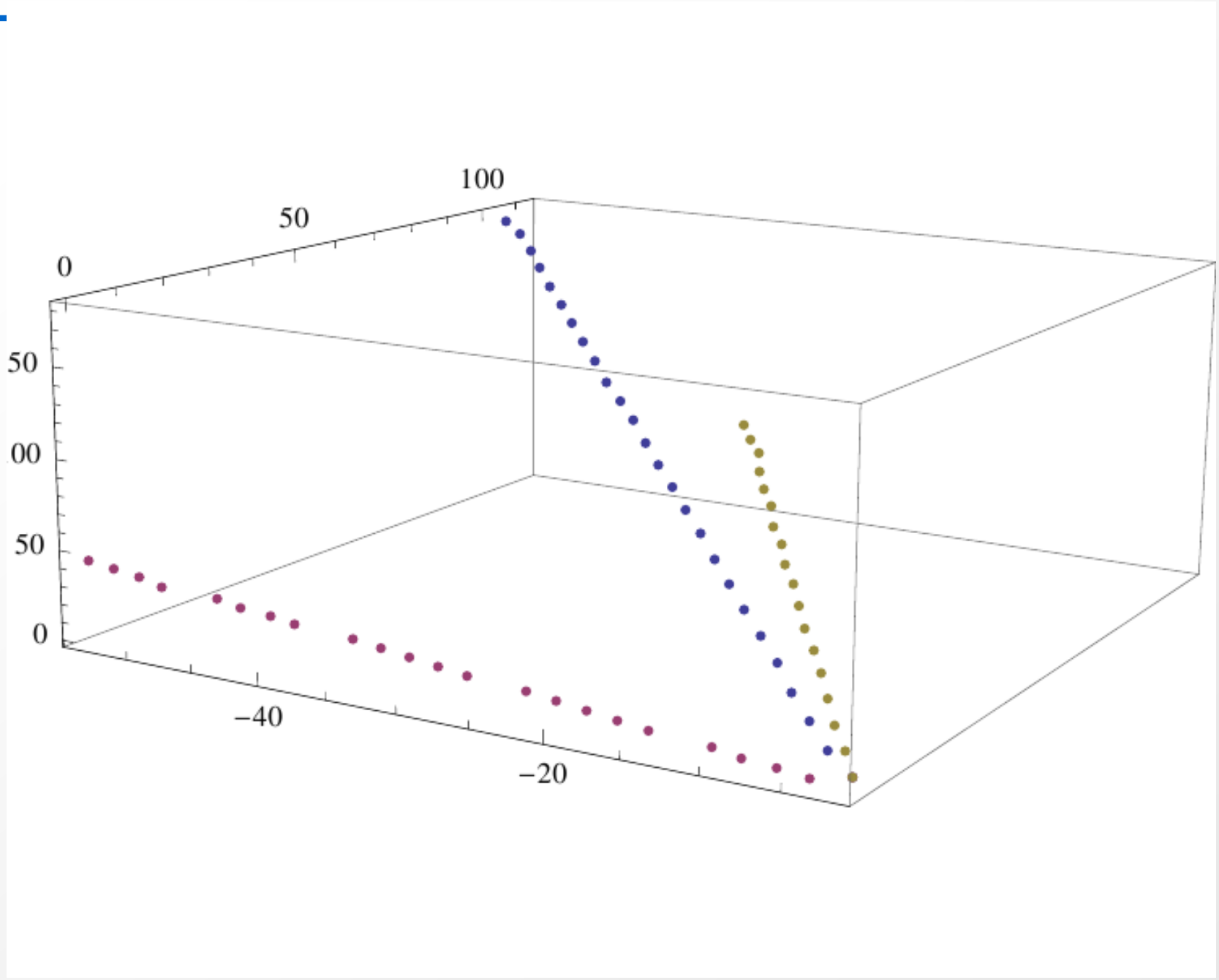

100
50
−40
−20
20
40
60
80
−50
−100
−150

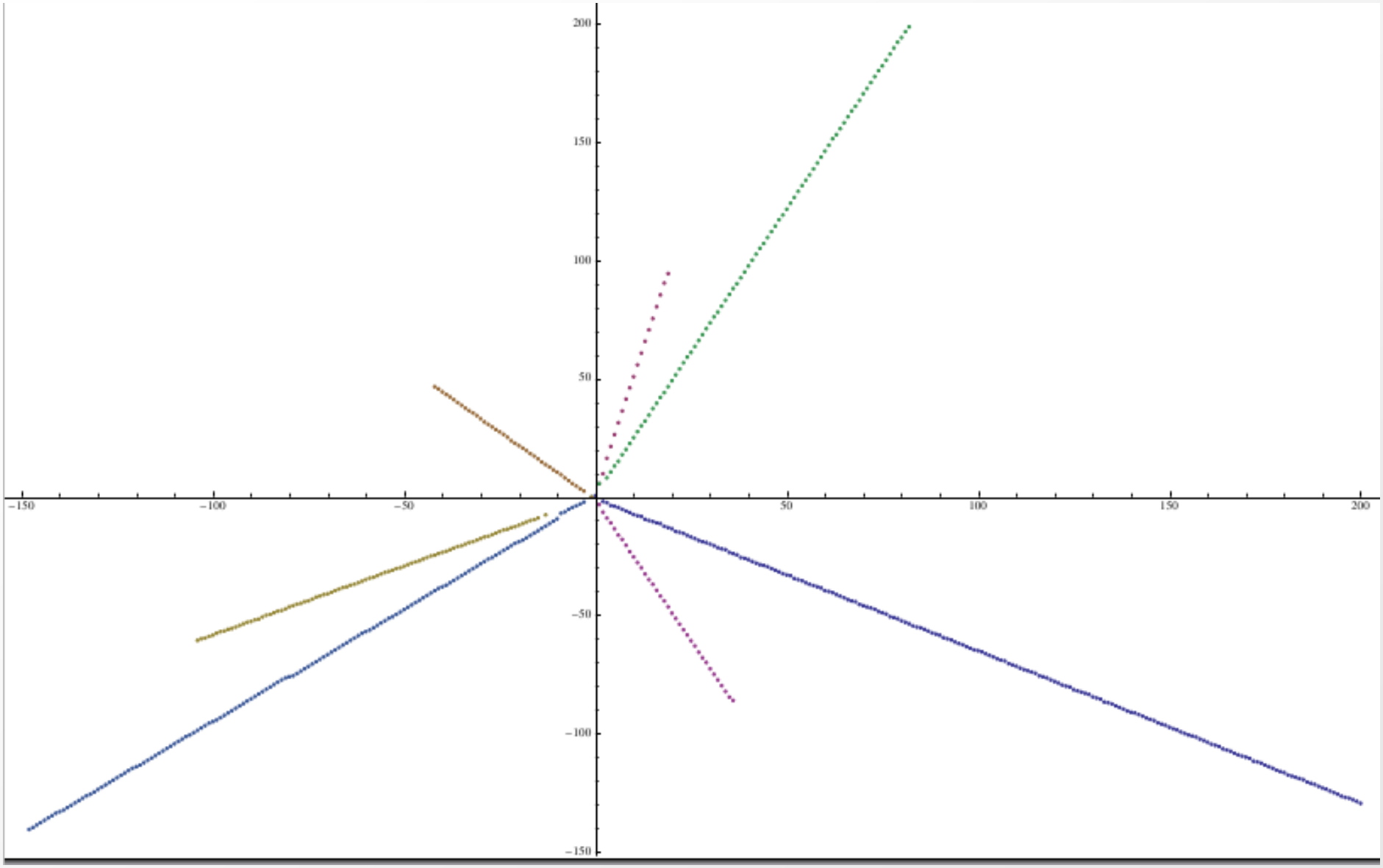

100
50
−40
−20
20
40
60
80
−50
−100
−150


50
10
20
30
40
50
60
70
−50
−100


50
−50
−100
10
20
30
40
50
60


100
50
0
50
100
50
0
−40
−20
0


100
50
0
50
00
50
0
−40
−20


200
150
100
50
−150
−100
−50
50
100
150
200
−50
−100
−150