# A combined target and detector to measure parity violation in neutron capture on 3He for the n3He Experiment

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for the n3He Collaboration

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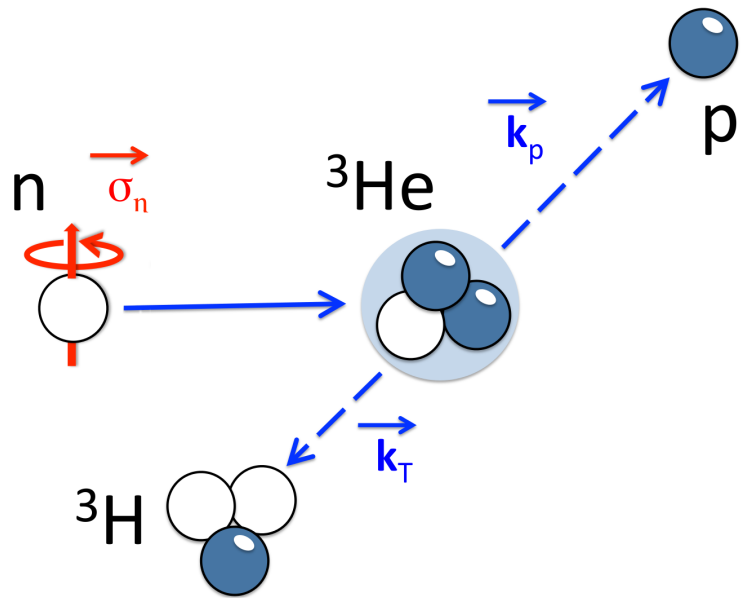
# n3He Introduction

High-precision measurement motivated to probe the hadronic weak interaction by measuring the parity violating directional asymmetry of the proton in the reaction-

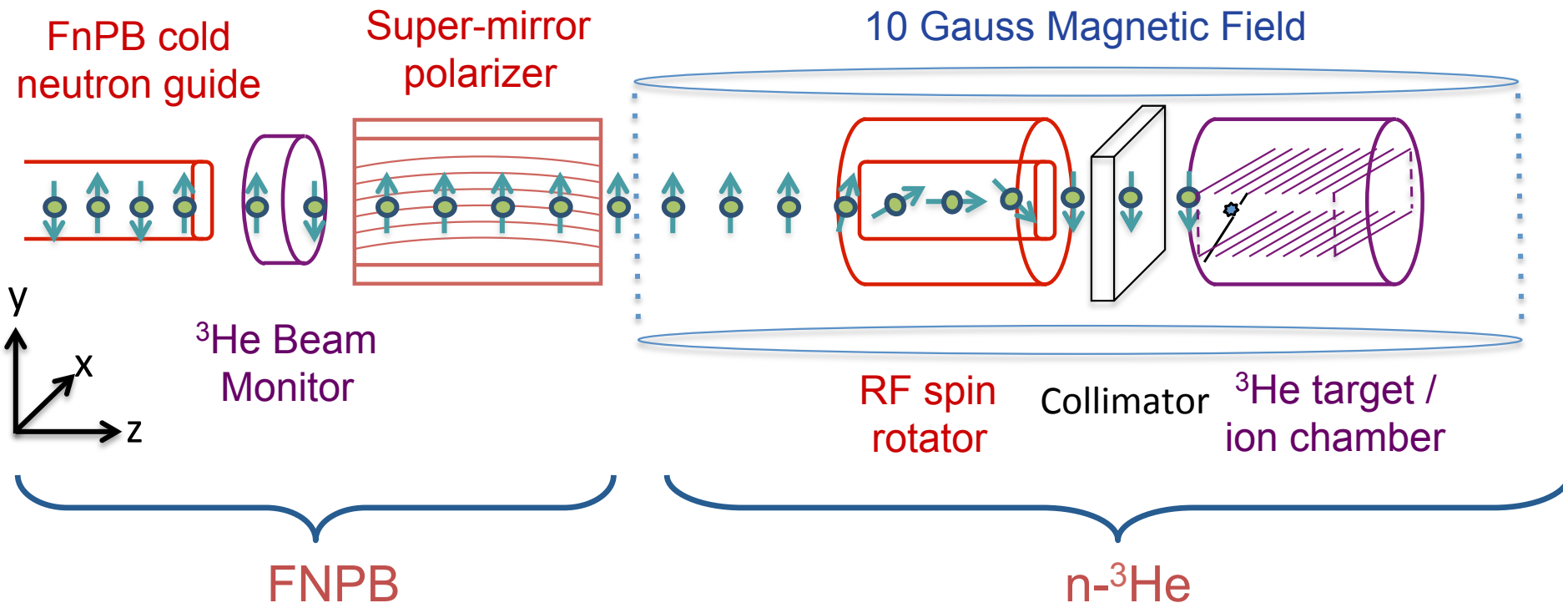
$$\vec{n} + {}^3He \rightarrow p + T + 765keV$$




The asymmetry is expected to be small around $10^{-7}$ and our goal is to measure it to $2 \times 10^{-8}$.

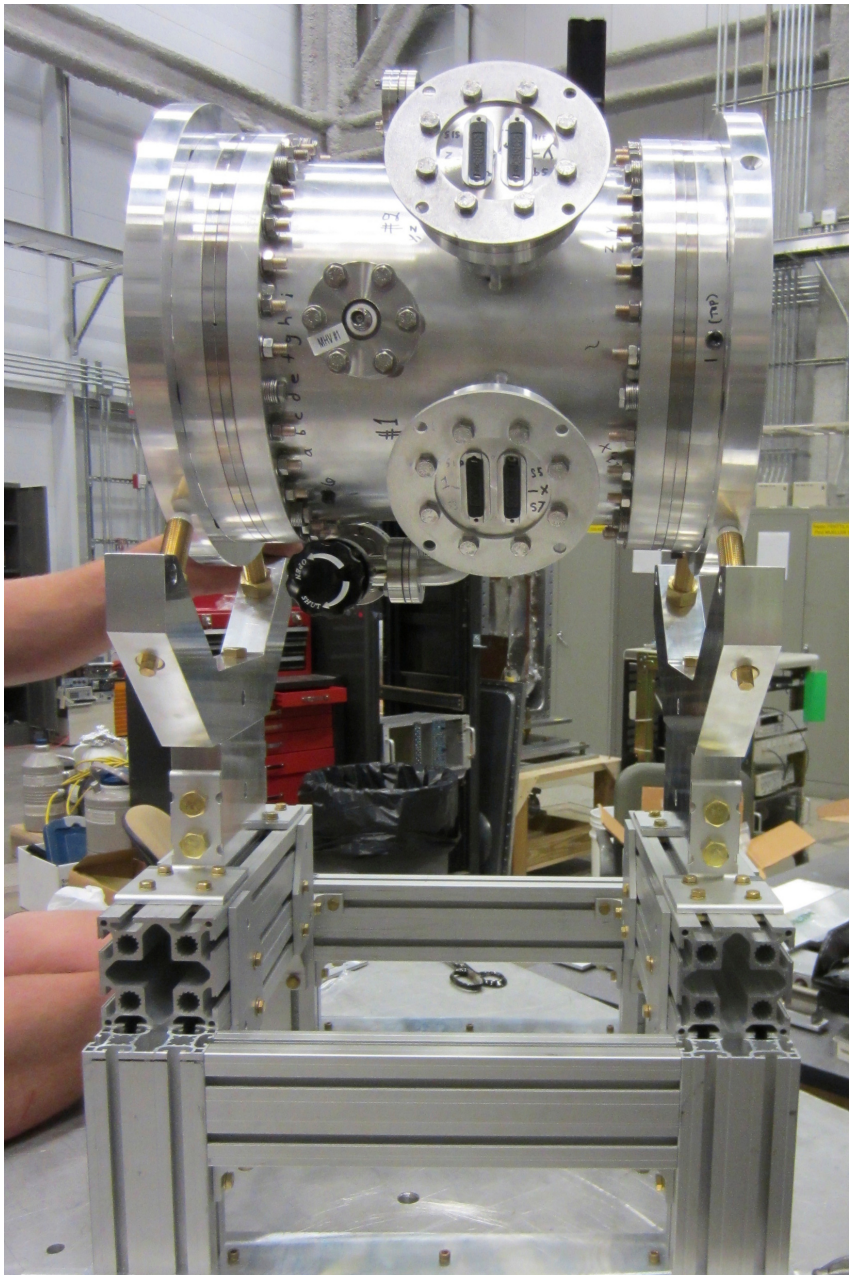
CJ.00007 : A Study of Hadronic Weak Interaction - The n3He Experiment at SNS, Latiful Kabir (Thursday @ 9:42)

# n3He Schematic Diagram



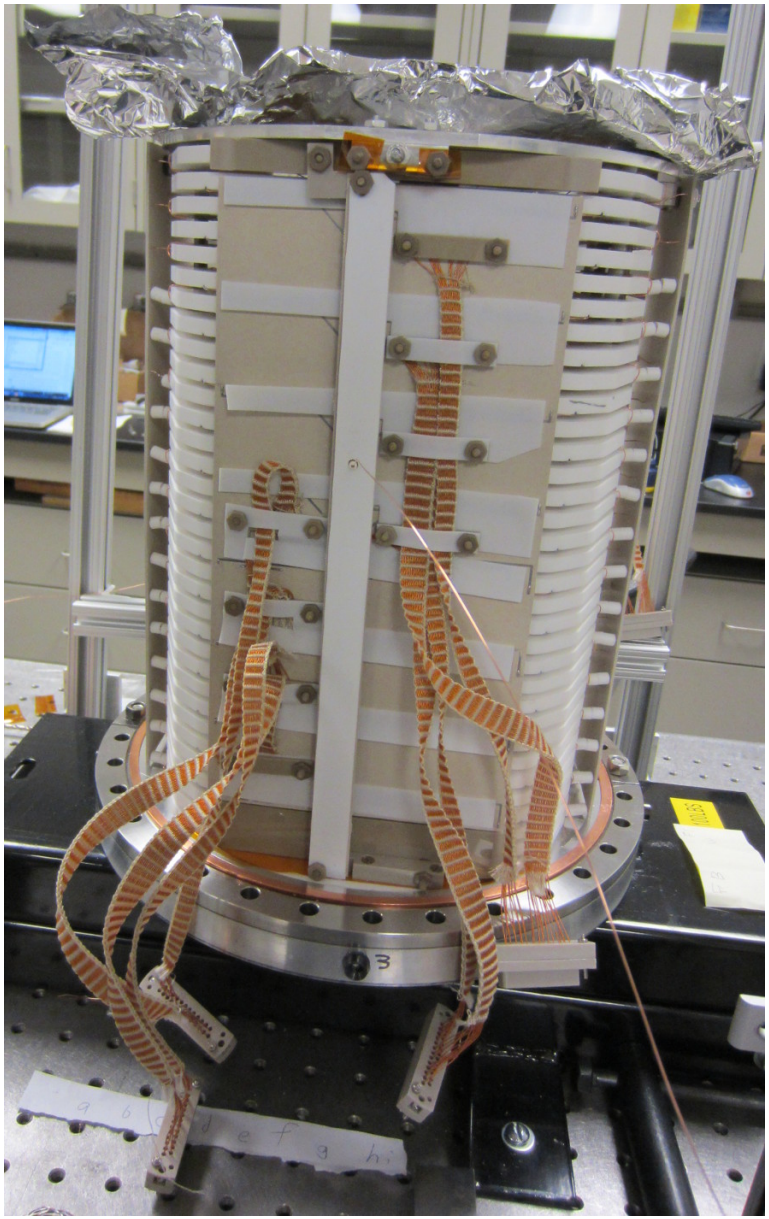

HF.00003: High Efficiency Spin Flipper for the n3He Experiment, Chris Hayes (Friday @ 8:30)

# Chamber Assembly

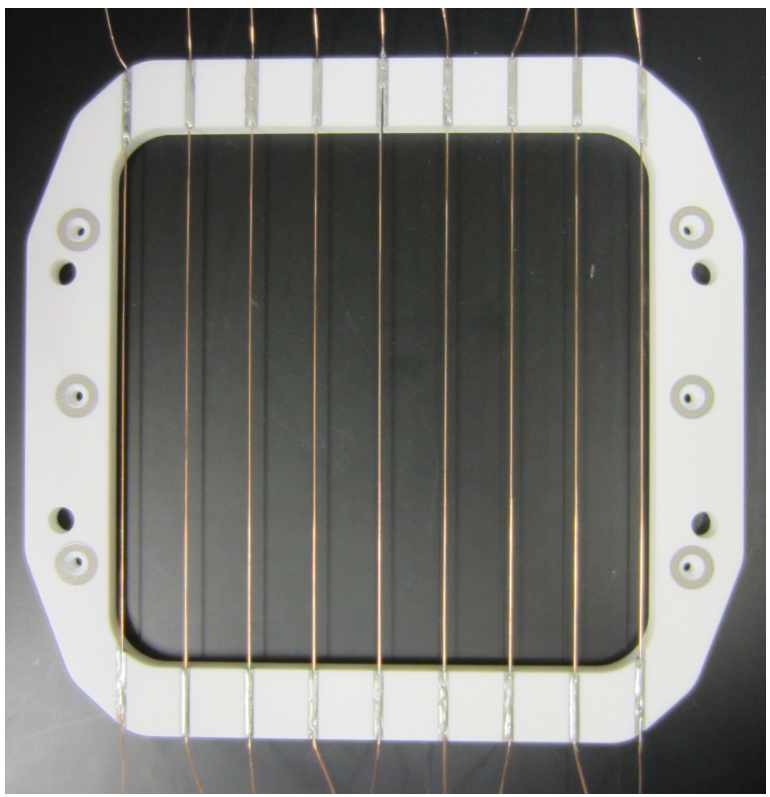


- 1mm aluminum windows
- 4 signal feed thrus
- 2 gas feed thrus
- 2 HV feed thrus
- operated at -350V
- 0.47 atm He-3 fill gas
- angle and height adjustable on stand

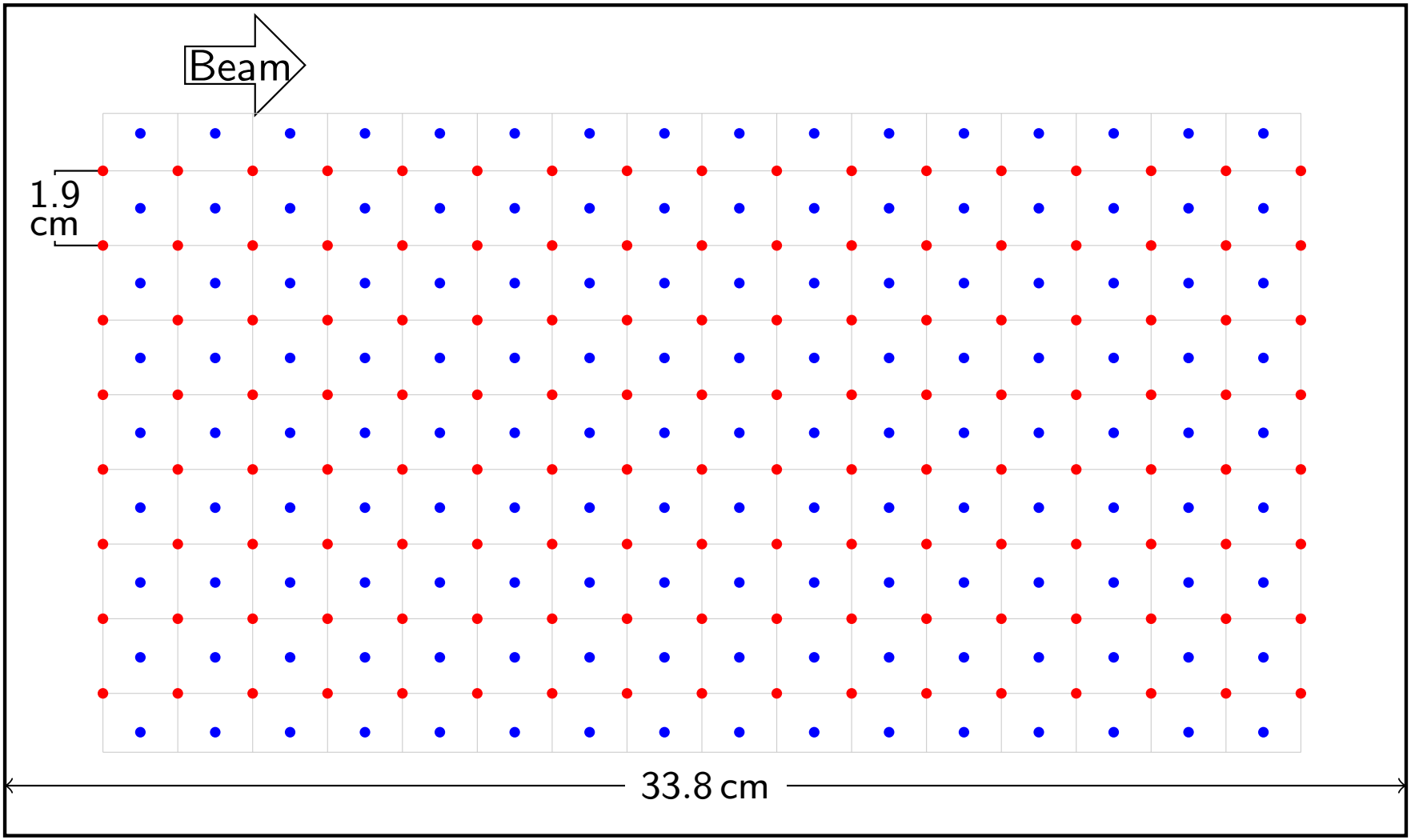
# Assembled Frame Stack



- 17 HV frames
- 16 signal frames
- 9 signal wires per frame
- 144 signals to read out
- 0.02” diameter wires



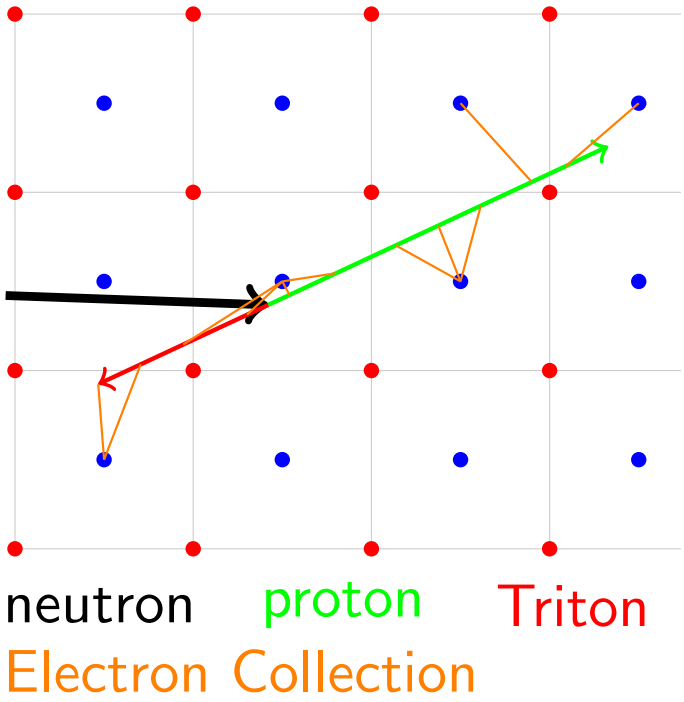
# n3He Target Chamber Schematic

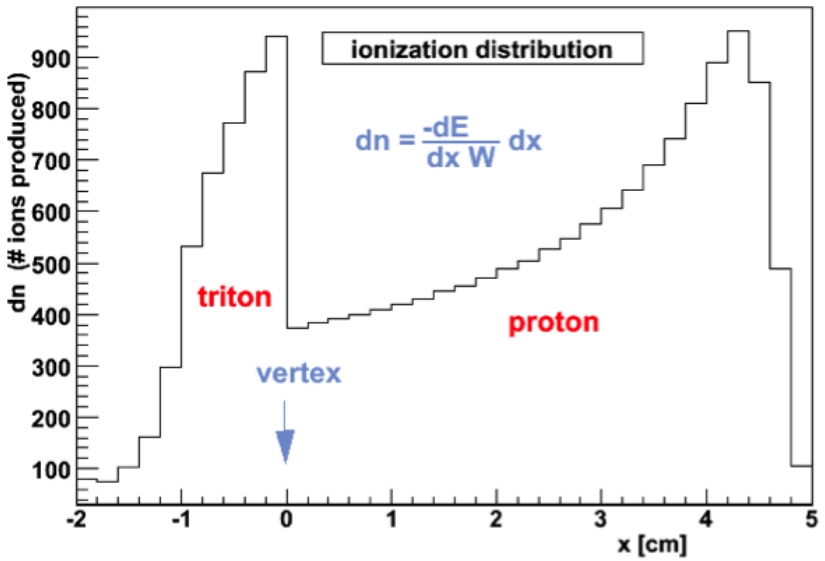



- HV 17 HV Frames with 8 wires each
- Signal 16 signal Frames with 9 wires each

# Proton Signal in Chamber

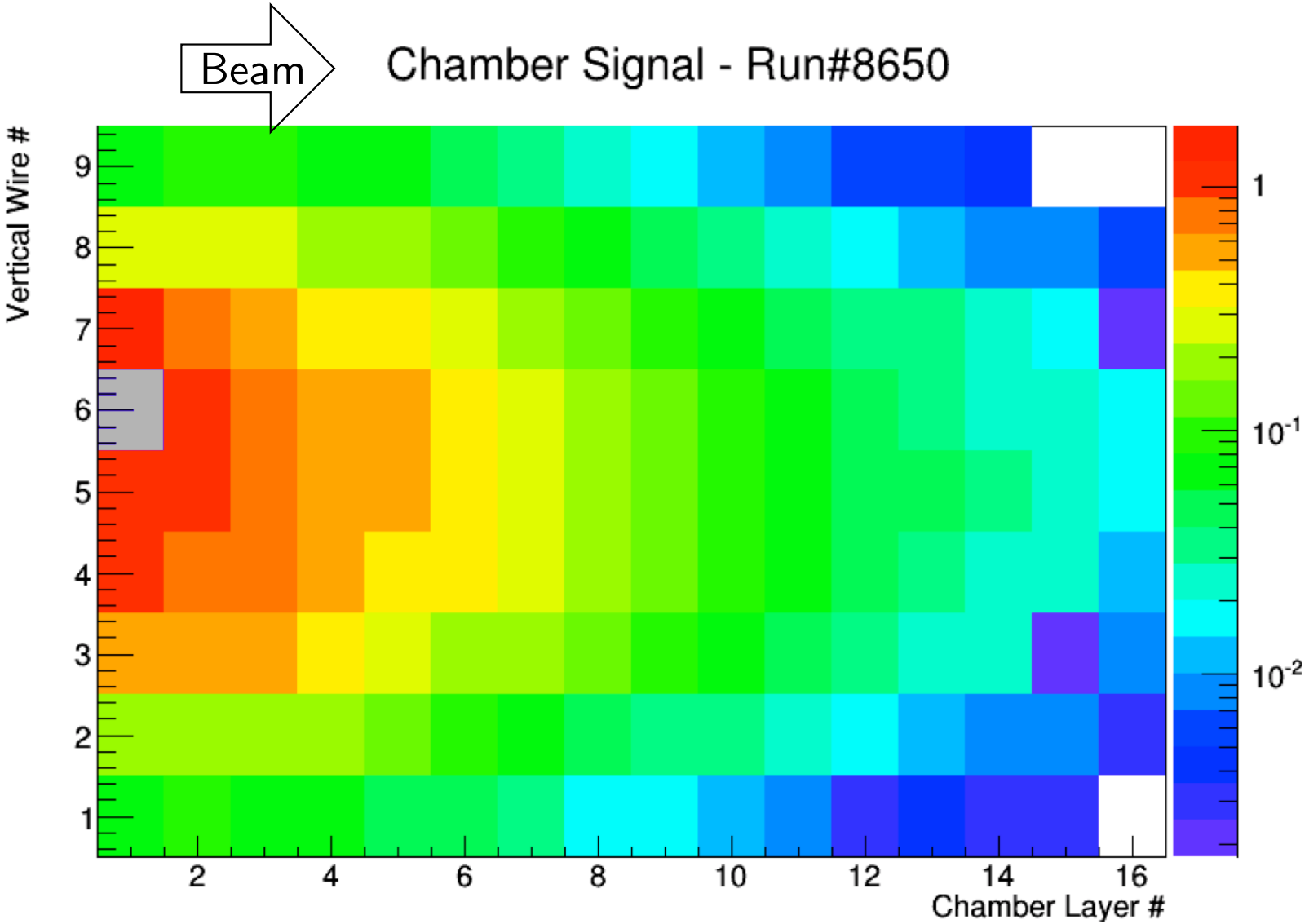
$$\vec{n} + {}^3He \rightarrow p + T + 765keV$$




- proton range is approximately 4 cm
- triton range is approximately 1 cm

# Measured Charge Distribution in the Chamber




- Read through $2 \times 10^6$ charge amplifier preamps

# Simulation of Charge Collection in the Chamber

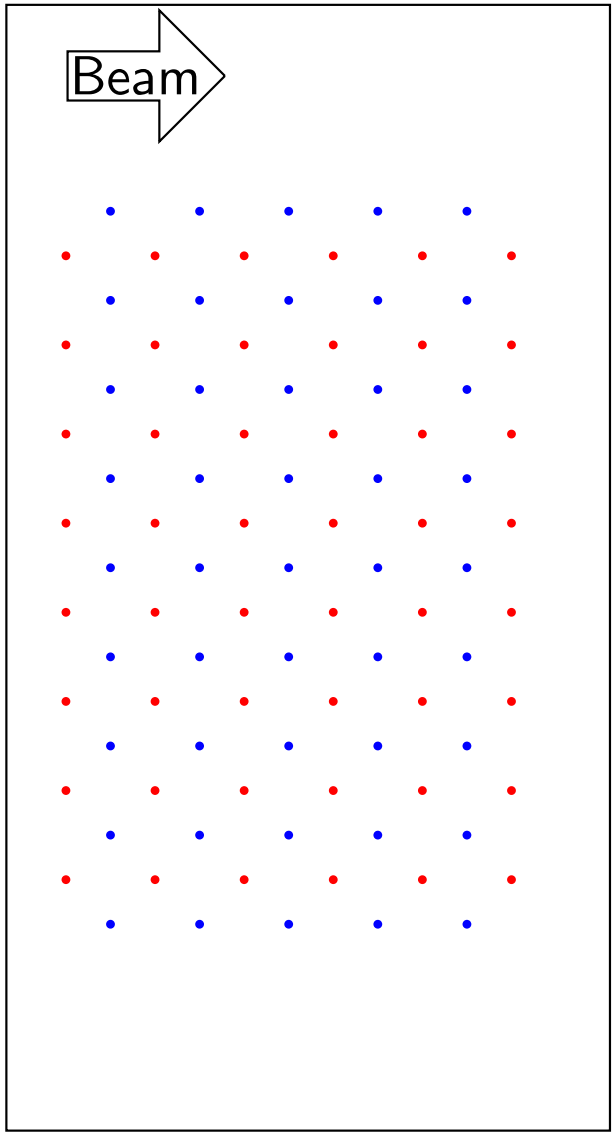
To aid in understanding the measured signals a charge collection simulation looking at factors including

- charge collection times
- secondary ionization
- induced signals
- cross talk between cells

will be done use Garfield++, a toolkit for the detailed simulation of particle detectors that use gas and semi-conductors as sensitive medium.

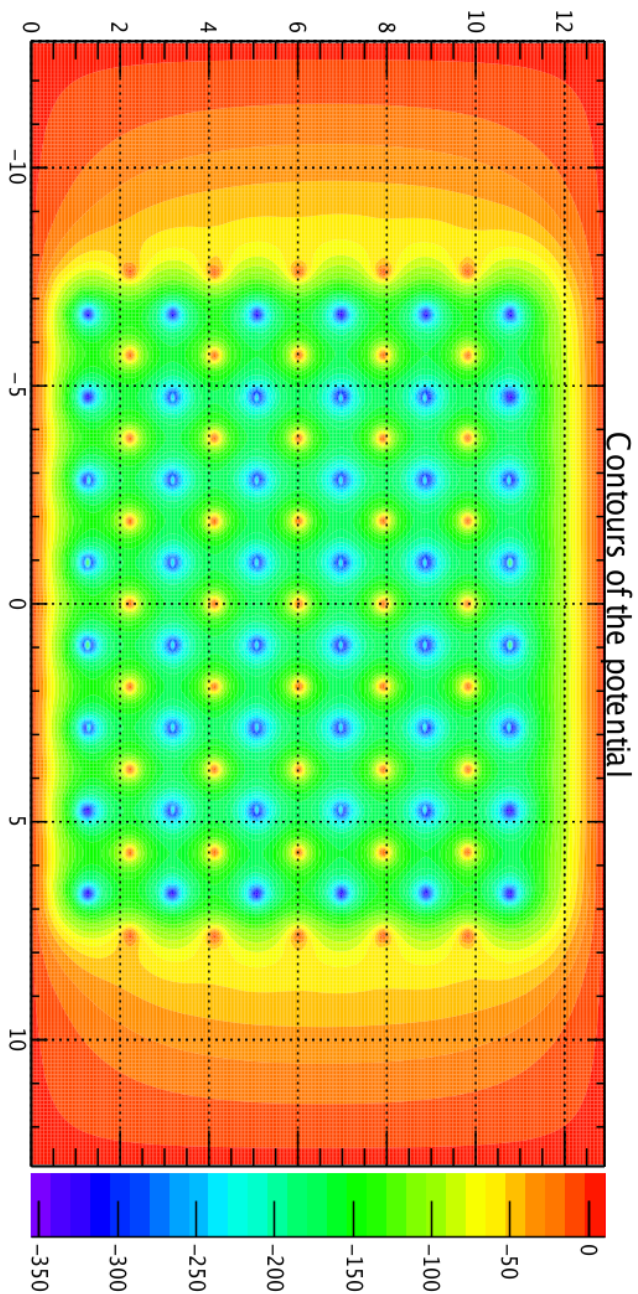
# Simulation Geometry

· HV · Signal



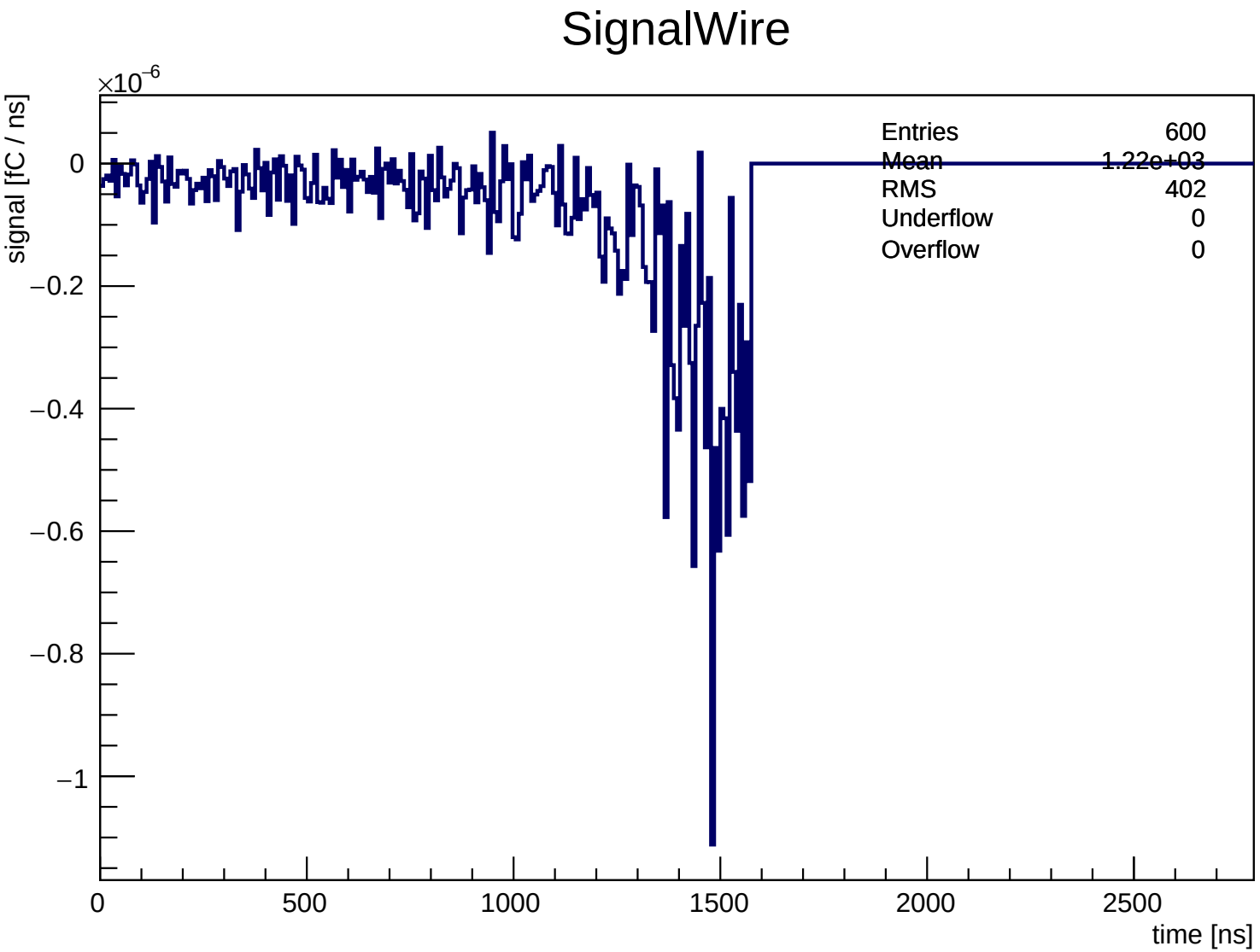

- Reduced Geometry Model
  - interior of housing
  - wires
  - no other features
- reduced number of wire planes
- Geometry defined in 3rd party program called gmsh by Christophe Geuzaine and Jean-Franois Remacle

# 3D Fields - Elmer FEM



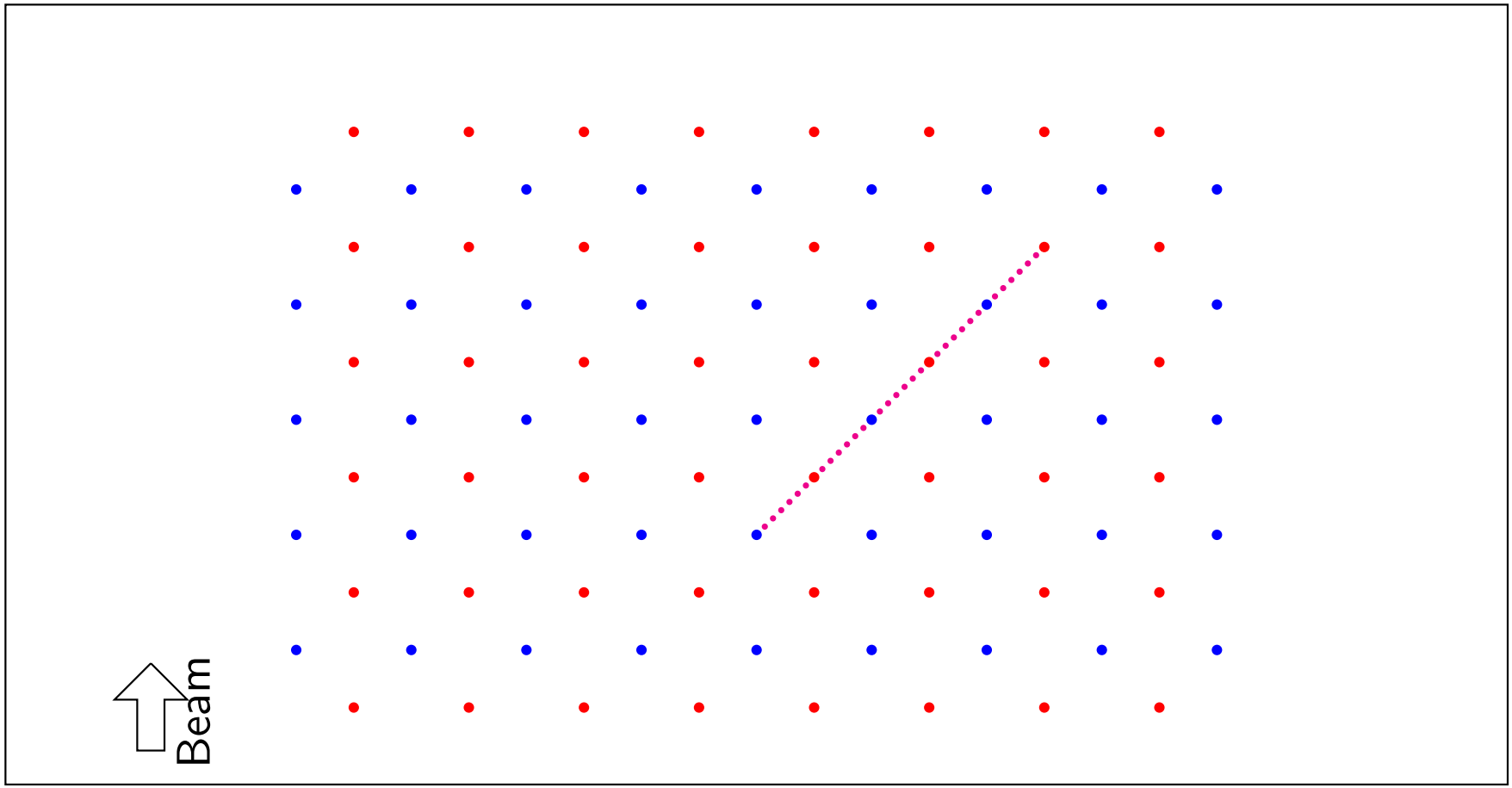

- Elmer is developed by CSC - IT Center for Science Ltd in collaboration with Finnish universities.
- Elmer is a Finite Element Multiphyics package
- Diagram is a cross section through the central axis with the plane perpendicular to the wire axis.
- 0V is red
- -350V is purple

# Single Electron Signal




No multiplication at -350V bias voltage.

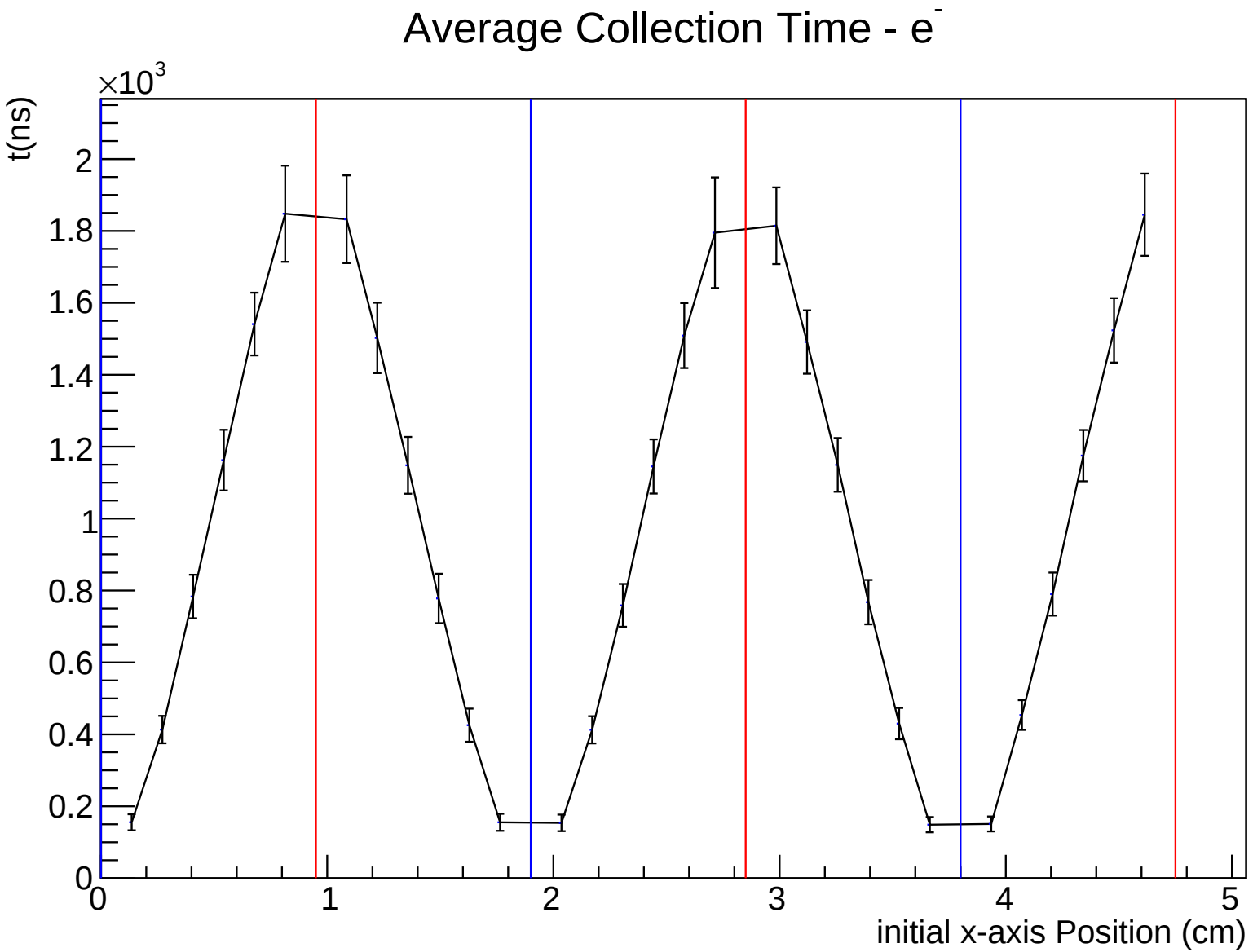
# Diagonal Line Over Multiple Cells



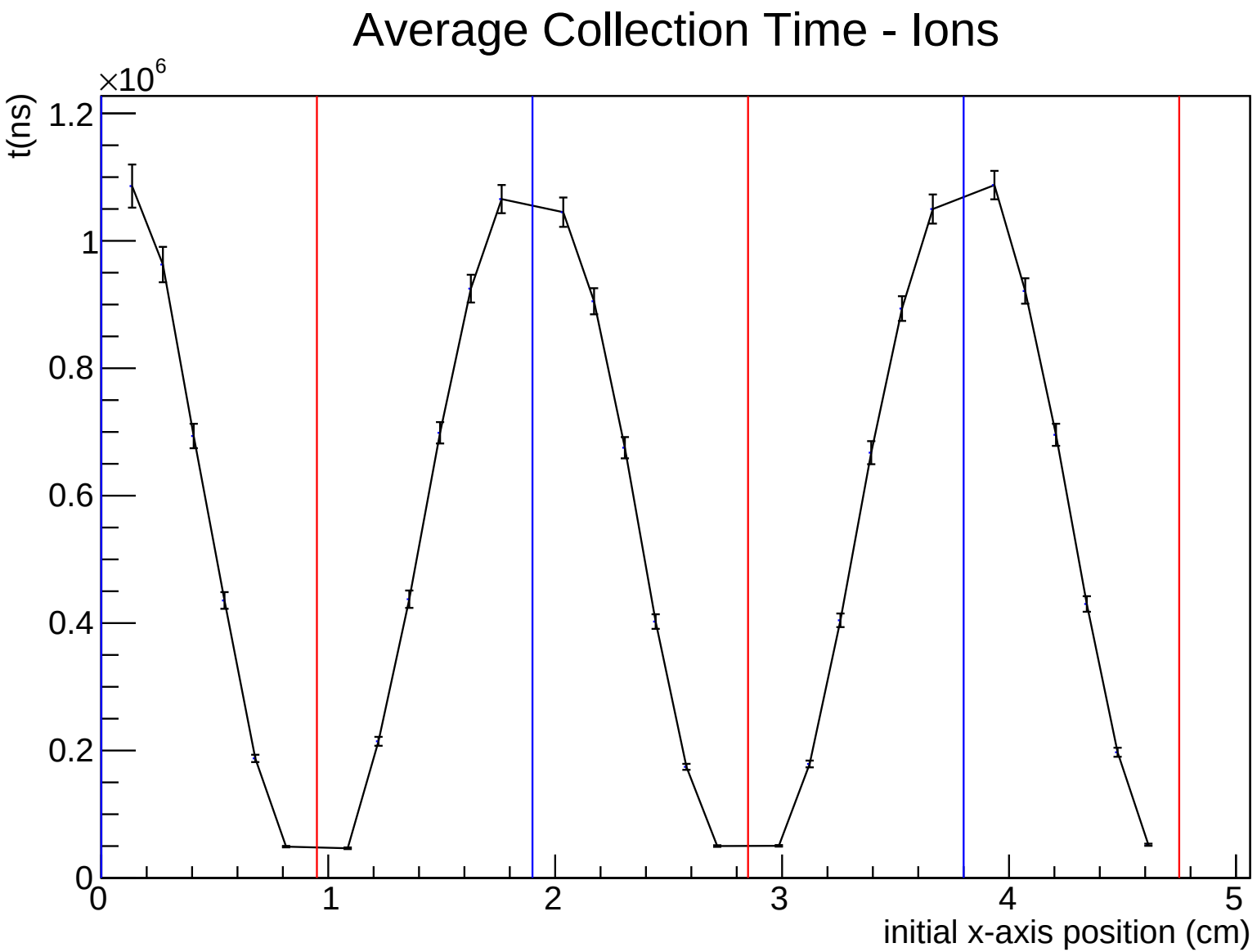

• Signal
• HV
• Diagonal

200 ion and electron pairs propagated from each point

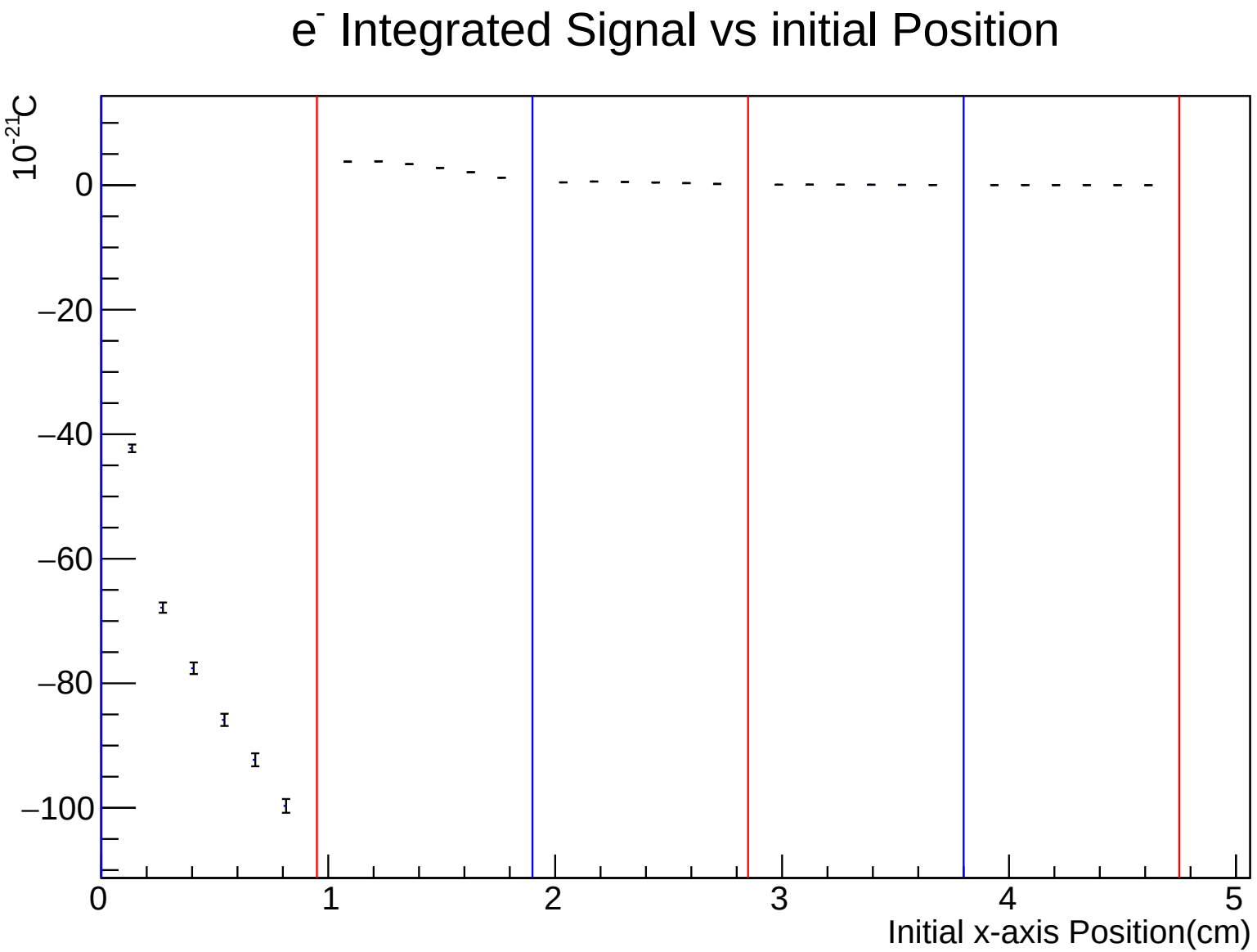
# Extended Diagonal - Collection Time - electron



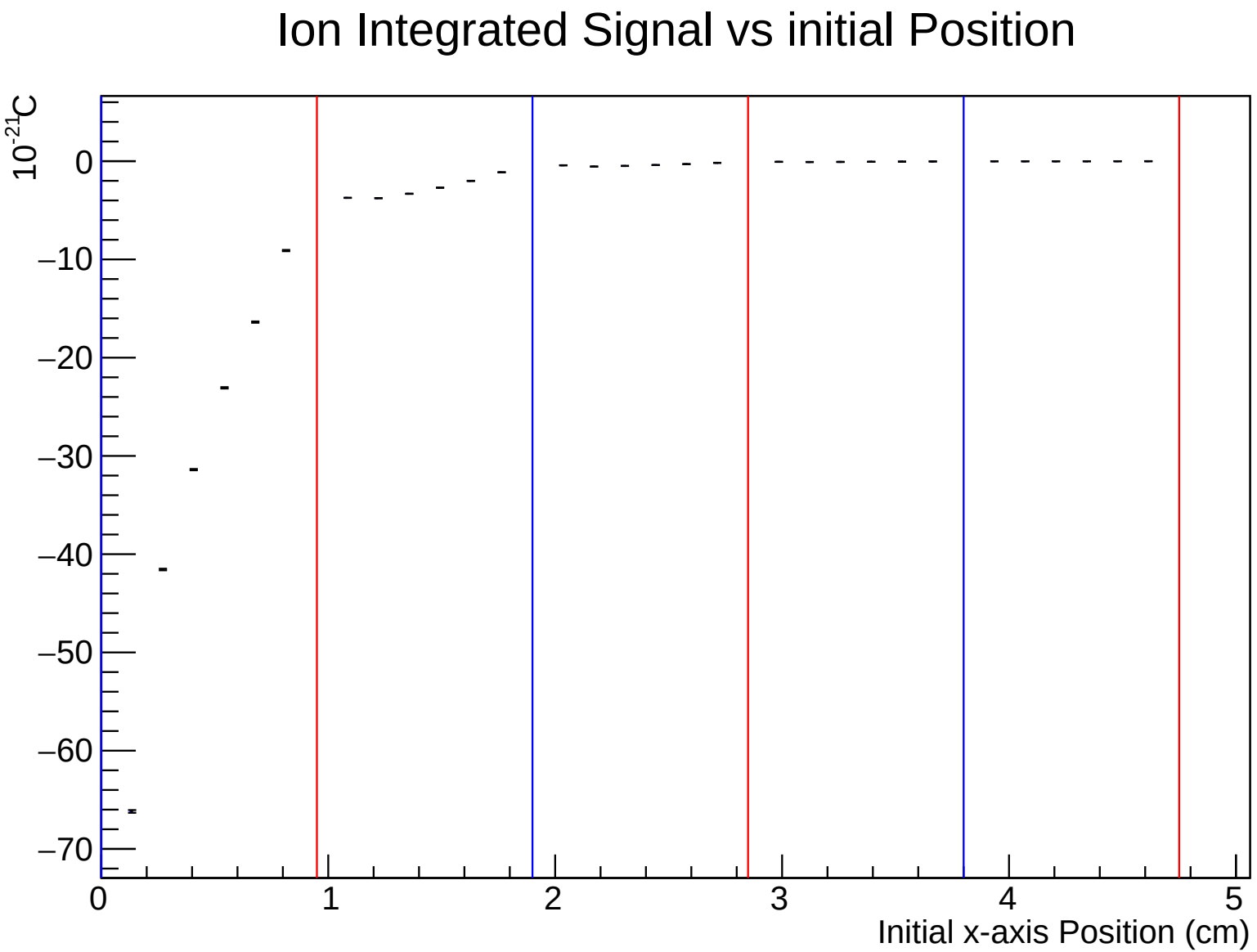
# Extended Diagonal - Collection Time - ions



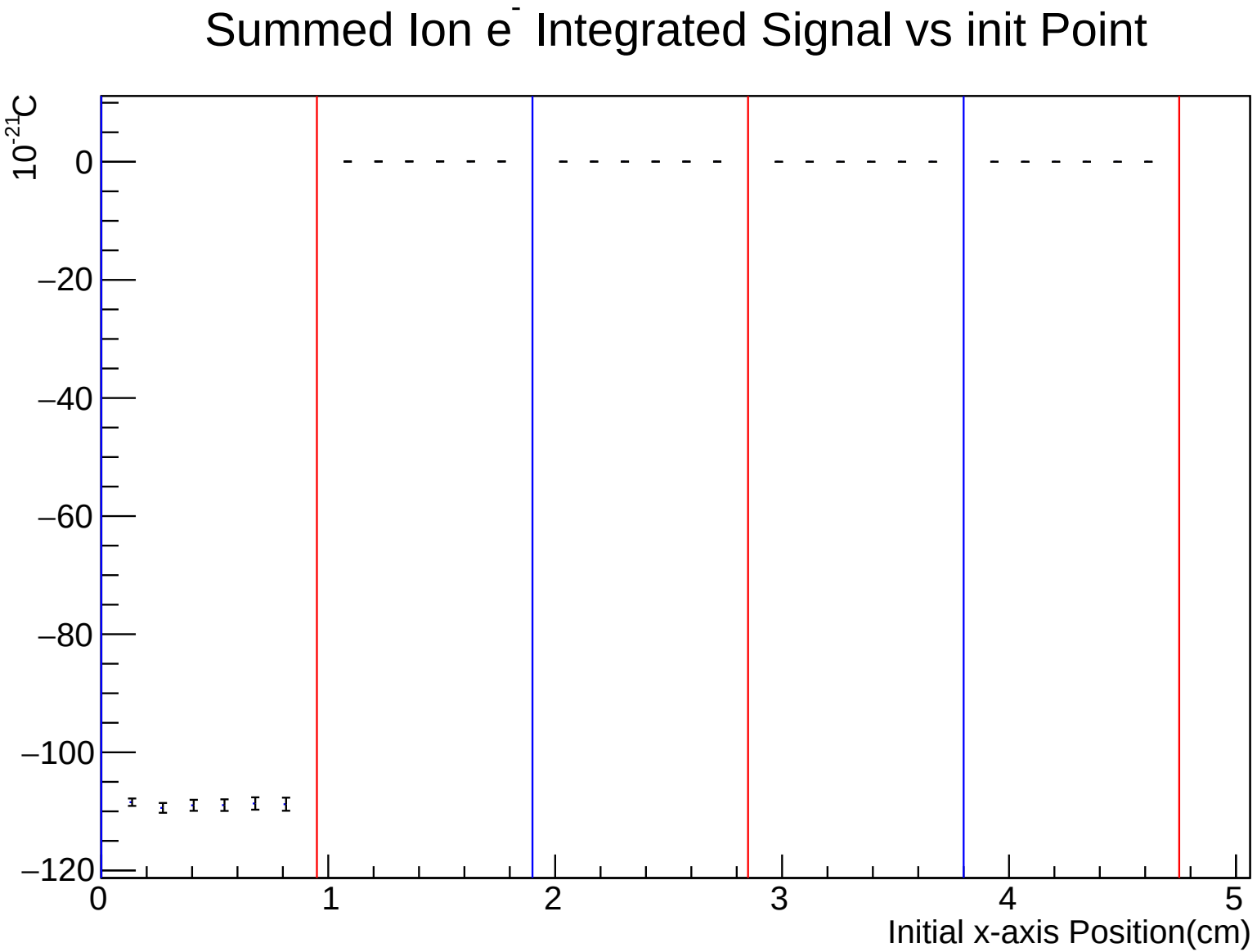
# Extended Diagonal - Average Integrated Signal - electron



# Extended Diagonal - Average Integrated Signal - ions



# Extended Diagonal - Average Integrated Signal - summed



# Summary

- target chamber assembled end of last year
- Data started Jan 2015, to go to end of 2015
- target chamber is functioning as expected
- Garfield++ simulations is setup and has preliminary results
- Initial charge collection times calculated
- Cross talk between cells is small
- Future Goals:
  - Charge collection for off diagonal cell points
  - benchmark charge collection vs measurements

# n3He Collaboration

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