

# Relativistic Behavior Detection through Electron Acceleration

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## Special Relativity

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- The speed of light,  $c$ , is constant in all reference frames
- The velocity of any particle is capped at  $c$



# Classical and Relativistic Kinetic Energies are Different

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## Classical Kinetic Energy

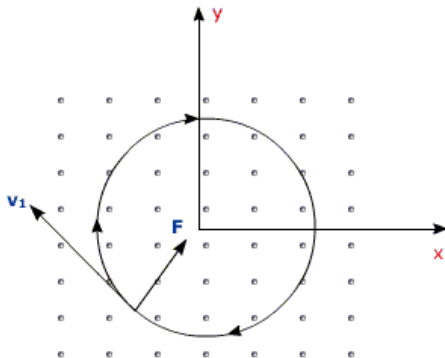
$$K = \frac{p^2}{2m}$$

## Relativistic Kinetic Energy

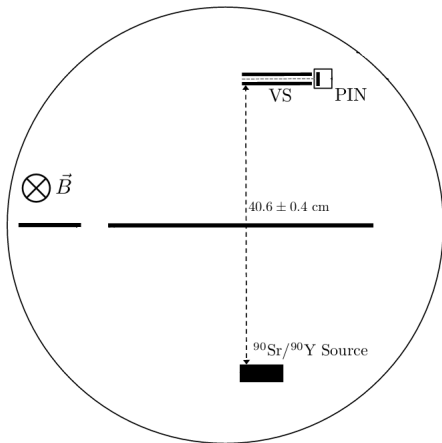
$$K = \sqrt{p^2 c^2 + m^2 c^4} - mc^2$$

# Electrons in Magnetic Fields are Accelerated in Circular Orbits

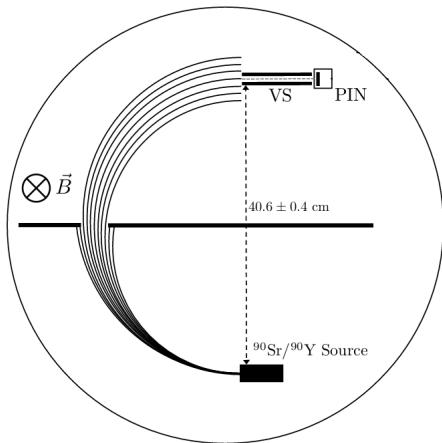
- $\frac{d\mathbf{p}}{dt} = e \left( \mathbf{E} + \frac{\mathbf{v}}{c} \times \mathbf{B} \right)$
- Electrons follow a circular orbit with radii proportional to their momentum
- $p = \frac{\rho e}{c} B$



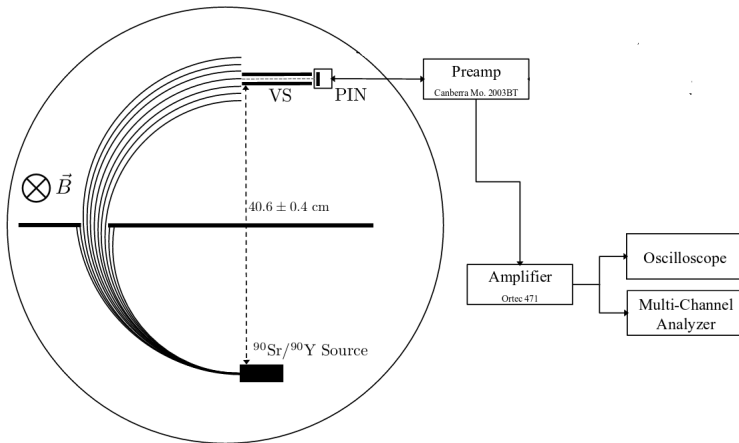
# Experimental Setup Constrains Radius of Electron Orbit



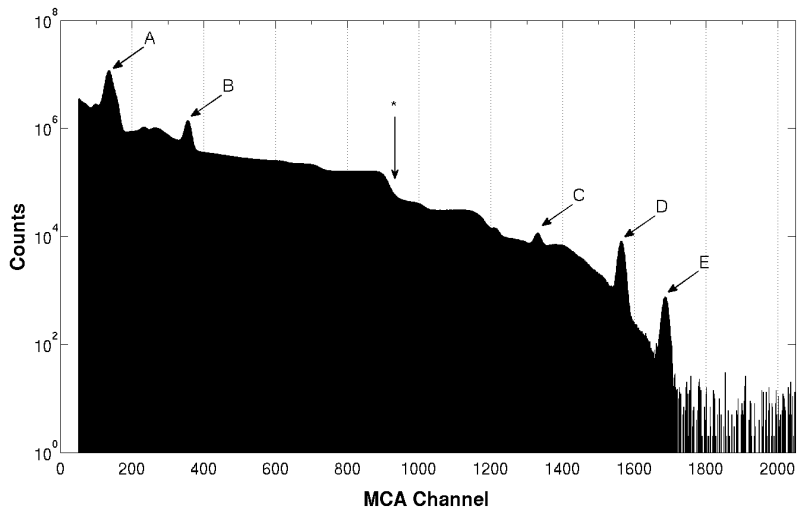
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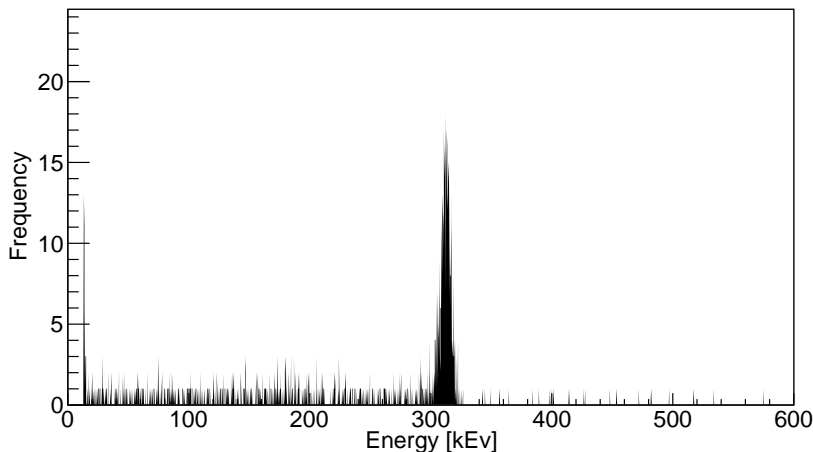
# Experimental Setup Constrains Radius of Electron Orbit



# Barium-133 Produces MCA Peaks at Known Energies

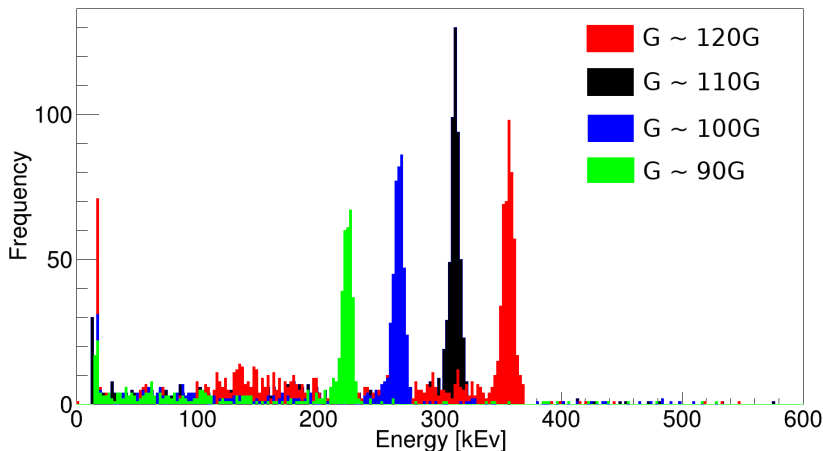


# MCA Readout for Sr-90/Y-90 Sharply Peaked around Energy Range

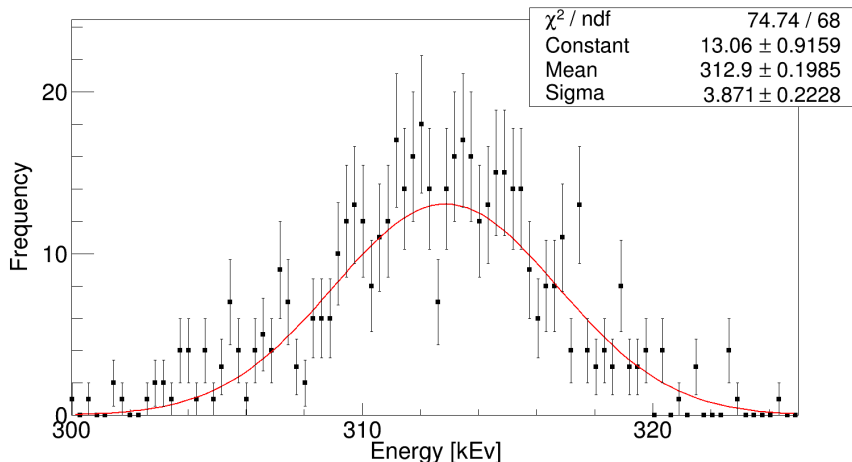




# Magnetic Field Affects Peak Energy Range



# Kinetic Energy Determined through Gaussian Fitting



# Gaussian Fits Bring Uncertainty in Kinetic Energy

$B_{approx}$ (G)	K (keV)	$\sigma_K$ (keV)
90	222	.2
100	265	.2
110	312	.4
120	355	.3

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# Uncertainties in Magnetic Field are Correlated

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- Variations between runs
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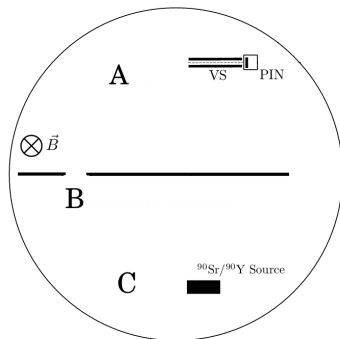
## Uncertainties in Magnetic Field

- Variations during individual runs from coil heating
- Variations between runs
- Inhomogeneous magnetic field during individual runs
- Systematic uncertainty in magnetometer

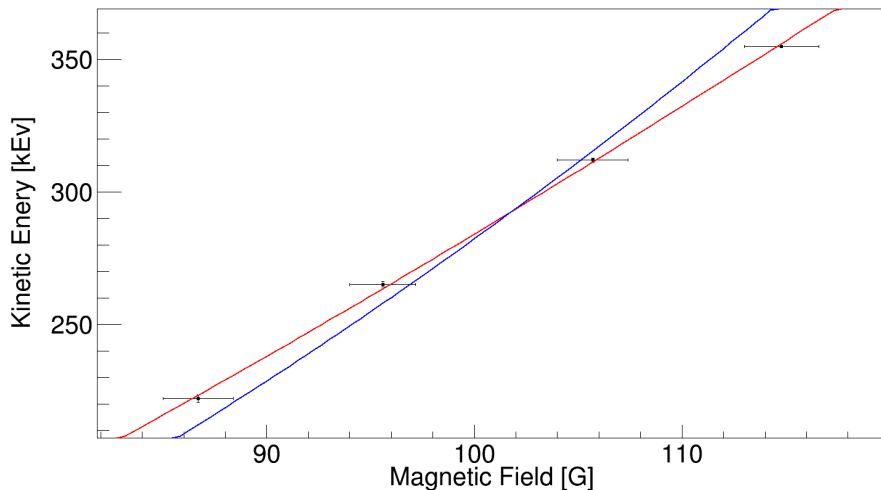


# Inhomogeneity Addressed by Averaging over Multiple Points

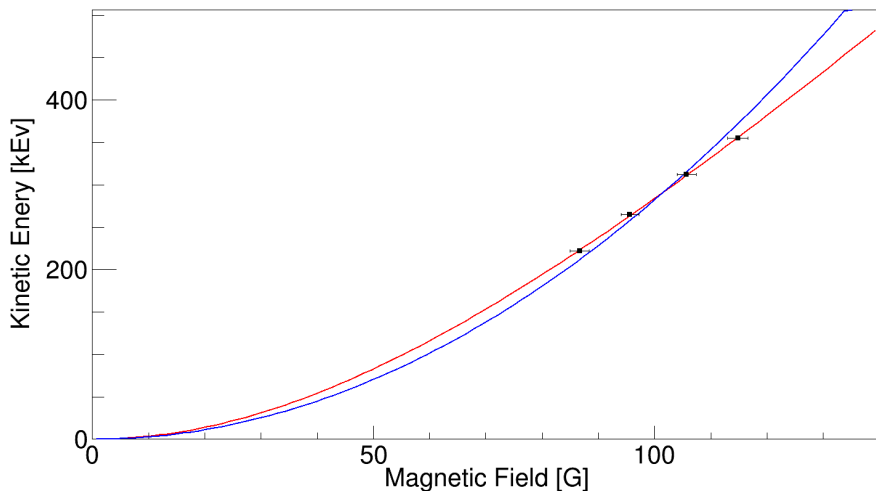
- Measured at point C during experimental runs
- Determined correspondance between magnetic field at point C and the average magnetic field over the path of the electron



# Data Follows Relativistic Trend



# Shapes of Fit Separate at Large Kinetic Energies



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