

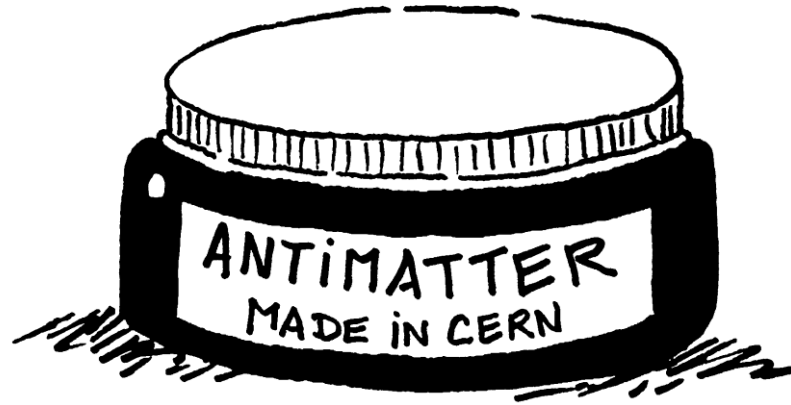
VISUALIZE THE BEAM

Howard Chiao



What Is ALPHA?

- **A**ntihydrogen
- **L**aser
- **P**Hysics
- **A**pparatus
- Located at the Antiproton Decelerator (AD), a storage ring at CERN
- Collaboration between 14 universities and 7 countries

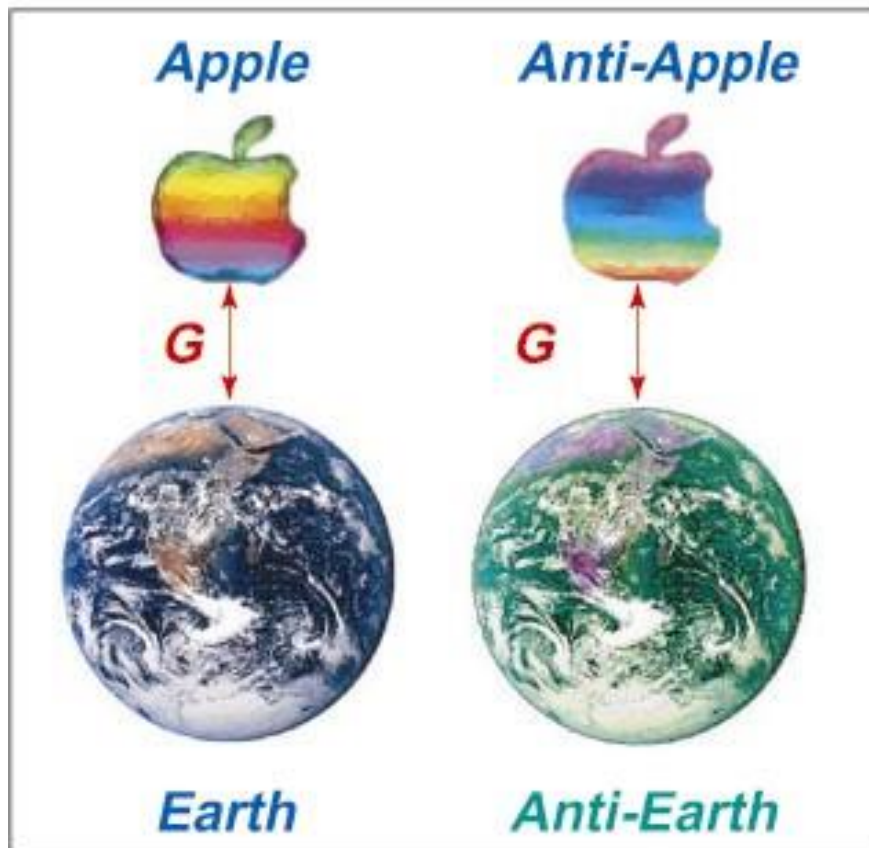


What Does ALPHA Do?

- Mixing positron and antiproton to create antihydrogen in low temperature
- Trap antihydrogen in a magnetic trap
- Test CPT symmetry through comparison of the atomic spectra
- Find out the gravity of antimatter

What Does ALPHA Do?

CPT Symmetric Situation



Not:



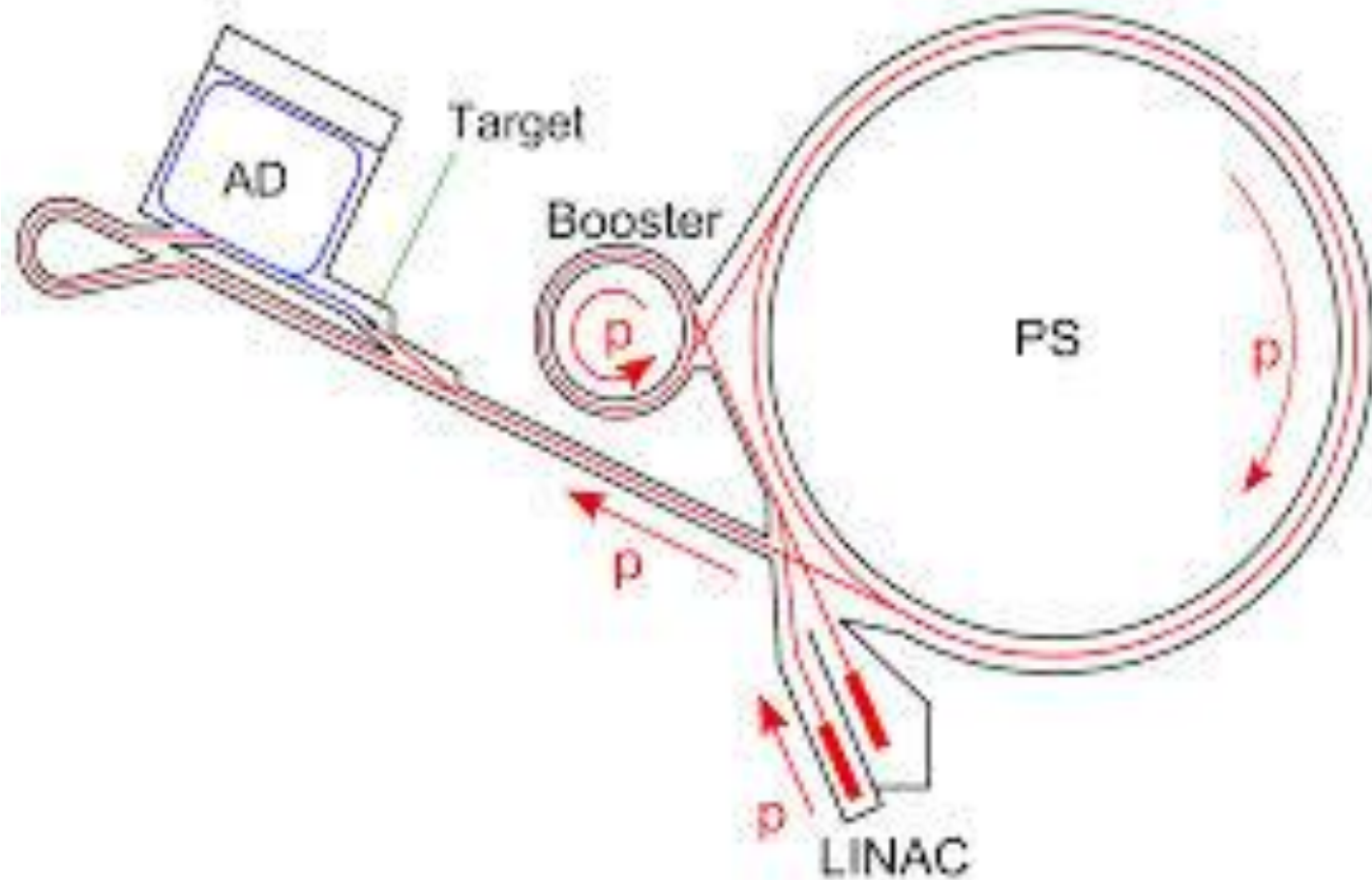
How To Get Positron?

- ALPHA uses the positron produced in the beta-plus (e^+) decay of sodium-22 atoms.













- Collides with nitrogen molecules to lose energy by producing an excitation of nitrogen.
- Positron is then sent to the accumulator.

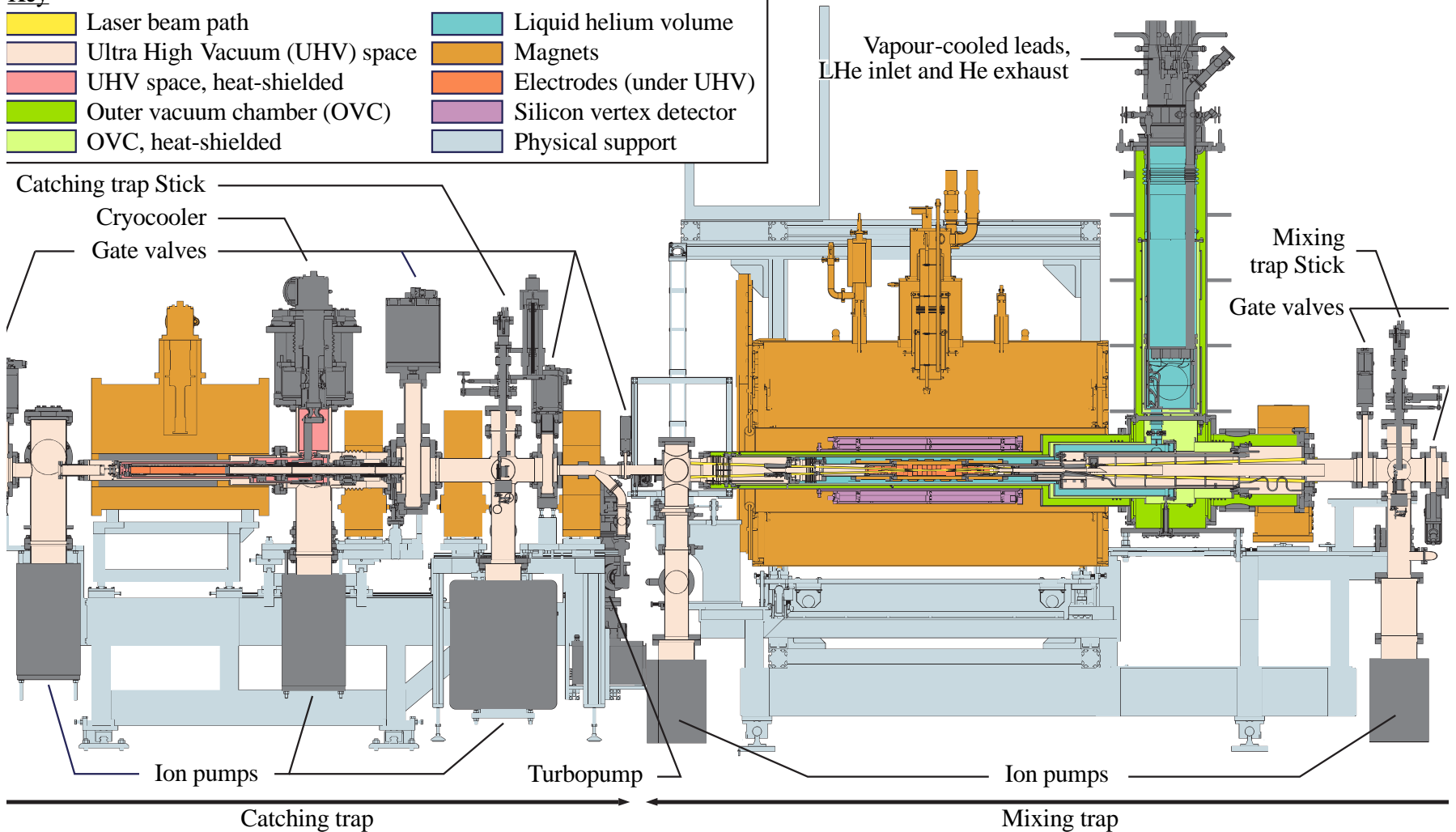
How To Get Antiproton?



The Setup of ALPHA Apparatus

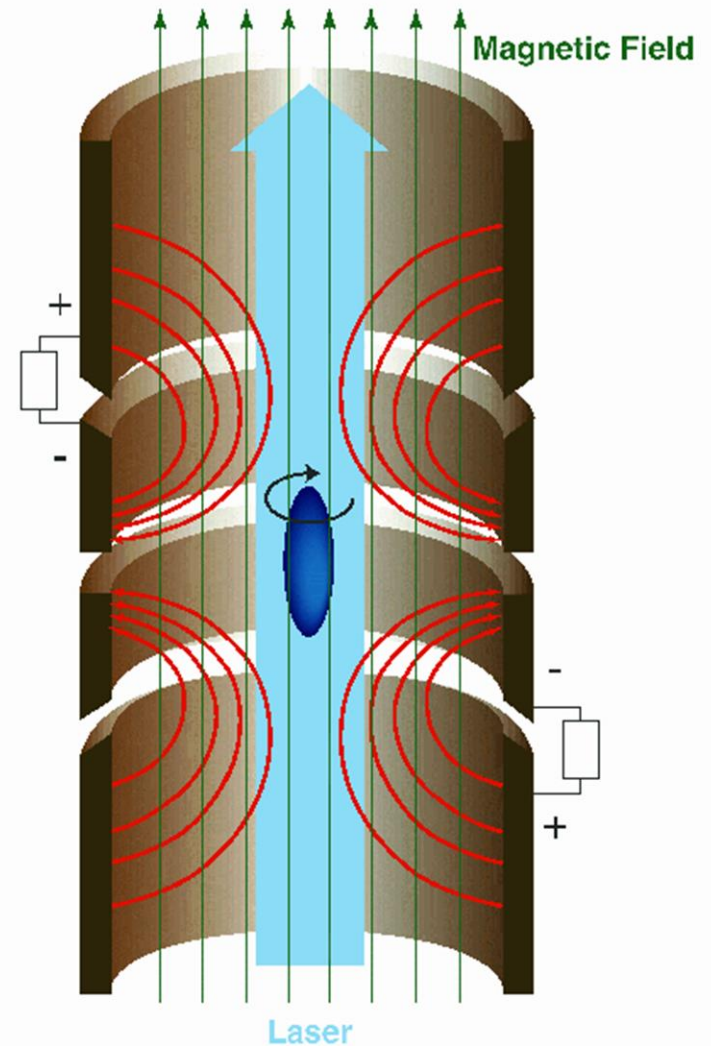
Key

	Laser beam path		Liquid helium volume
	Ultra High Vacuum (UHV) space		Magnets
	UHV space, heat-shielded		Electrodes (under UHV)
	Outer vacuum chamber (OVC)		Silicon vertex detector
	OVC, heat-shielded		Physical support



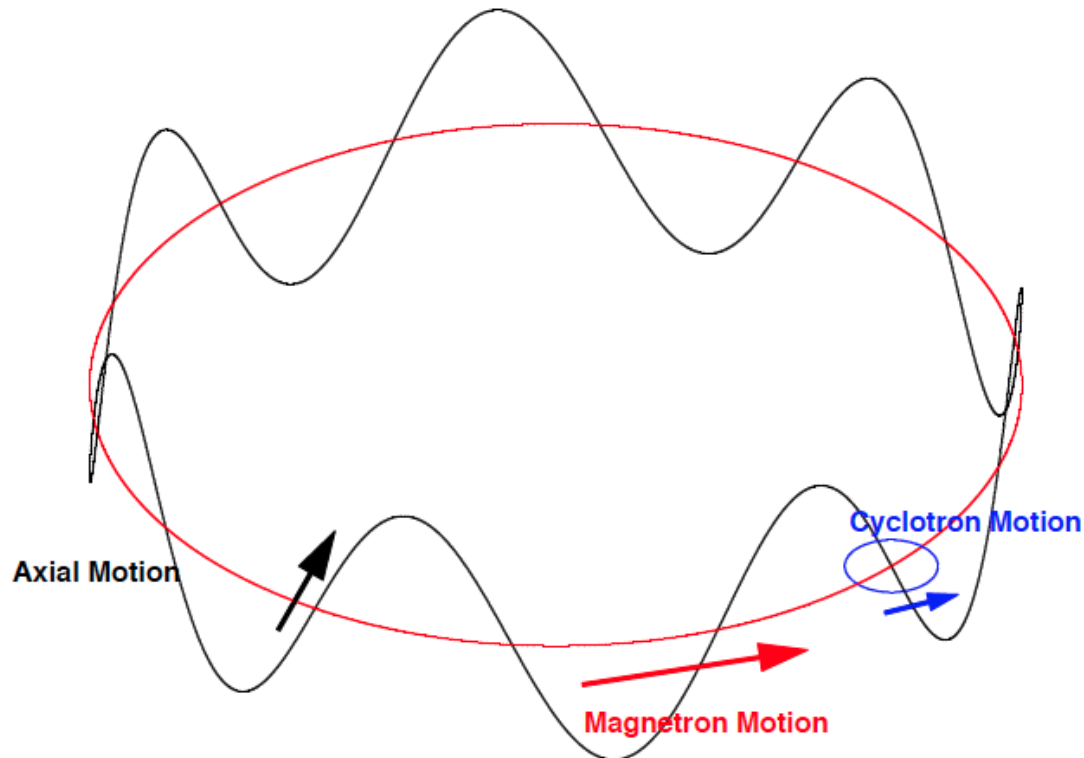
Penning Trap

- A widely-used charged particle trap
- Uniform magnetic field
- Quadratic electric potential



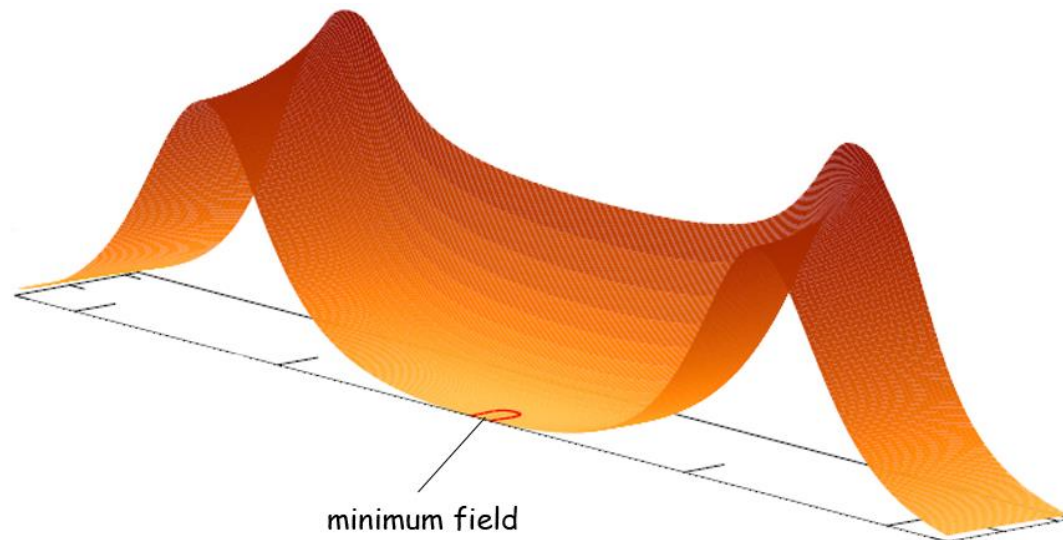
Penning Trap

- Charged particles move in the different circular motions.



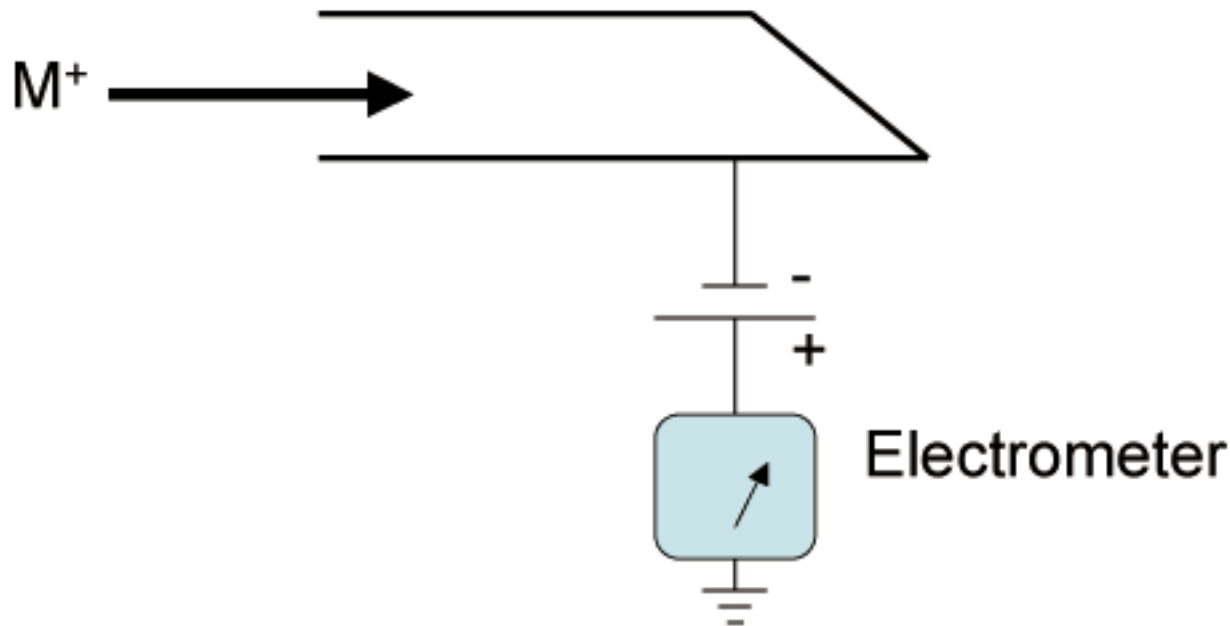
Magnetic Trap

- Trapping neutral particles with magnetic dipole moments (ex. Antihydrogen)
- Only antihydrogen with temperature lower than 0.5K can be trapped.



Faraday Cup

- Measure the amount of charge
- Consists of a piece of Beryllium foil, which acts as a degrader of the antiproton beam

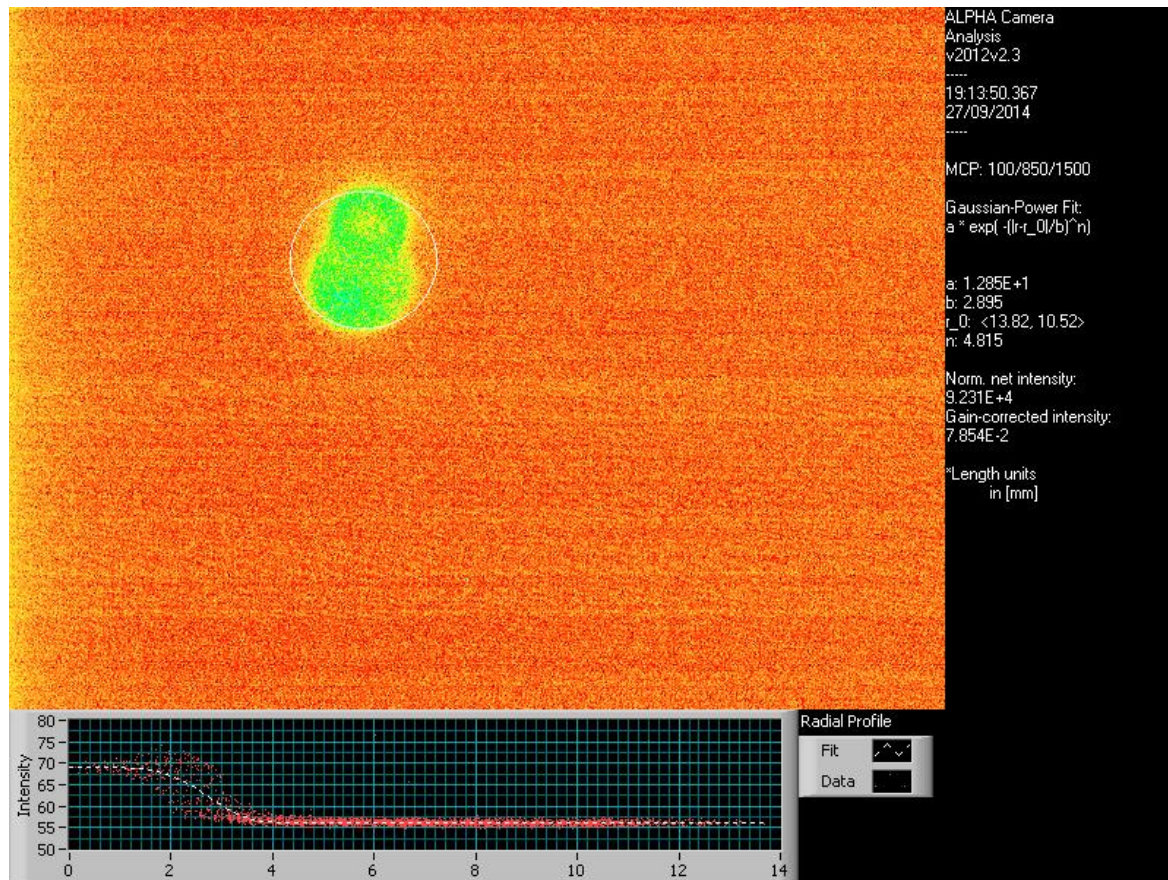


Microchannel Plate Detector (MCP)

- The “camera” of particle beams.
- An array of small electron multipliers
- Large potential difference across
- Particles are accelerated onto a phosphor screen to produce light.

My Project

- Image recognition and analysis for two circles



Other Responsibilities

- Taking shifts
- Assembling zombie computers