

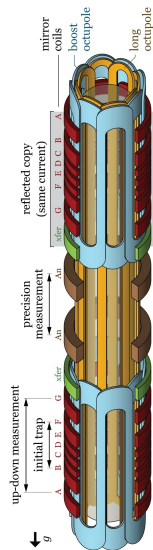
# Commissioning the Radial Time Projection Chamber for the ALPHA-g antimatter gravity experiment

Lars Martin for the ALPHA collaboration

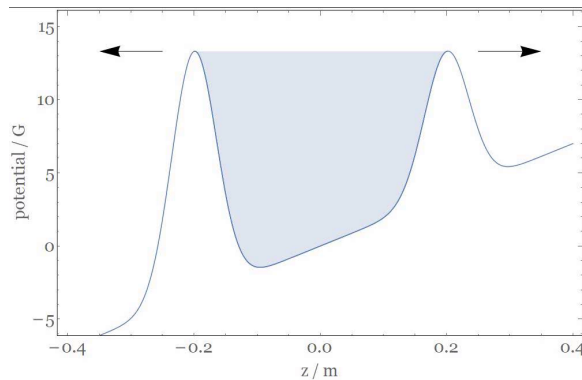


CAP Congress, June 2019

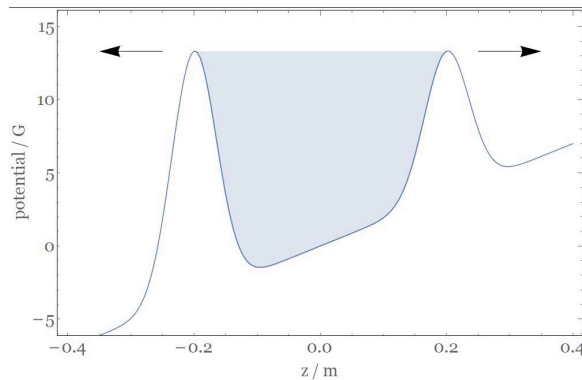
- ALPHA-g aims to investigate the behaviour of anti-hydrogen in free fall
- Based on previous ALPHA2 apparatus (see Chukman So T2-11)
- Vertical orientation, much longer ( $> 2$  m)
- Silicon detector array replaced with radial TPC
- Plastic scintillator Barrel detector for cosmic suppression (see N. Massacret T2-11)

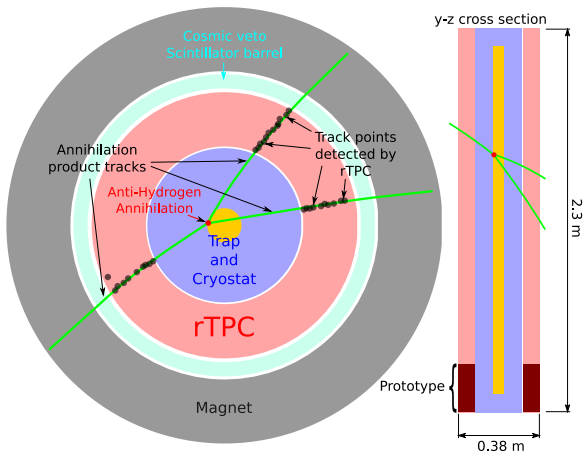


- Mix antiprotons and positrons in overlapping traps
- Hold anti-atoms in magnetic trap while dumping charged particles
- Slowly lower top and bottom potential wall
- Observe annihilations by tracking  $\approx 3$  pions
- Adapt potential walls until annihilation distribution is symmetric

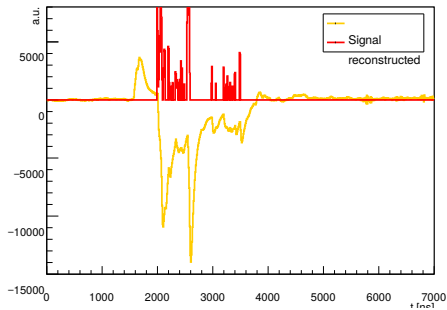
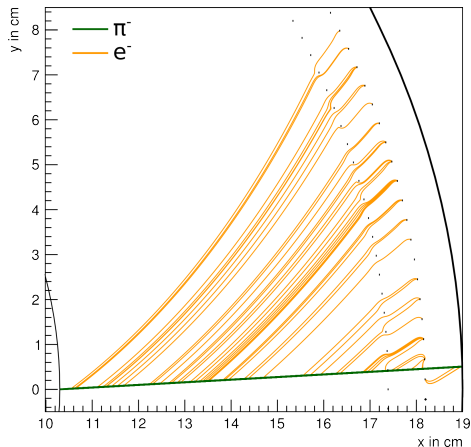


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- Profit?

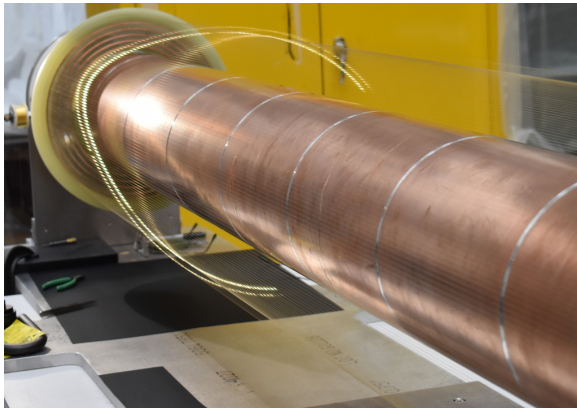


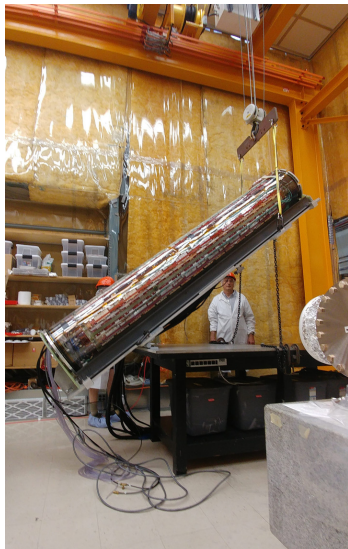


- LHe cooled atom trap
- Vertical on top of beam line
- Helical tracks
- Annihilation vertex from helix closest approach
- Symmetric around measurement trap
- Required z resolution cm-scale
- >18000 channels of signal digitization inside solenoid
- Watercooling for electronics
- Laser calibration system to confirm drift parameters independent of cosmics or beam



- Each arriving electron cluster induces an avalanche signal on anode wire
- Neighbouring wires and pads see an opposite sign signal
- Signal has to be deconvolved to reconstruct electron arrival times





L. Martin (TRIUMF)

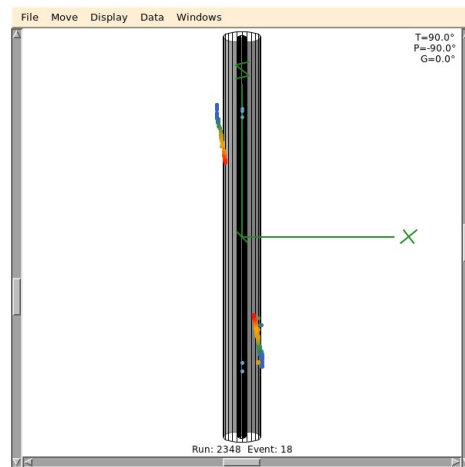


ALPHA-g rTPC commissioning

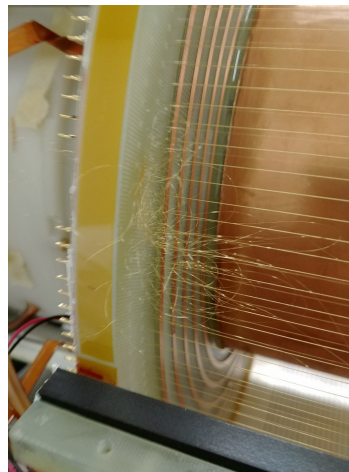


- Horizontal data taking to confirm no transport damage
- Vertical insertion of rTPC in BV (first time!)
- Insertion of detector package in solenoid
- Insertion of trap cryostat in rTPC bore
- Lifting of entire setup on top of beamline
- Vertical cosmics data with and without magnetic field
- Vertical operation together with BV
- Observe antiproton annihilations from trap
- Observe antiproton annihilations from trapped  $\bar{H}$

- 13 July: rTPC shipped
- 24 July: rTPC received, installed on the ring, start cabling, etc.
- 30 July: Gas flowing in rTPC
- 30 July: all 64 PWBs working
- 31 July: rTPC holds High Voltage
- 31 July: First Cosmics ✓



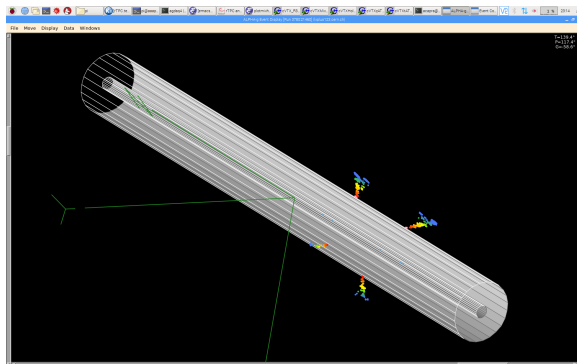
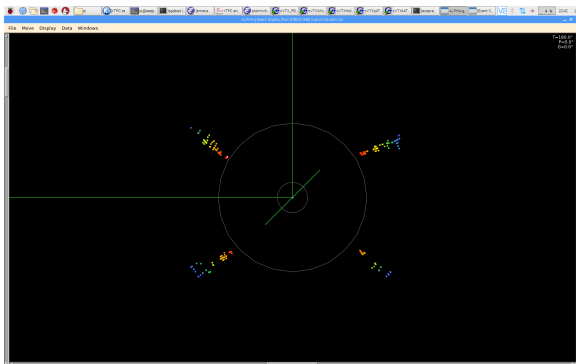
- 20 August: An anode wire breaks !
- 31 August: rTPC in clean room
- 7 September: back in business, all subsystems running,  
commissioning resumed  
the Barrel Scintillator has arrived





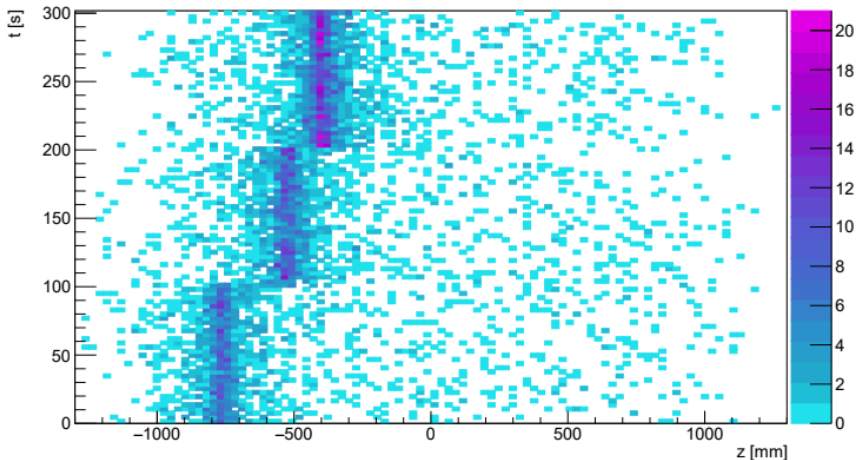
27 September: rTPC+BV installation in solenoid

31 October: first antiprotons detected with the rTPC



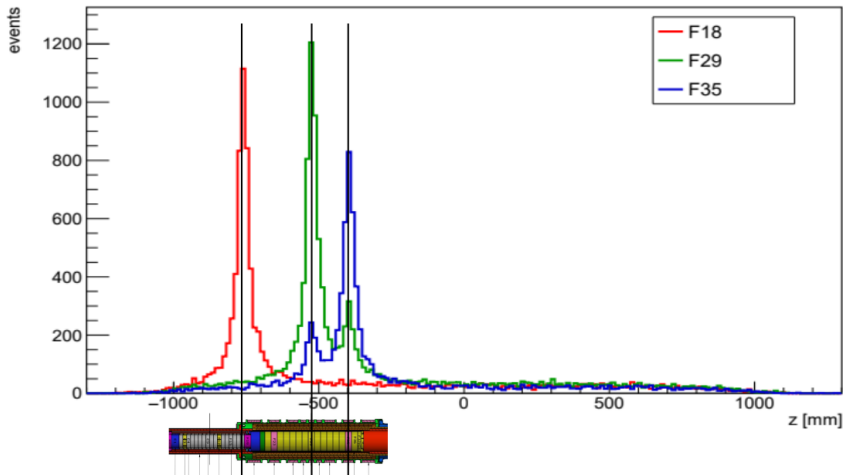
## Holding and moving $\bar{p}$ in different trap sections

Z-T Vertex



## Holding and moving $\bar{p}$ in different trap sections

Z Vertex



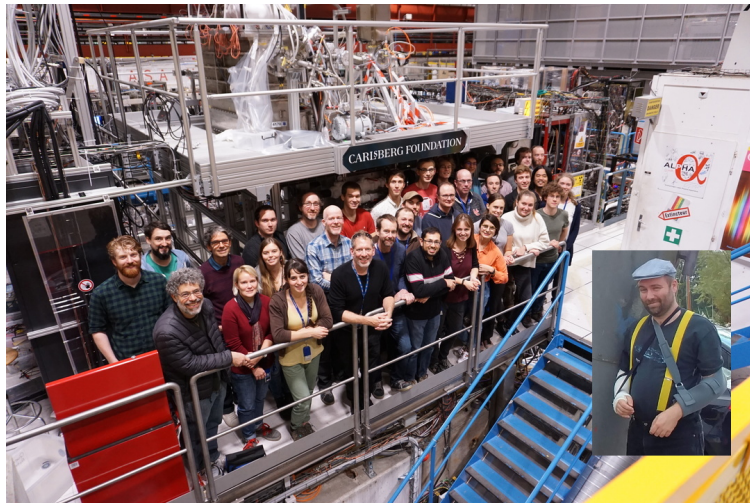
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# Thank You



L. Martin (TRIUMF)



ALPHA-g rTPC commissioning

