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Fast Annihilation Cryogenic Tracking

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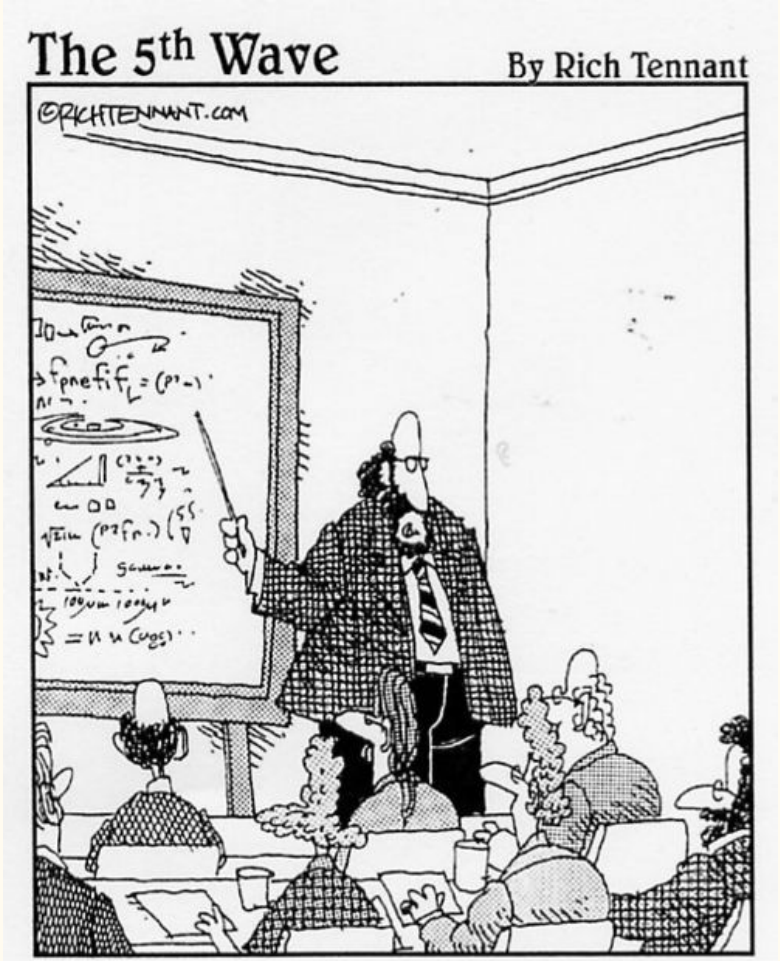

"After the discovery of 'antimatter' and 'dark matter', we have just confirmed the existence of 'doesn't matter', which does not have any influence on the Universe whatsoever."

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- Antihydrogen Experiment: Gravity, Interferometry, Spectroscopy
- Why does the observable universe appear to contain only ordinary baryonic matter and no sizable amounts of antimatter?

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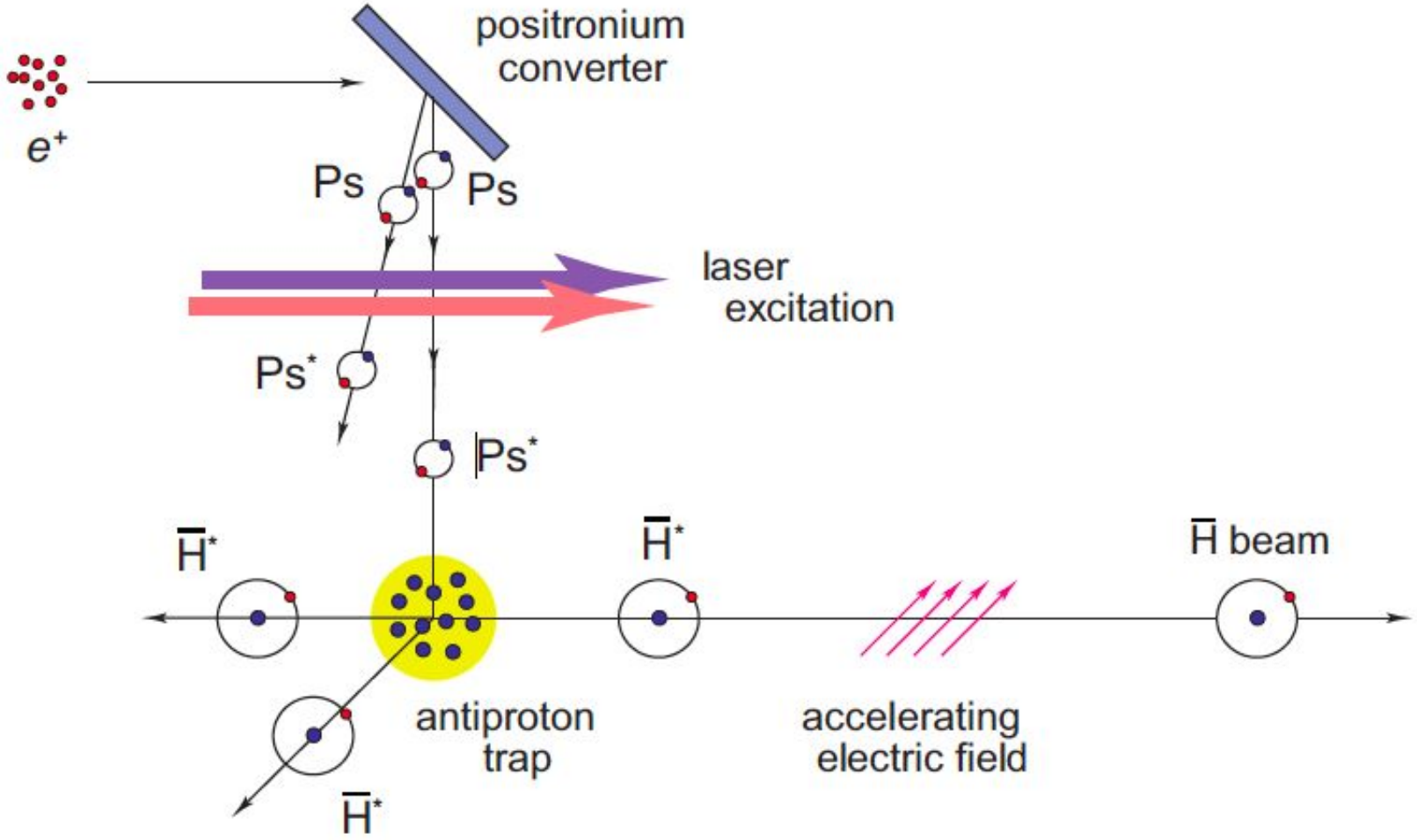
- performing the first direct measurement of the Earth's gravitational acceleration on antimatter
- So the job divides into:
  - Cooling down antiproton
  - Trapping antiproton
  - Extending positronium's lifetime
  - Mix them to form antihydrogen
  - $Ps^* + \overline{p} \longrightarrow \overline{H}^* + e^-$


positronium
converter
e^+
Ps
Ps
laser
excitation
Ps^*
Ps^*
$\bar{H}^*$
$\bar{H}^*$
$\bar{H}$ beam
antiproton
trap
accelerating
electric field
$\bar{H}^*$

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- a pulsed horizontal antihydrogen beam with a velocity of several 100 m/s will be produced.

- The productions of *cold* antiprotons, and in return, *cold* antihydrogen atoms are critical to AEGIS

FACT

- What FACT can do / What we expect from FACT
- The Setup of FACT
- What I have been doing / Where we are now
- What's next

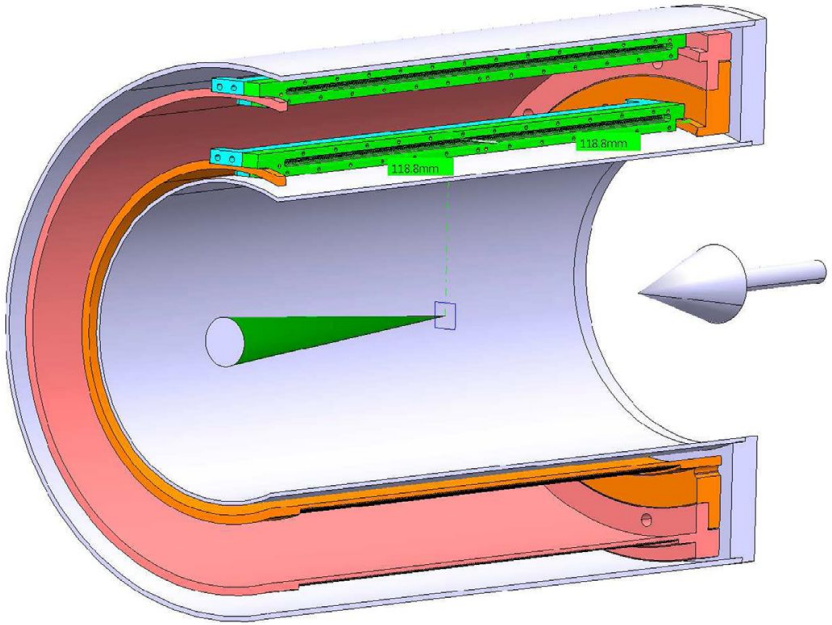
What Fact Can Do

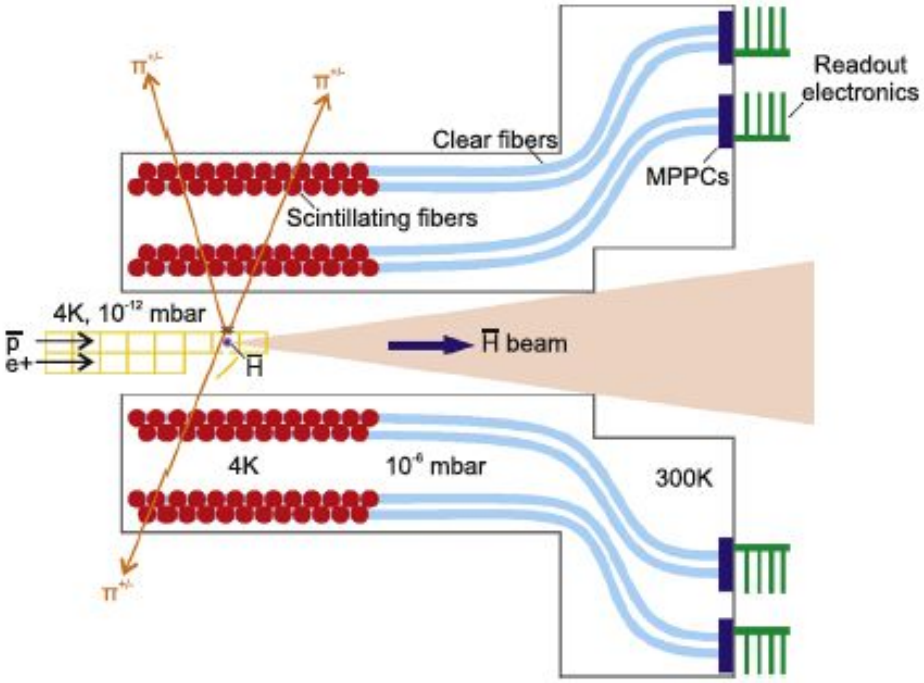
What we expect from FACT

- measure the production and temperature of the antihydrogen atom and
- identify each of the thousand or so annihilations in the 1ms period of pulsed antihydrogen production
- operate at 4K inside a 1T solenoidal field
- not produce more than 10W heat.

The Setup of FACT

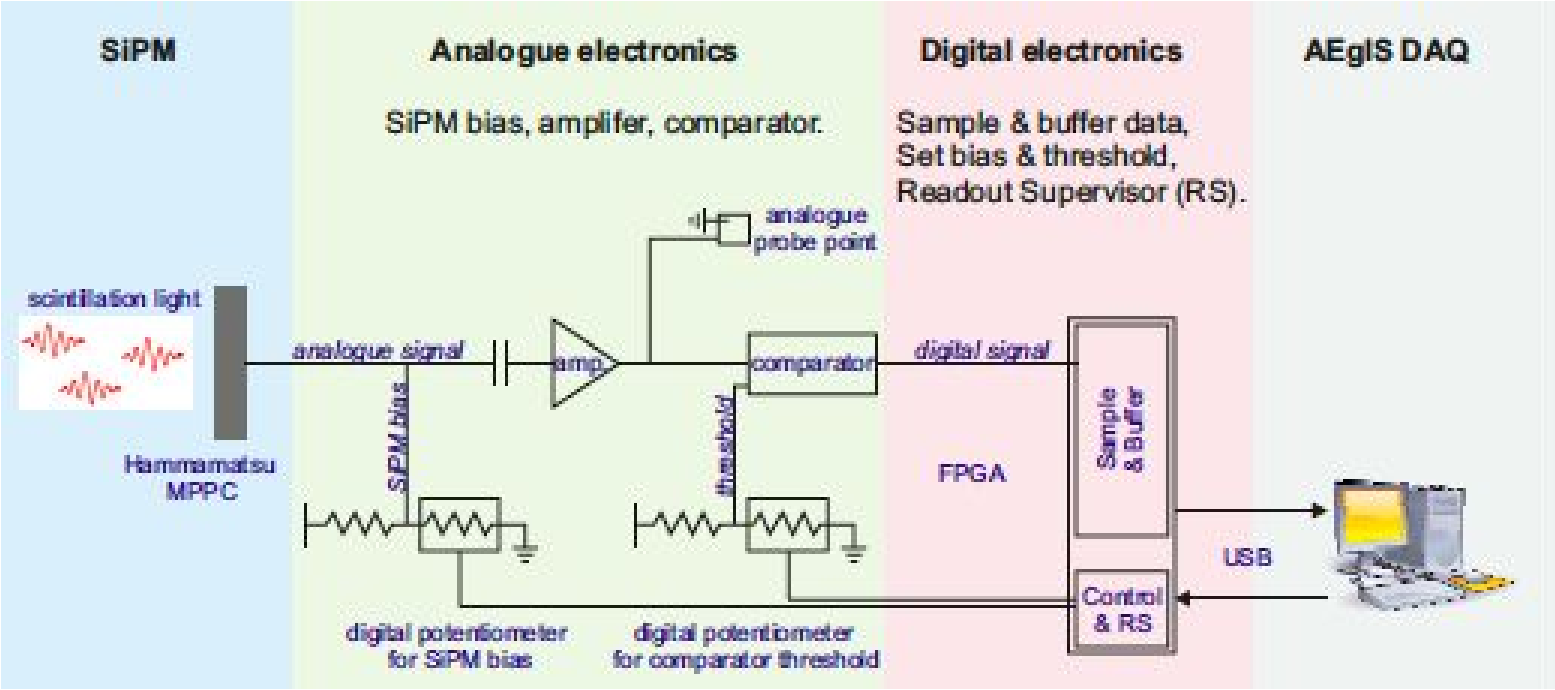
- 800 scintillating fibers (4x200)
- 70mm and 98mm from the beam line
- Each scintillating fiber is connected to a 200m long clear fiber sending signals to the electronics

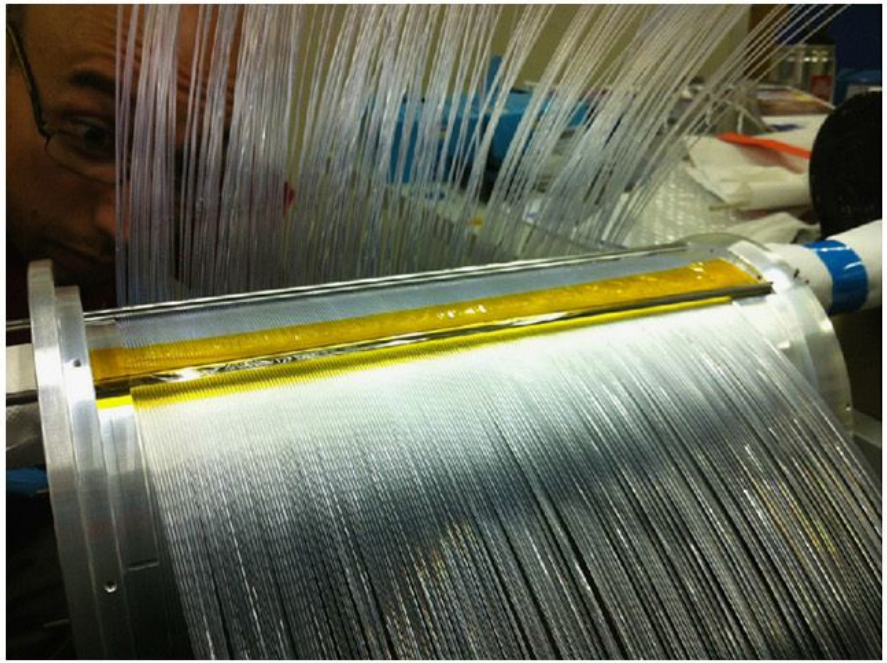


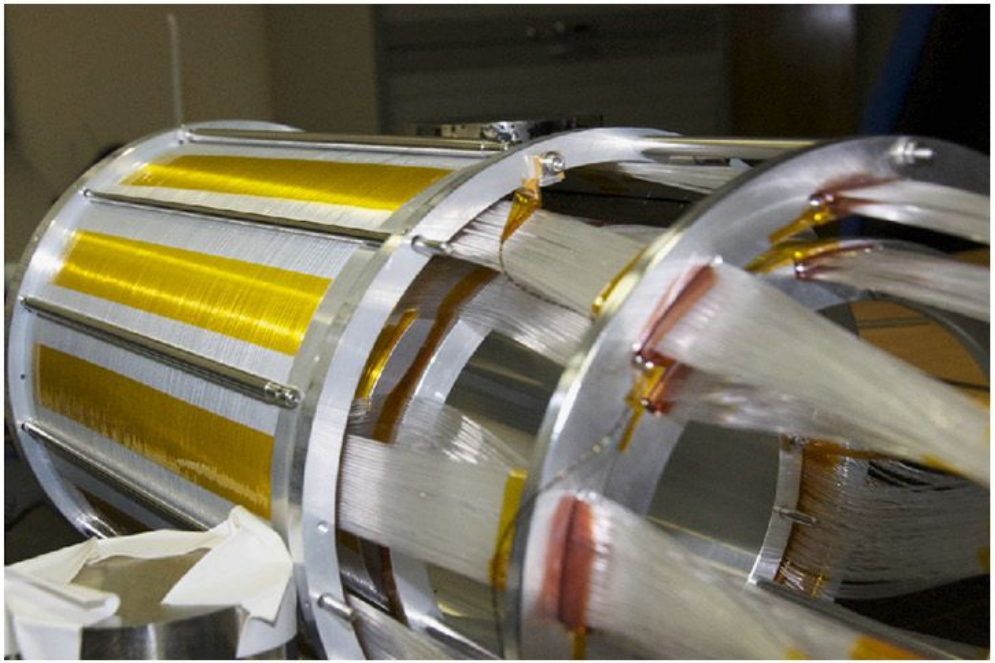


The Setup of FACT

- 24 both Analog (Voltage) and Digital data readout + 768 only Digital + 8 dummy fibers

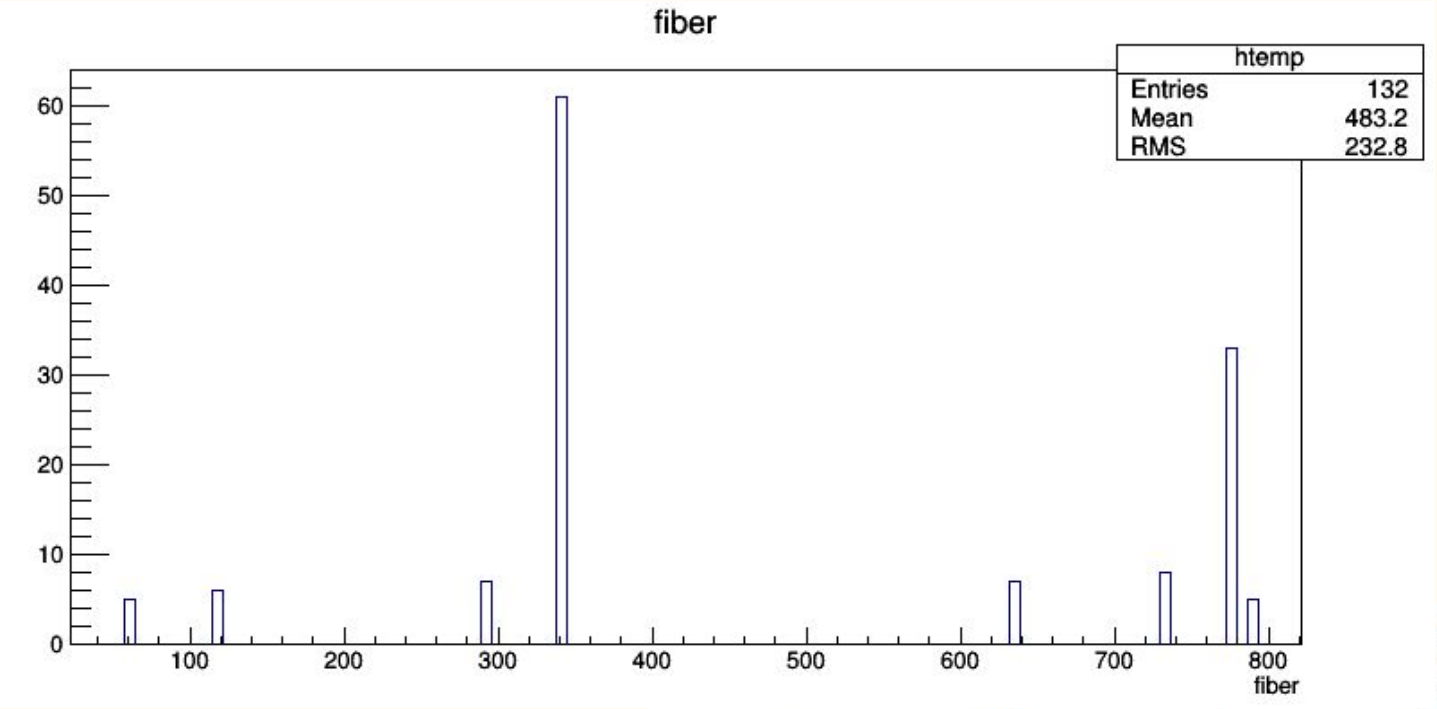






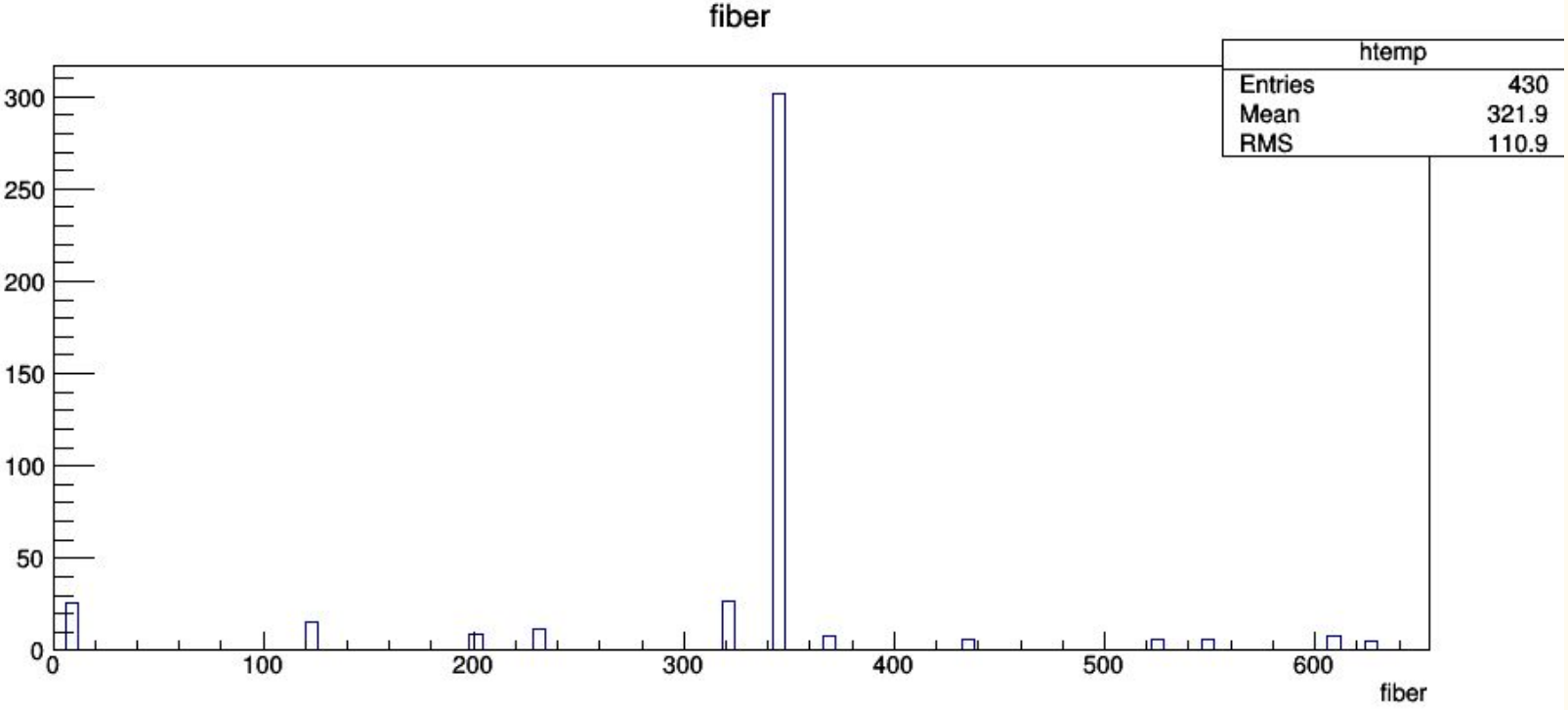
What I have been doing...

- Build an analysis system for the data coming out from the FACT
  - Transfer raw data into readable data
  - See if any of the fibers are not working (or working too well)



*	15 *	342 *	2 *	16 *	584 *	0 *
*	16 *	342 *	2 *	16 *	585 *	0 *
*	17 *	342 *	2 *	16 *	634 *	0 *
*	18 *	342 *	2 *	16 *	635 *	0 *
*	19 *	342 *	2 *	16 *	636 *	0 *
*	20 *	342 *	2 *	16 *	637 *	0 *
*	21 *	342 *	2 *	16 *	638 *	0 *
*	22 *	342 *	2 *	16 *	639 *	0 *
*	23 *	634 *	15 *	8 *	718 *	0 *
*	24 *	634 *	15 *	8 *	719 *	0 *

*	580 *	0 *
*	582 *	0 *
*	583 *	0 *

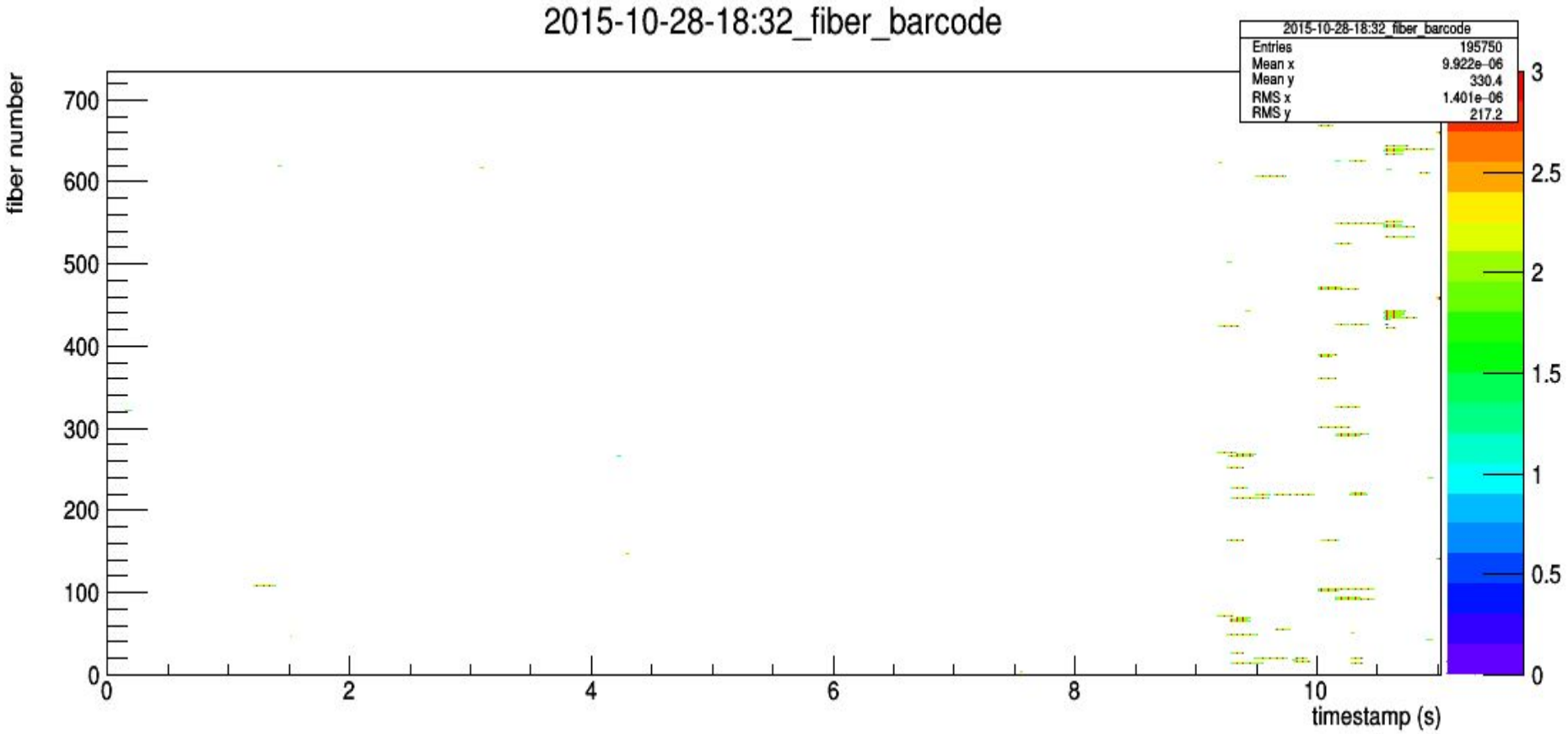



```
if(fiber_sorted != 342){
t_fiber_sorted->Fill();
}
}
```

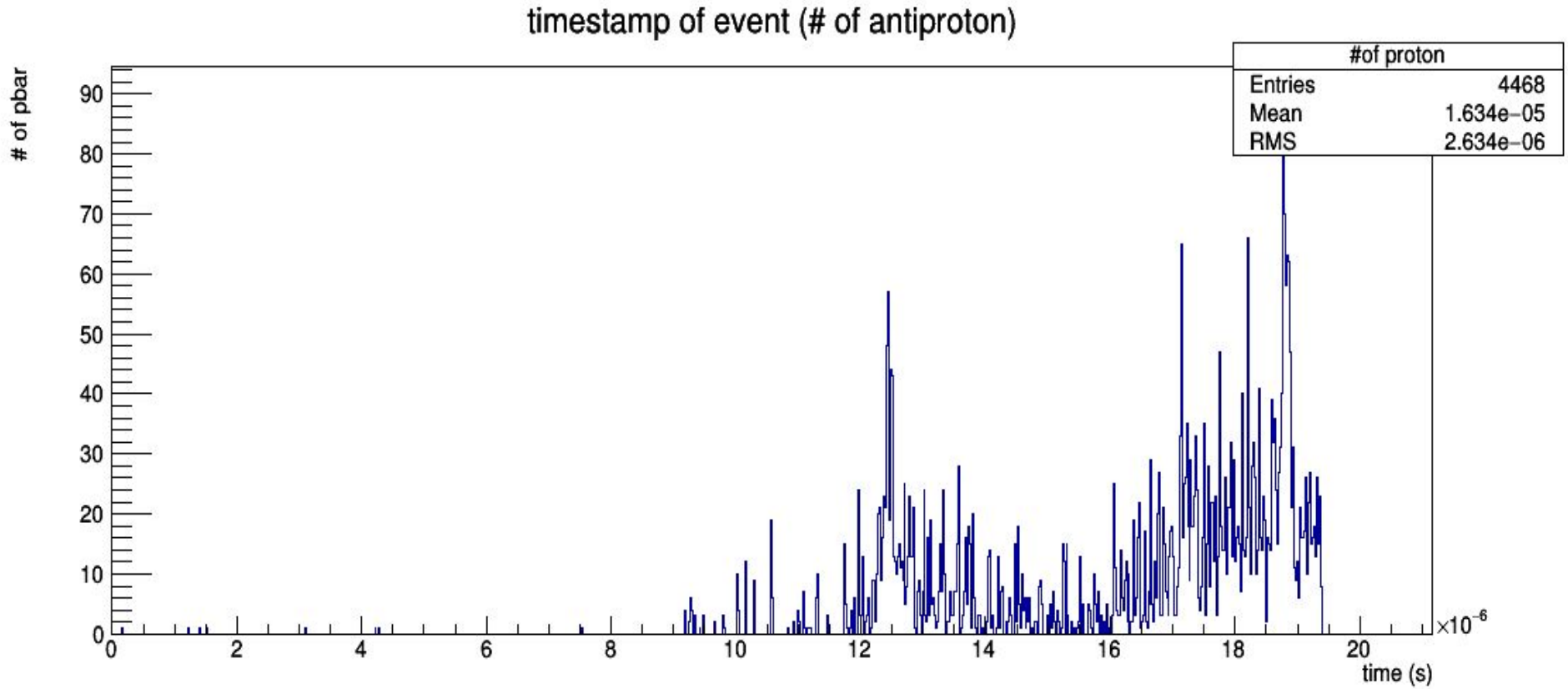
What I have been doing...

- Build an analysis system for the data coming out from the FACT
  - Check parameters for different antiparticles
    - Pbar: to look at pion tracks
    - Twophoton: to look at photon tracks

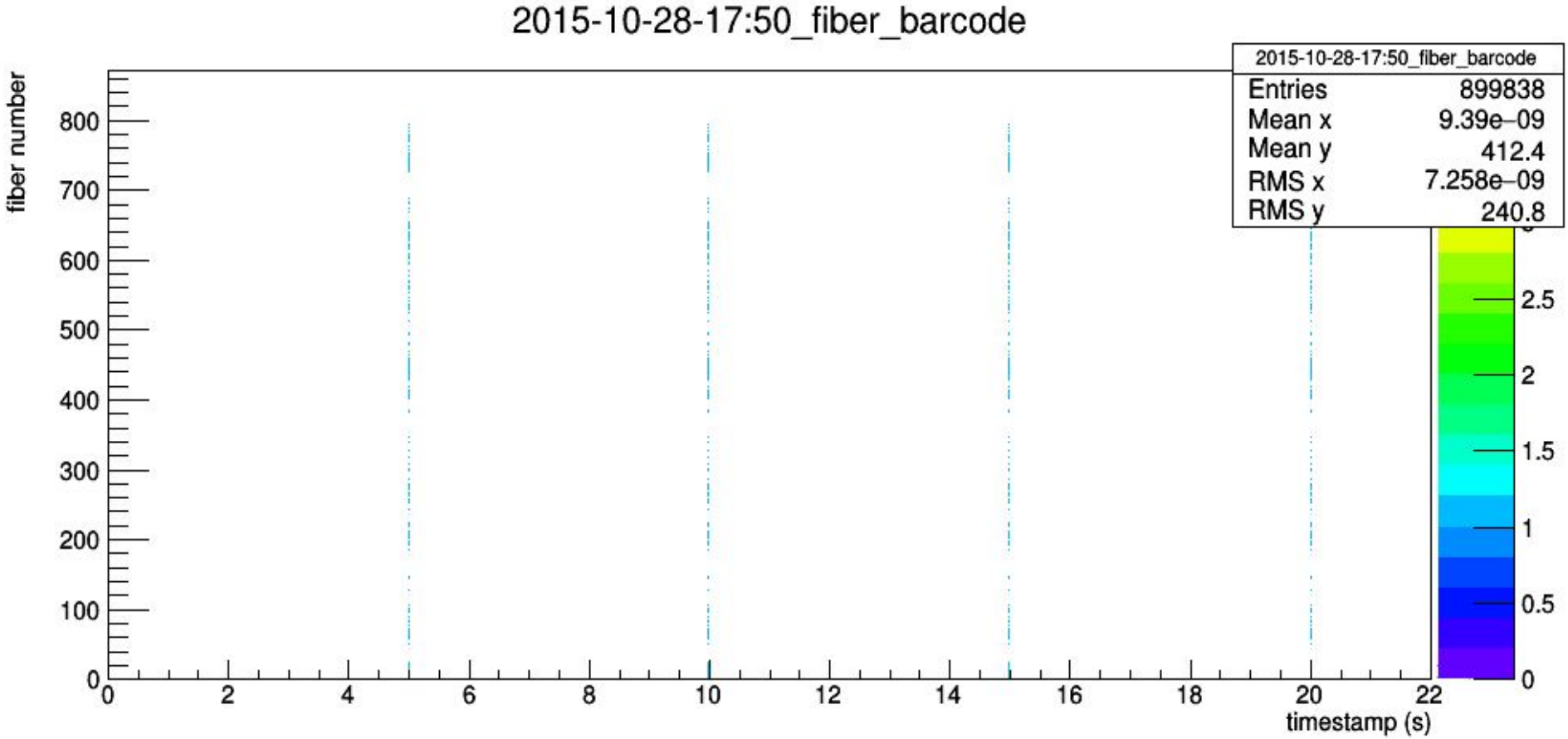
Pbar Parameter: 10s mixing e+ CD: 3.06e6 +/-6e4 pbar HD: 15000



Pbar Parameter: 10s mixing e+ CD: 3.06e6 +/-6e4 pbar HD: 15000

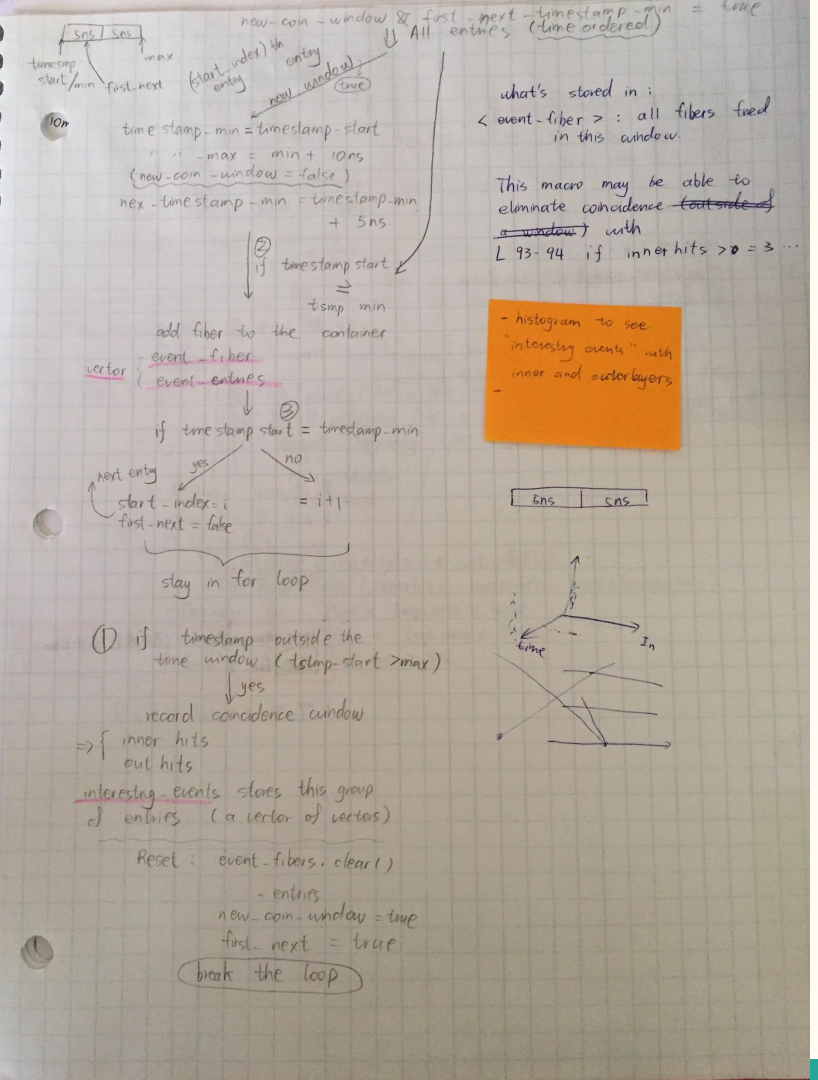


Twophoton Parameter: e+ CD: 8e6 +/-6e4, pbar HD: 15000



What's Next

- In a few weeks...open FACT and take dark count data
- In a few months...antiprotons are coming, AEgIs will use FACT to see if antiprotons are well-trapped; if positronium's lifetime is long enough
- Hopefully, in a few years, AEGIS will successfully continuously produce cold antihydrogen atom...



Reference

- Particle tracking at cryogenic temperatures: the Fast Annihilation Cryogenic Tracking (FACT) Detector for the AEgIS antimatter gravity experiment
- Particle tracking at 4K: The FACT detector for the AEgIS antimatter gravity experiment
- Probing antimatter gravity - The AEGIS experiment at CERN

------“If I can understand a ‘for’ loop, I can work at CERN!!!”