Fermilab

Managed by Fermi Research Alliance, LLC for the U.S. Department of Energy Office of Science

g-2 trolley system

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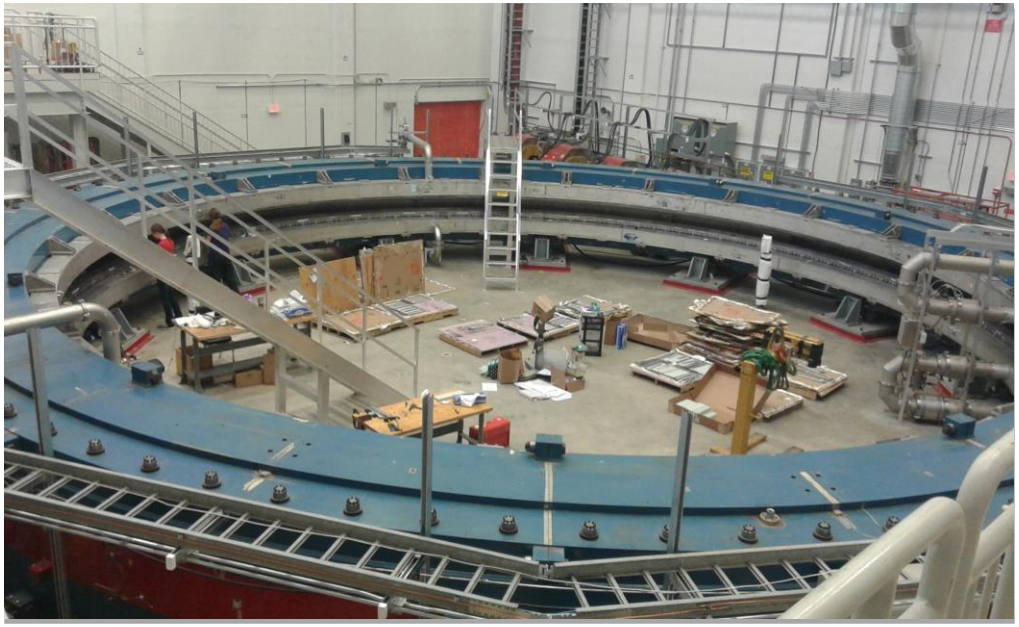
Today we will talk about

- g-2 introduction
- My work
- Future improvements



- Superconducting magnets generate 1.45 Tesla magnet field
- 7.1 metres radius

Introduction

- g-2 experiment at Fermilab aims at measuring the anomalous magnetic moment of muons
- Previous experiment at Brookhaven (E821) measured a 3.6 sigma deviation from the theoretical value
- Fermilab goal is to improve precision to 140 ppb to see if hints of new physics beyond the SM are confirmed

Introduction

- Fermilab new muon production facility can deliver 21 times more muons to the ring, thus increasing statistic
- Muons originate from decaying pions produced by protons hitting a nickel target
- First data scheduled in 2017

B-field

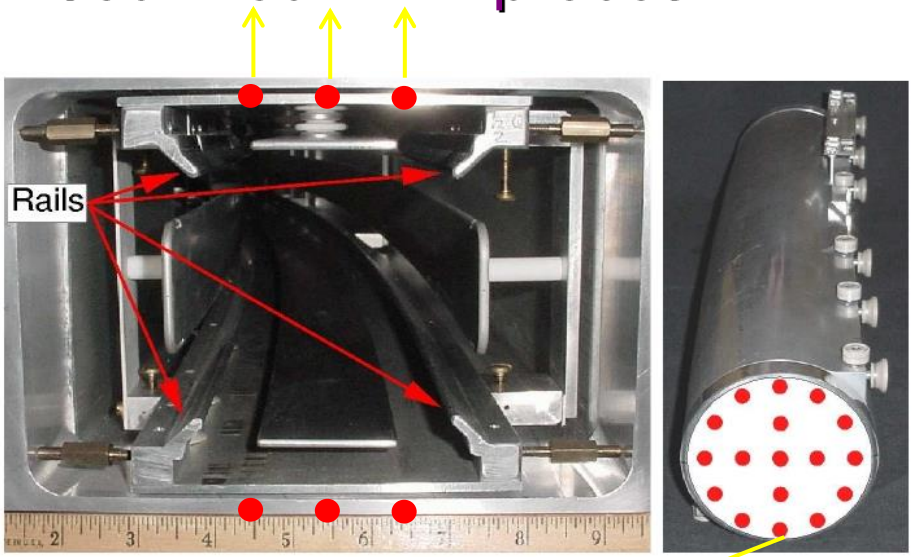
- Magnetic field around the ring will be mapped using a trolley system made of 17 fixed petroleum gelly (more stable over time) NMR probes
- Each of these probes will measure the field with a precision of 30 ppb

- These probes must be calibrated using a very homogeneous field generated by a MRI solenoid and compare the value to the one measured by absolute water probes

1) Put water probes in the solenoid to measure B_{Abs}
2) Measure the same field with gelly petroleum probes to get $B_{Trolley}$
3) Take the difference B_{Abs} - $B_{Trolley}$

Trolley system

360 fixed NMR probes

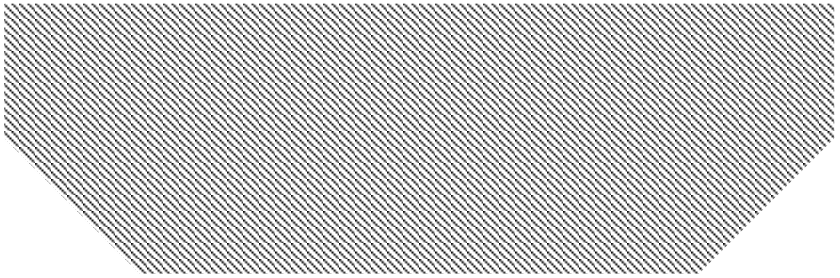


17 NMR probes on trolley to take map at 6000 azimuthal locations

But

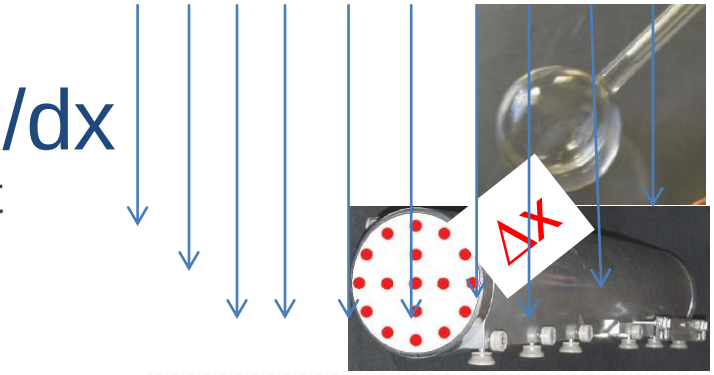
- We want

  $\Delta B = B_{abs} - B_{trolley}$
- We measure instead:
- $\Delta B = \Delta B + \frac{dB}{dx}\Delta x$

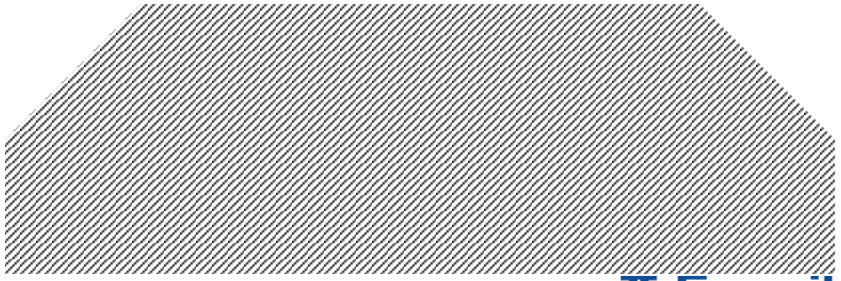


We would like to have a stable system that places probes always in the same spot. This is crucial to get an accurate value of the field

dB/dx



This solenoid has a gradient of about 10 ppb/mm.



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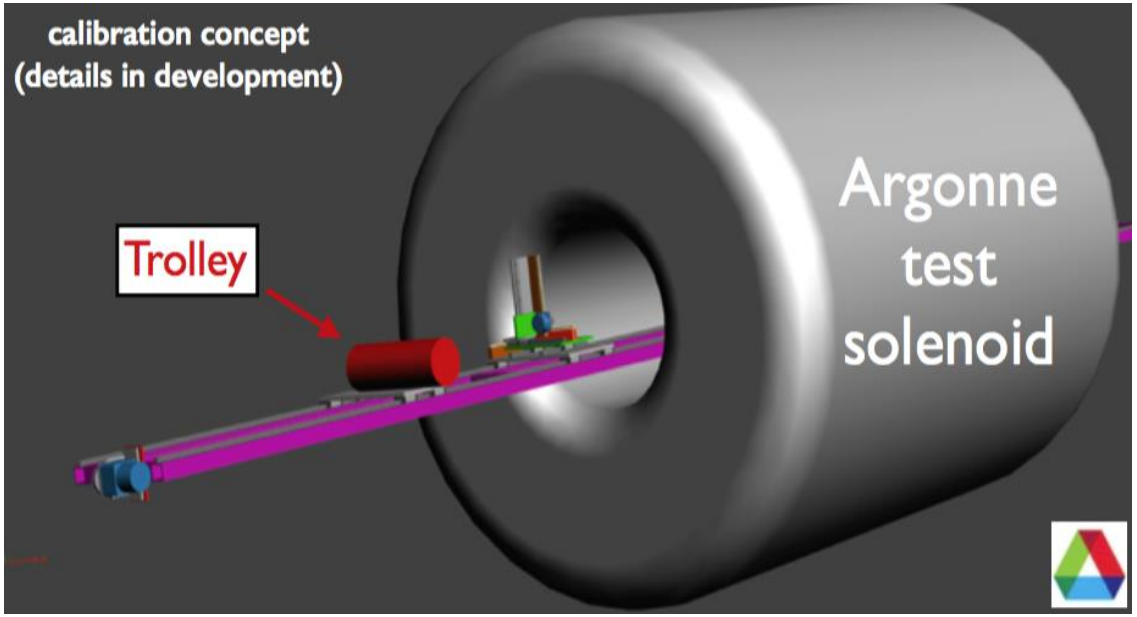
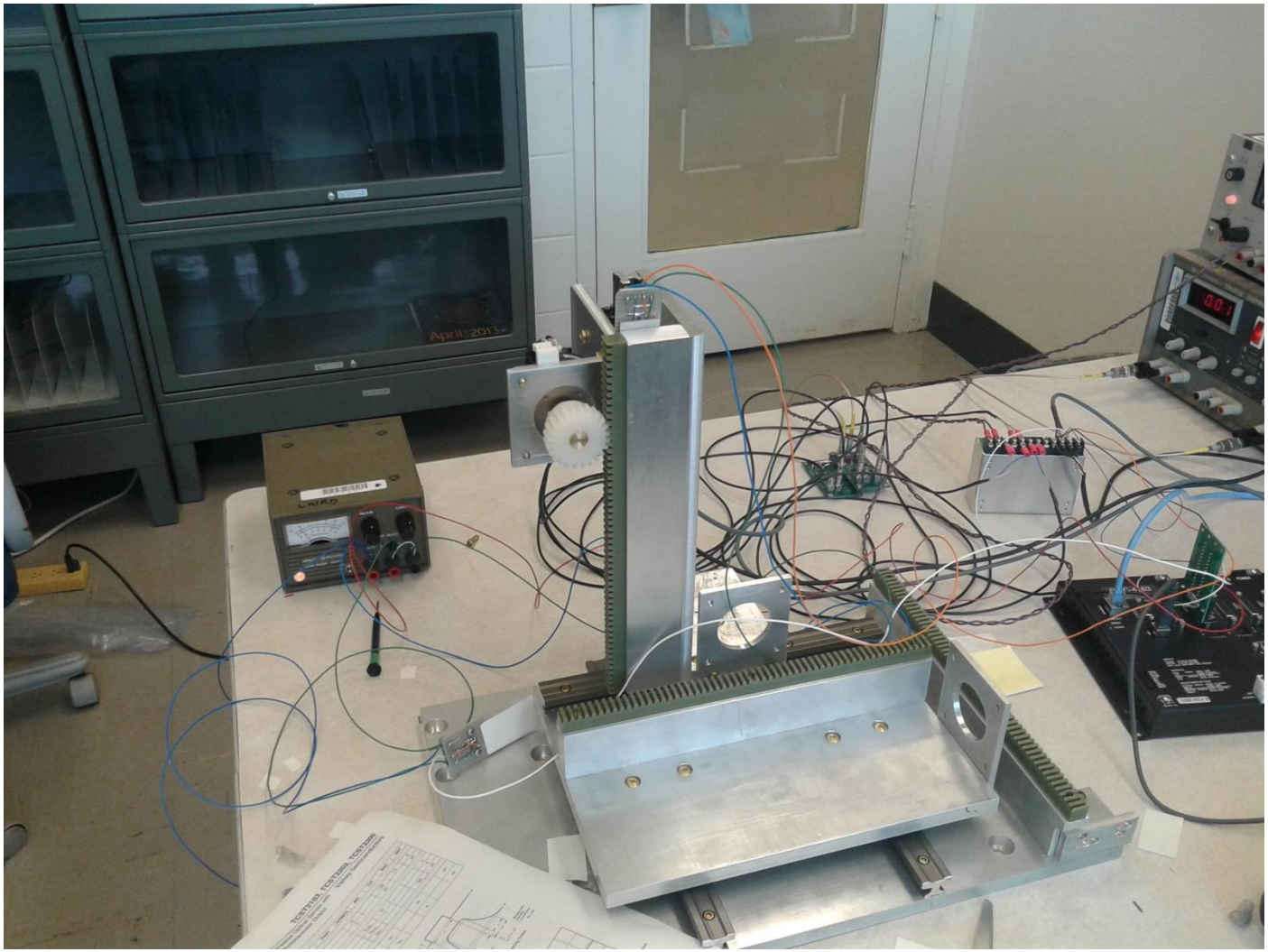
Basic idea:

- Bring trolley system inside the solenoid

- Try to bring water probes in the same spot of the trolley probes




April 2013

How do we move probes? Galil motion crontrol

- 6 axes motion control
- Each axes has 6 pins to comunicate with the motor
- Can be programmed using C++ libraries

It can be integrated into MIDAS,
g-2 data acquisition system

MIDAS

- Data acquisition is being built using MIDAS software package

- It provides:

1) Framework for an event builder

2) Datas can be output into a binary data format that will be processed using ROOT

3)Web interface for control of the experiment

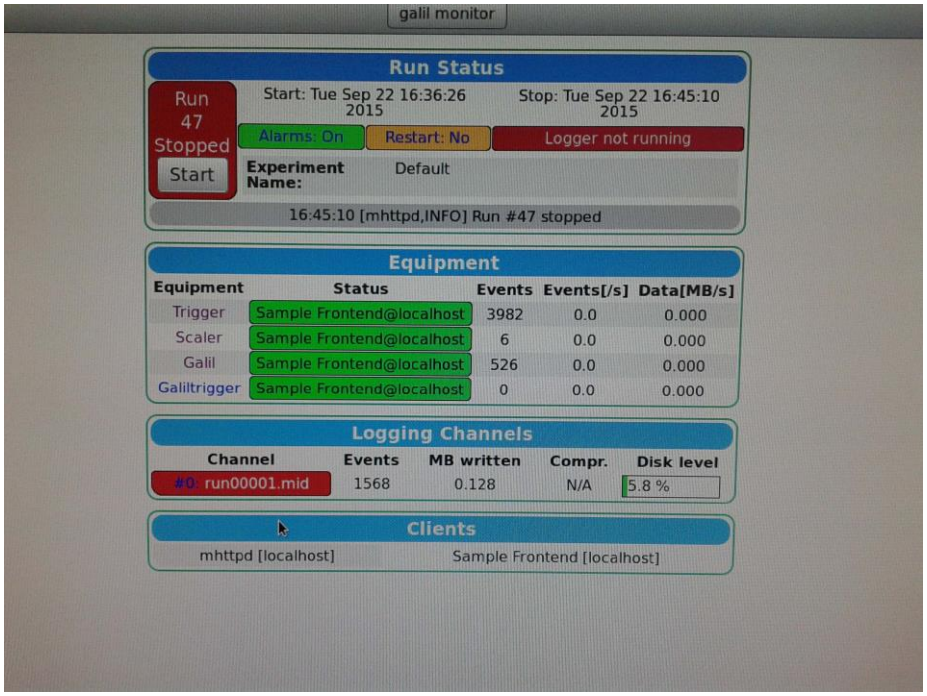
My work

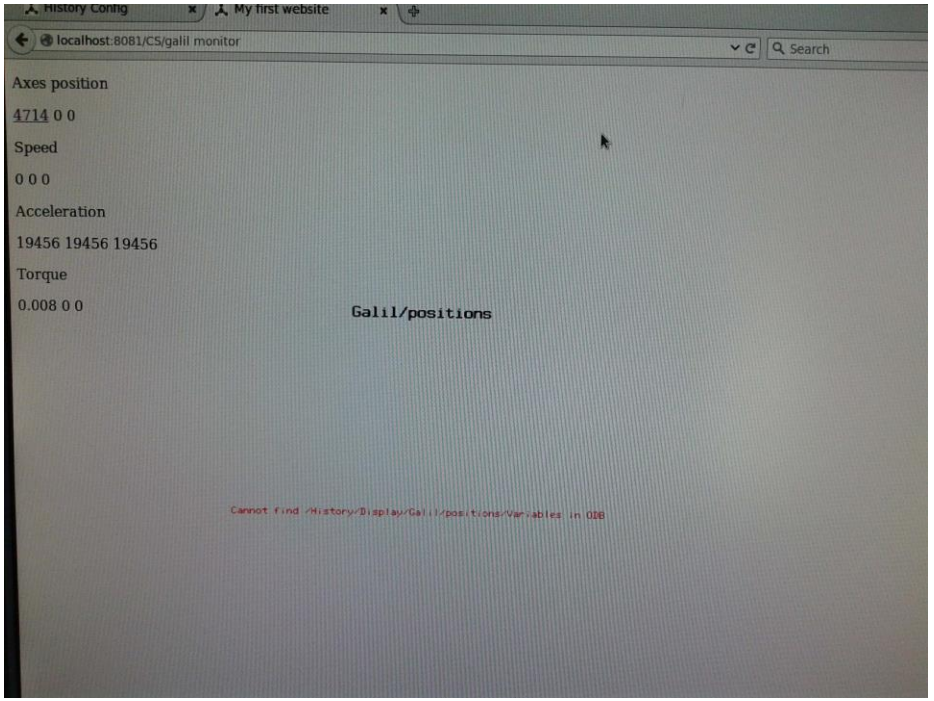
My work was to :

- learn how to comunicate with Galil through c++ code

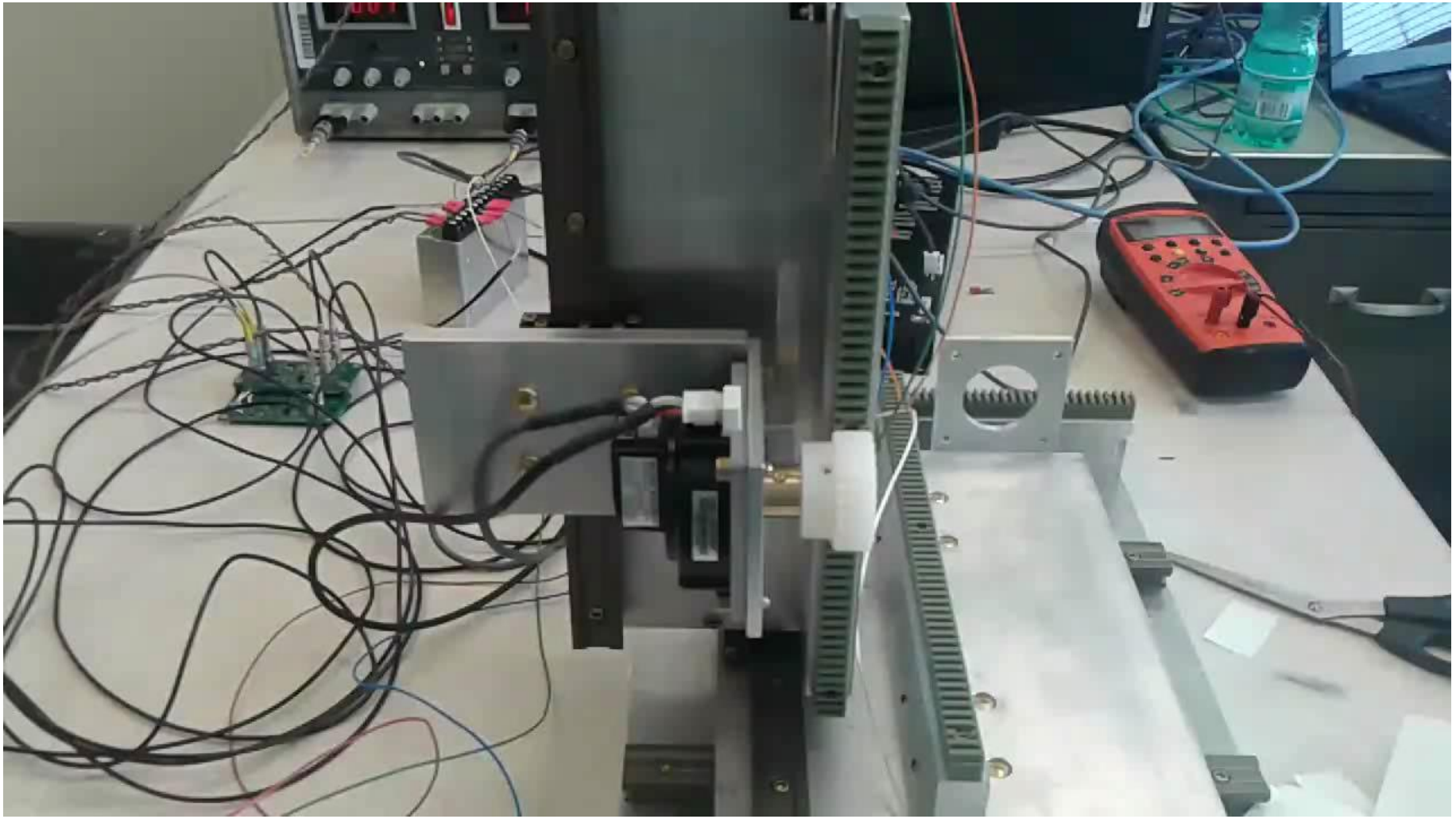
- Develop the interface using MIDAS sofware package

Interface


galil monitor
Run Status
Run 47 Stopped
Start
Start: Tue Sep 22 16:36:26 2015
Stop: Tue Sep 22 16:45:10 2015
Alarms: On
Restart: No
Logger not running
Experiment Name:
Default
16:45:10 [mhttpd,INFO] Run #47 stopped
Equipment
Equipment Status Events Events[/s] Data[MB/s]
Trigger Sample Frontend@localhost 3982 0.0 0.000
Scaler Sample Frontend@localhost 6 0.0 0.000
Galil Sample Frontend@localhost 526 0.0 0.000
Galiltrigger Sample Frontend@localhost 0 0.0 0.000
Logging Channels
Channel Events MB written Compr. Disk level
#0 run00001.mid 1568 0.128 N/A 5.8 %
Clients
mhttpd [localhost]
Sample Frontend [localhost]


History Config
My first website
localhost:8081/CS/galil monitor
Search
Axes position
4714 0 0
Speed
0 0 0
Acceleration
19456 19456 19456
Torque
0.008 0 0
Galil/positions
Cannot find /History/Display/Galil/positions/Variables in ODB

First test: repeatability

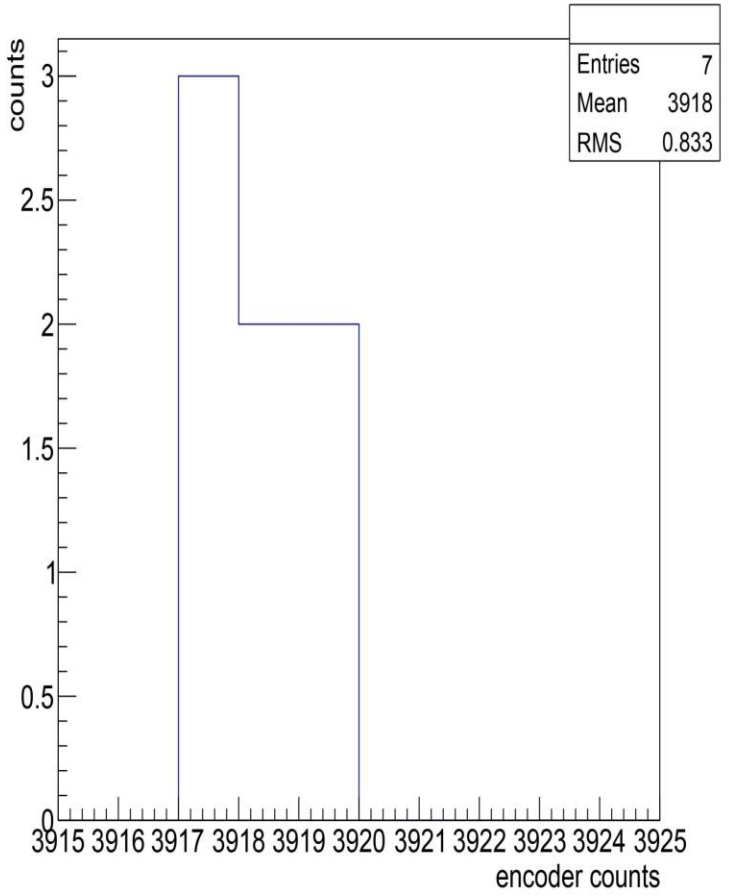


First test:repeatability

- We measured the number of centimeters per encoder counts:

$$(3.242 \pm 0.003) * 10^{-3}\ cm/encodercounts$$

- We used a switch to limit the motion in the forward direction

3 counts spred from the histogram

this corresponds to 0.1 mm resolution