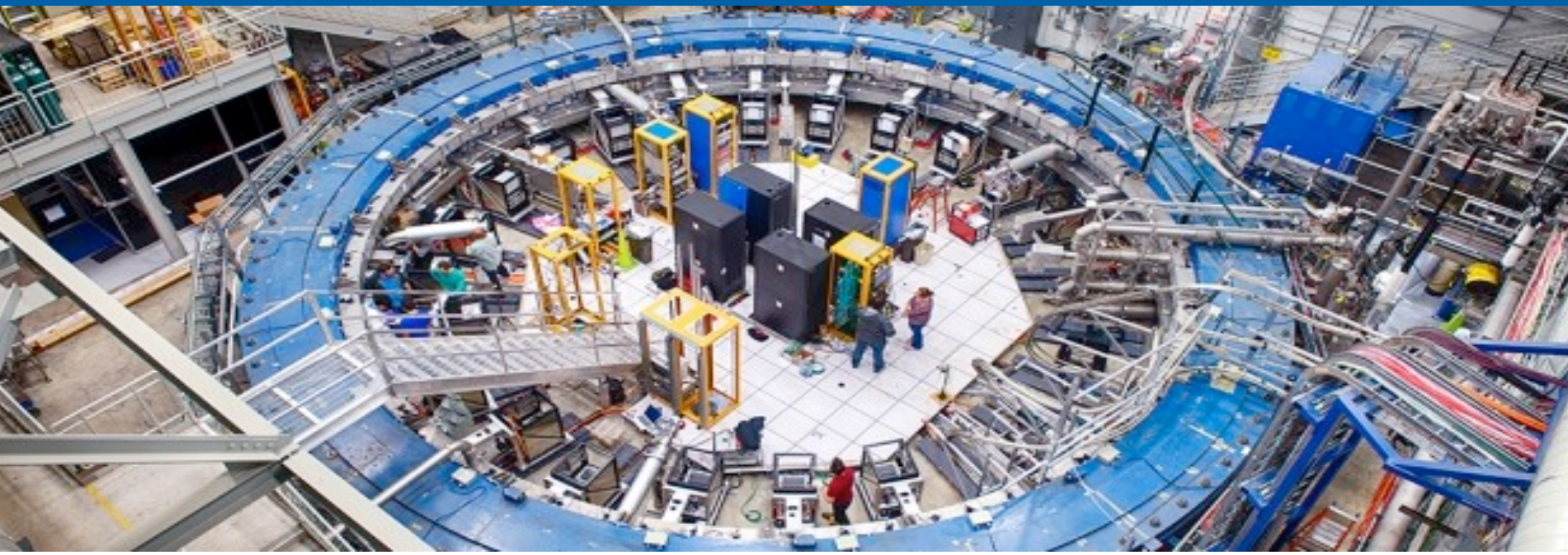
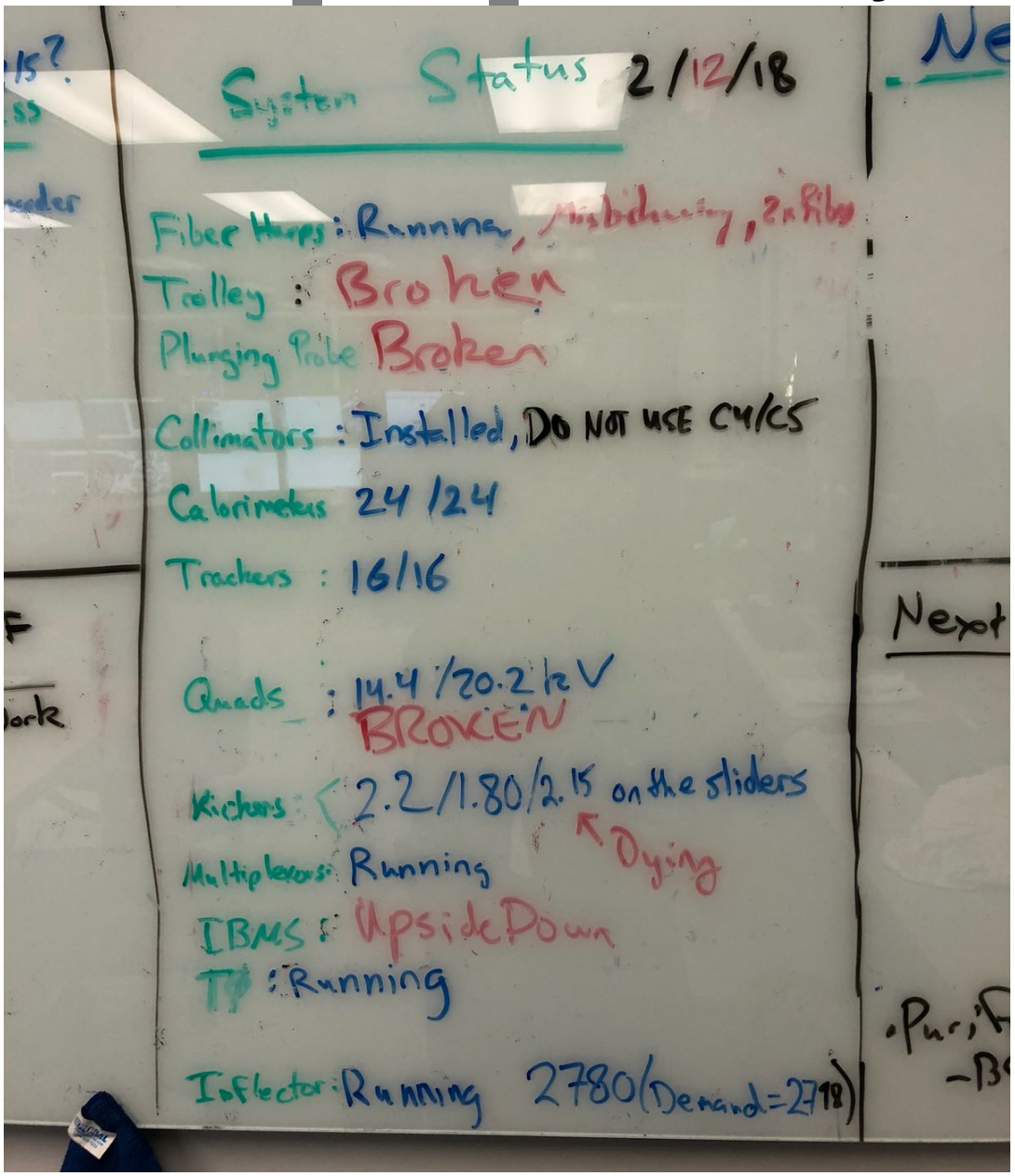


Stato dell'esperimento

Graziano Venanzoni– INFN Pisa

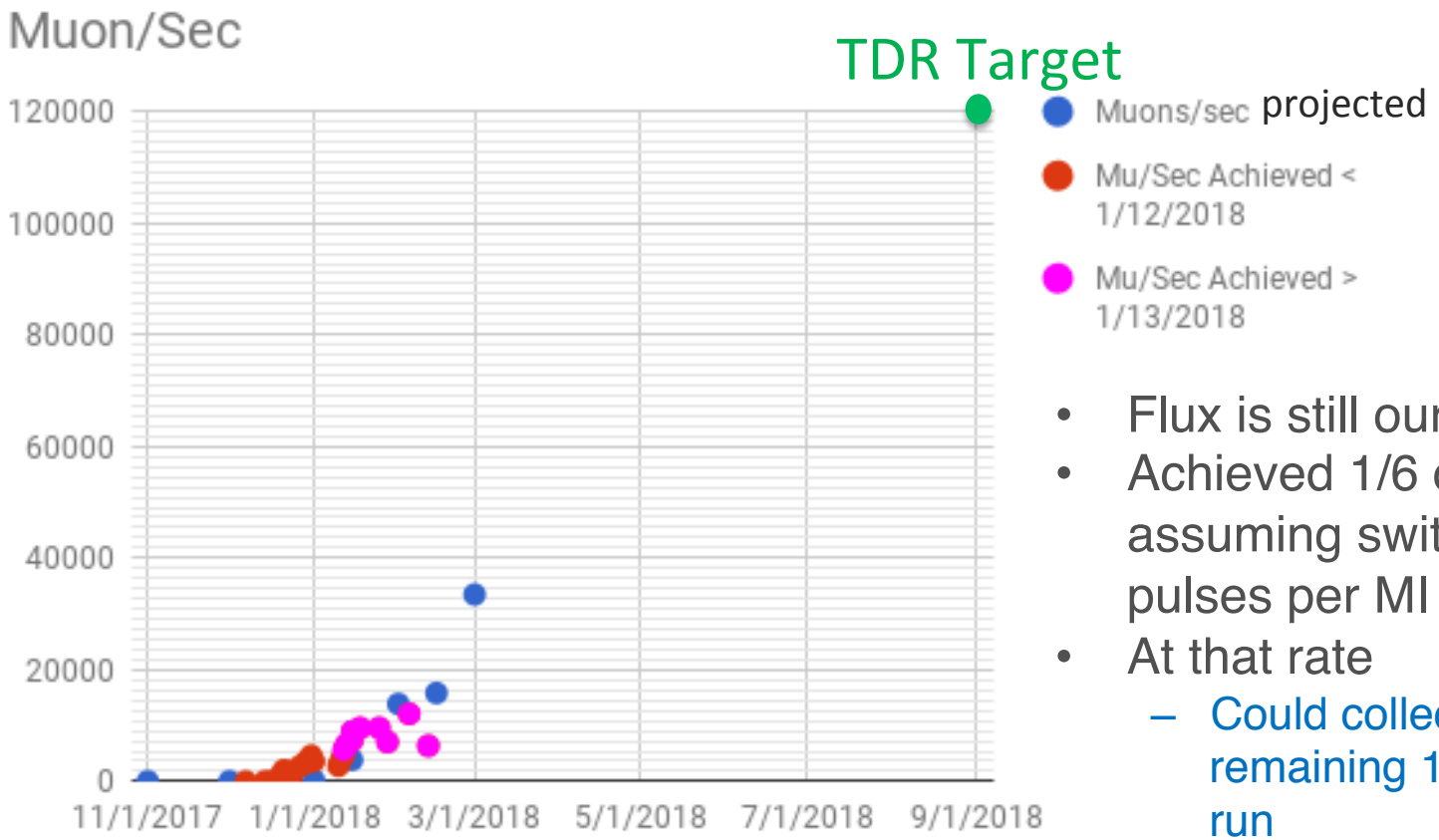
16/mar/2018

A "nice" summary



(picture taken by M. Karuza on shift 13/2/18)

Current Flux Situation



- Flux is still our biggest issue
- Achieved 1/6 of design goal assuming switch from 8 to 16 pulses per MI goes well
- At that rate
  - Could collect 1.6 x BNL in remaining 18 weeks of FY18 run
  - 44 months of running to achieve 22x BNL goal

A lot (x10) of improvement from July 2017 run…
However a factor x 6 still missing respect to TDR

TDR Numbers:

- 1.6 x 10^{11} good decay positrons (E>1.8GeV, t>30μs) for 22 BNL statistics (7x10^{9})
- Needs 1.5 x 10^{8} fills (=7 months)

→ **3BNL/month; ~10^{3} e^{+}/fill; 10^{4} μ/fill →1.2x10^{5} μ/s (assuming 12 Hz fill rate)**

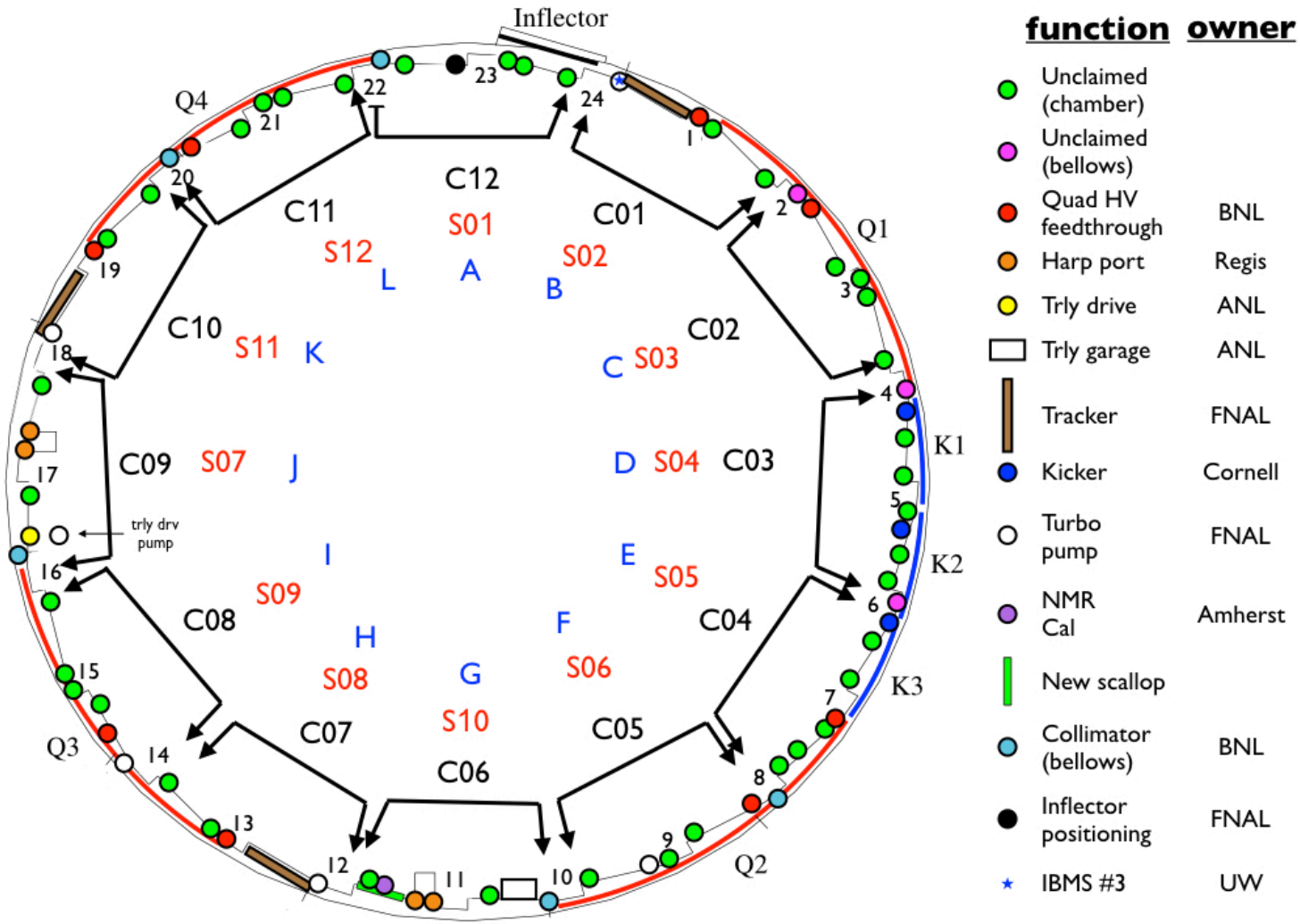
RUN 2018 numbers:

~0.2x10^{5} μ/s; 170 e^{+}/fill; 1700 μ/fil **Factor 6 below TDR**

Currently 1 BNL/2 month

Expected 1-3 BNL for the end of 2018 (6 months of running)

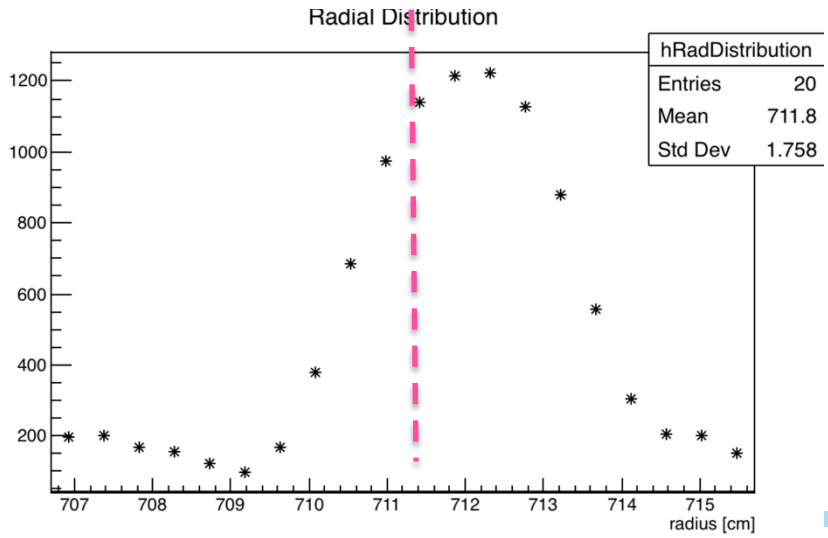
Where does this “missing” factor 6 come from? The ring

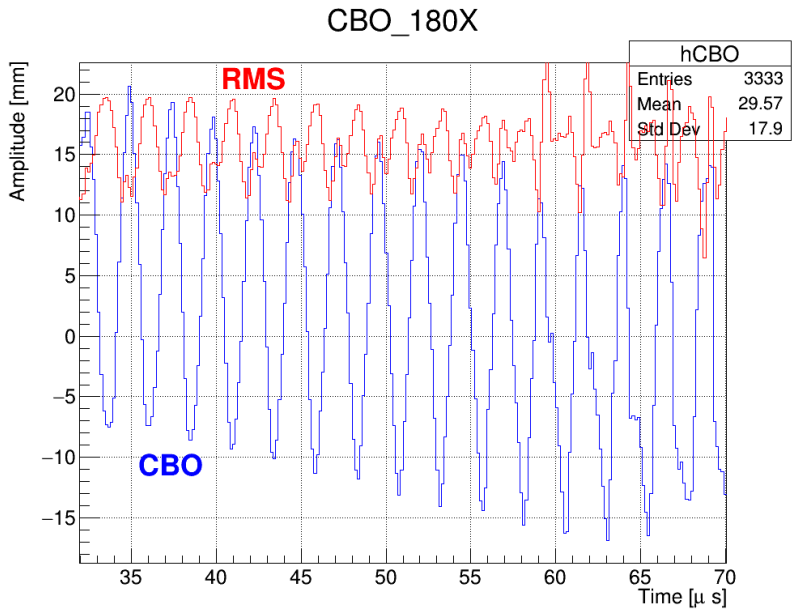


Where does this factor 6 come from?

- It mainly comes from the ring:
  - ~2 from the inflector (50% injection efficiency)
  - ~3 from not perfect beam optics (kicker, quads):
    - Stored beam not centered on magic momentum
    - CBO 3x larger than it was at BNL

HUGE activity (simulation, measurement, tests) to understand and correct these issues unfortunately without a clear improvement so far





The Kicker as an example

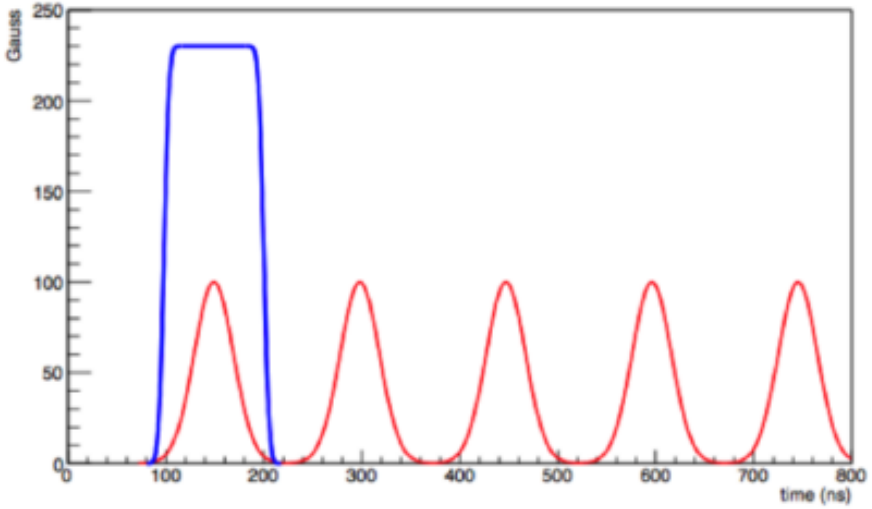
⇒ The ideal kicker pulse:

→ Flat-top ∼230 Gauss field.

→ Duration of only 120ns.

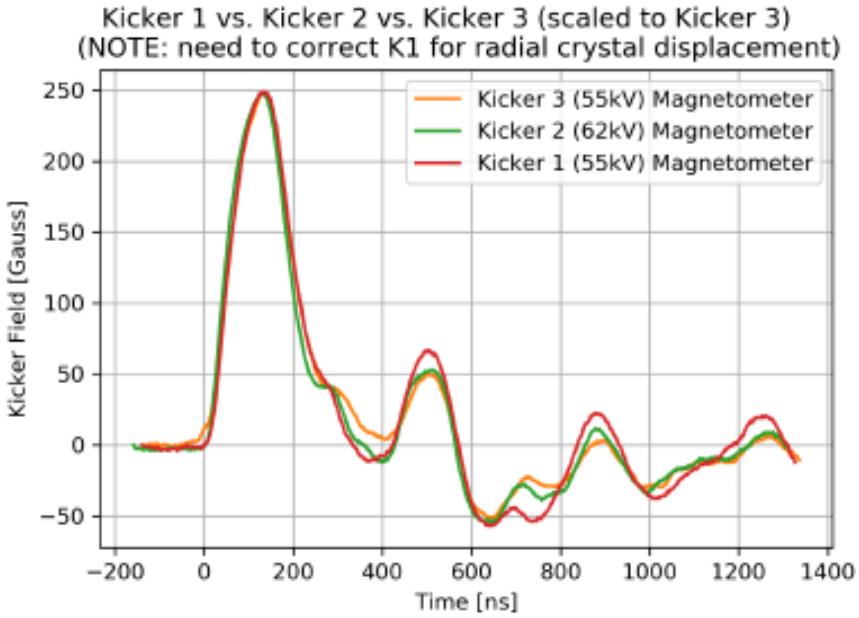
→ Known to 10ppb.

→ Achieved by three kicker magnets.

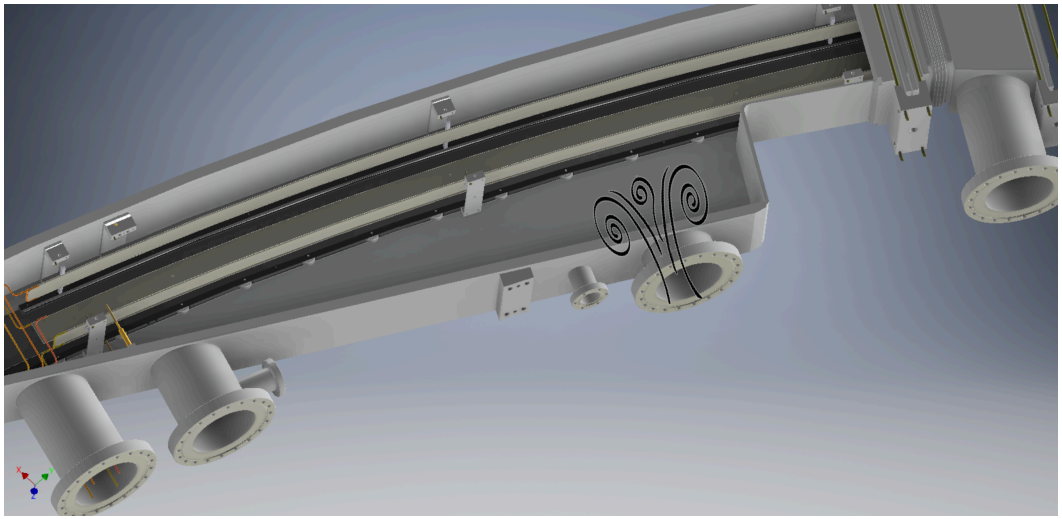


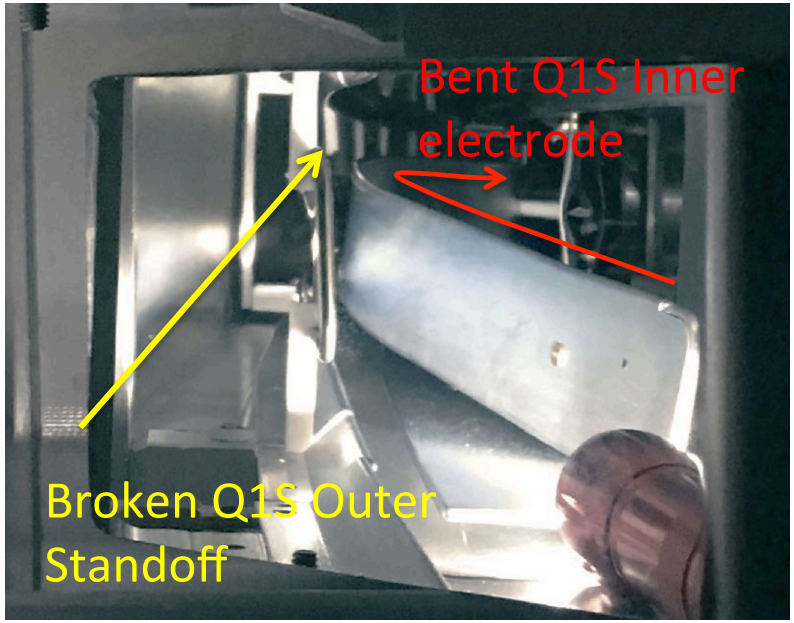
[S. Kim, Nucl.Part.Phys.Proc. 273-275, 198-203]

The real behaviour→ Afterpulses perturbate the optics and reduce the storing efficiency



Q1 Vacuum Incident 2/15





- During testing of new cryopumps, a small 1 atm volume was discharged into the 10e-4 Torr vacuum chamber
- Precursers
  - Test environment, interlocks not yet in place, valves in manual mode
  - Engineer stepped out to get laptop and technician opened valve thinking it was a safe operation
- Reaction
  - Stood down on work over weekend
  - Developed plan for *in situ* repair first half of last week
  - Write-up from engineer describing incident
  - Performing an HPI
- Current status
  - Quad plates repaired
  - Passed alignment tests
  - Vacuum pumped back down
  - Electrical test underway
- Pending successful electrical test, beam back in ring by tomorrow

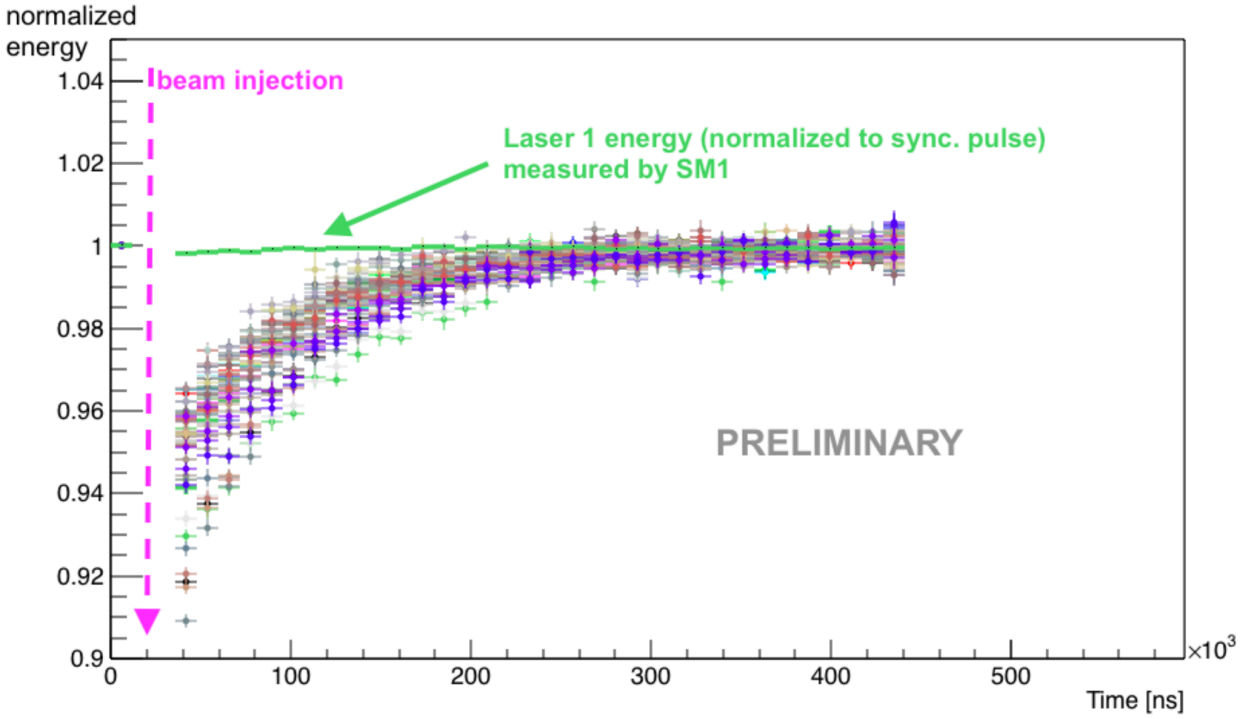
Current status (3/15)

- Last two weeks of February were used to diagnose, repair and recondition Quad 1.
- We have been conditioning and doing beam studies since the end of last week, however we still have some electrical issues with Quad 4 that we are trying to condition away
- We are restarting slowly circulating beam
- Meanwhile many activities on the detector side: tracking stations (2) behave well; Calorimeter gain saga discovered (thanks to us); a lot of work with the laser system and other aux detectors (fiber harps) to understand the beam shape and behaviour

The Calorimeter Gain Saga
Chapter 1 - the Discovery

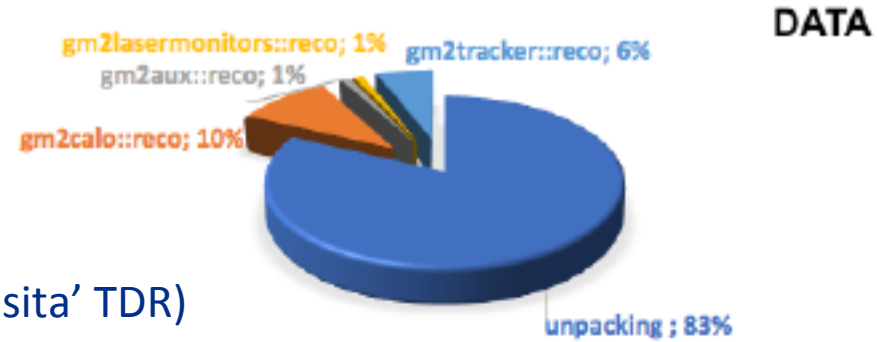
Anna Driutti, Marco Incagli, Matthias Smith - INFN

March 15, 2018



Richiesta sblocco SJ 2018 spazio disco Pisa

- We plan to save 10% of reconstructed data (60TB)+10% of simulation (20TB)+~20TB of raw data to tune/exercise the calibration → 100 TB



Assunzioni:
2018: proiezione stato attuale (1/6 luminosita' TDR)
2019 e 2020: ½ luminosita' TDR (1.5BNL/month)

Year	N. detected positrons	BNL Statistics	Raw Data [TB]	Full Reconstructed Data [TB]	Simulated Data [TB]
2018 (6 m)	21×10^9	3	750	600	200
2019 (9 m)	105×10^9	15	1250	1100	1000
2020 (3 m)	35×10^9	5	400	350	400

Table 1: Expected space resources required for data storage in year 2018, 2019 and 2020.

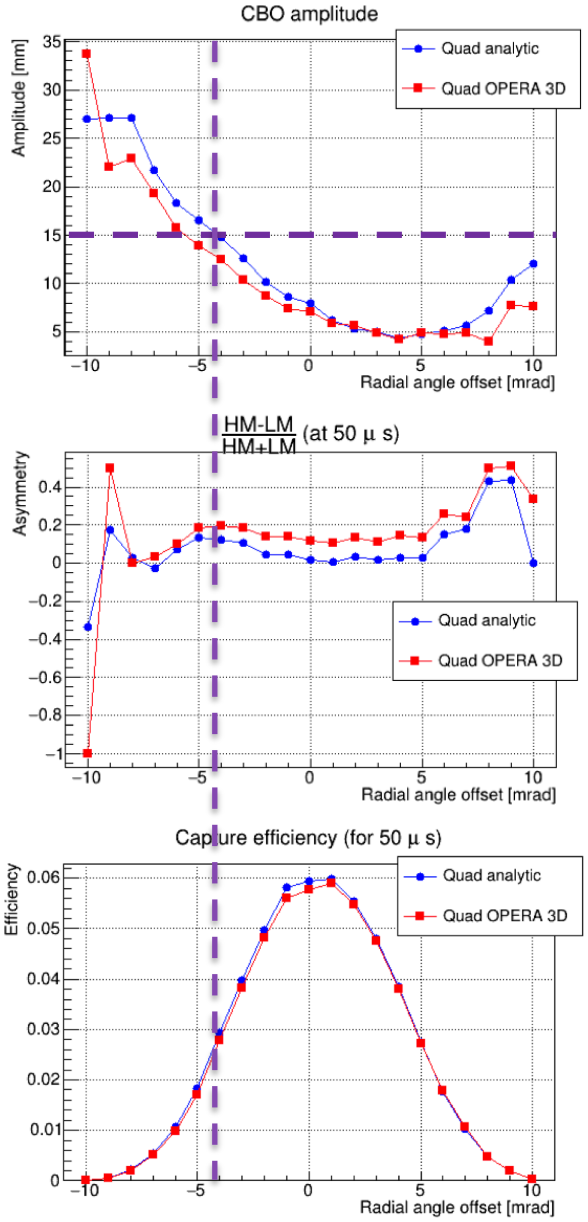
Conclusion & Prospects

- Significant improvement (x10) respect to July 2017 as results of many improvements on the ring optics (and vacuum). Q1 accident almost solved (however Q4 is discharging).
- However still a factor 6 below TDR → 44 months to reach the nominal statistics (22 BNL). Not known knobs to easily improve the storing efficiency
- Expect to take 1-3 BNL statistics by the ends of 2018
- Richiesta di sblocco SJ 100TB per analisi dati e calibrazione locale a Pisa dati 2018
- For 2019:
  - Rotate/Replace the inflector?
  - Add a 4^{th} Kicker?
  - Improve the Quads performances?
  - Organize a visit to Lourdes?

THE END

Inflector tilt discussion

- Last ‘easy’ knob that we haven’t turned yet is the inflector angle
  - Not that easy, requires extracting the inflector vacuum chamber and rolling the entire leadbox and valve can assembly forward to access bolts
  - Turned 4 or 5 times at BNL to get it right
  - Engineered this procedure long ago and implemented rail/roller system as part of project
  - Still has risk
    - Thermal cycle of inflector
    - Potential for mechanical stress
    - Has not been done in 18 years
- This knob can cause both a flux issue and is the leading theory at the moment for why the CBO is 3x larger
  - Above 1-2 mrad, can’t be corrected in any other way



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→ **3BNL/month; ~10^{3} e^{+}/fill; 10^{4} μ/fill**

Item	Factor	Value per fill
Protons on target		10^{12} p
Positive pions captured in FODO, $\delta p/p = \pm 0.5\%$	1.2×10^{-4}	1.2×10^{8}
Muons captured and transmitted to SR, $\delta p/p = \pm 2\%$	0.67%	8.1×10^{5}
Transmission efficiency after commissioning	90%	7.3×10^{5}
Transmission and capture in SR	$(2.5 \pm 0.5)\%$	1.8×10^{4}
Stored muons after scraping	87%	1.6×10^{4}
Stored muons after 30 μs	63%	1.0×10^{4}
Accepted positrons above E = 1.86 GeV	10.7%	1.1×10^{3}
Fills to acquire 1.6×10^{11} events (100 ppb)		1.5×10^{8}
Days of good data accumulation	17 h/d	202 d
Beam-on commissioning days		150 d
Dedicated systematic studies days		50 d
Approximate running time		402 ± 80 d
Approximate total proton on target request		$(3.0 \pm 0.6) \times 10^{20}$

Beam structure

- 16 fill in 1.4 sec → 12Hz fill rate