PT status and future planning

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OUTLINE

- Polarized target in 2018
  - Summary of incidents since April (see Vincent's report)
  - Status of improved systems (PLC CPU bunker and Air conditioner)
  - Manpower
  - Radiation damage of the target material

- Plan of deuteron run in 2021
  - Target material and target cells configuration
  - Shopping list

Incidents summary 1

- Interruptions of He4 pumps system (July 4, August 1, August 22 ,August 31)
  - Jumped He4 recovery line pressure → interlocked by PLC
  - Regeneration of Cold box filter
  - Due to some delay of switching to balloon line
  - Someone around each time → no polarization losses
  - Discussion on next Tuesday with Michel
  - Modification of control system or regular operation on Wednesday manually

- Power Glitch (July 5 6h33)
  - Only He3 root pumps system affected
  - Jaakko was on Shift and restarted at 6h42.
  - Lost of polarizations

- Lost of frequency control of a EIO tube (reported in the last TB)
  - Changing cathode voltage for each polarity of polarization
  - controlling the frequency by hand

Incidents summary 2

- Dipole discharge (July 22 20h38)
  - No MSS error and no PLC error
  - Broken one module of one of two power supply
  - July 23 9:00 power convertor module exchanged

- Dipole discharge (July 25 0:08)
  - Benoit arrived at 3 am
  - Caused by heat inside rack probably in both cases
  - Removed rack doors and restarted at 7h00 July 25
  - Improvement during next LMD (TS)

Incidents summary 3

- Cooling water leak and no cooling water (August 27 afternoon)
  - No air conditioner, diffusion pump OFF, Cold box OFF

August 27 evening

- Recovered most of 3He gas (tank #3 -#8) at first
- Diffusion pump restarted by switching tap water
- Sending a request of liquid He4 delivery

August 28 morning

- Recovered other He3 (He4 rich gas, tank phi1 – phi4)

August 28 afternoon

- Restarted cooling water
- Air conditioner back
- Restarted compressor for liquid helium

August 29 early morning

- refilling liquid He4 to dewar

August 29 night

- Finished filling He3 gas to DR
- Restart polarization

Photo of power convertor rack

No failure of PLC in 2018

2015

- Several times of PLC failures
- 3 times magnet PLC failure

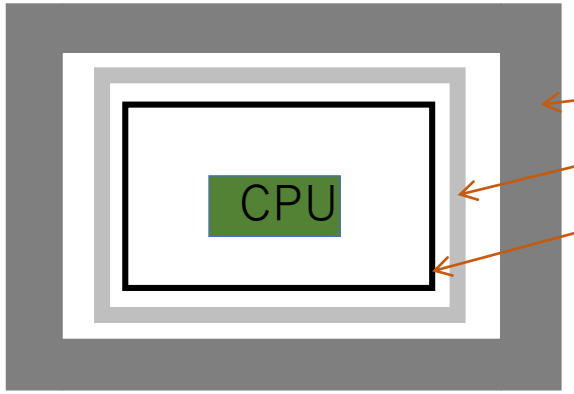
(17 times incidents of magnet failure in total)

- 1 PLC failure of cold box
- A few times isolation vacuum PLC failures

2018

- No PLC failure happen up to now.

Protection of PLC CPU



Concrete : For high energy neutrons
Polyethylene : for low energy neutrons
Boron-carbid : to stop thermal neutrons

Top cover of Polyethylene with Boron-carbid

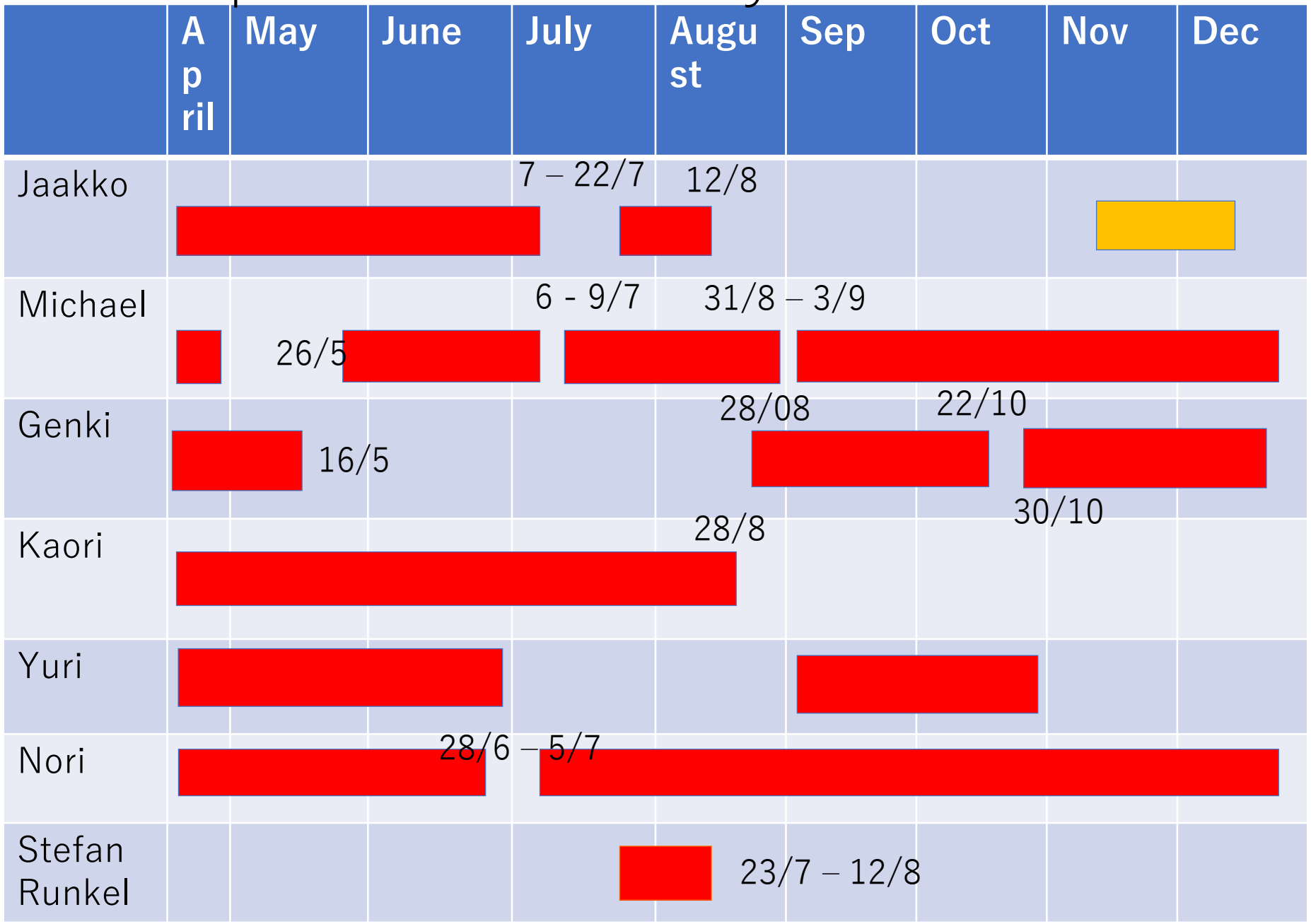
New air conditioner

- Enough cooling power
  - He3 roots pumps could survive even during hot summer.
- Need air blower
  - Heat localized and very week of air circulation
  - Using several air blowers
- Chilled water
  - Normally very stable temperature

Man power

- Stefan Runkel (Bonn) : big support for 3 weeks
- Kaori : moved to Gran Ssao
- Jaakko : 1 month stay for TE and material unloading
  - still under discussion inside Illinois group
- Genki : stay until the end of December
- Yuri : stay for 2 months (September and October)
- Vincent and Christophe : taken into account as target member

Man power availability



Annealing NH3

- There is a long MD (TS) on September.
- Werner comments on the radiation damage
  Polarization behavior of the present material indicates already damaged.
- Relaxation time is getting faster (Genki and Vincent).
- Optimized microwave frequency slightly looks shifted.
- The maximum polarization looks not so much changed.
- Difference between electron and pion beam

- Risk of warming up 70 K
- Decision : we will not anneal the material at 70 K.

- Relaxation time in 2015 was almost stable (Vincent).
- Warmed up to 1 K 3 times in 2015
- Annealing at 1 K may be helpful.

Annealing time estimation

- **Warming up to 80K**
- **How long ?**
  - **30 min at 80 K**
- **1 week needed at least**
  - 1 day He3 recovery,
  - 2 days warming up,
  - 1 day cooling,
  - 1 day filling He3,
  - 1 day polarization
- **Other operations**
  - Generating LN2 trap
- **Risk**
  - Lost of paramagnetic center of the Material
  - Blockage of He3 line after annealing

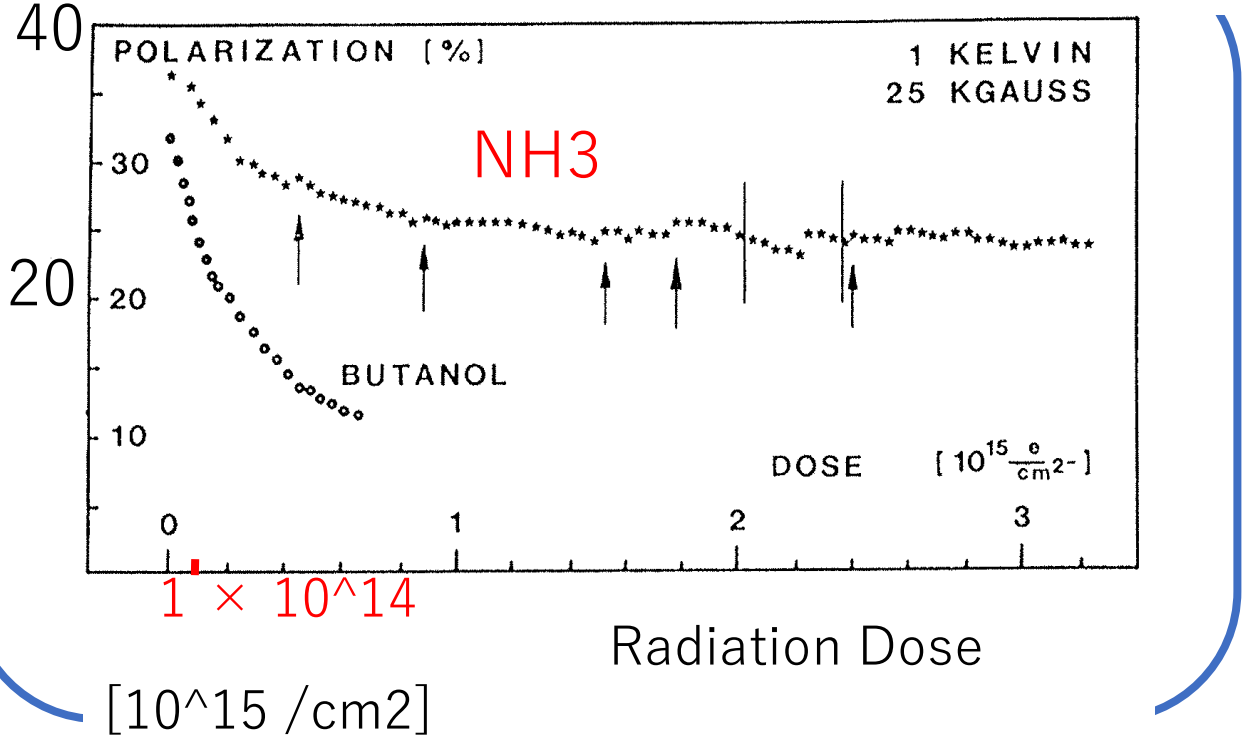
Radiation damage

Additional radicals are produced by beam.

W. Meyer et. al., Proceedings of the 4th international workshop on Polarized target materials and techniques (1984)

The polarization drops to 1/e of maximum polarization is 7 × 10^15 particles/cm2 (electrons) for ammonia

Radiation effect to polarization at 1K and 2.5T



For safe margin, we propose

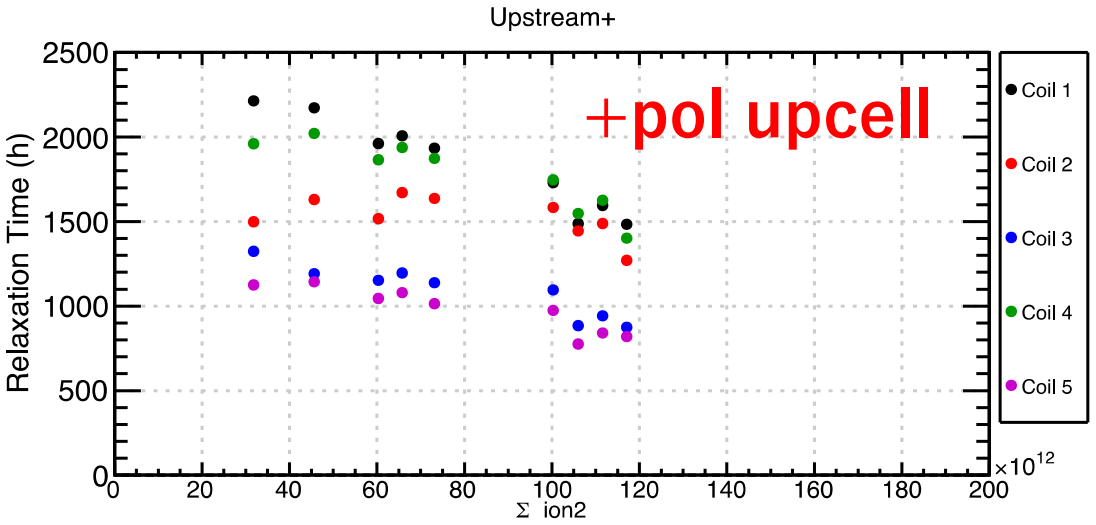
To keep flux of the pion beam below 1 × 10^14 /cm2 for 1 year.

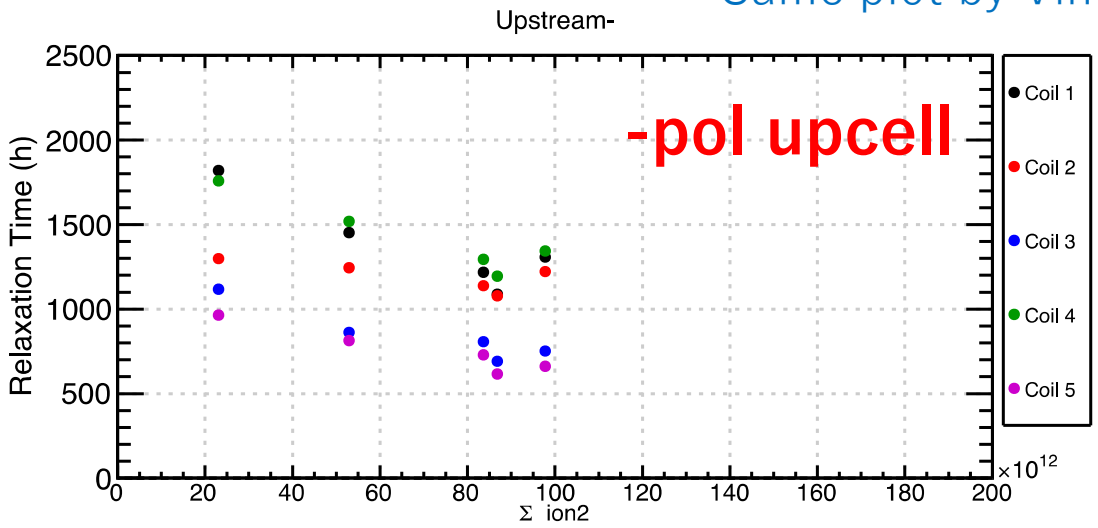
Total doses up to now

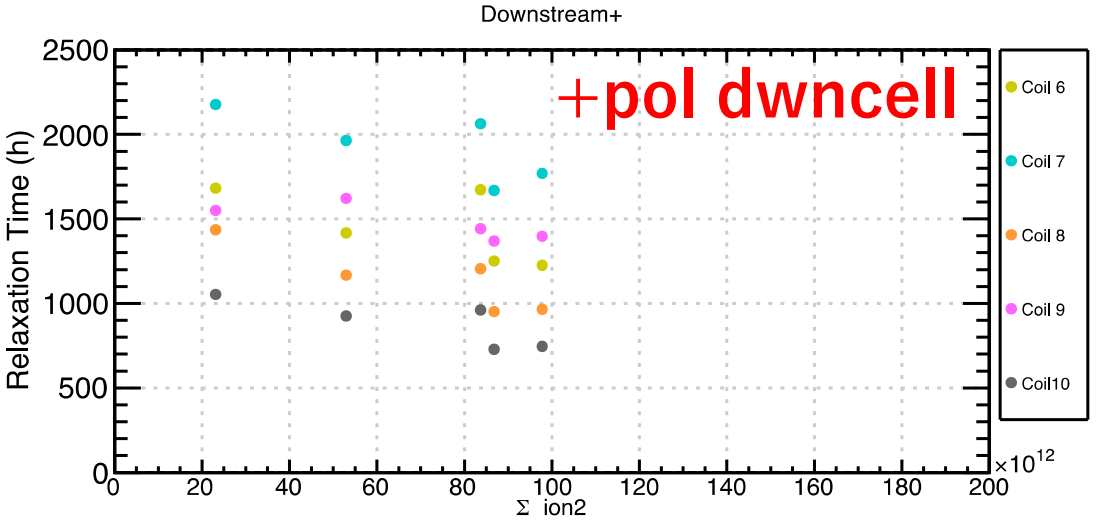
- Ion chamber 2 calib=5300 (already included)
- Target cell cross section : 12 cm^2
- Multiplicity : 5
- 100 x 10^12 ion2 : corresponds to **0.4 x 10^14 doses/cm^2**

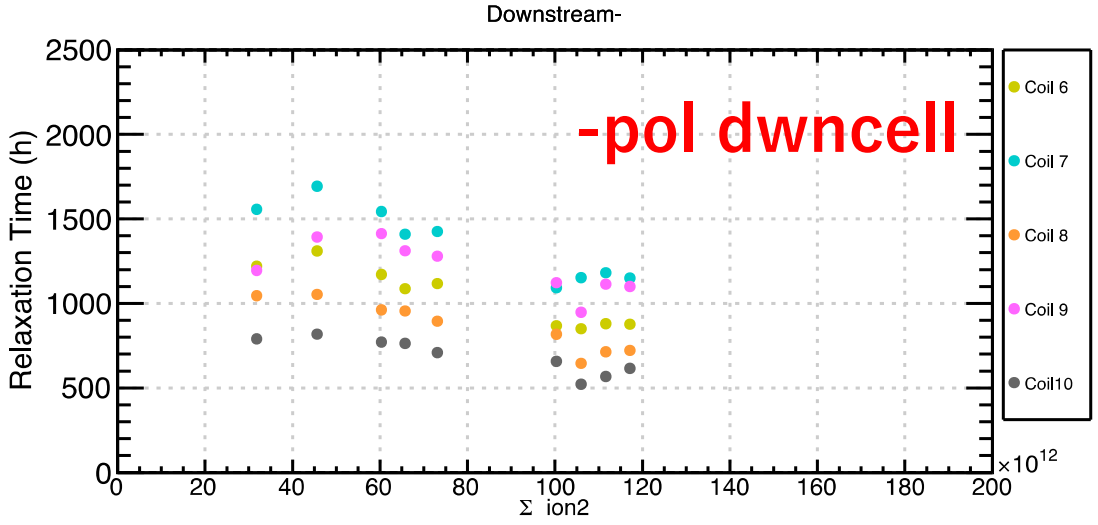
Relaxation time change in 2018

Produced by Genki
Same plot by Vincent



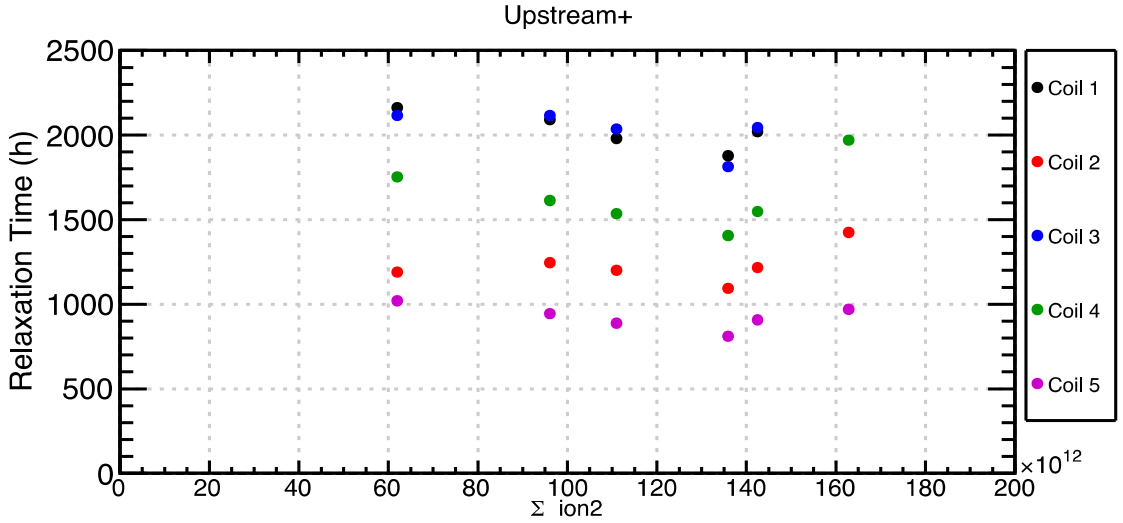


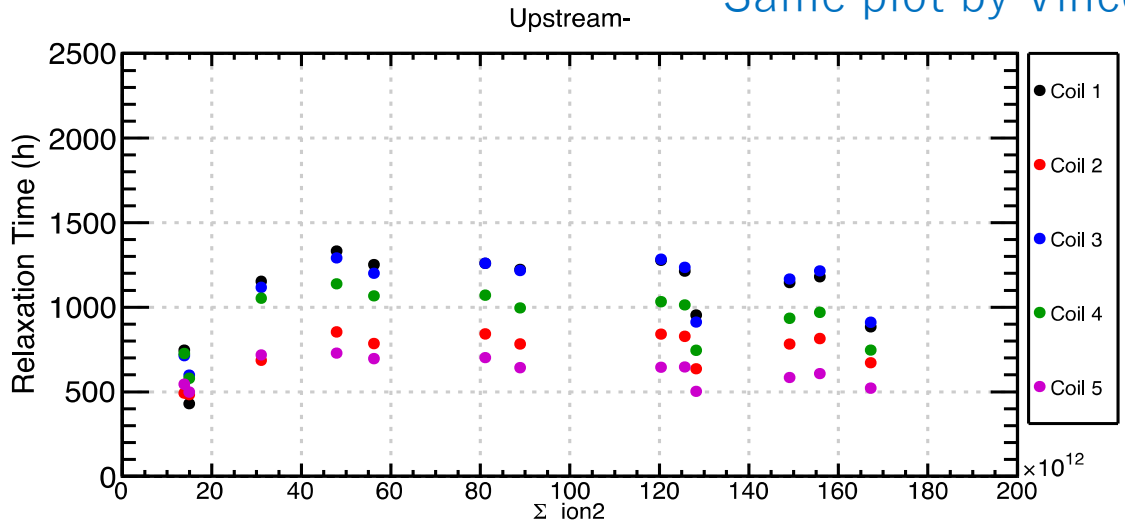


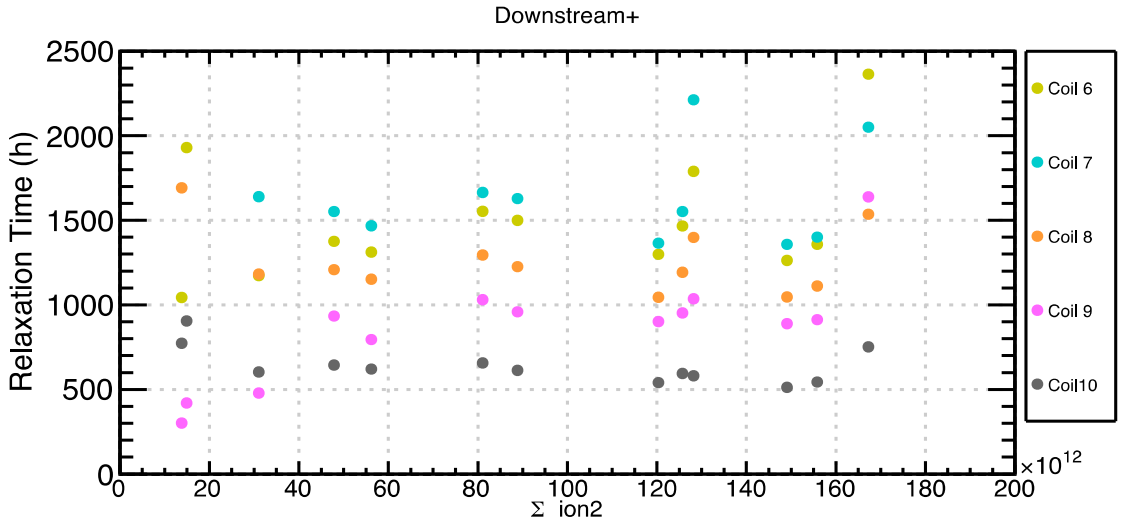


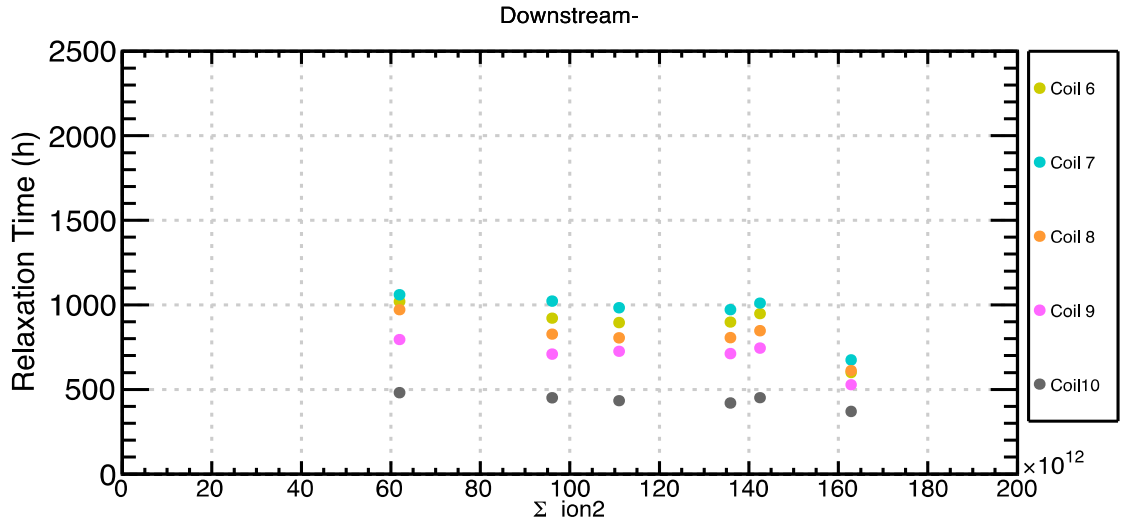
Relaxation time change in 2015

Produced by Genki
Same plot by Vincent









He3 removal in 2015

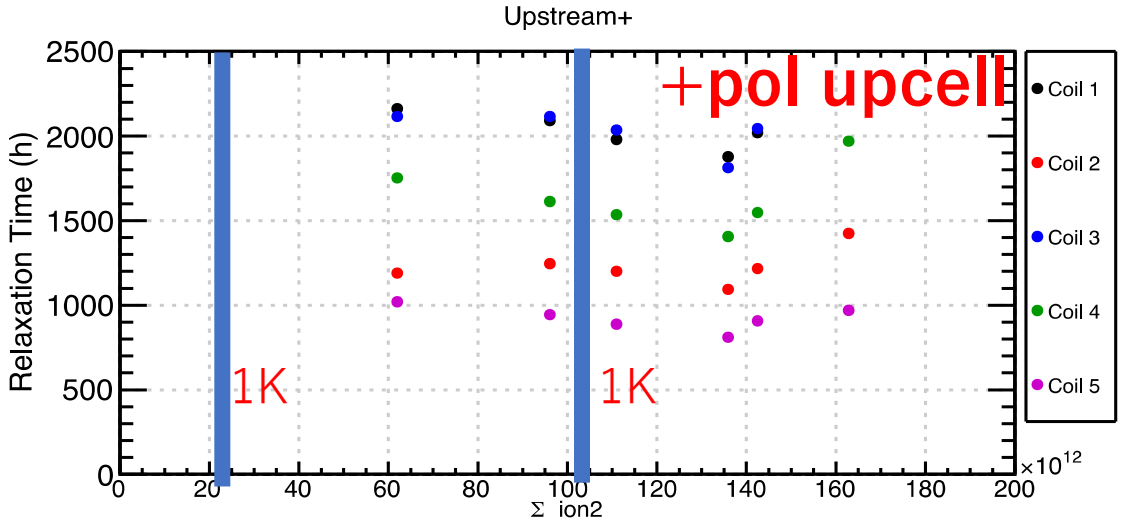
- 15/6/2015 : scrubbing run and TE calibration
- 22/6/2015 : dilution mode

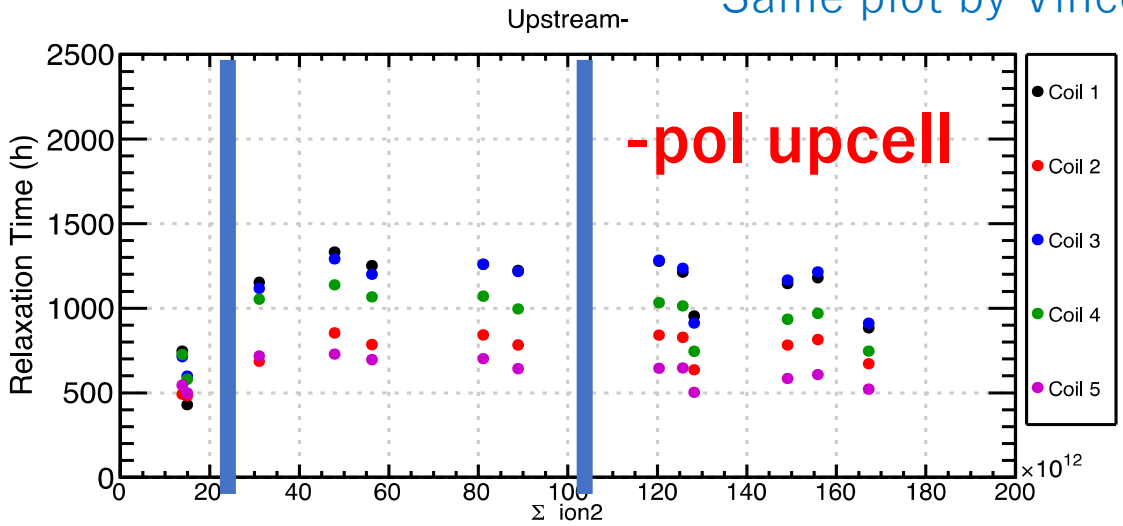
- 28/6/2015 : Cold box problem : a valve of filling line closed
- 30/6/2015 : dilution mode

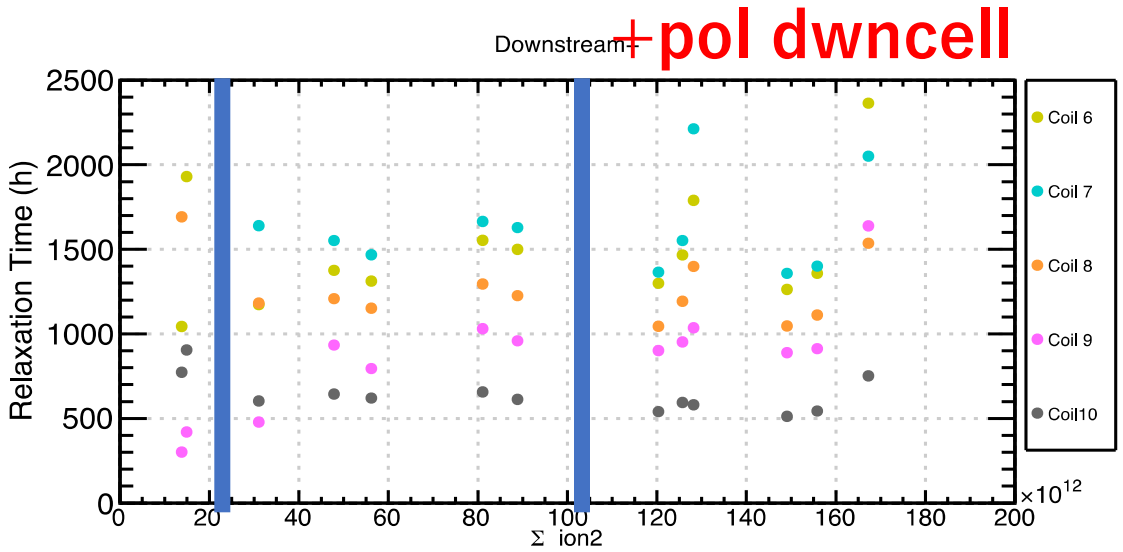
- 11/9/2015 : Cold box problem : PLC down
- 12/9/2015 : dilution mode

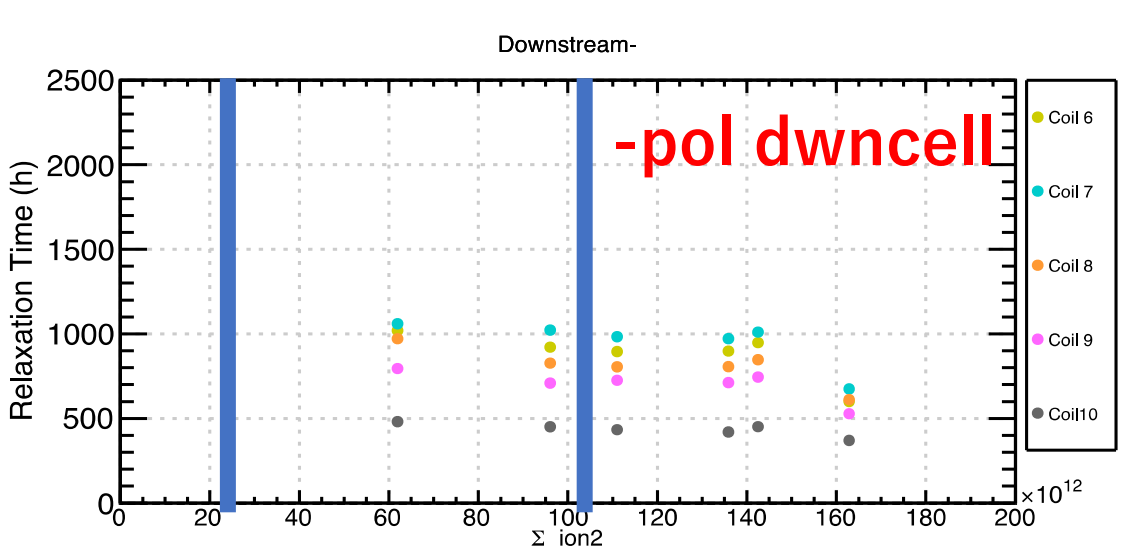
Relaxation time change in 2015

Produced by Genki
Same plot by Vincent









Plan of deuteron run in 2021

- **Target material**
  - 6LiD : used in 2002 – 2004 and 2006
  - material test needed : in Bochum or maybe in Bonn
- **Target cells**
  - 3cm diameter
  - 2 cells set-up : same as in 2018 ➔ no need to remove DR
- **Microwave frequency modulation**
  - Downstream microwave PSU : no function
  - Possibility of magnet field modulation
- **Moving platform 2m downstream**
  - Target platform movement : organized by V. Anosov
  - Cryogenics pipes : TE-CRG
  - Microwave table movement

Shopping list for 2021

- **EIO tube (155 kCHF)**
- **Repair of current EIO tube (> 10 kCHF)**
  - plan to ship the tube to USA in 2019
- **NMR system (7 kCHF Mallot 2018)**
  - received quote from NI
- **New PLC system for DR ( )**
  - meeting with CERN support group on last Thursday (Roberto Speroni and Enrique Blanco)
    -- Christophe and Nori from COMPASS
    -- New CPU obtained and no more other parts needed (Maybe memory card needed)
    -- Support of Christophe needed in 2019
- **Spare vacuum sensors (~ 4 kCHF Yamagata 2018)**
  -Full range gauge 2(614CHFx2), Pirani 2(234 CHFx2), Piezo 1(850CHF), Meter (892 CHF)
- **Microwave power sensor (1 kCHF Yamagata 2018)**
  - 2 sets of power monitoring
  - Inventory needed

Shopping list for 2021 part2

- **Spare EIP sensor**
  - One spare in Yamagata
- **AVS47 (10 kCHF)**
  - more stable connection
  - Maybe spare one in Yamagata
- **He3 roots maintenance (100 kCHF??)**
  - vibration meter obtained
  - cooling water line
  - depends on what the company can do
- **Power supply for EIO tube (115 kCHF)**
  - no function of modulation
- **He4 pumps maintenance**
  - will be done by TE-CRG
- **Still heater power supply (??)**
  - to be able to remote control