FDD ageing studies

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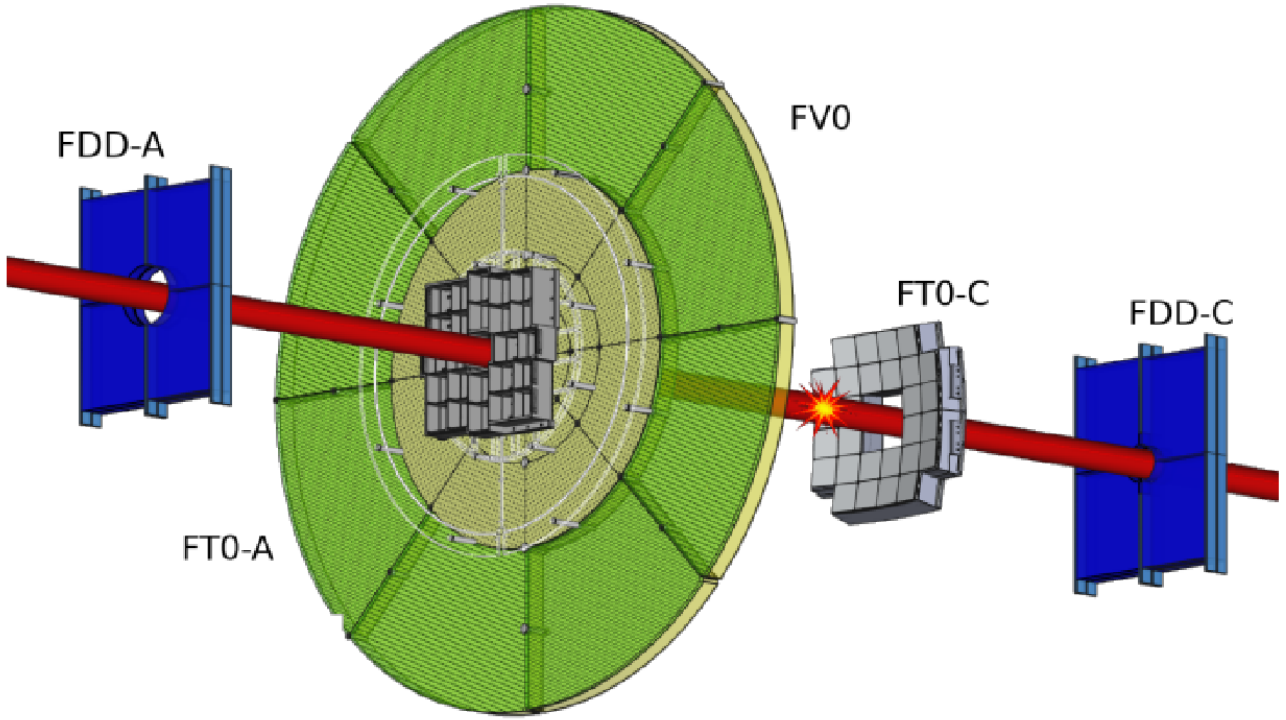
On behalf of the FIT Collaboration

25/11/2024

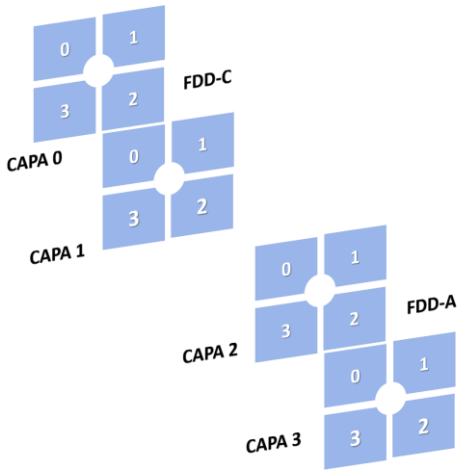
ALICE FIT



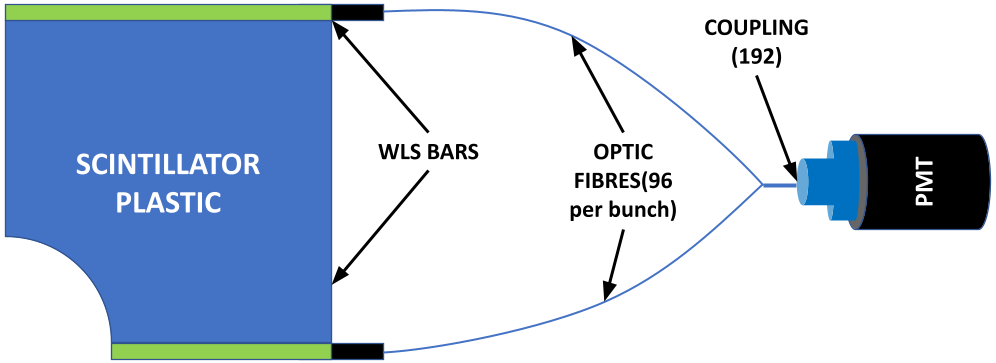
- The FIT system is part of the ALICE trigger and is one of ALICE Forward detectors.
- FIT is composed of 3 sub-detectors: FT0, FV0, and FDD.

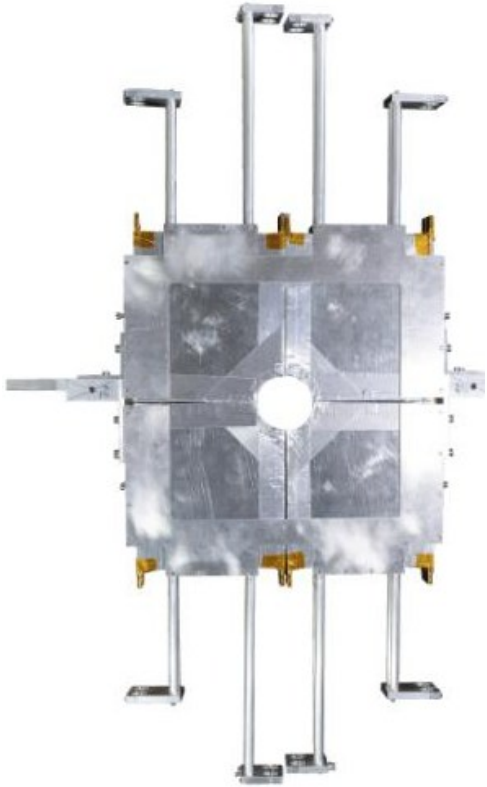
FDD

- **What does it do?**
  - It helps study diffractive physics.
  - It's part of ALICE's trigger system.



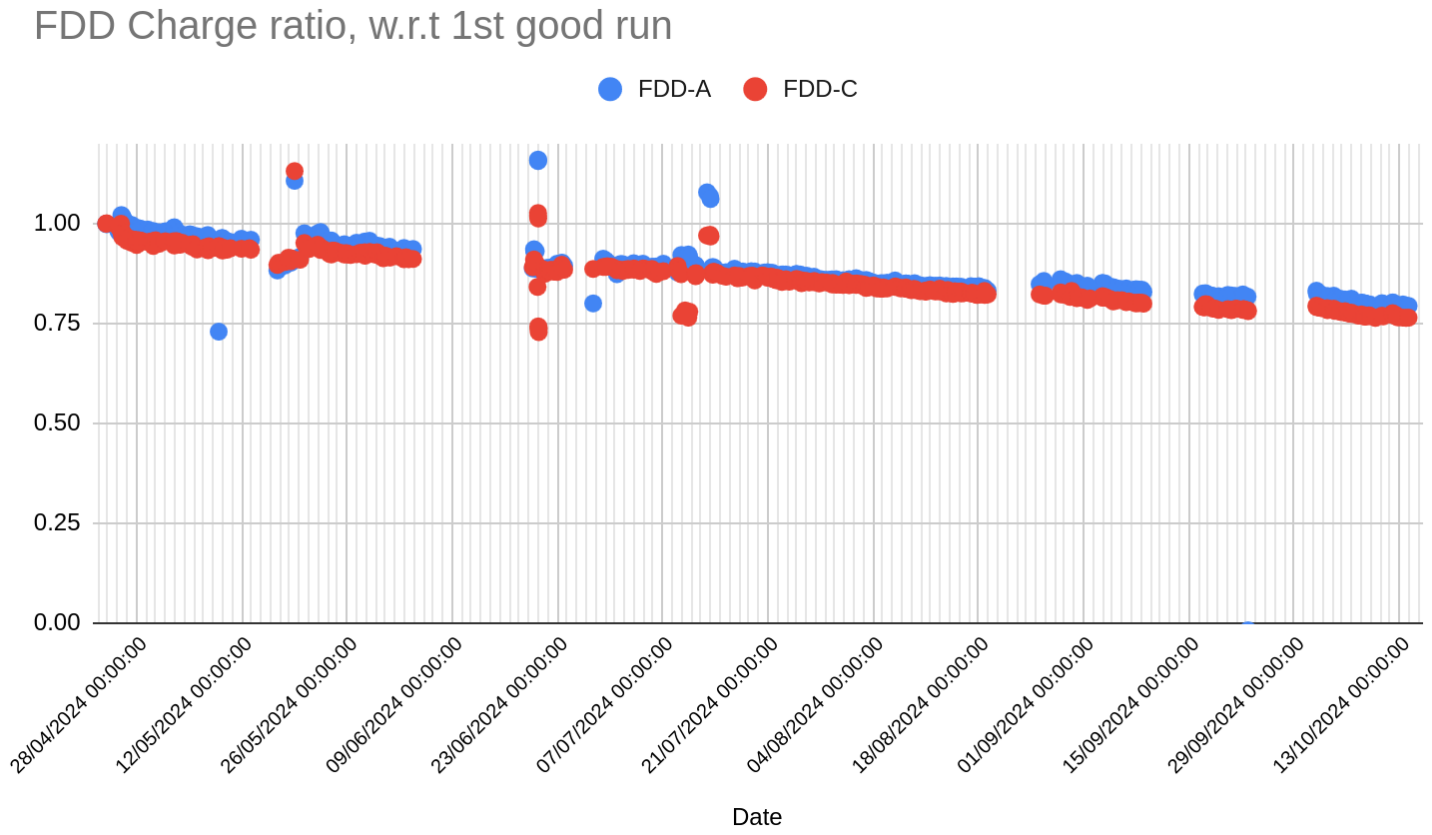
- **How is it composed?**
  - It's composed of 2 stations, one of each side of ALICE: FDDA and FDDC, which are 17 m and 19.5 m away from the Interaction Point respectively.
  - Each station has 2 layers.
  - Each layer has 4 modules.
  - Each module consists of a plastic scintillator block with WLS bars on the sides.





FDD QC Checks

- We in the FDD team have been keeping a logbook this year to track the detector's performance an ageing.
- There, we have taken notes of certain parameters the sum of amplitudes (from the TCM board) for each pp run this year.
- To crosscheck this results, we were recently asked to analyse some of these runs.

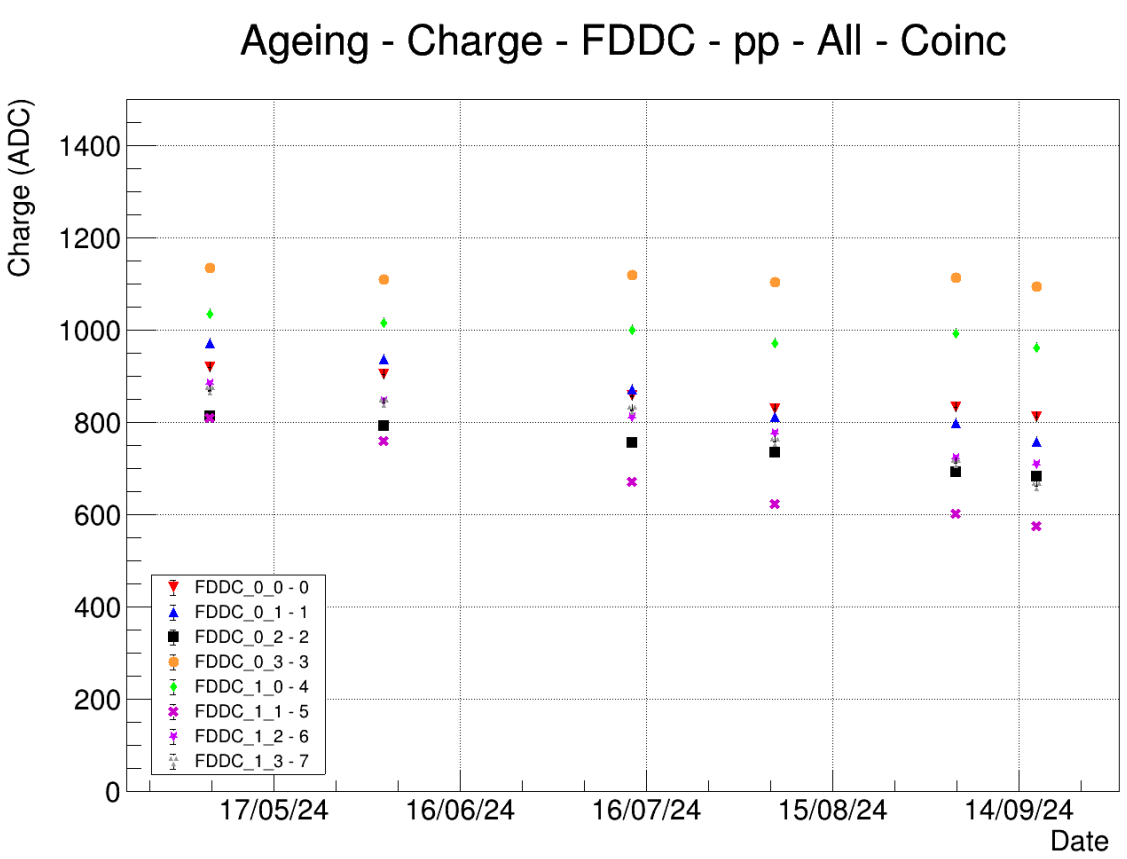


Method – pp runs

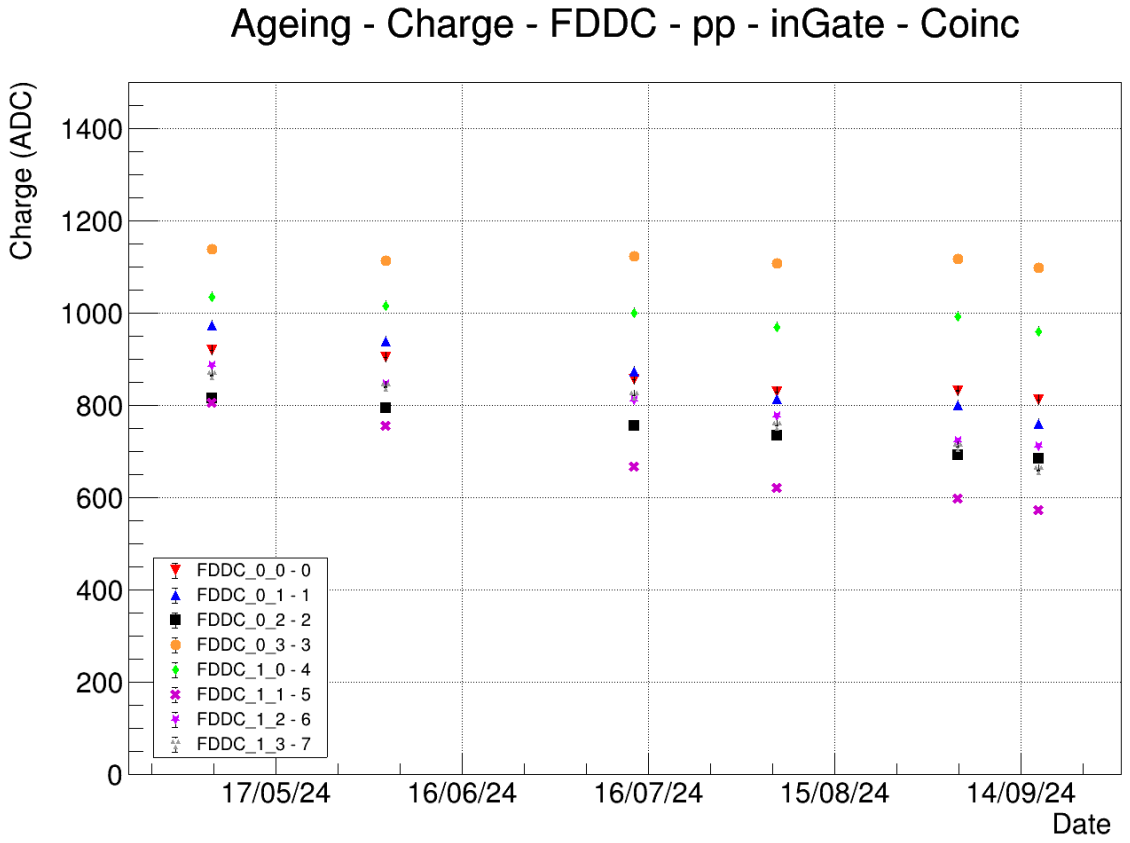
- **Filling scheme:** 25ns_2352b_2340_2004_2133_108 bpi_24inj
- **Nominal voltage.**
- **Period:** May 6th 2024 – Sept. 16th 2024
- These runs were checked using 2 cases:
  - inGate bit.
  - Qcut of 0 (All signals).
- In both cases, to clear out the noise, we applied the layer coincidence condition.
- From there, we took the mean charge for each run in both cases.

Run	Day	Duration	Energy (GeV)
551230	06/05/2024	00:39:27	6798.24
552369	03/06/2024	01:51:08	6798.36
554201	13/07/2024	00:29:03	6798.12
555270	05/08/2024	00:36:47	6797.88
556639	03/09/2024	00:21:04	6797.52
557374	16/09/2024	00:48:38	6797.28

FDDC ageing – pp – Coincidence – Mean Charge

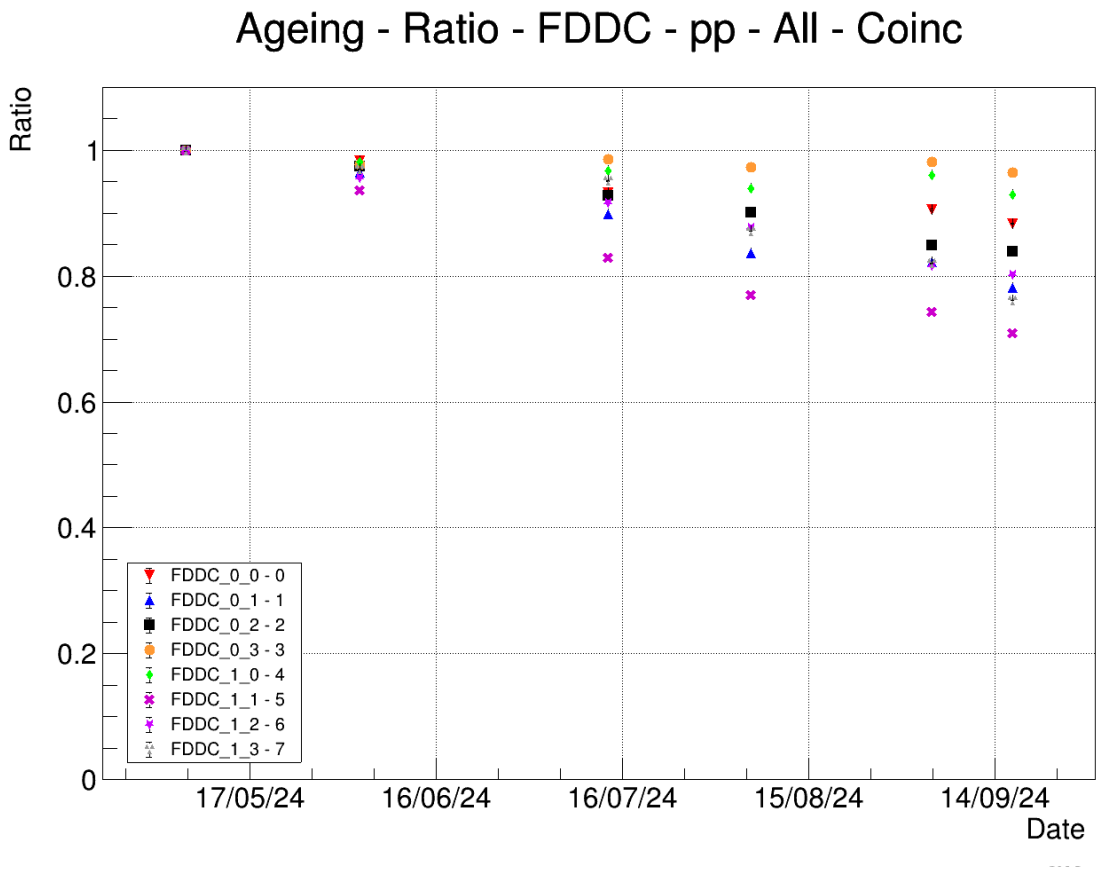


FDDC – pp – All – Coincidences
Mean charge vs Date

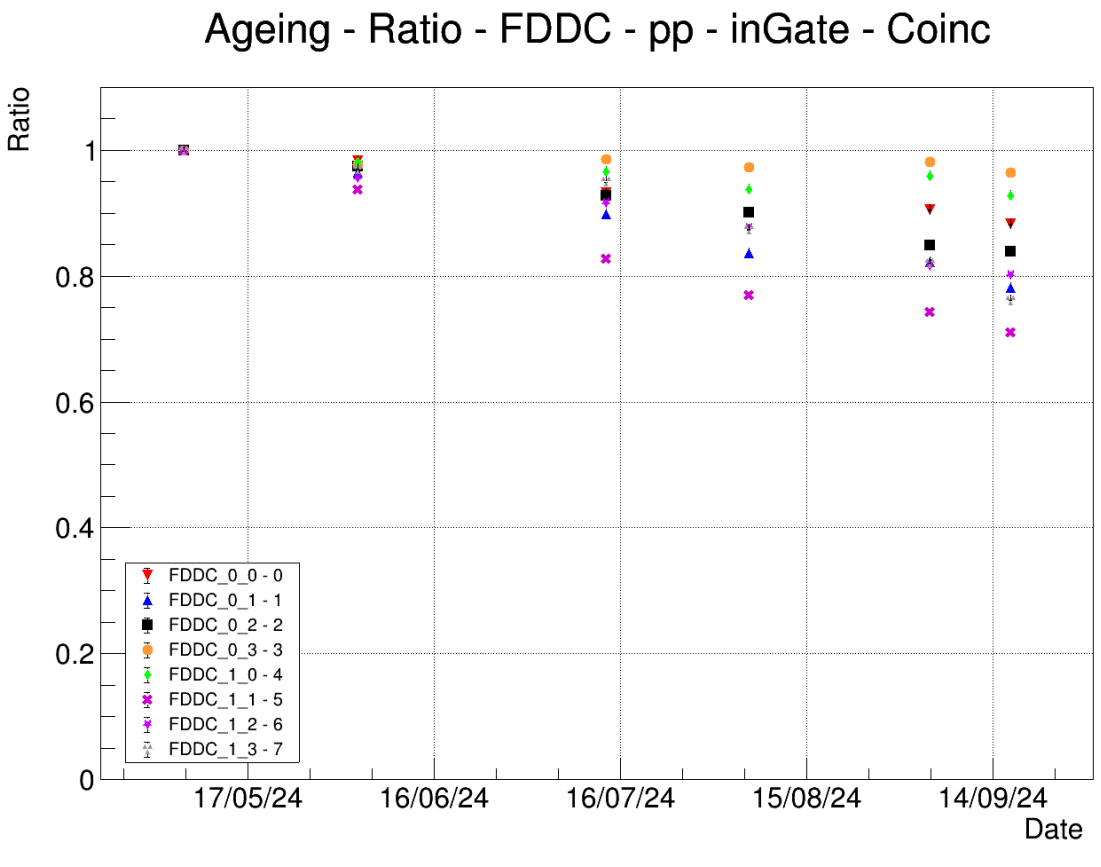


FDDC – pp – inGate – Coincidences
Mean charge vs Date

FDDC ageing – pp – Coincidence – Ratio

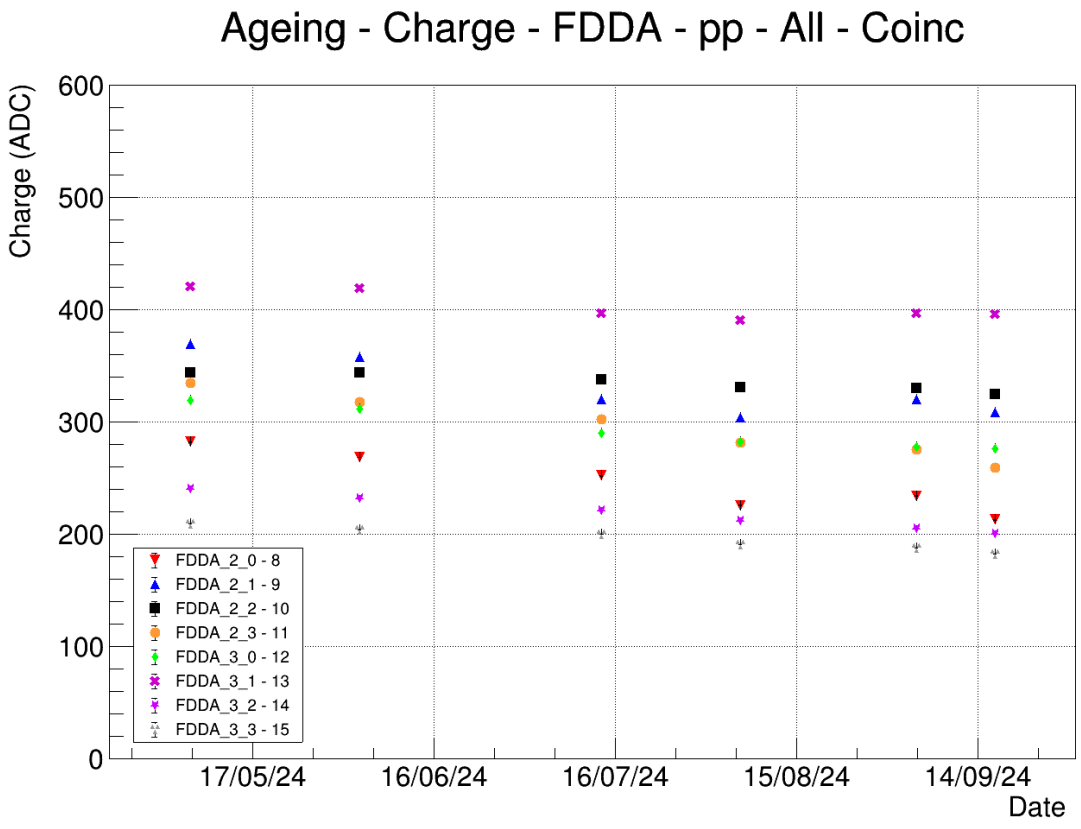


FDDC – pp – All – Coincidences
Ratio with respect to first run vs Date

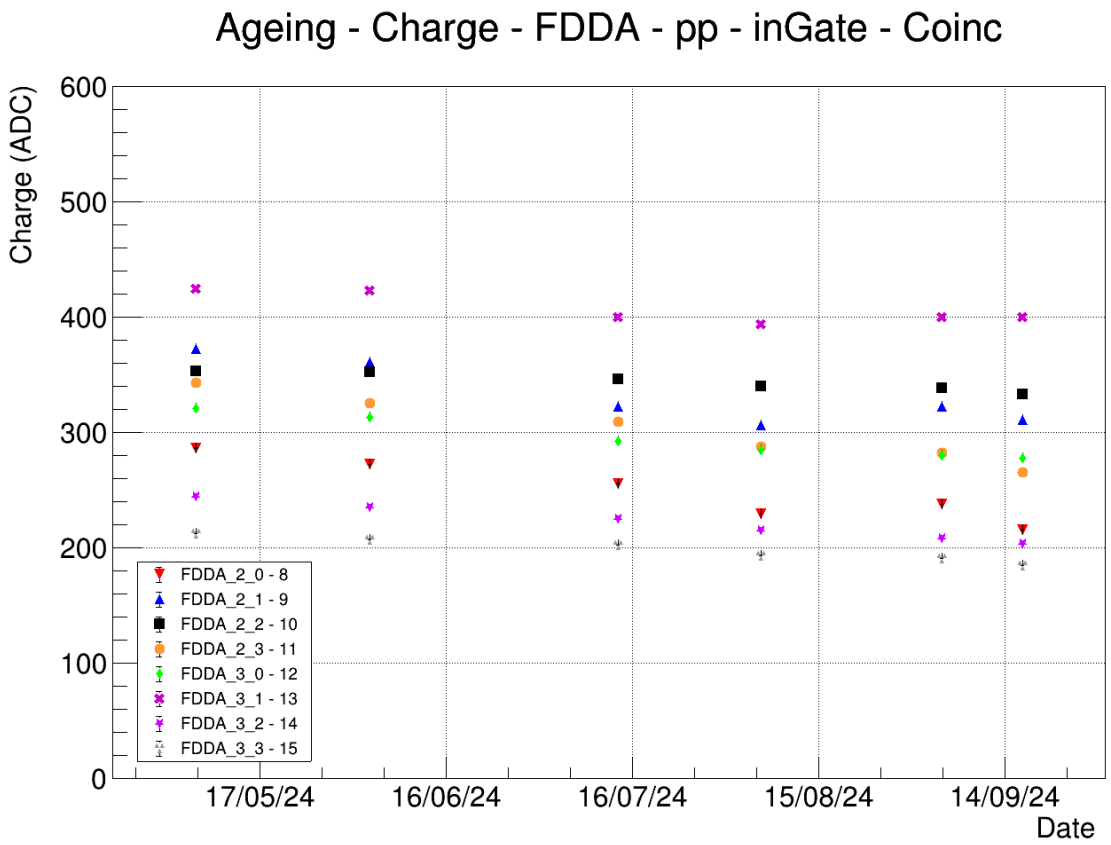


FDDC – pp – All – Coincidences
Ratio with respect to first run vs Date

FDDA ageing – pp – Coincidence – Mean Charge

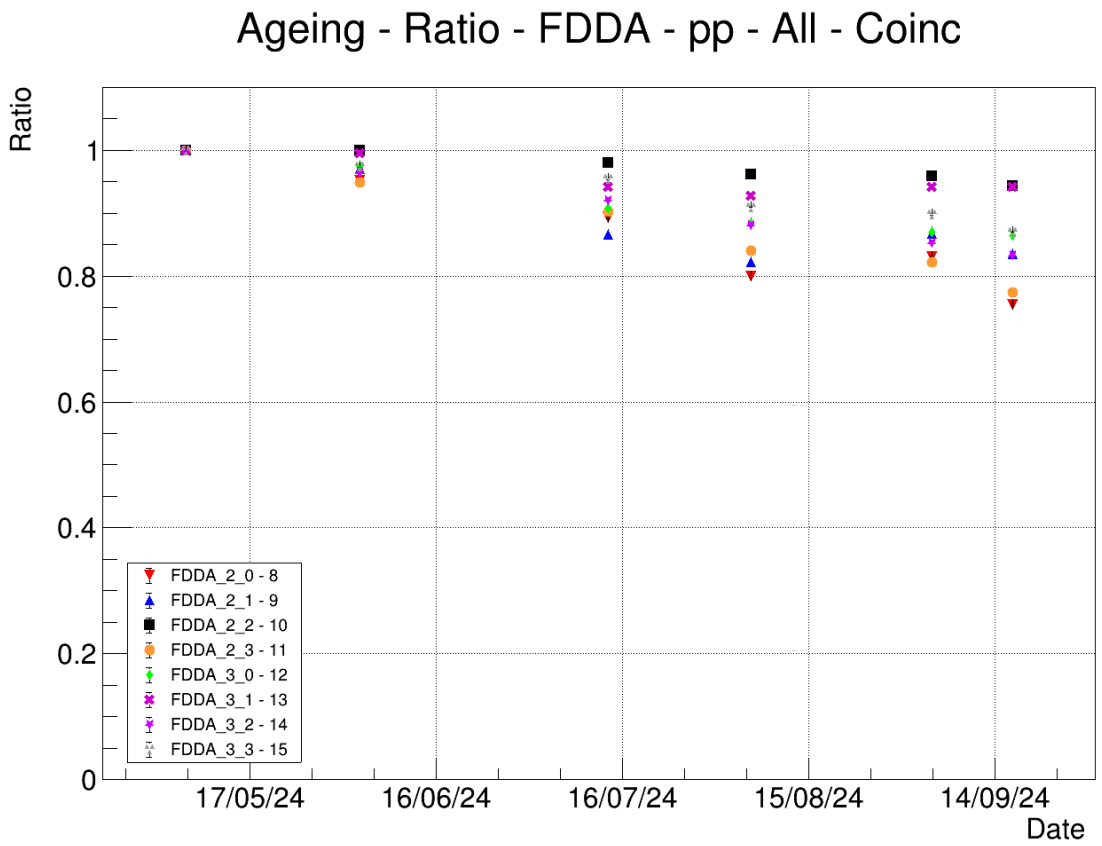


FDDA – pp – All – Coincidences
Mean charge vs Date

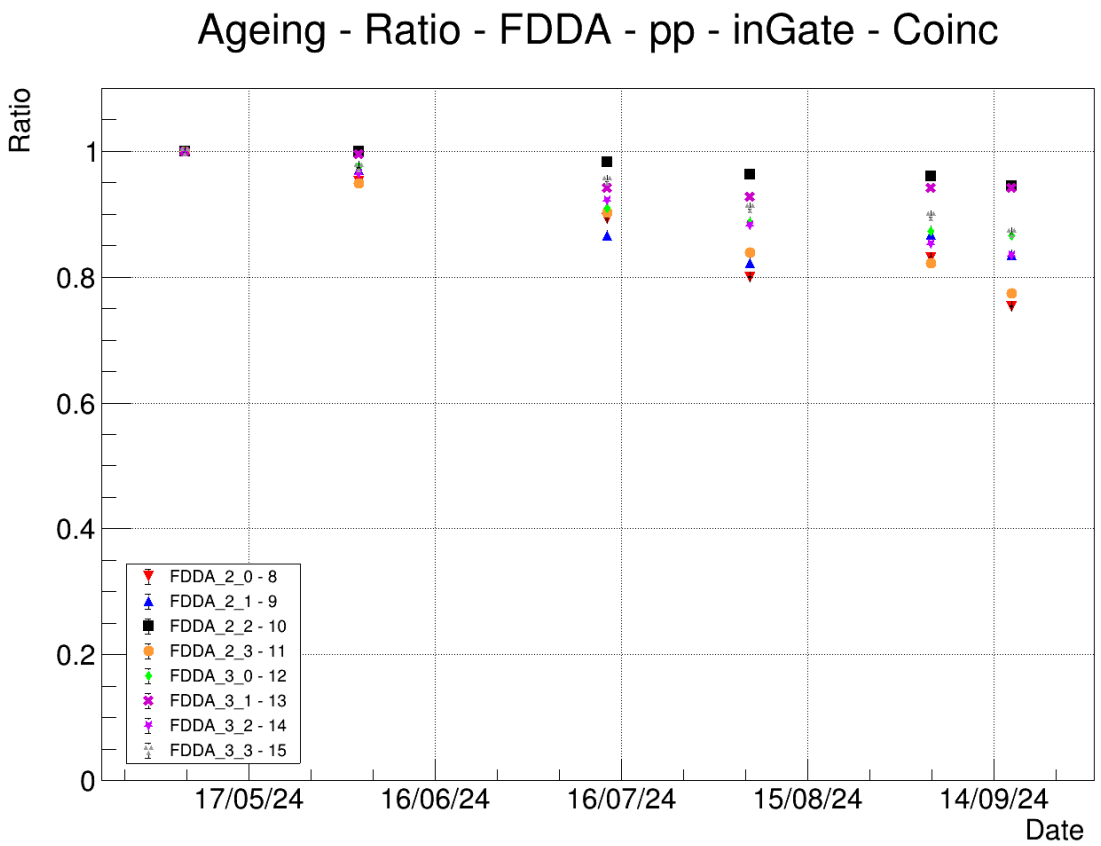


FDDA – pp – inGate – Coincidences
Mean charge vs Date

FDDA ageing – pp – Coincidence – Ratio



FDDA – pp – All – Coincidences
Ratio with respect to first run vs Date



FDDA – pp – inGate – Coincidences
Ratio with respect to first run vs Date

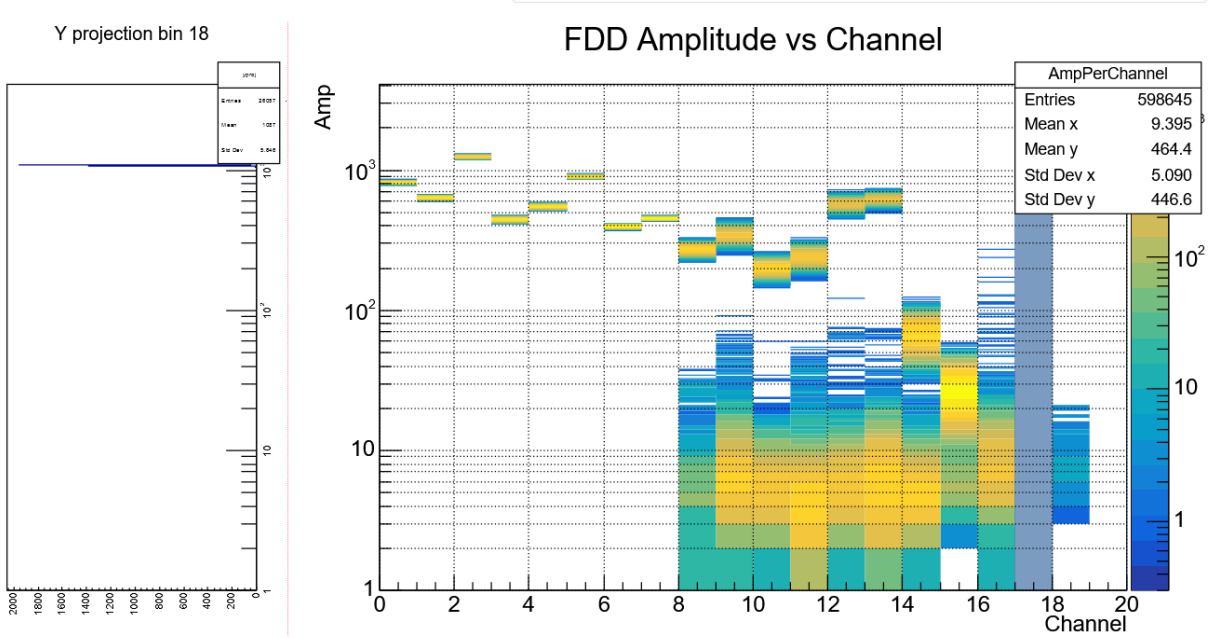
Method – Laser – Mean Charge

- First, from the list of laser runs we had done before, we identified sets with the same characteristics where the reference PMTs were on:
  - FDDC – 1600V – Att: 5000 steps.
  - FDDA – 1800 V – Att: 5000 steps.
- Then we obtained the mean charge for each channel, including the reference PMTs.
- We divided the mean charge of each channel by the mean charge of the reference PMT of its respective side.

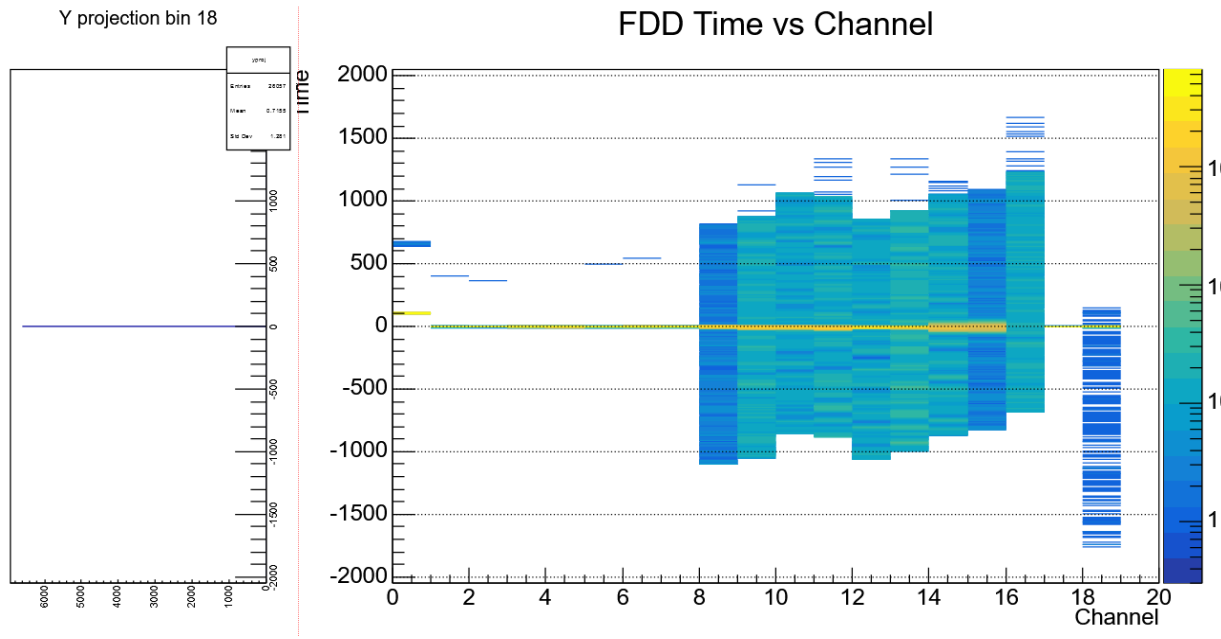
Run	Day	HV (V)	Attenuation (steps)
545583	13/11/2023	1800	5000
552246	31/05/2024	1800	5000
555094	01/08/2024	1800	5000
556041	22/08/2024	1800	5000

Run	Day	HV (V)	Attenuation (steps)
545501	08/11/2023	1600	5000
552239	31/05/2024	1600	5000
555093	01/08/2024	1600	5000
556040	22/08/2024	1600	5000

Charge – Reference PMT – FDD-C

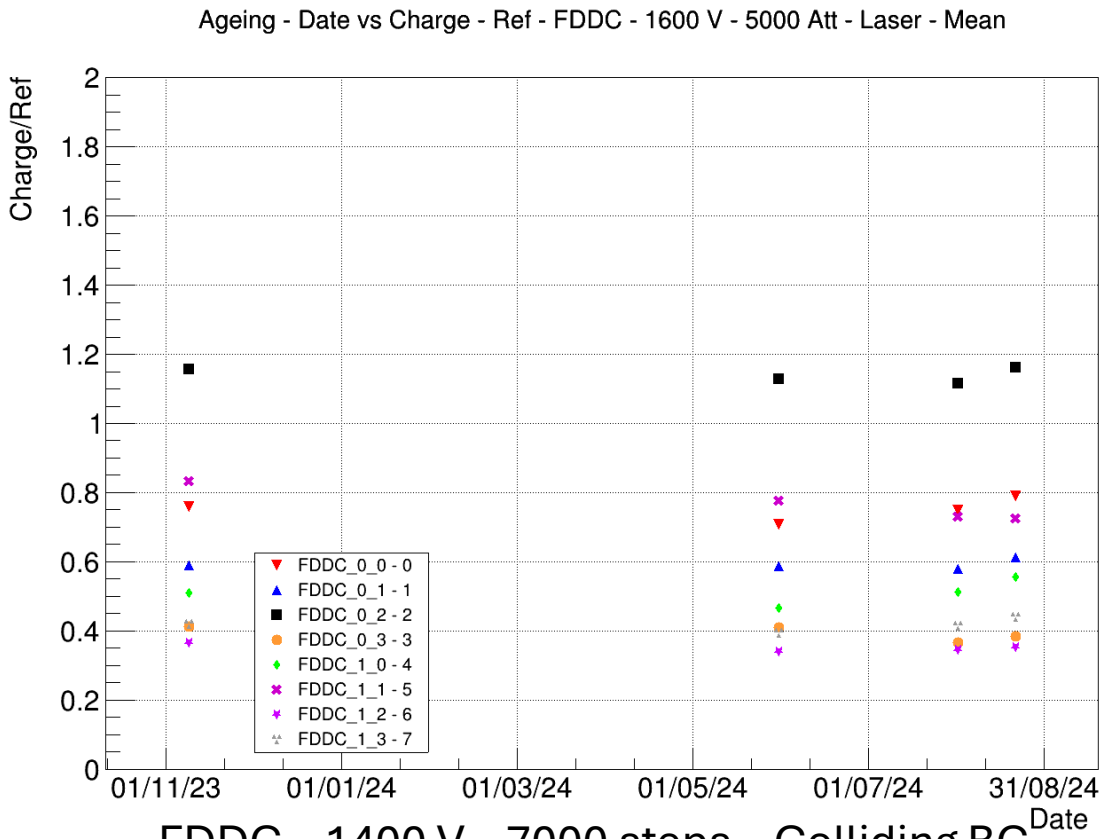


Amplitude vs Channel, FDD-C reference PMT projection, Run 545501, November 2023

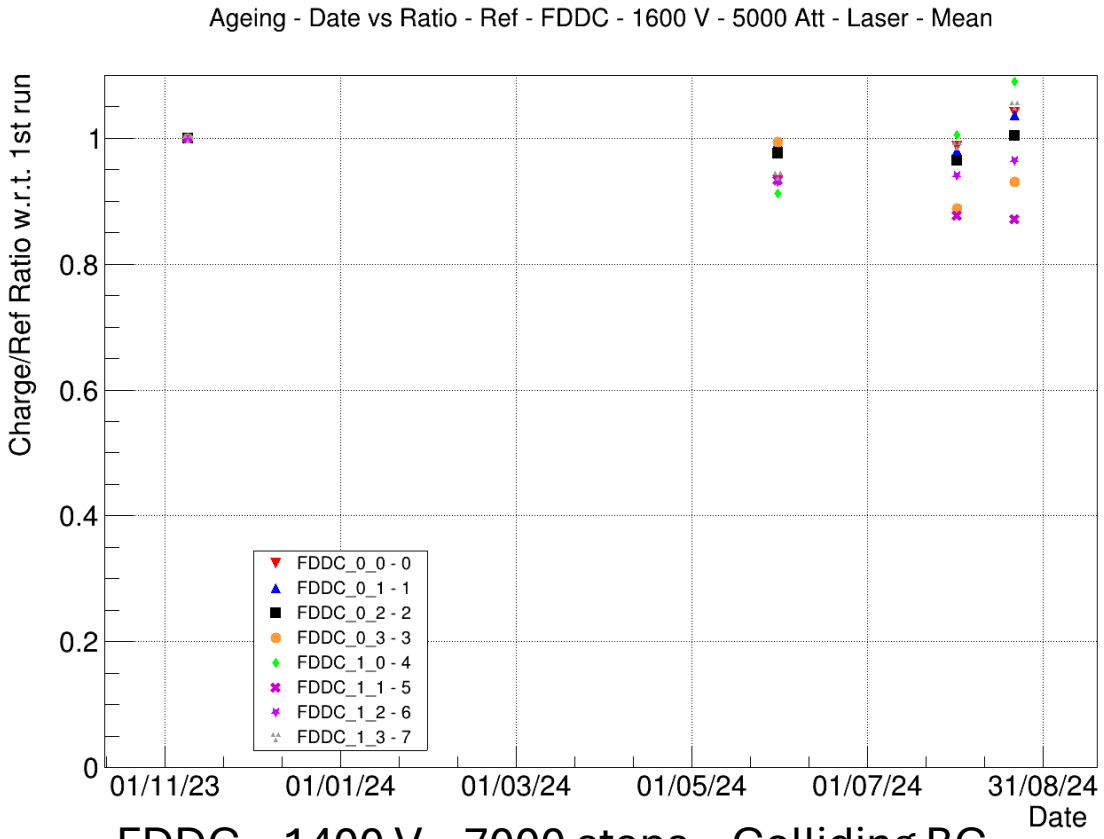


Time vs Channel, FDD-C reference PMT projection, Run 545501, November 2023

FDDC – 1600 V – 5000 Att – Laser – Mean Charge – Ref Ch

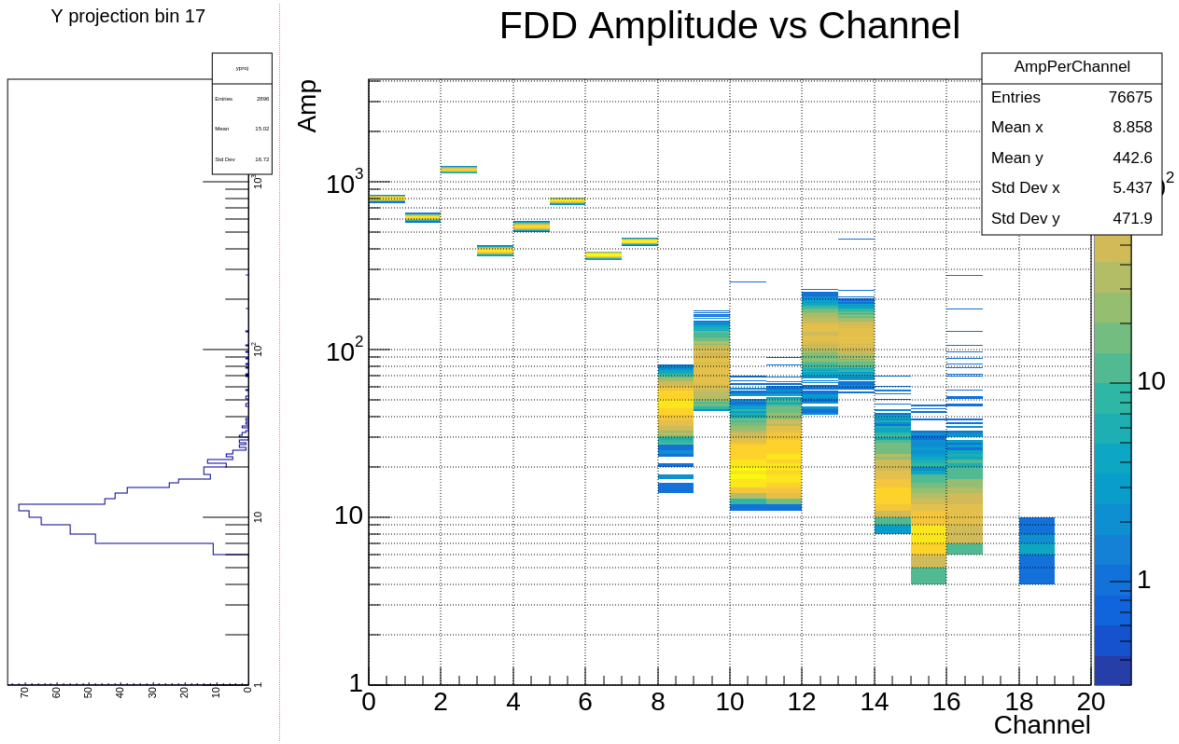


FDDC – 1400 V – 7000 steps – Colliding BC
Charge / Ref vs Date

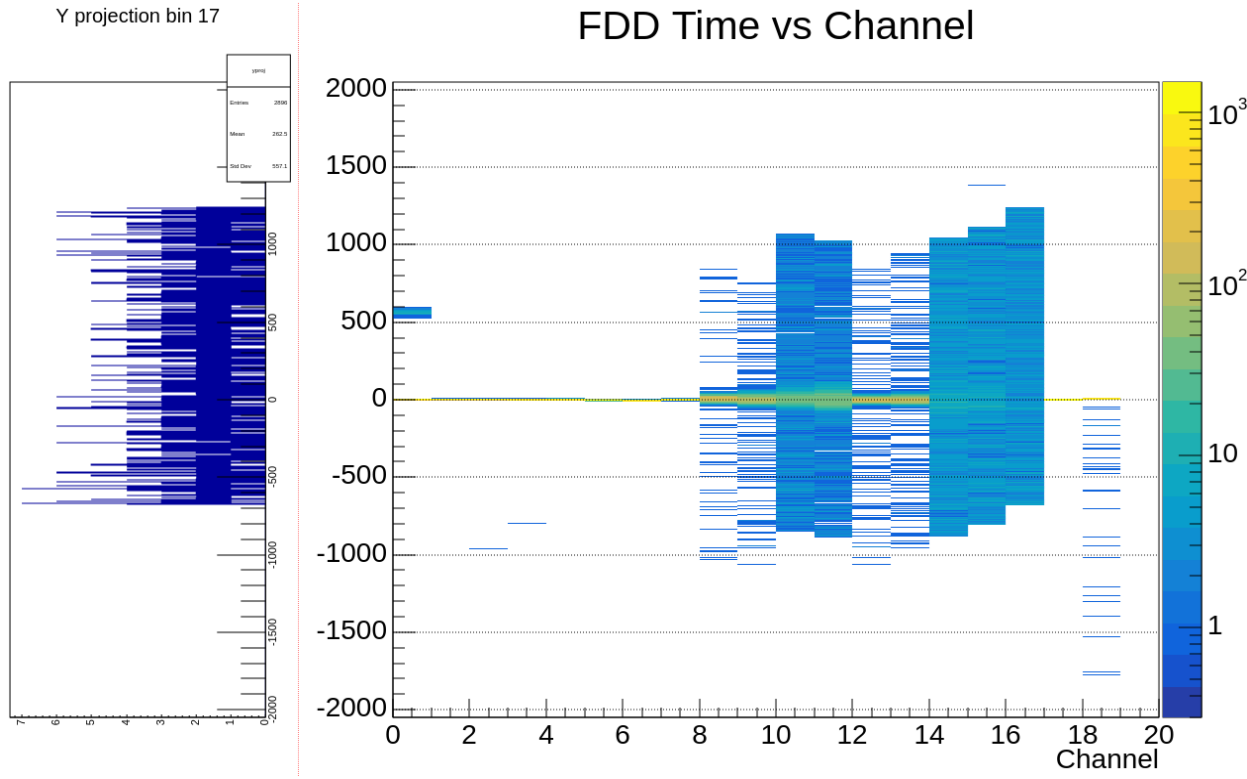


FDDC – 1400 V – 7000 steps – Colliding BC
Ratio with respect to first run vs Date

Reference PMT – FDD-A

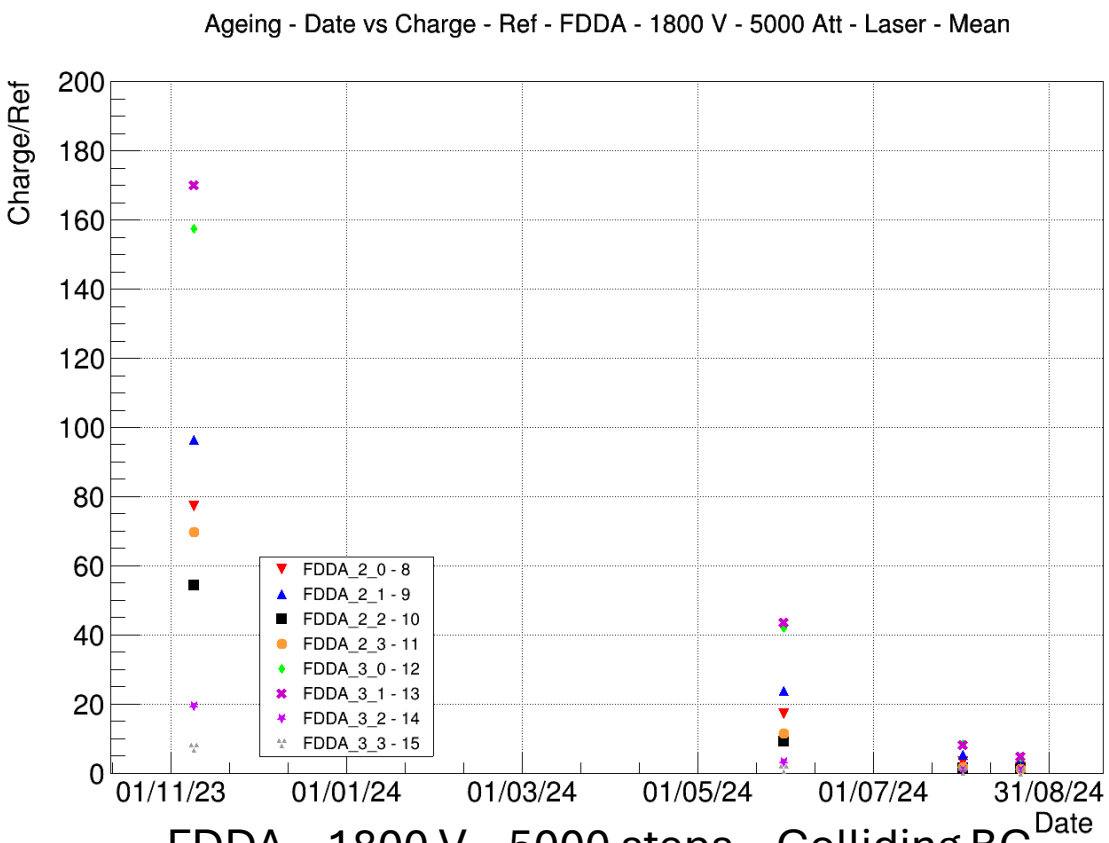


Amplitude vs Channel, FDD-A reference PMT projection, Run 555094, August 1st 2024

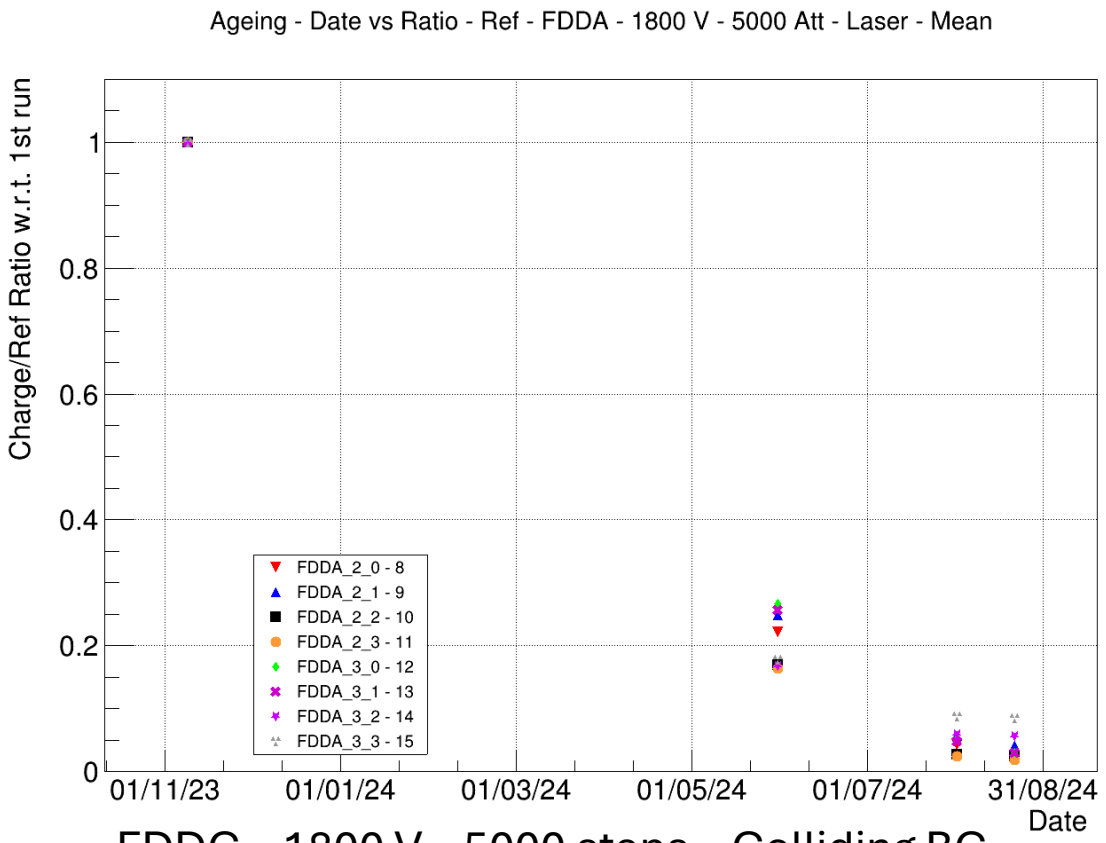


Time vs Channel, FDD-A reference PMT projection, Run 555094, August 1st 2024

FDDA – 1800 V – 5000 Att – Laser – Mean Charge – Ref Ch



FDDA – 1800 V – 5000 steps – Colliding BC
Charge vs Date

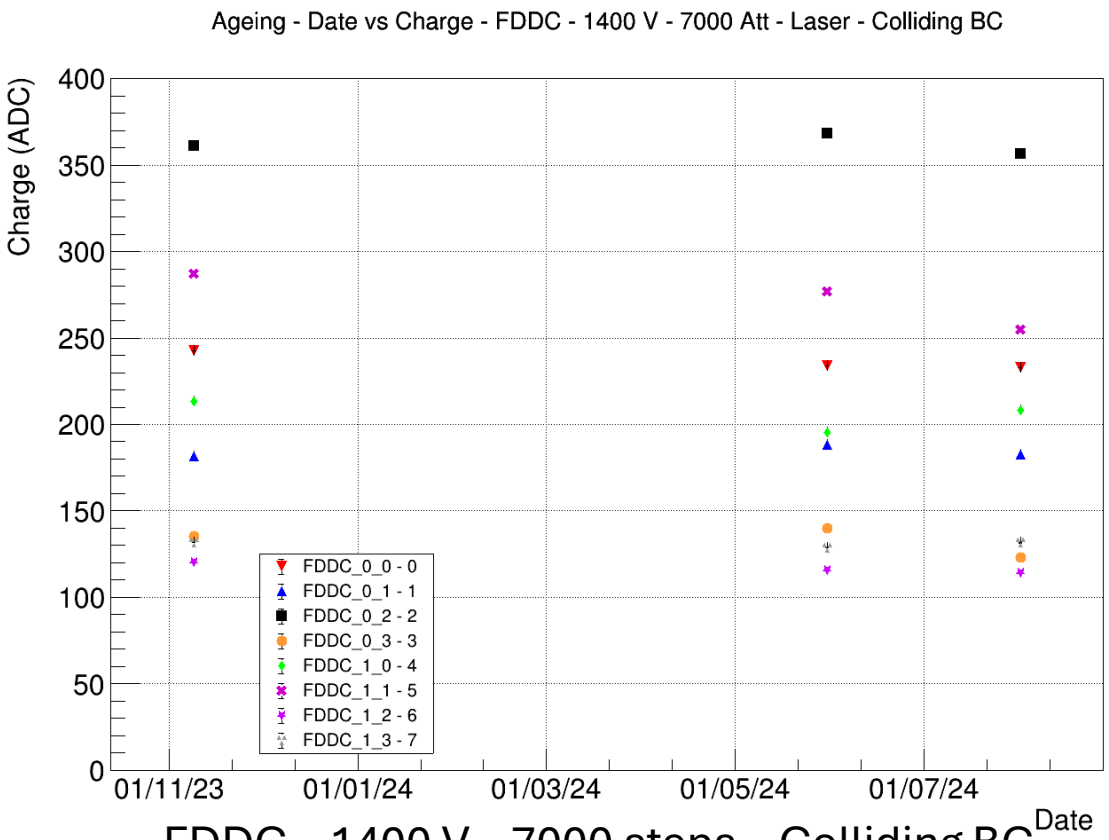


FDDC – 1800 V – 5000 steps – Colliding BC
Ratio with respect to first run vs Date

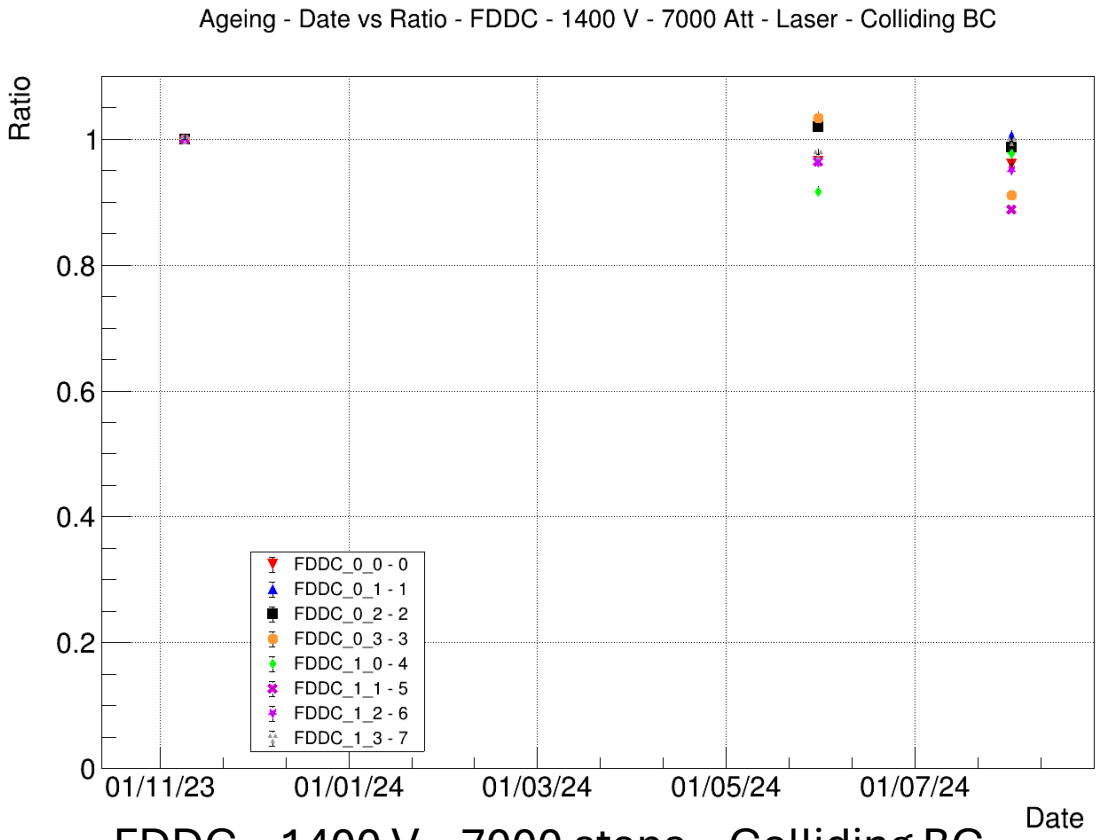
Method – Laser – Colliding BC

- After this, we processed different sets of runs, that were also used to study the Gain for each channel, but this time, selecting only the information in the colliding BC and fitting the data.
- The results obtained for ageing for each side are similar and show similar tendencies to the previous study using the mean charge.

FDDC – 1400 V – 7000 Att – Laser – Colliding BC

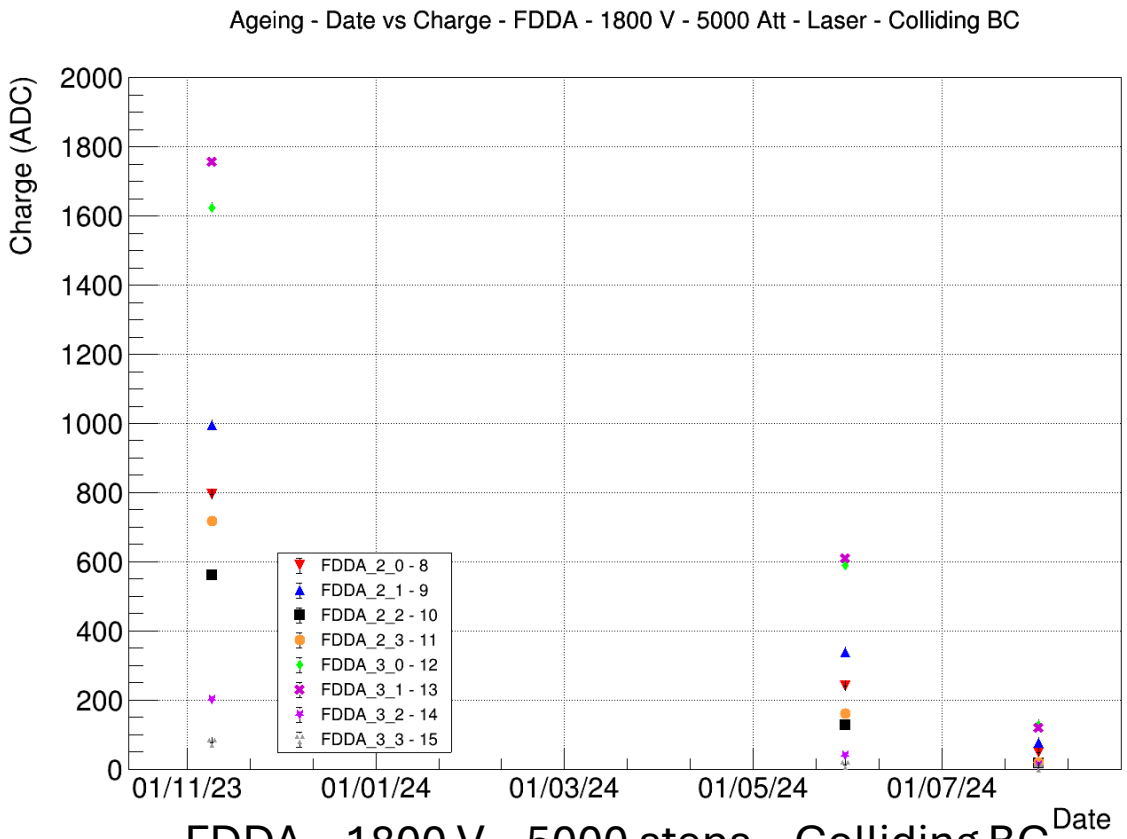


FDDC – 1400 V – 7000 steps – Colliding BC
Charge vs Date

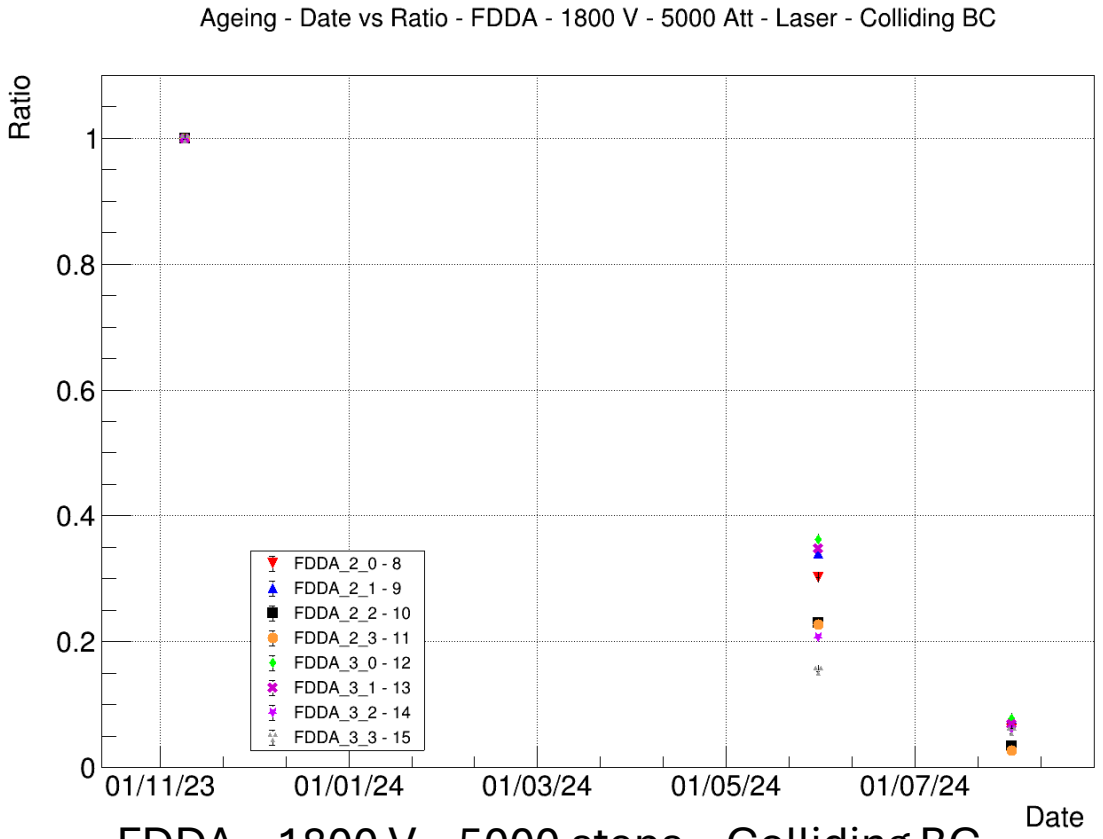


FDDC – 1400 V – 7000 steps – Colliding BC
Ratio with respect to first run vs Date

FDDA – 1800 V – 5000 Att – Laser – Colliding BC



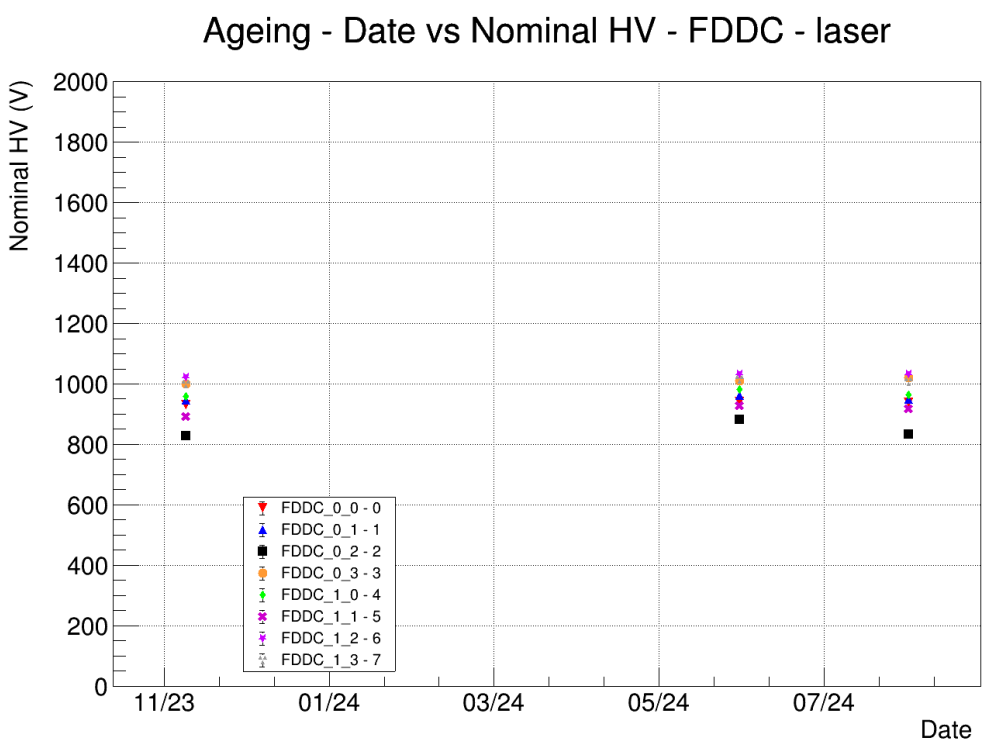
FDDA – 1800 V – 5000 steps – Colliding BC
Charge vs Date



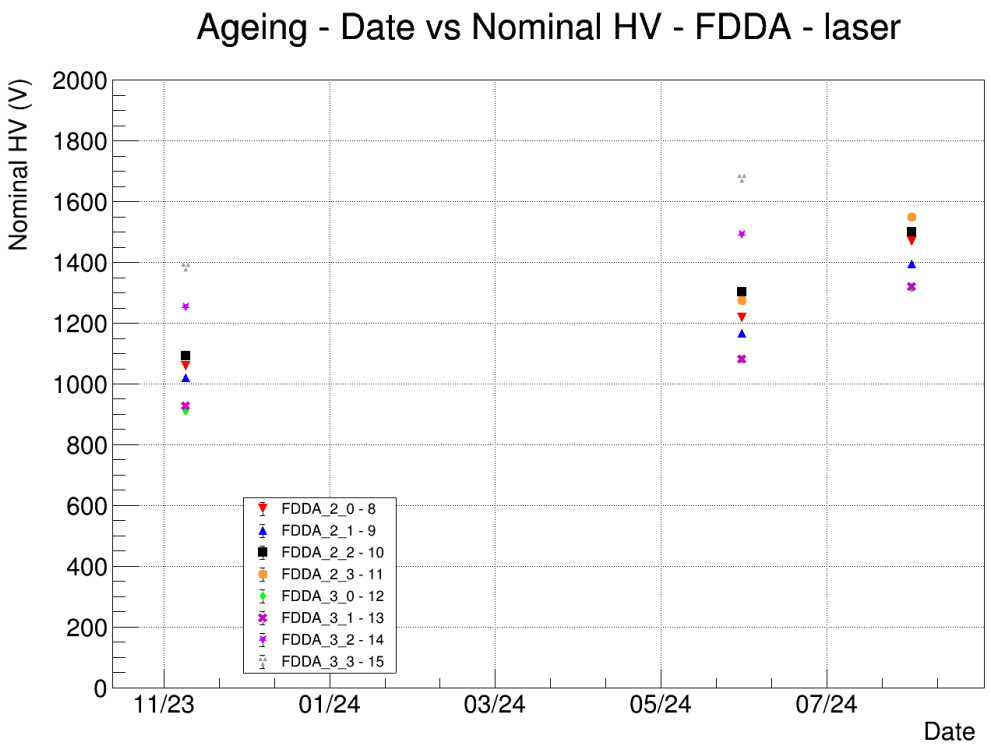
FDDA – 1800 V – 5000 steps – Colliding BC
Ratio with respect to first run vs Date

Nominal Voltages – Laser

Nominal Voltages FDDC

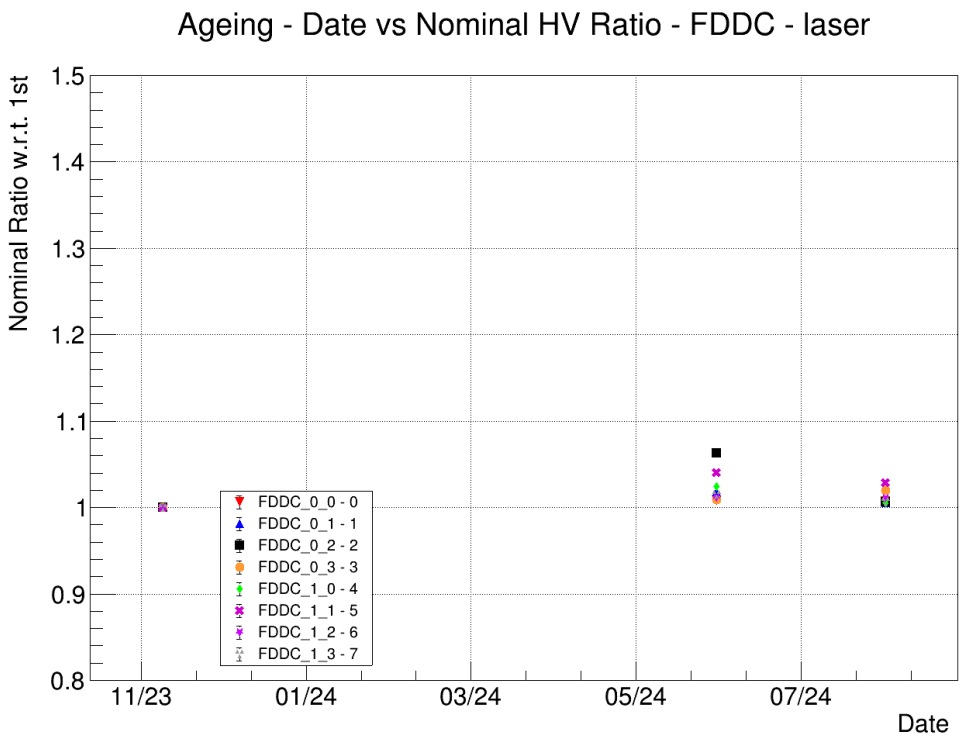


Nominal Voltages FDDA

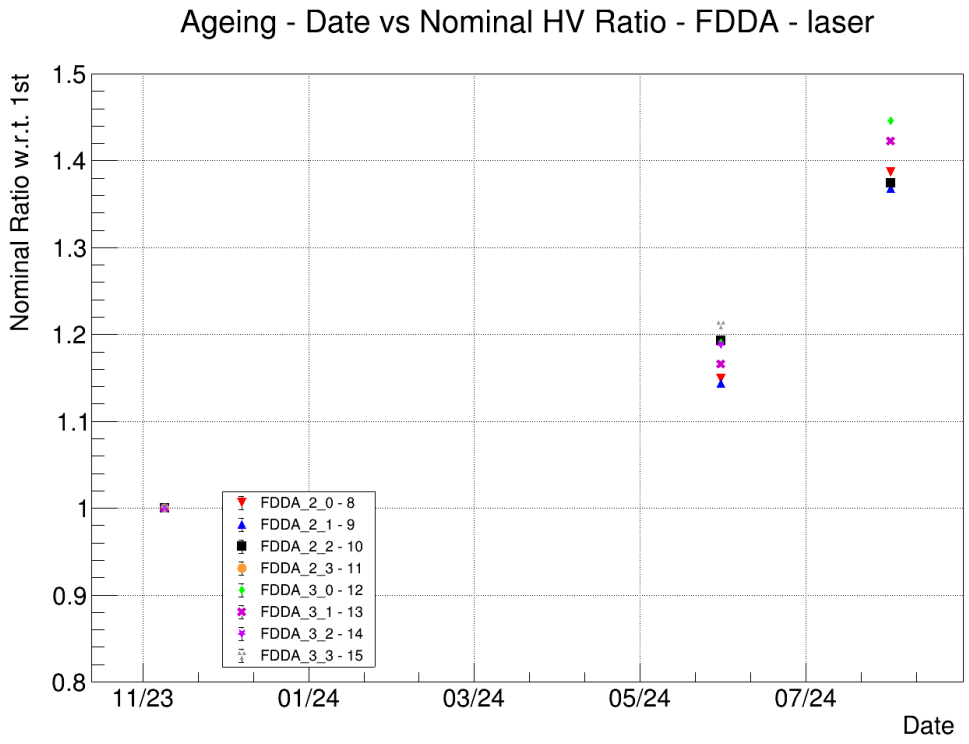


Nominal Voltages – Laser - Ratio

Nominal Voltages FDDC - Ratio

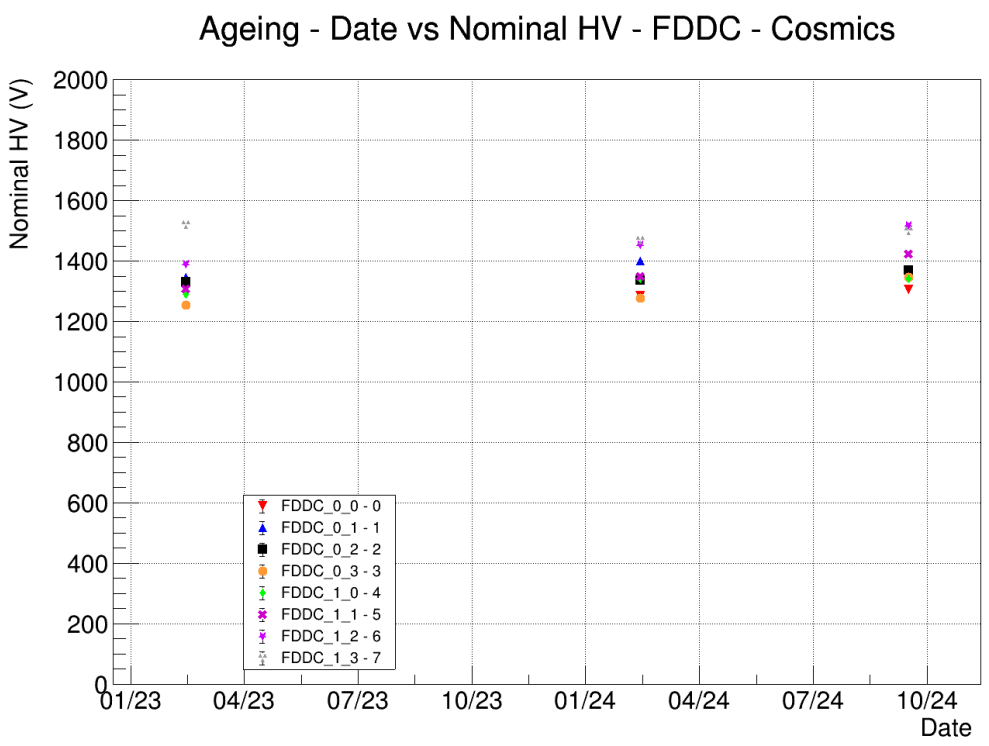


Nominal Voltages FDDA - Ratio

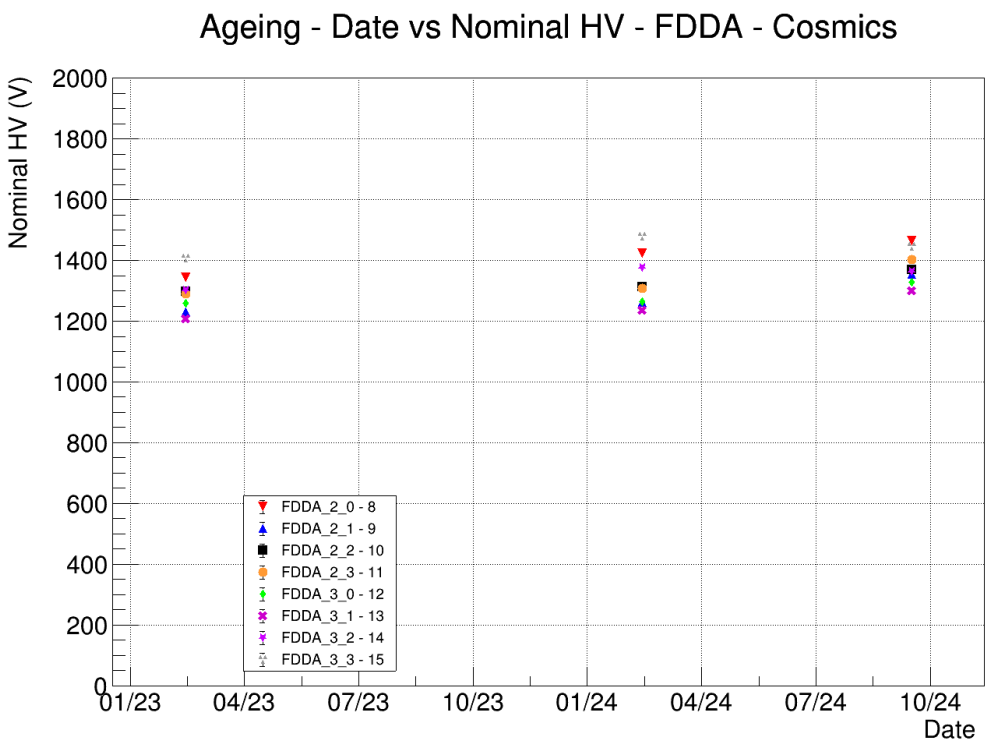


Nominal Voltages – Cosmics

Nominal Voltages FDDC

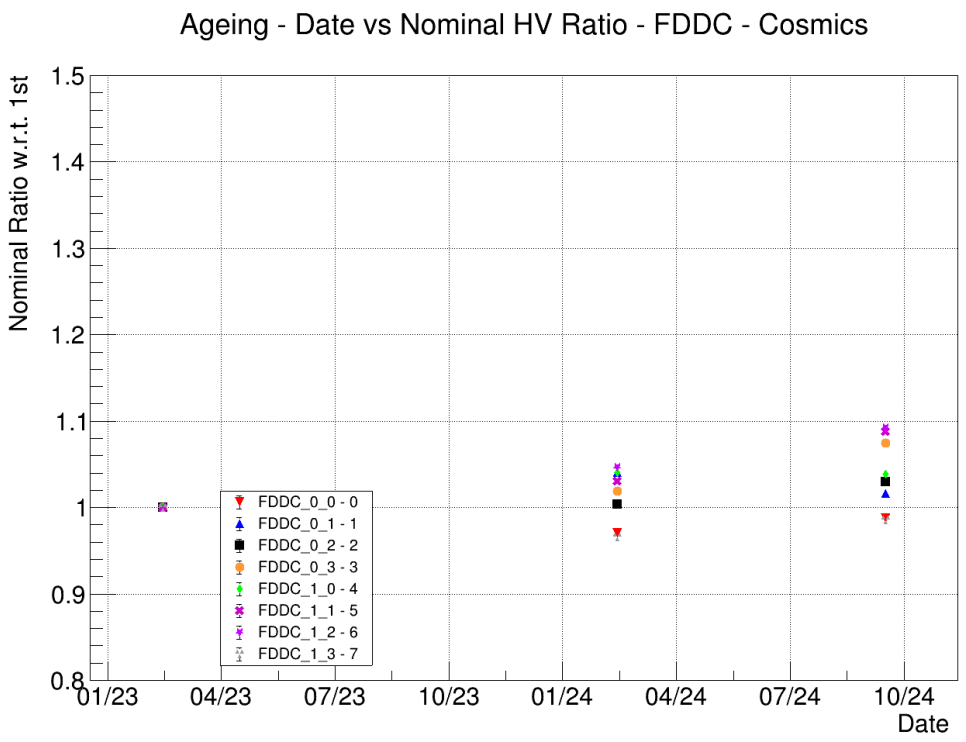


Nominal Voltages FDDA

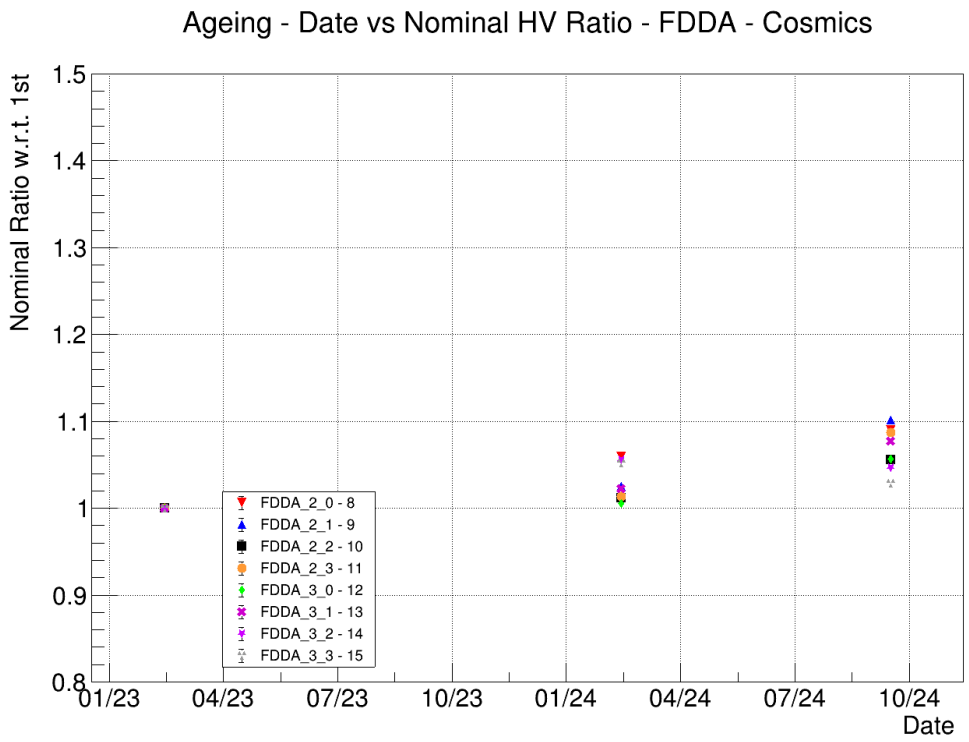


Nominal Voltages – Cosmics - Ratio

Nominal Voltages FDDC - Ratio

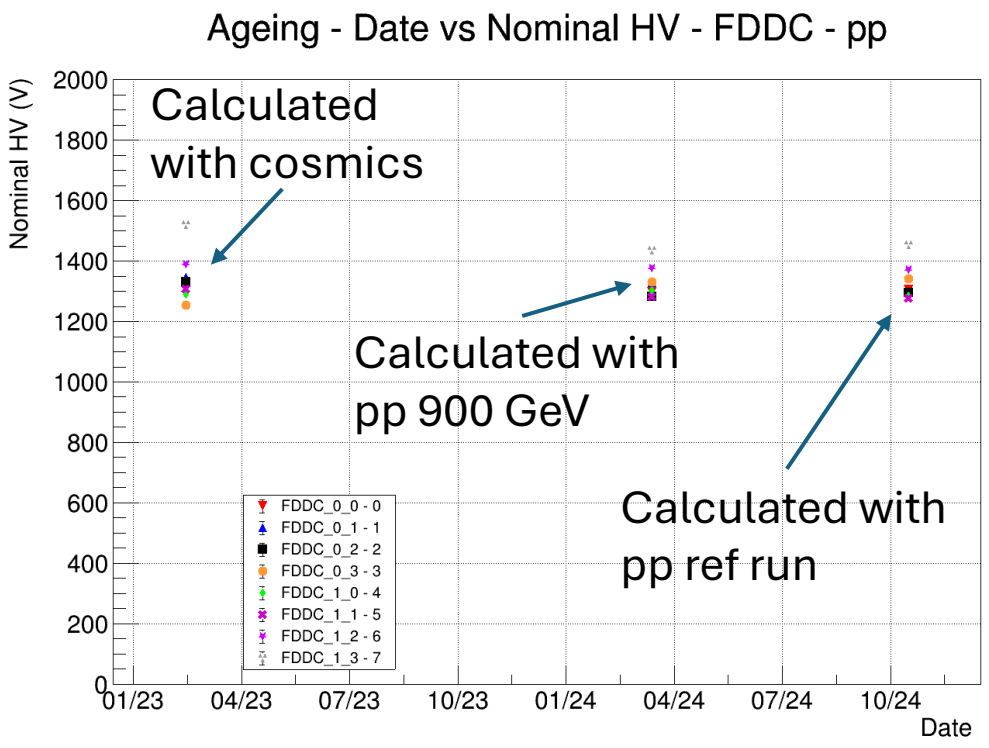


Nominal Voltages FDDA - Ratio

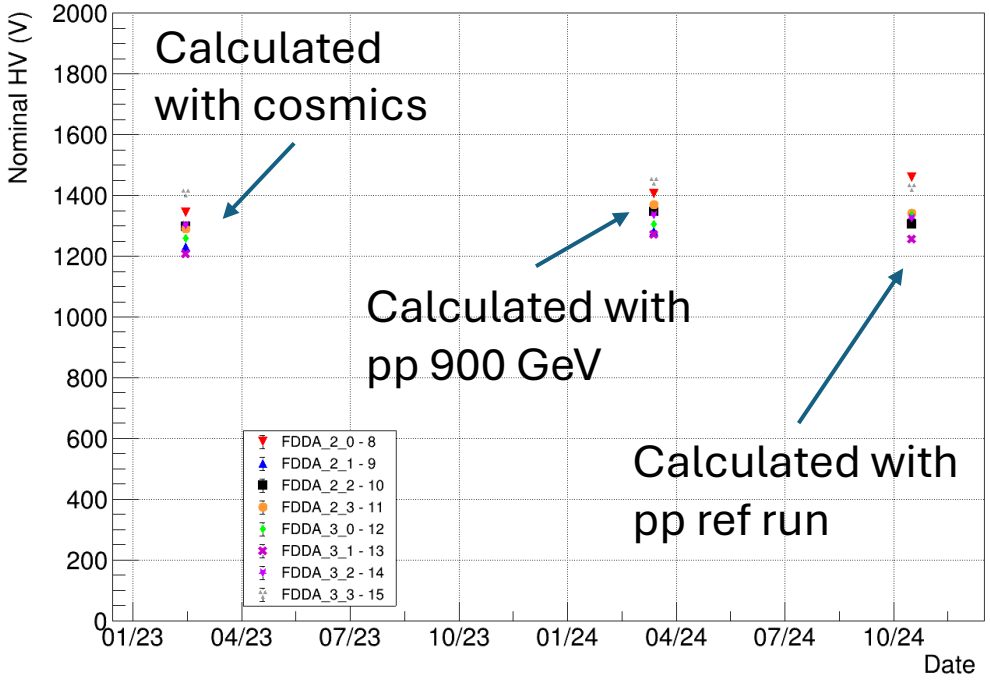


Nominal Voltages – pp runs

Nominal Voltages FDDC



Nominal Voltages FDDA



Conclusions

- The ageing we are obtaining through the information gathered in our weekly QC checks seems consistent with what we're seeing in the individual channels for pp runs as both results indicate a reduction of 20%-25% in the charges obtained.
- However, according to the results using laser data, FDDC hasn't aged more than 10-15% since November 2023.
- Laser data is not relaible for FDDA channels, we think this is due to a mechanical problem, it will be check before the LHC is restarted.

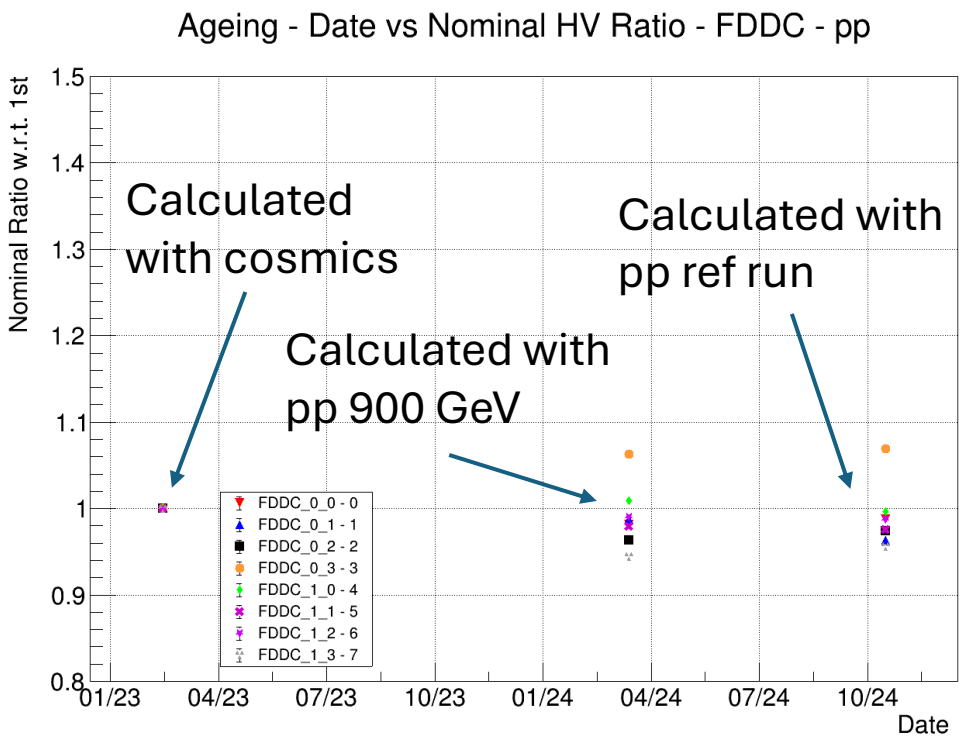
To be done

- We need to perform the analyses for laser data selecting only colliding bunches for more recent laser runs.
- We are yet to apply a selection using Vertex Trigger for pp runs and then fit the data.
- We need to investigate what's the problem with the FDDA laser system.
- We are going keep taking data using laser to study ageing.
- A similar study using cosmics is yet to be performed.
- We need to determine how much each component of the system has aged and why.

Backup slides

Nominal Voltages – pp runs - Ratio

Nominal Voltages FDDC – Ratio



Nominal Voltages FDDA – Ratio