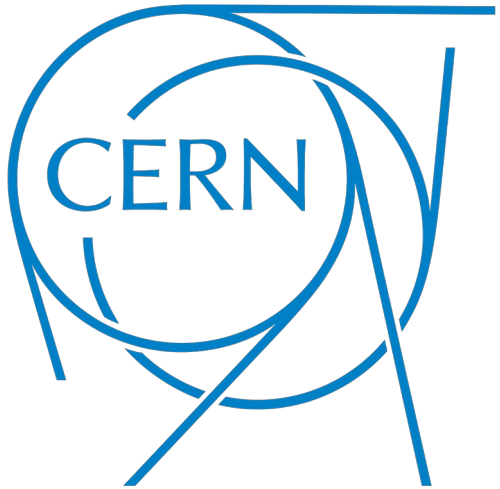
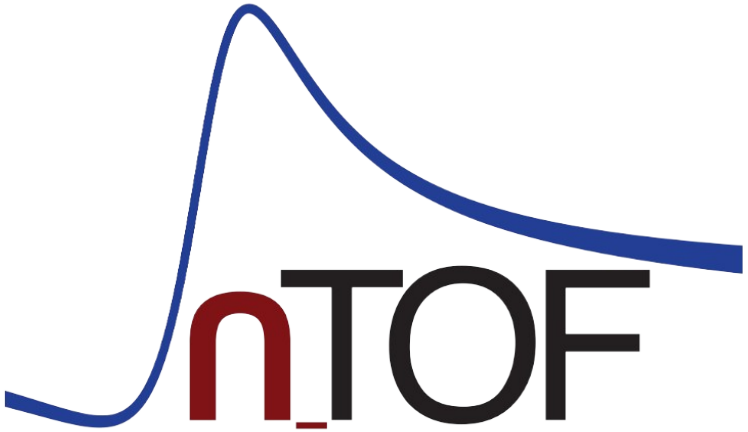
Feedback from n_TOF on 2022 Operation and Outlook 2023

User feedback meeting, CERN, 02/12/2022

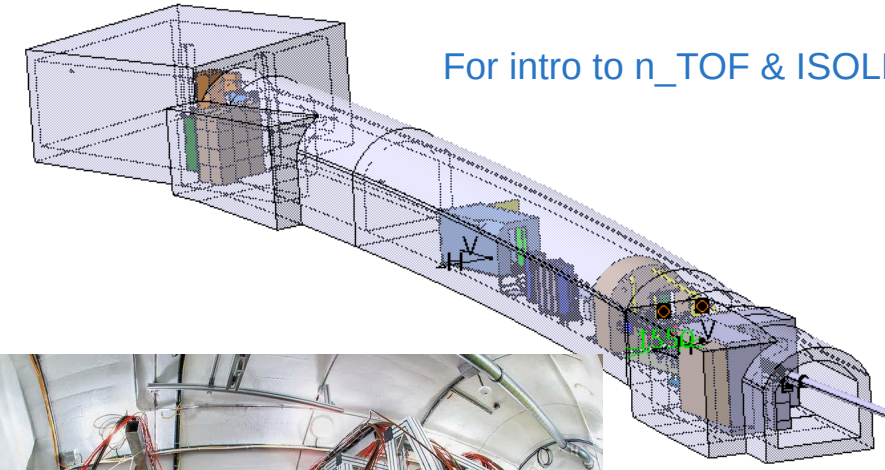
Nikolas Patronis & **Michael Bacak**

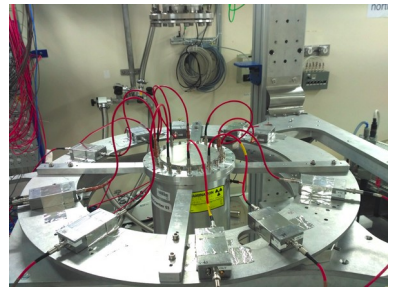


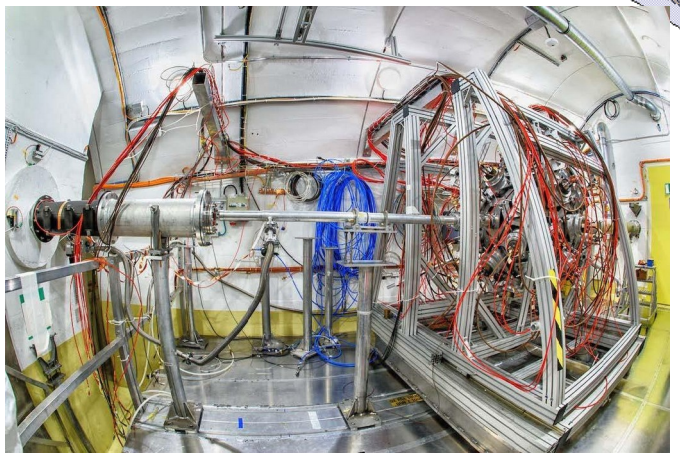


The n_TOF facility: EAR1 + EAR2 + NEAR

For intro to n_TOF & ISOLDE see Karl Johnston talk on IEF-2021

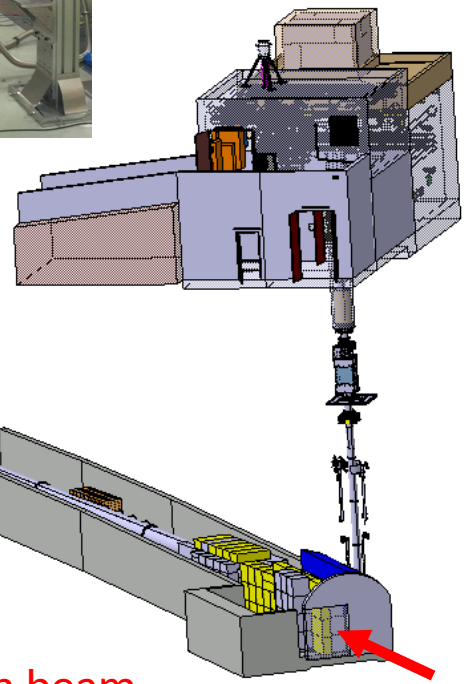


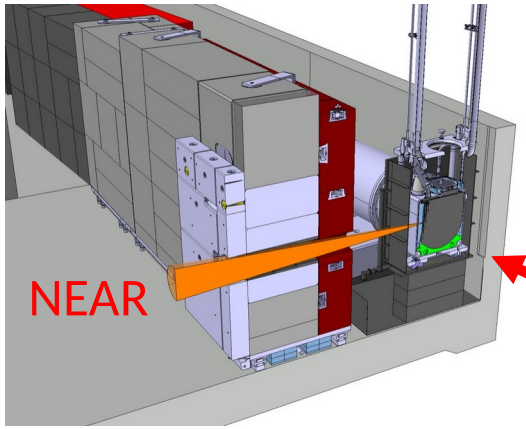




Three experimental areas (EAR)

- Horizontal flight path: EAR1 at 200 m
- Vertical flight-path: EAR2 at 20 m
- NEAR at 3m distance: activation measurements





NEAR

20 GeV proton beam from the PS

EAR1 & EAR2 beam lines with:

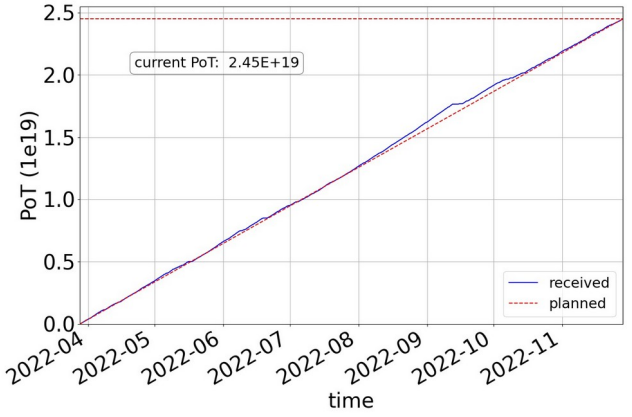
- 1st collimator
- halo cleaning, initial beam shaping
- Filter station
- Sweeping magnet
- 2nd collimator for beam shaping

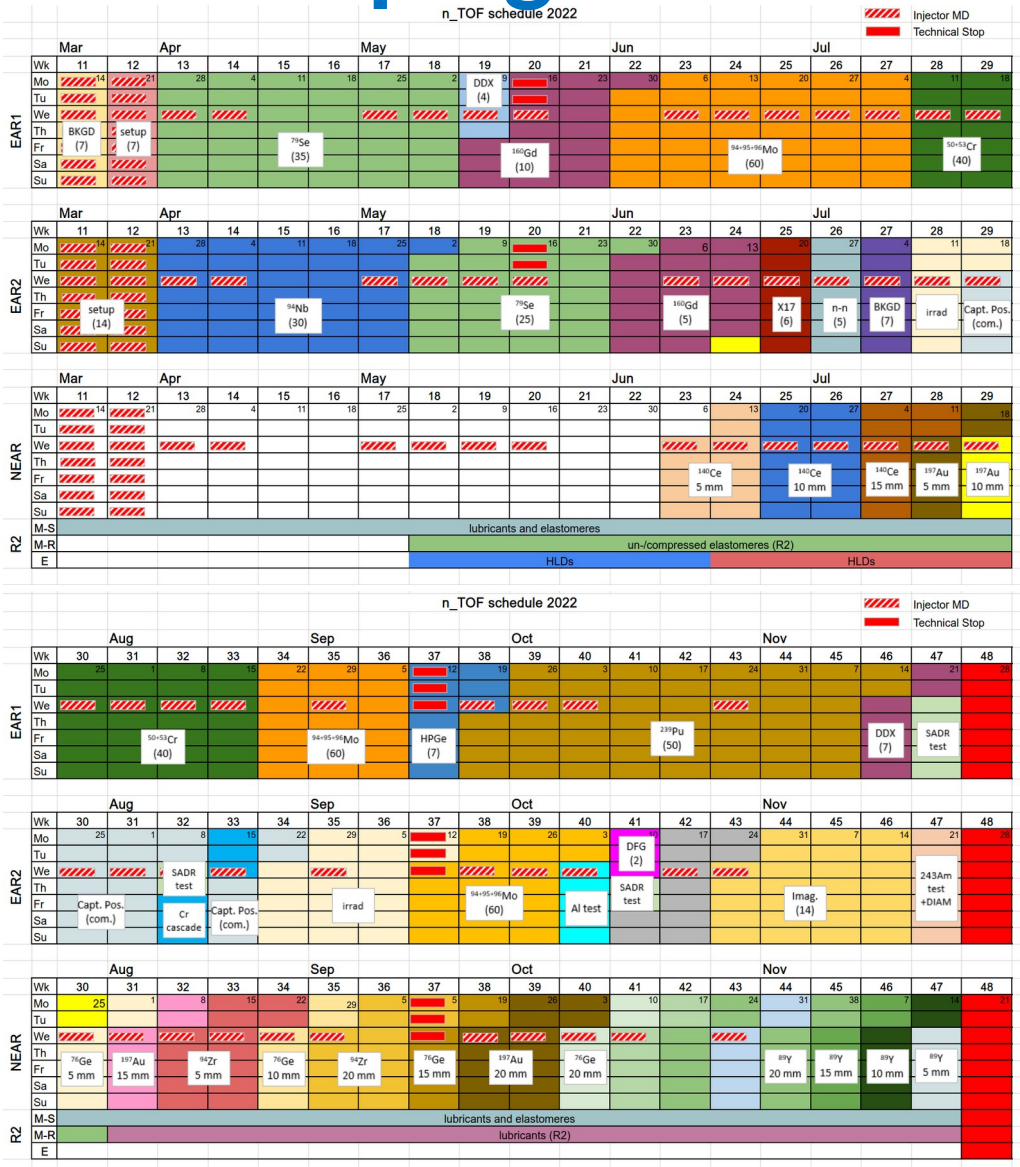
Highlights of the 2022 n_TOF campaign

EAR1	EAR2	NEAR
• ^{79}Se(n,γ) • ^{160}Gd(n,γ) • ^{94,95,96}Mo(n,γ) • ^{50,53}Cr(n,γ) • ^{239}Pu(n,γ)(n,f)(a-ratio) • DDX det. dev. • HPGe test	• ^{79}Se(n,γ) • ^{94}Nb(n,γ) • ^{160}Gd(n,γ) • ^{94,95,96}Mo(n,γ) • X17 detector test • nn scattering det. test • neutron imaging • diamond det. test • BKG and other commissioning actions	• ^{197}Au(n,γ) • ^{140}Ce(n,γ) • ^{76}Ge(n,γ) • ^{94}Zr(n,γ) • ^{89}Y(n,γ)

- 9 neutron capture reactions have been studied (2 of the for the first time) at EAR1 & EAR2
- 5 detector development projects have been accomplished
- 1 fission tagging measurement has been performed
- 5 neutron capture reactions have been studied at NEAR with different filter configurations
- 2 new detector setups have been successfully applied for the first time

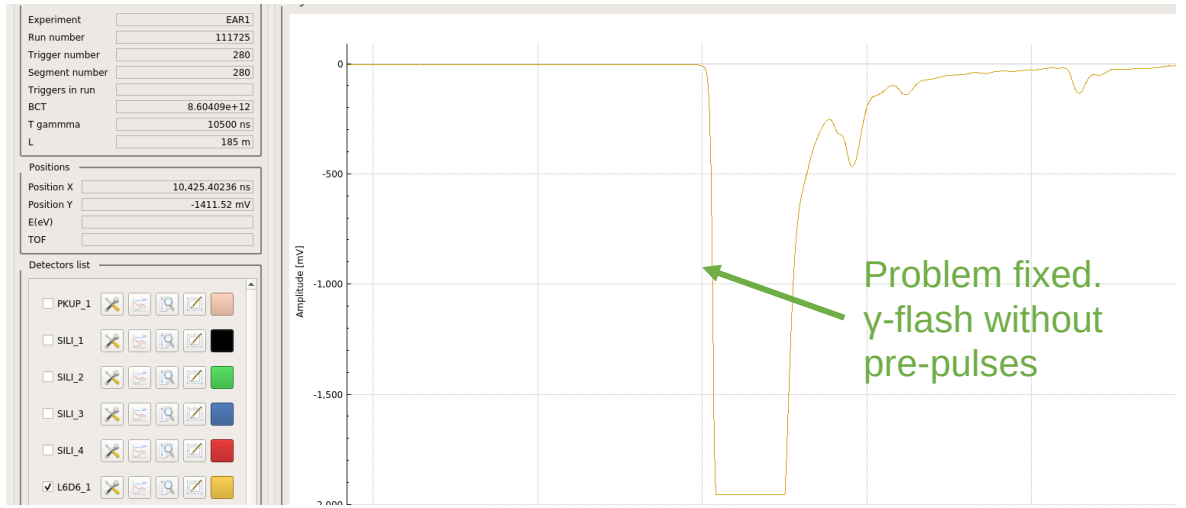
- protons expected:2.45E19
- protons received: 2.45E19





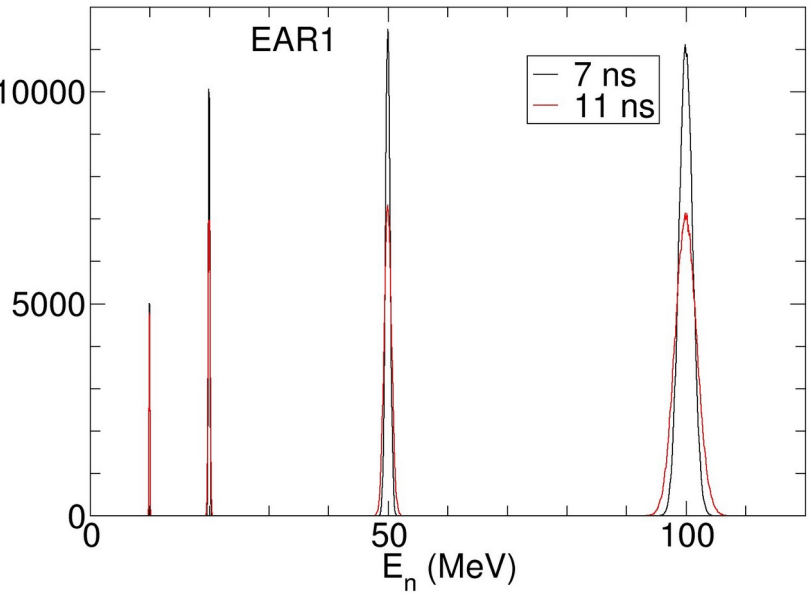
Issues during the 2022 campaign

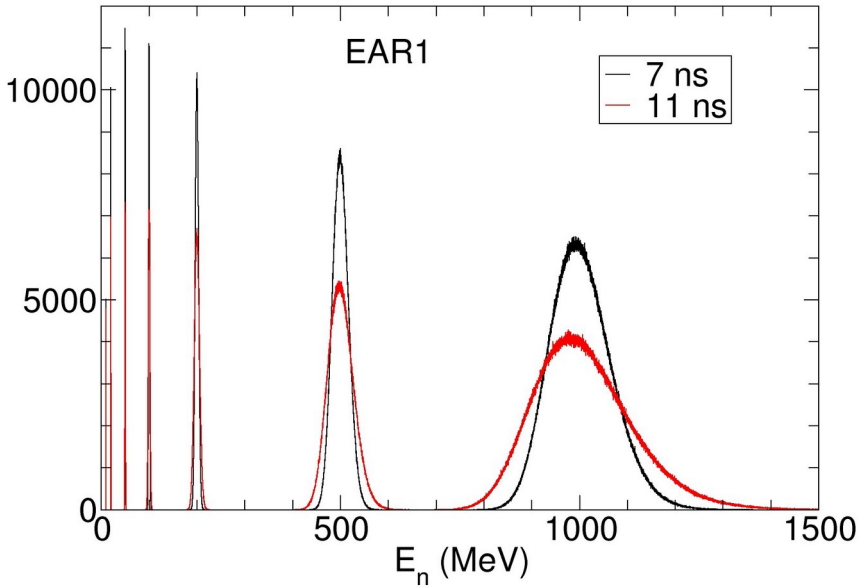
- At the beginning of 2022 campaign some pre-pulses were recorded from our detectors. This complicates a lot the data analysis of our TOF data. Problem solved by adjusting the bunch rotation (42 ns vs 28 ns)
- On n_TOF request the PS produced the cleanest beam ever wrt pre- and post tails of the TOF pulse at the cost of a slightly degraded pulse width (42 ns (2022) vs 28 ns (2018)). Ideal would be 7 ns (4σ=28 ns) without tails – first shots delivered end of 2022 Run.
- The neutron flux in EAR2 is changing with respect the vertical position of the beam centroid – +- 3 mm SIS interlock on vertical centroid in place from machine side – 1% flux fluctuation.
- For a few days (between 14.09.2022 - 18.09.2022) the BCT values were not correct (NXCALS). This imposes difficulties in the quality checks of the data.

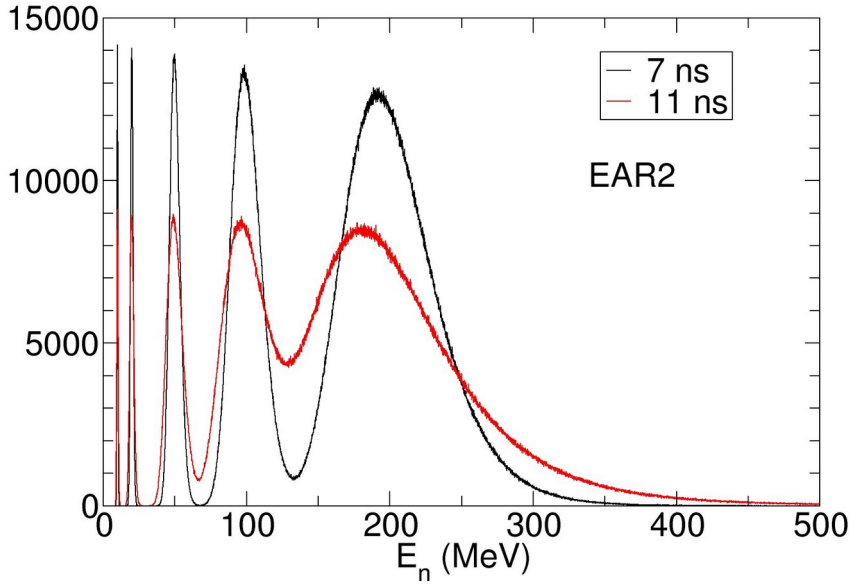


Issues during the 2022 campaign

- At the beginning of 2022 campaign some pre-pulses were recorded from our detectors. This complicates a lot the data analysis of our TOF data. Problem solved by adjusting the bunch rotation (42 ns vs 28 ns)
- On n_TOF request the PS produced the cleanest beam ever wrt pre- and post tails of the TOF pulse at the cost of a slightly degraded pulse width (42 ns (2022) vs 28 ns (2018)). Ideal would be 7 ns (4σ=28 ns) without tails – first shots delivered end of 2022 Run.
- The neutron flux in EAR2 is changing with respect the vertical position of the beam centroid – +- 3 mm SIS interlock on vertical centroid in place from machine side – 1% flux fluctuation.
- For a few days (between 14.09.2022 - 18.09.2022) the BCT values were not correct (NXCALS). This imposes difficulties in the quality checks of the data.

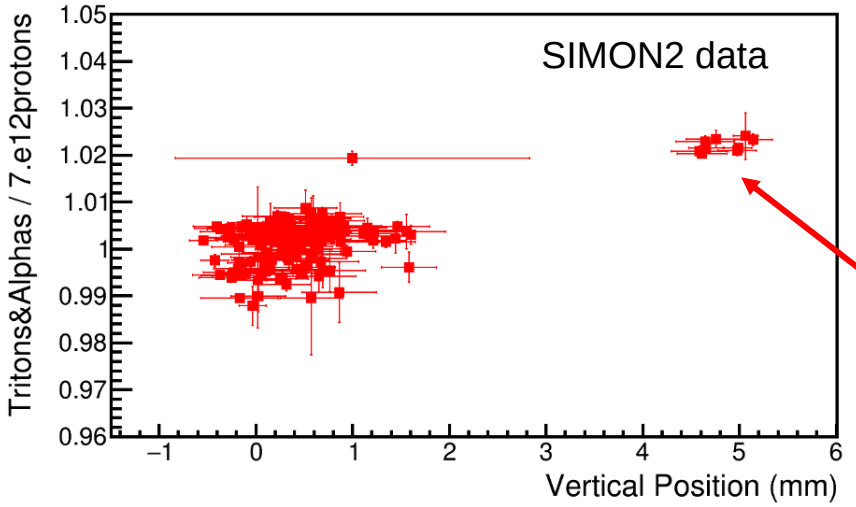




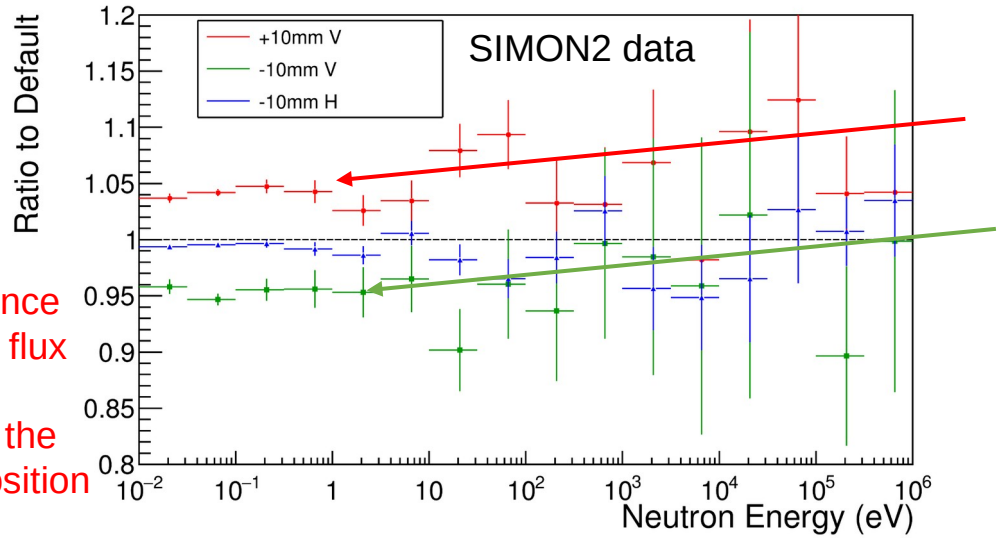


Issues during the 2022 campaign

- At the beginning of 2022 campaign some pre-pulses were recorded from our detectors. This complicates a lot the data analysis of our TOF data. Problem solved by adjusting the bunch rotation (42 ns vs 28 ns)
- On n_TOF request the PS produced the cleanest beam ever wrt pre- and post tails of the TOF pulse at the cost of a slightly degraded pulse width (42 ns (2022) vs 28 ns (2018)). Ideal would be 7 ns (4σ=28 ns) without tails – first shots delivered end of 2022 Run.
- The neutron flux in EAR2 is changing with respect the vertical position of the beam centroid – +- 3 mm SIS interlock on vertical centroid in place from machine side – 1% flux fluctuation.
- For a few days (between 14.09.2022 - 18.09.2022) the BCT values were not correct (NXCALS). This imposes difficulties in the quality checks of the data.



2% difference in neutron flux for 5mm change in the vertical position



±4% difference in neutron flux for ± 10 mm change in the vertical position

Issues during the 2022 campaign

- At the beginning of 2022 campaign some pre-pulses were recorded from our detectors. This complicates a lot the data analysis of our TOF data. Problem solved by adjusting the bunch rotation (42 ns vs 28 ns)
- On n_TOF request the PS produced the cleanest beam ever wrt pre- and post tails of the TOF pulse at the cost of a slightly degraded pulse width (42 ns (2022) vs 28 ns (2018)). Ideal would be 7 ns (4σ=28 ns) without tails – first shots delivered end of 2022 Run.
- The neutron flux in EAR2 is changing with respect the vertical position of the beam centroid – +- 3 mm SIS interlock on vertical centroid in place from machine side – 1% flux fluctuation.
- For a few days (between 14.09.2022 - 18.09.2022) the BCT values were not correct (NXCALS). This imposes difficulties in the quality checks of the data.

n_TOF 2022 and 2023

Conclusions 2022:

- **>20 successful measurements: physics + commissioning + several detector developments**
- **100% match of experiment planning vs. delivered beam**
- **Stable beam conditions throughout the whole year**
- **Thanks to all the people, teams and machines involved in this successful run**

Outlook/wishlist 2023:

- **Proton planning: 203 days physics @ 1E17 p/day = 2.03E19 protons**
- **Proton bunch characteristics:**
  - **Come back to a “no-tails 28 ns bunch” @ bunch intensity up to 8.5E12**
  - **Double bunch cycle (make use of empty slots in the machines)**
  - **Transverse profile on target as 2022**
- **Spallation target: intention to increase the avg. intensity interlock from 1.67E12 p/s to 2.2E12 p/s. Test successfully performed this year – formal approval from authorities pending (+ SY-STI-TCD and RP but no show stoppers observed)**