Nice to meet you!

Federica Borgato

INFN - SESAME International School on EFFICIENT SCIENTIFIC COMPUTING
ESC@SESAME

My past and current activities:

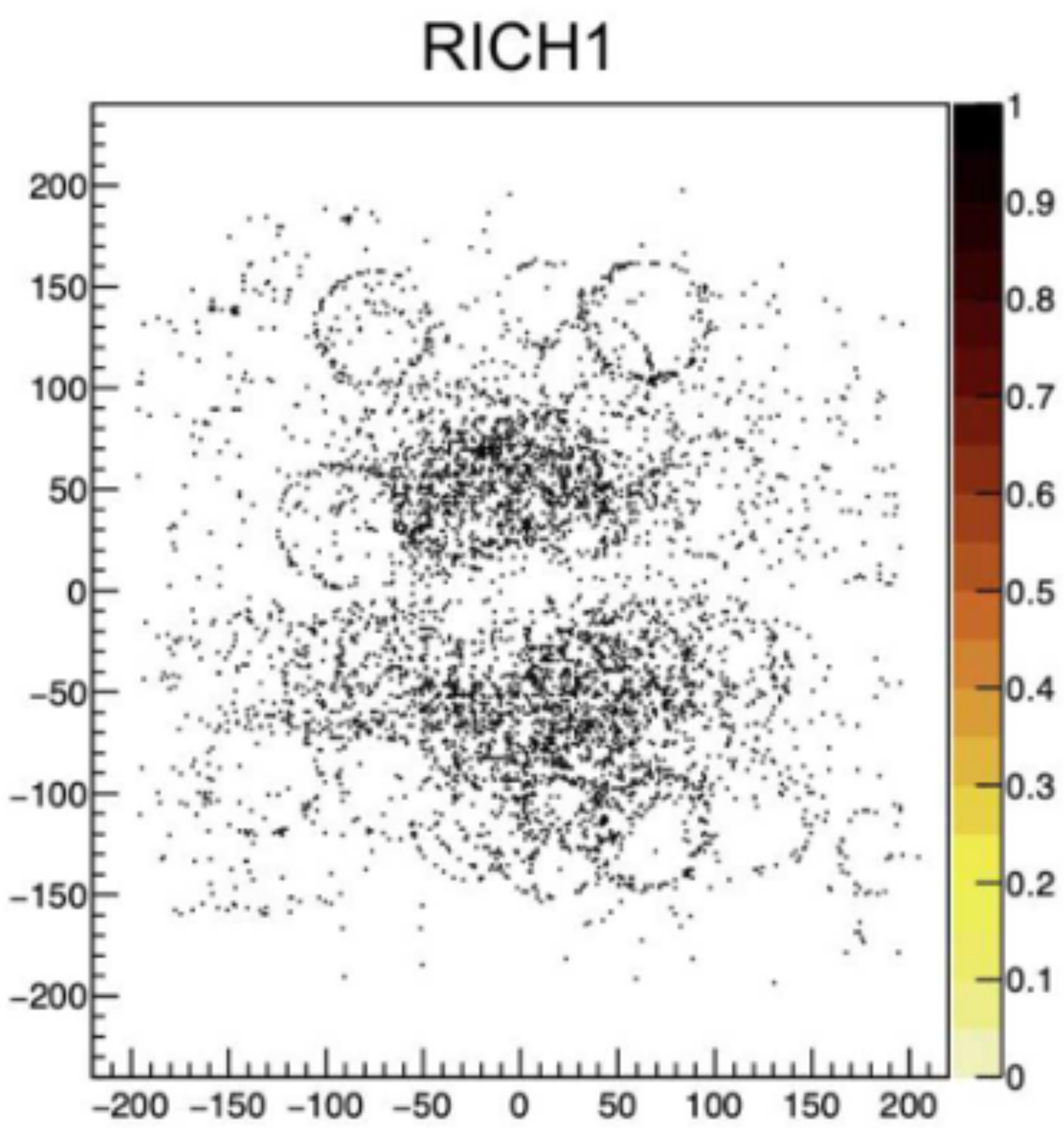
- I studied in Padova and got graduated with a thesis on TimeSPOT 3D silicon sensors.
  I performed the static characterization and dynamic characterization with 2MeV protons from National Legnaro Laboratories AN2000 accelerator.

- Now I am a PhD at the university of Padova and my activity is focused on R&D for the LHCb Upgrade:

  - I joined TimeSPOT test-beams at CERN SPS to establish the time resolution of such sensors, performing then the data analysis to extract the detection efficiency.

  - I joined RICH test-beams at CERN SPS to test the new electronic chain for the Upgrade 1b. I am currently performing the data analysis to extract the single photon time resolution of the MaPMTs and SiPM read out with the FASTIC asic.

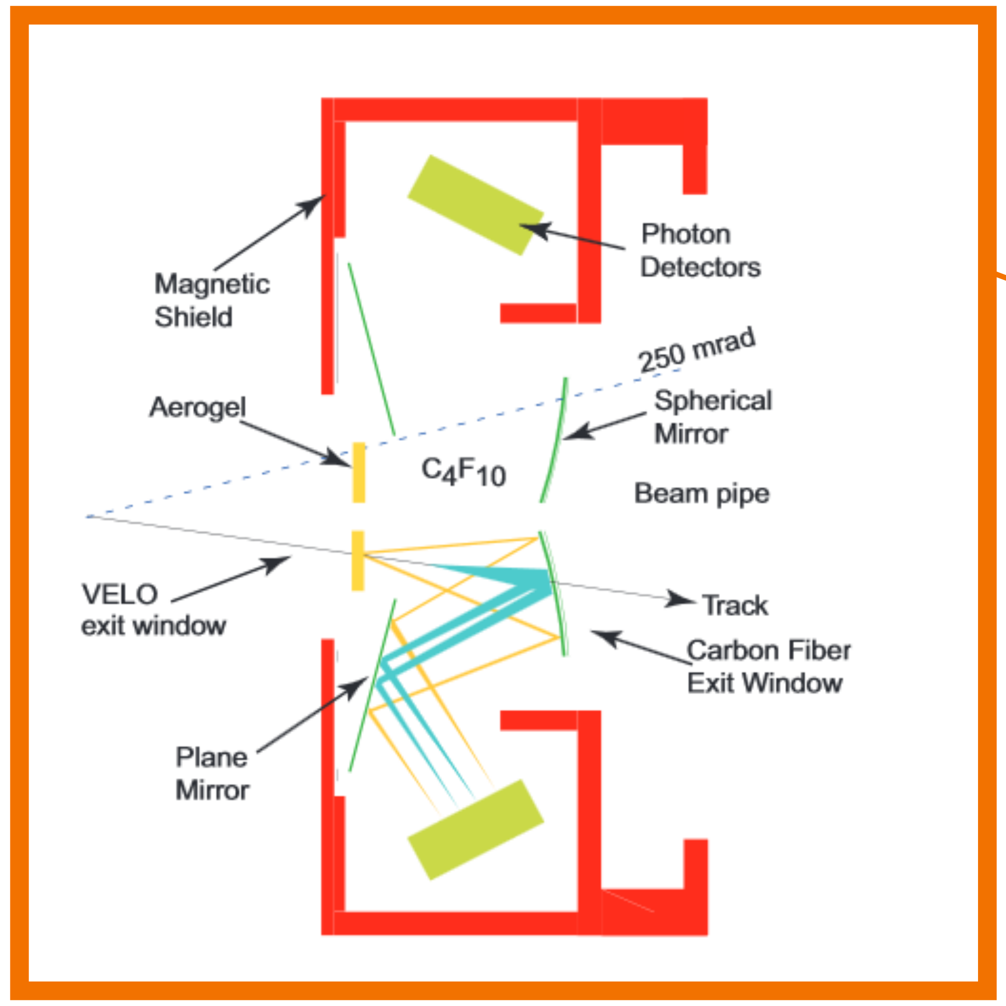
  - I am performing the measurement of BR($\Lambda_b^0 \to \Lambda_c^* D_s^{(*)} / \Lambda_b^0 \to \Lambda_c D_s^{(*)}$) (dominant background of R(Λ_c^*)) .

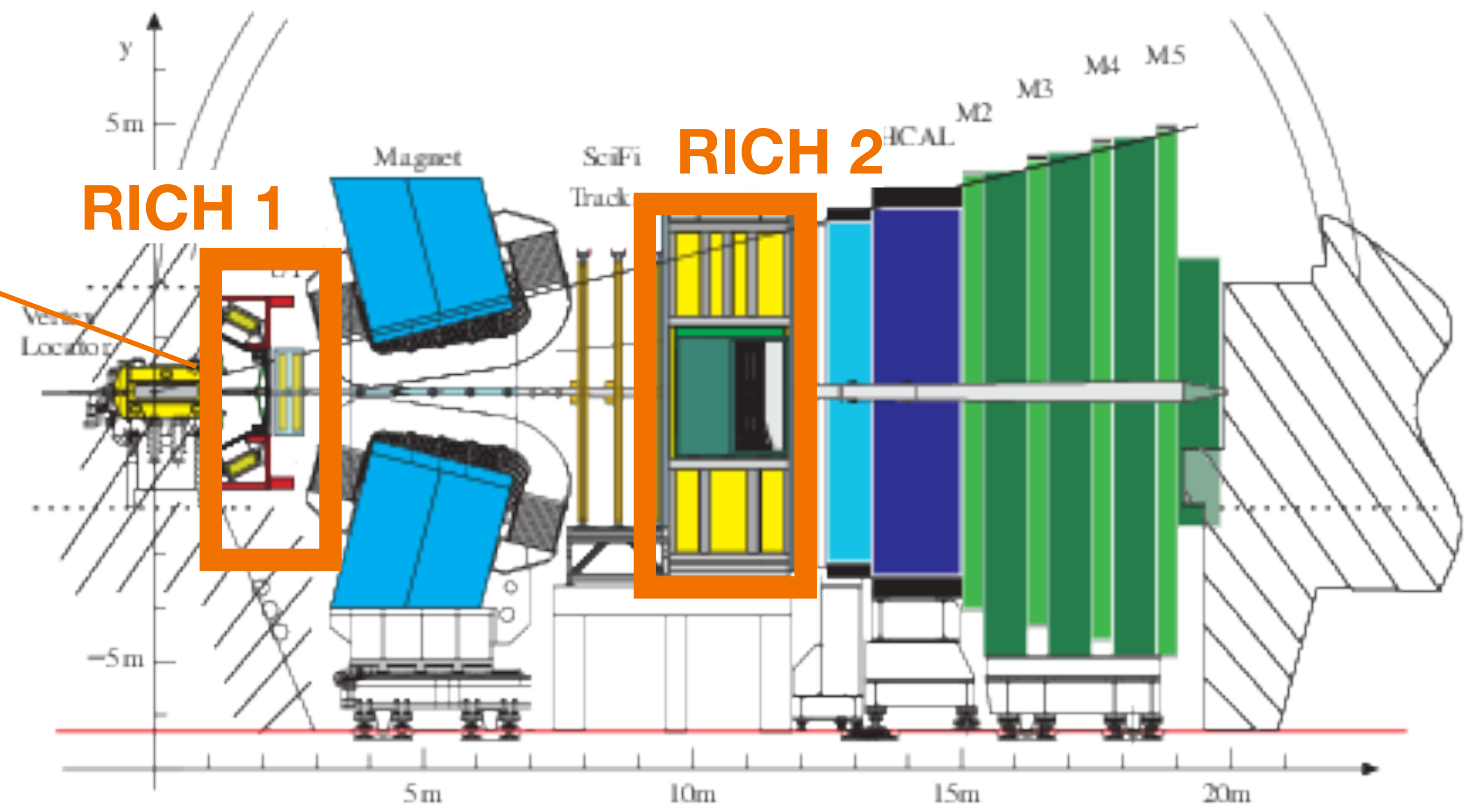


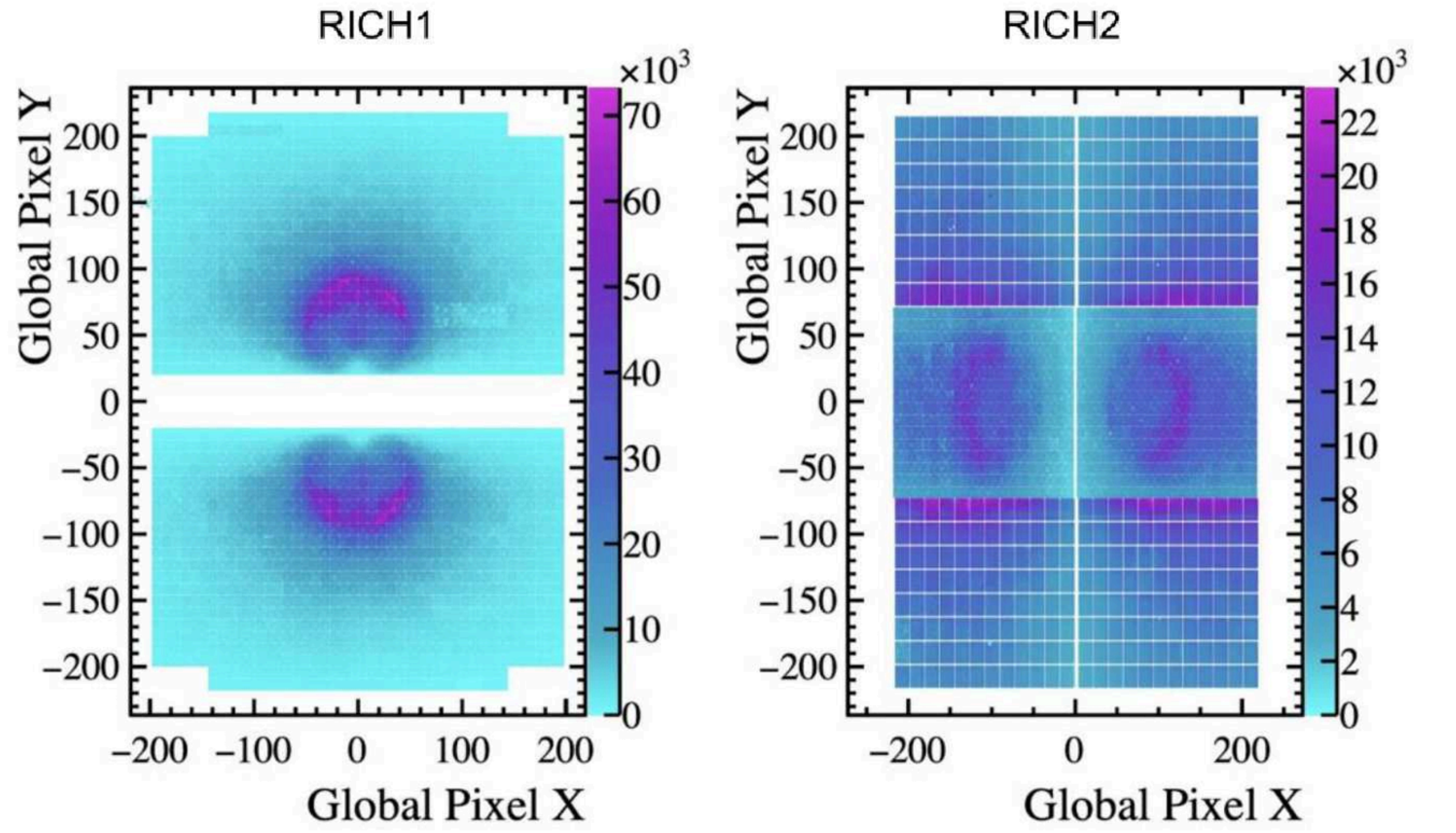
LHCC, 29/11/22

The LHCb RICH subsystem

LHCb relies on the Ring Imaging Cherenkov (RICH) detector system for the charged hadrons identification in a wide momentum range (2 - 100 GeV/c).
The Cherenkov light produced by the particles is redirected by an optical system towards the photodetector planes and outside the acceptance of the spectrometer.

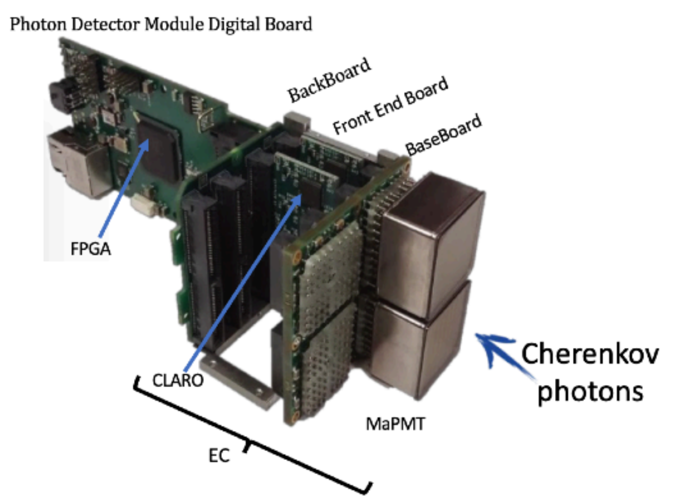


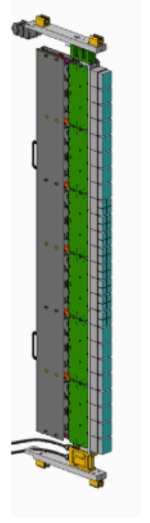


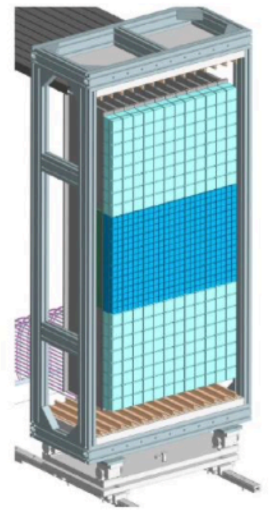


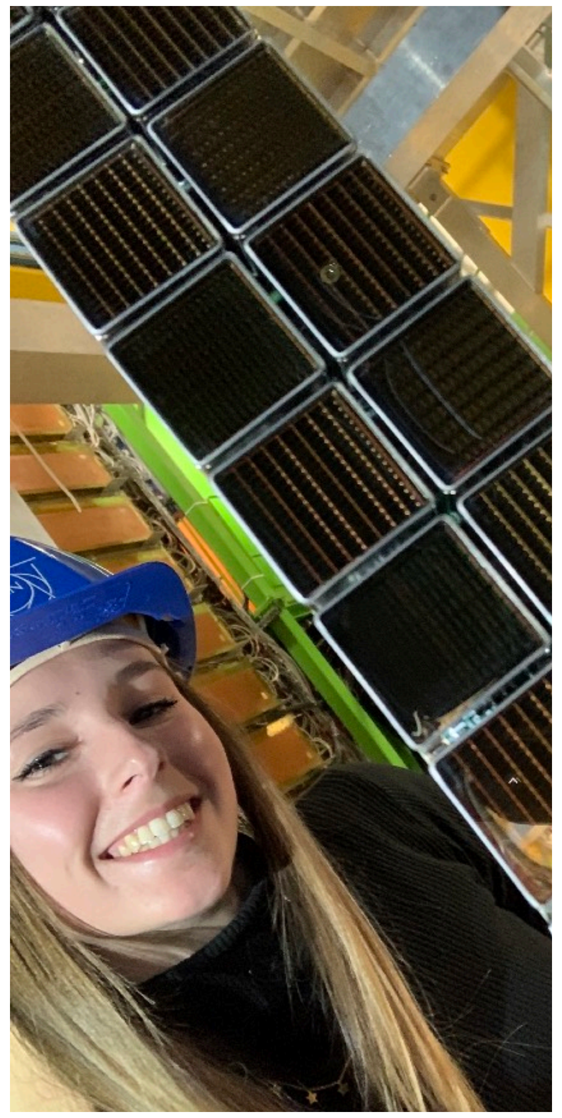
Photon-Detection chain

- **MaPMT**
  - – Hamamatsu R13742 MaPMTs for high occupancy region, R13743 MaPMTs for low occupancy region
  - – 64 anodes with low dark count rate(<1kHz) and gain ~2×10^6 at 1kV
  - – high quantum efficiency
- **CLARO chip**
  - – 8-channel amplifier/discriminator ASIC
  - – adjustable threshold and attenuation for each channel
  - – radiation-hard by design









RICH commissioning: threshold scan analysis

Threshold scans analysis are a fundamental tool to **optimize the detector performance** since it allows to:
- choose the **optimal threshold** of operation
- **fine tune** the **HV**
- check the **aging** of the sensors

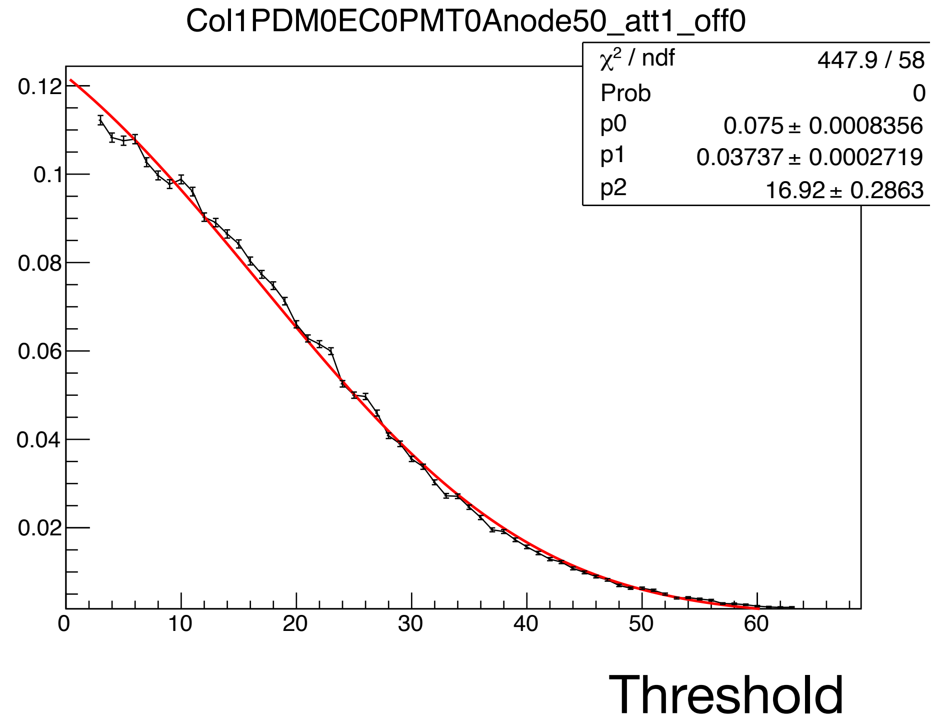
Before the columns installation a **full set of scans** was taken at the CERN Comlab. This means:
- One **integrated charge spectrum** for **each anode** (threshold scan)
- One **DAC scan for each anode** , to correlate threshold and charge

x4 ! **CLARO asic** has **two possible configuration parameters**:
- **Attenuation** (equal to 1,2 ; amount of charge for each threshold step)
- **Offset** (equal to 0,1 ; shift of CLARO baseline)

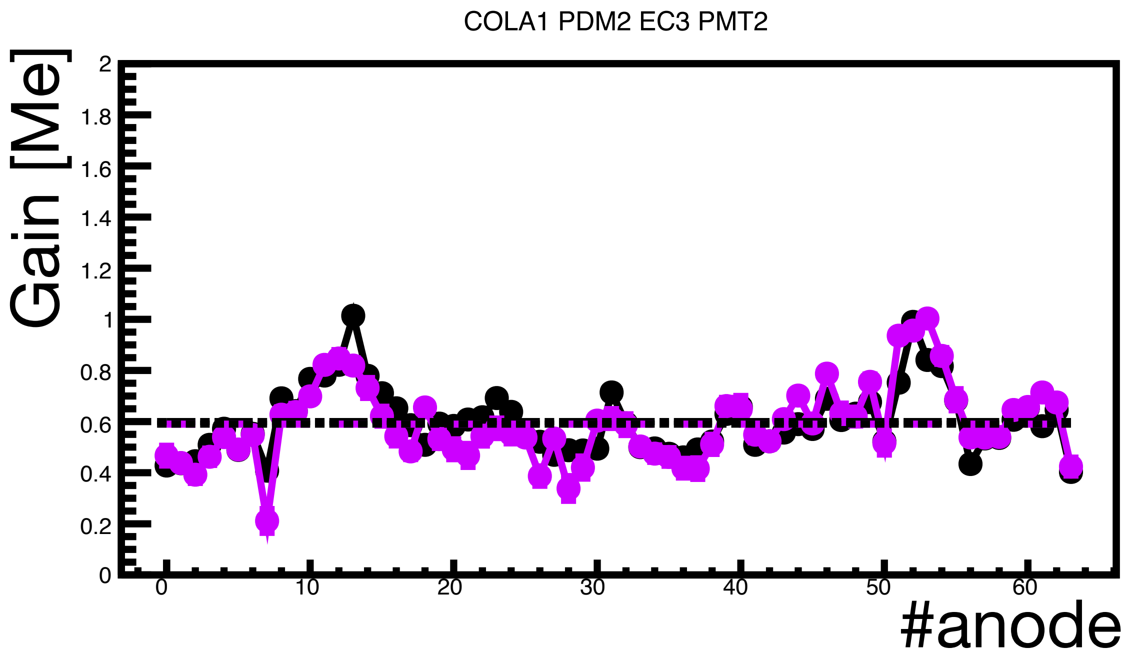
For a single column of RICH1 (22 columns) 5632 anodes each column x4 configurations	For a single column of RICH2 (24 columns) 3072 anodes each column x4 configurations

To analyze such data. I developed a custom code in c++ exploiting ROOT libraries.

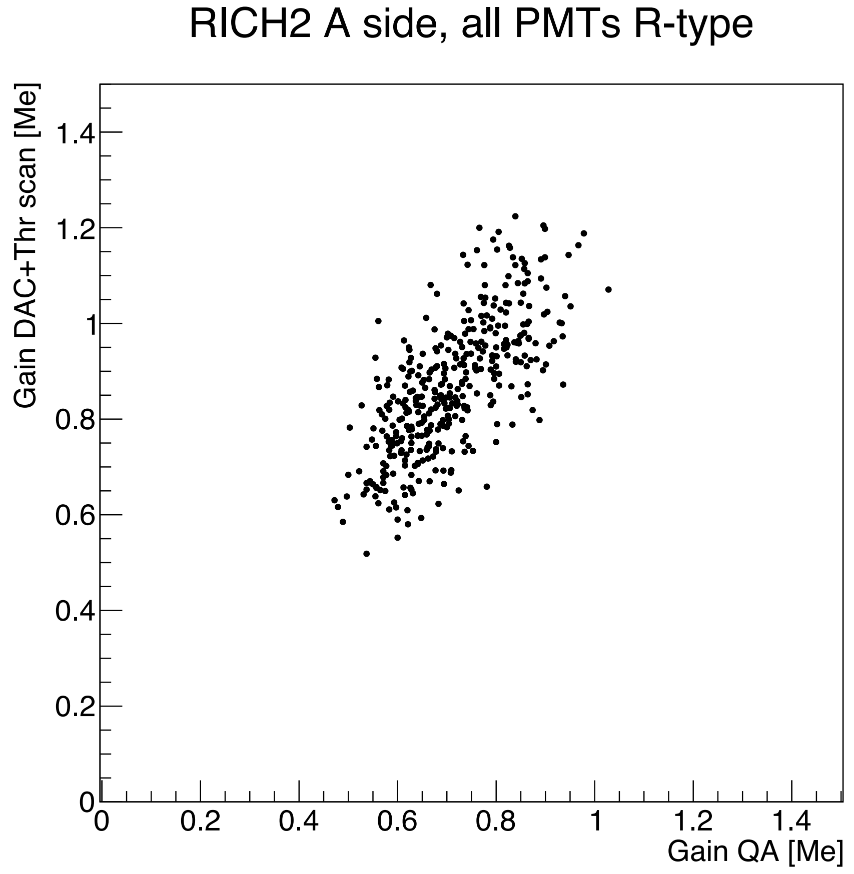
From single anode data..



.. to the PMT gain overview..

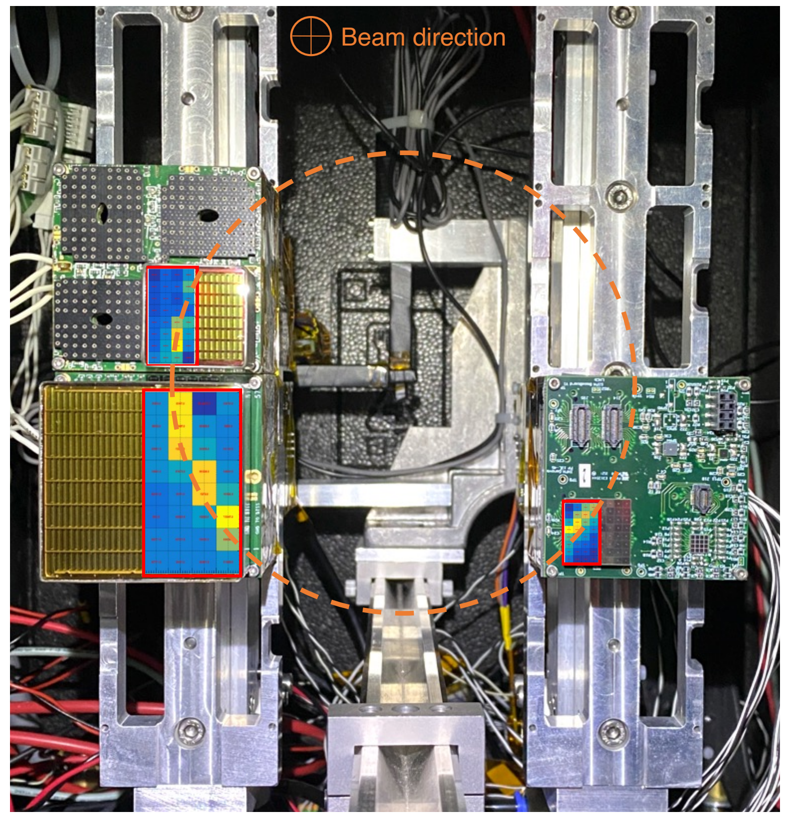


.. to the all PMTs gain summary

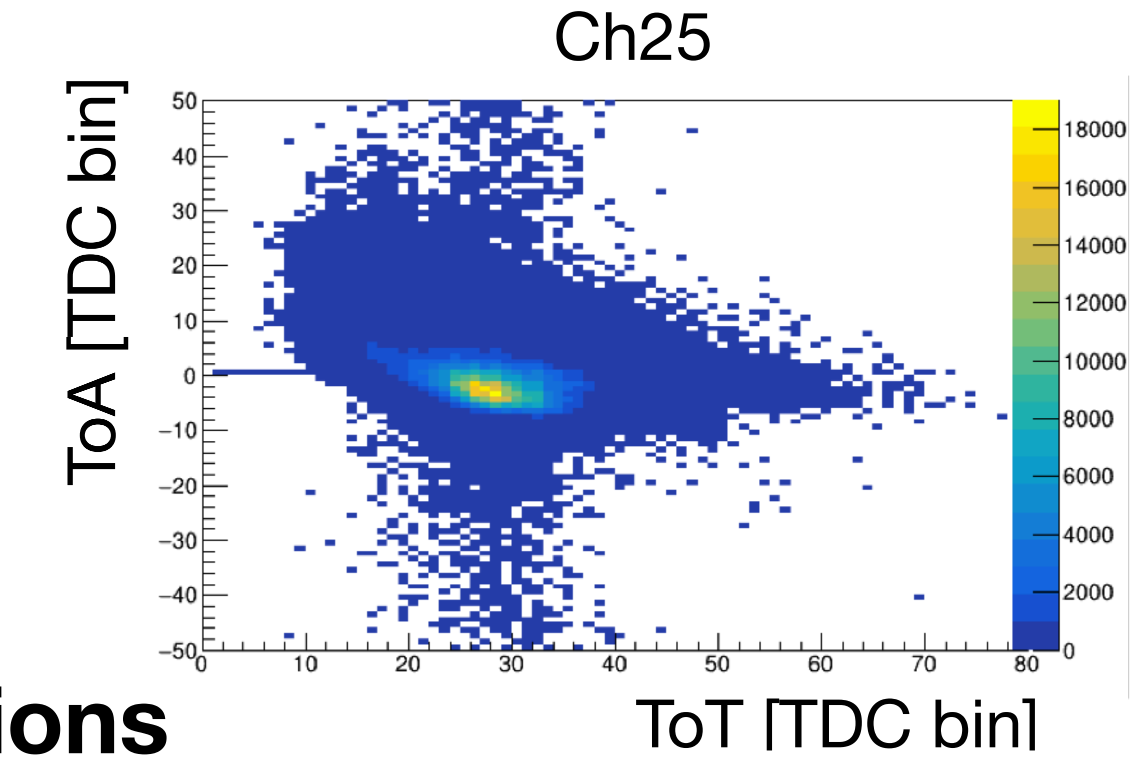


RICH MaPMT Single Photon Time resolution

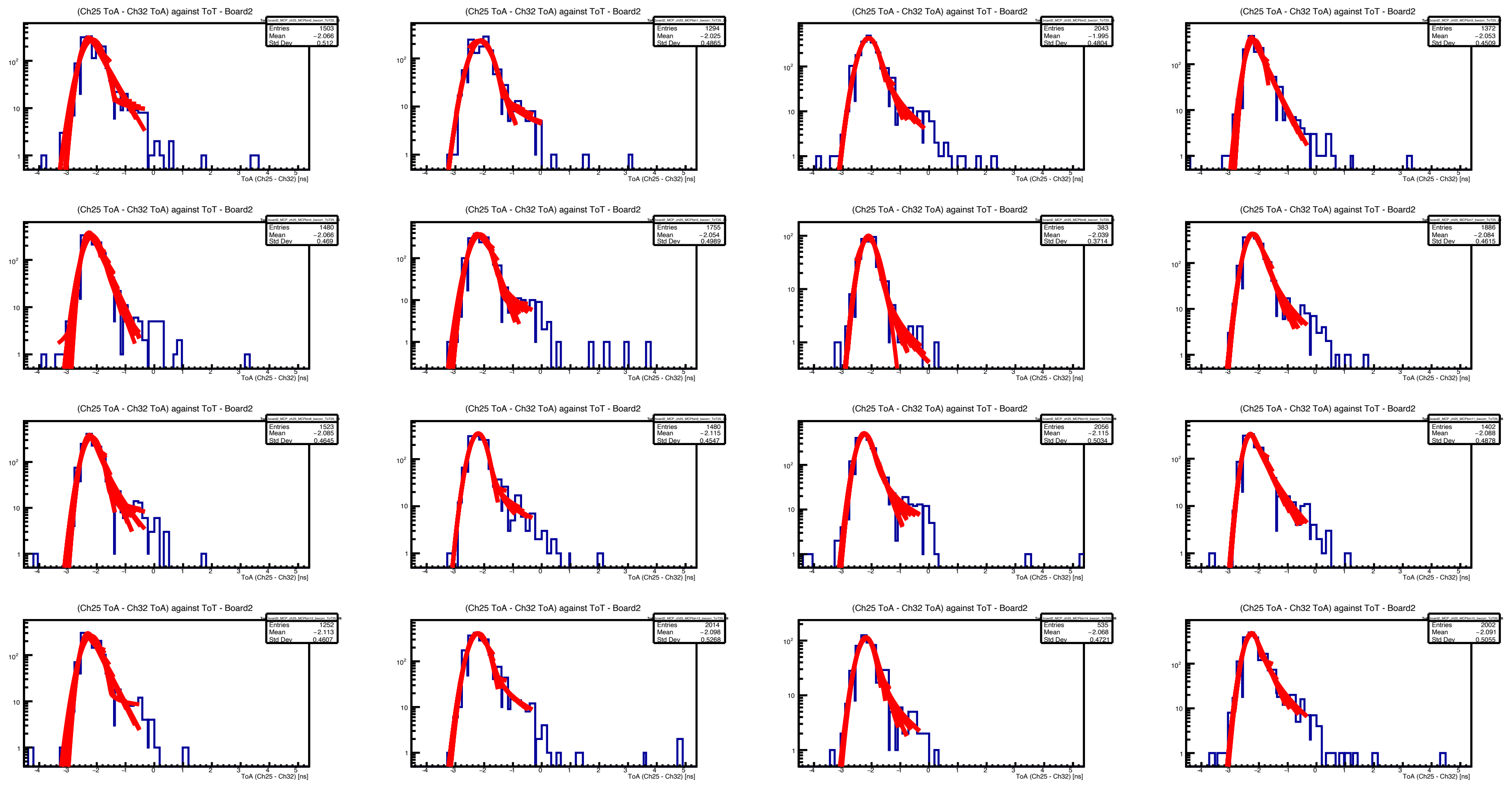
In 2022 two **beam tests** have been performed at **CERN-SPS** to test a **prototype readout chain with fast-timing information**.
The MaPMTs/SiPM are coupled with FastICs and read out by a TDC-in-FPGA.



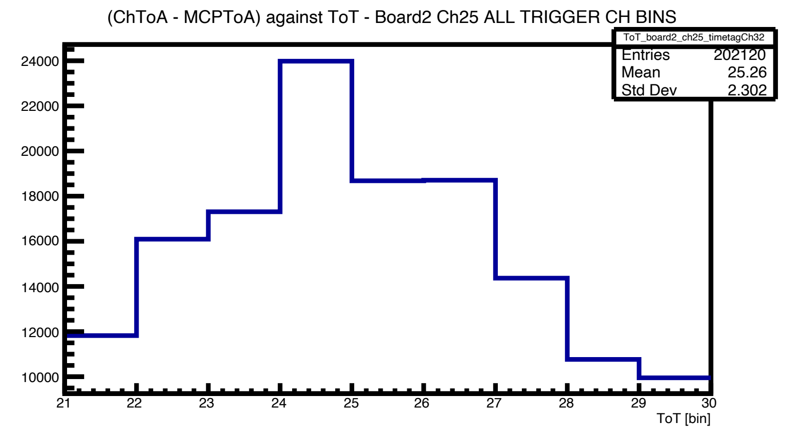
The analysis is performed **subdividing the data with respect to their ToT**.
In this way it is possible to create subsets of events sharing the same signal time length above threshold allowing to decouple the time resolution measurement from the **time walk contribution**.



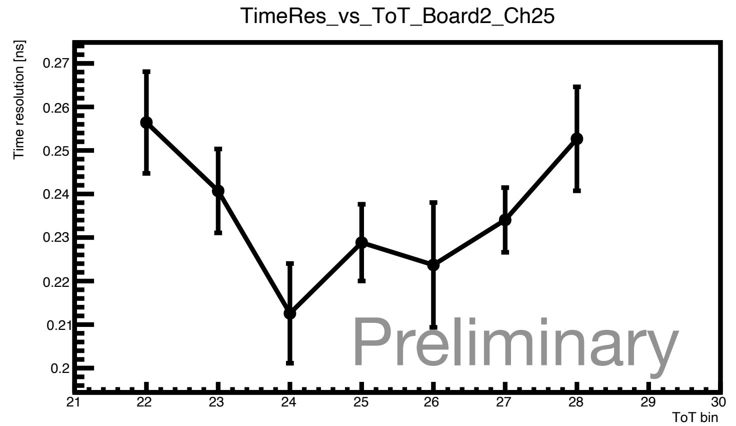
Multiple CrystalBall fits are performed changing the fit range in order estimate the systematic uncertainty as well. In this way for each channel under study there will be a **subset of 16 time resolution for each ToT bin**.



To **obtain a final estimation**, the **time resolutions** are combined according to the **statistics present in each ToT bin**.



This **procedure** is applied to all the **sensor channels on the Cherenkov ring** for the testbeam data. The same procedure is also applied to the analysis obtained acquiring **data with a laser**.



Sicherheit in Technik und Chemie

Bundesanstalt für Materialforschung und -prüfung

29.05.2023

COMBINED EXPERIMENTAL AND SIMULATIONAL APPROACHES TO ACCESS RADIATION DAMAGE TO DNA-PROTEIN COMPLEXES

Marc Benjamin Hahn

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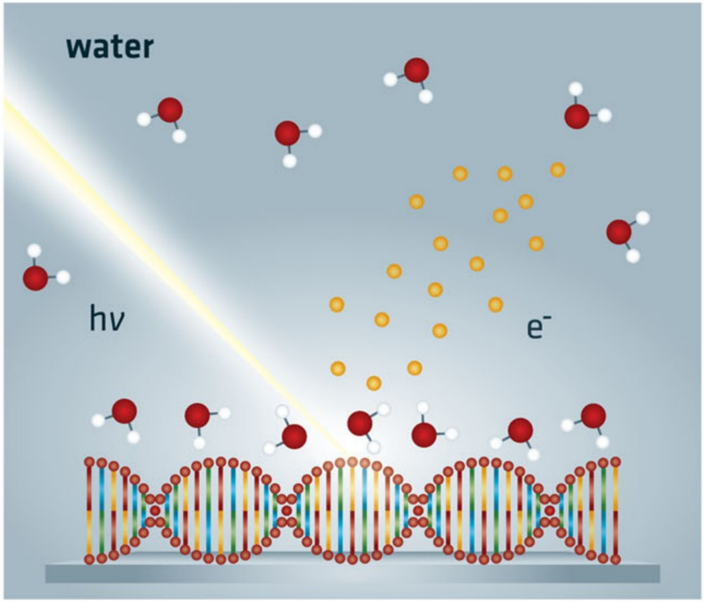
Radiation damage to DNA

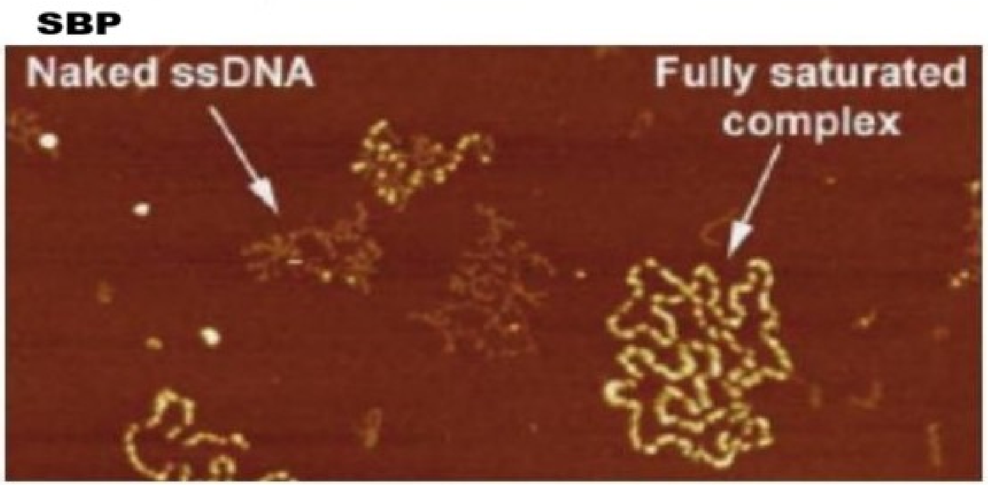
- Ionizing radiation damage to DNA:
  - **Cancer therapy** and medical imaging
  - DNA carrier of **genetic information**



Hahn et al. *Commun Chem* **4,** 50 (2021)

DNA-Protein interaction

- DNA binding proteins
  - Tasks during DNA replication and repair
  - Interact directly with DNA

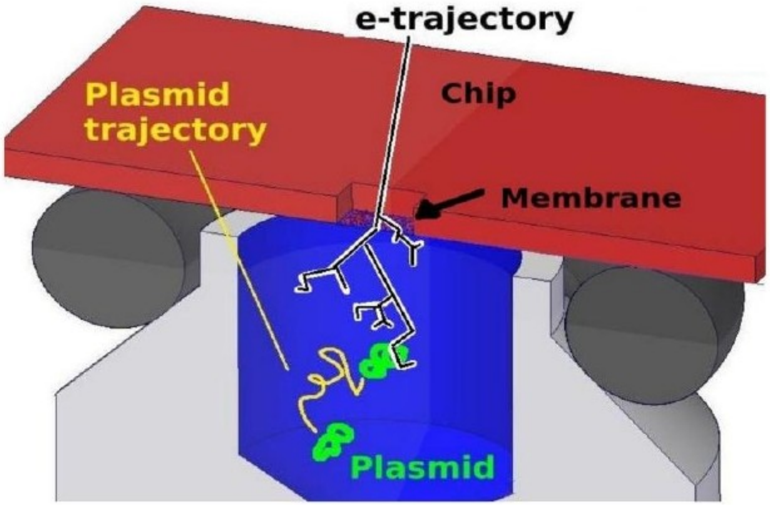


Hamon et al. *Nucl. Ac. Res.* **35,** e58 (2007)

Problems

Experiments often give only access to microscopic dose.

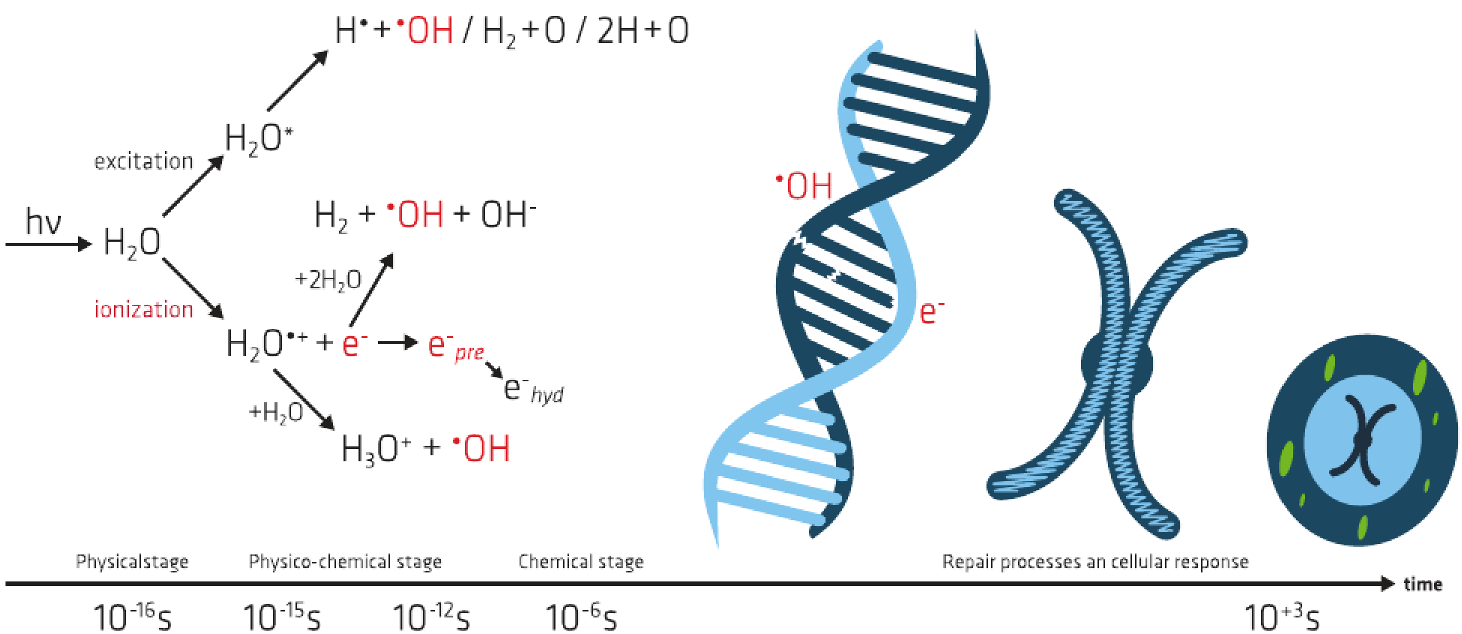
But we are interested in fundamental processes.



Hahn et al. Phys Rev E (2017)

Questions

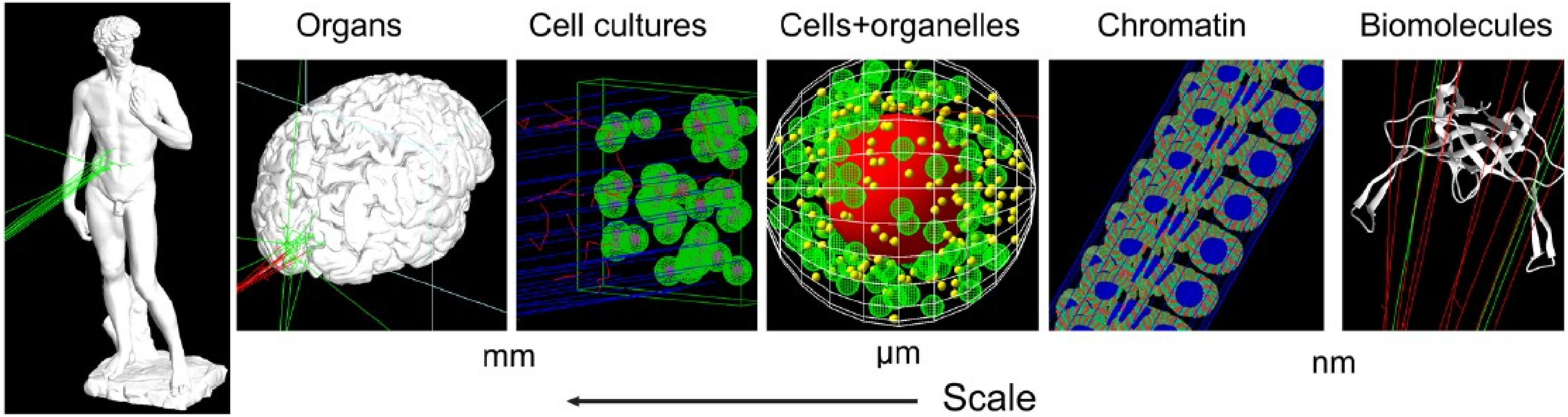
1. ***Microscopic processes on molecular level?***
2. ***Involved scattering processes?***
3. ***Direct (scattering) & indirect (radicals) effects?***



Hahn J Phys Comm (2023)

Access microscopic events by simulations

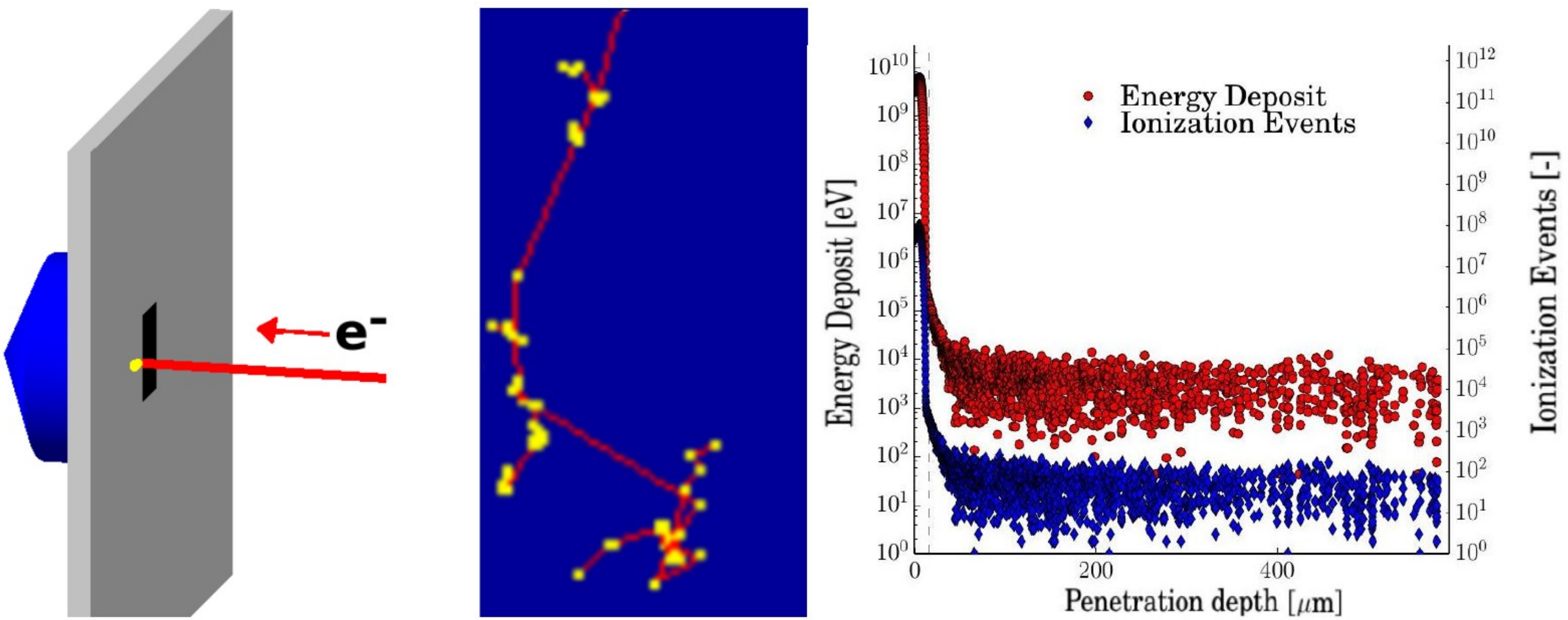
Particle scattering simulations with Geant4/TOPAS to access events on differents scales



Hahn J Phys Comm (2023)

Example I:
Electron irradiated DNA in water

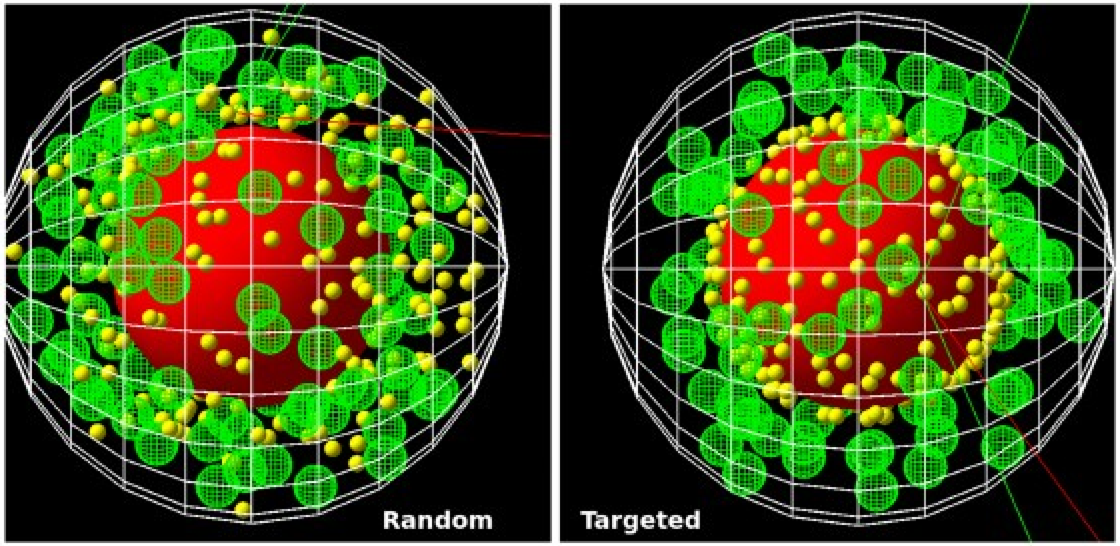
Determine microscopic dose-damage relation



Hahn *et al.* Phys. Chem. Chem. Phys. **2017a**

Example II:
Cell models

Radiation damage and Nanoparticles in Cells: effects of nanoparticles and their location on dose in cell organelles



Zutta-Villate et al. Sci Rep (2020)

Acknowledgements

Thank you for your attention!

- Harald Seitz
- Dorothea Hallier
- Tihomir Solomun
- Heinz Sturm

DFG Deutsche Forschungsgemeinschaft

- DFG (Grant 442240902)

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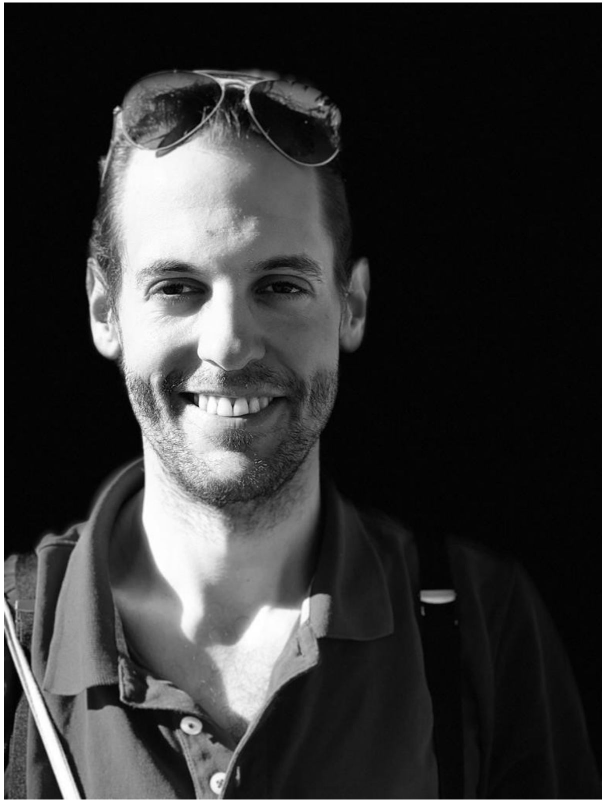


I am a crystallographer. - I am interested in e.g. machine learning, approximation theory, automation, philosophy.

My work is about X-ray diffraction data processing and correction strategies any quality assessment, investigations of phase change materials for data storage applications, pharmaceuticals. This all involves scientific computing, where high performance computing can be an important aspect.

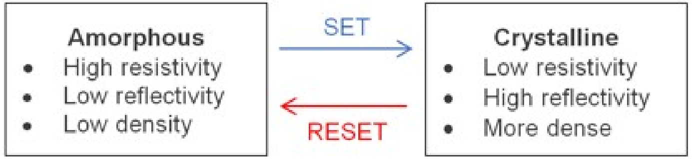
Hobbies: programming, sitting in the sun, climbing, kettlebell, socializing

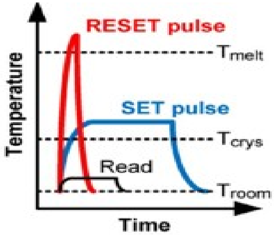
I will be happy if you contact me to discuss.

Phase Change Materials (PCM) for PCRAMs

- **Ge-Te-Sb alloy PCMs:**
- used in memory devices: CD/DVD RW, PC RAM

Reversibility between 2 states



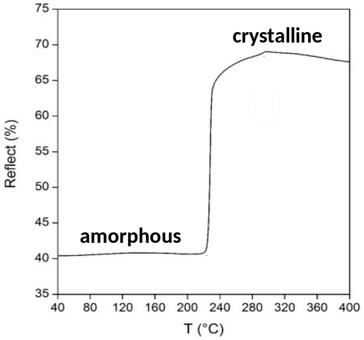


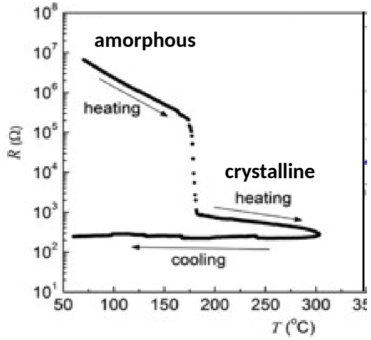
H.-S. Wong, IEEE (2010)

Δ Optical reflectivity +25 %

Δ Resistivity -10^4

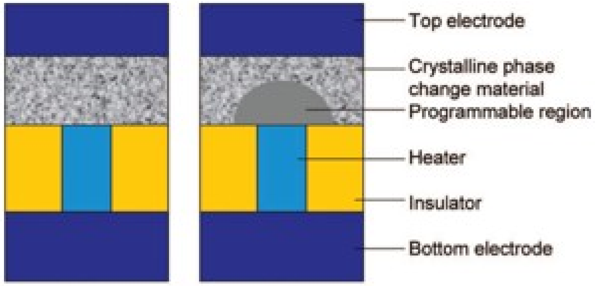
Δ Density +7-8 %



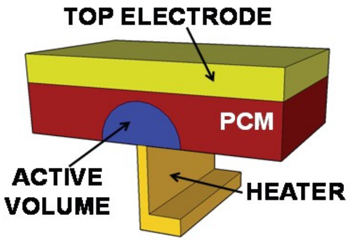


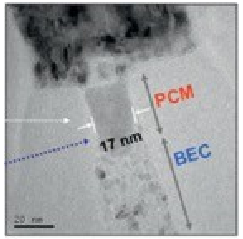
Y.G Choi, JAC (2016)

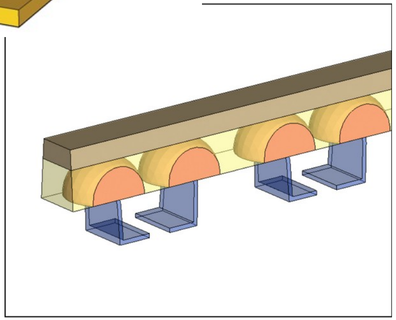
technical realization



S. Raoux, Chem Rev. (2010)



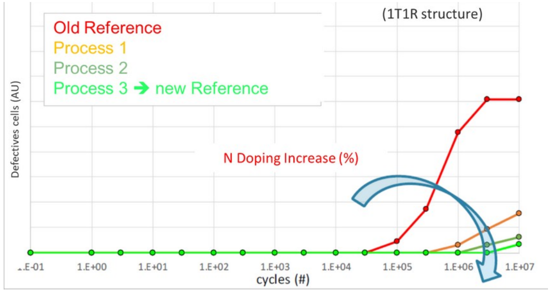




Ge-rich composition shifts T_x and data retention to higher temperatures (important for automotive applications)

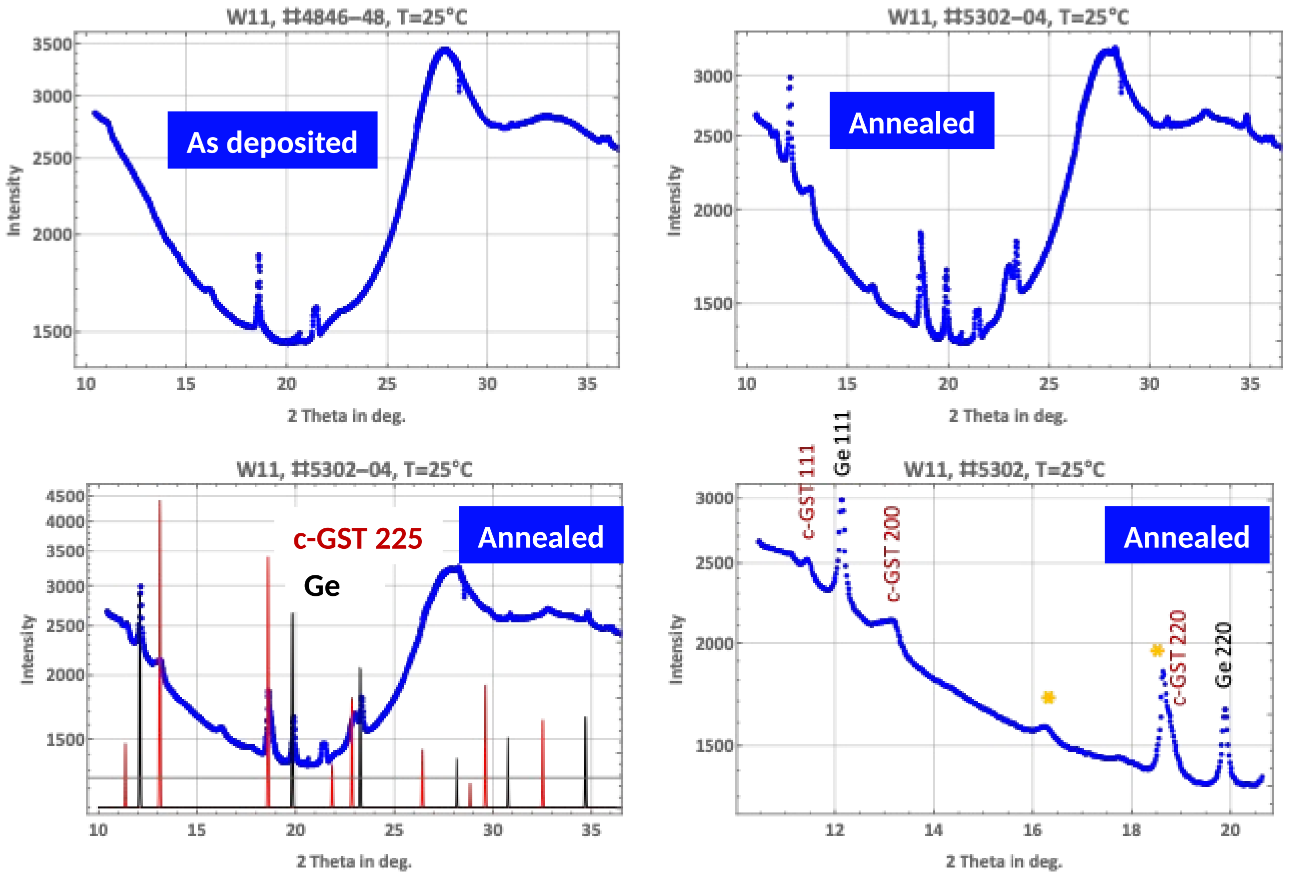
θ–GST

N-doping increases endurance



Next aim: time resolved + high throughput

measured with 2D detector -> reduction
here: 1D patterns before and after in situ annealing



Mixture of Ge and metastable cubic $Ge_2Sb_2Te_5$ (c-GST 225)

- patterns with a range of peaks.
- find out which peaks belong together ("which phase"; can be difficult)
- analyze the peaks to estimate ensemble effects and dynamics + quantification

Calibration of a diffraction setup using `Jupyter` notebooks

This notebook presents a very simple GUI for doing the calibration of diffraction setup within the `Jupyter` lab or notebook environment with `Matplotlib` and `Ipywidgets`. It has been tested with `widget` and the `notebook` (aka `nbagg`) integration of matplotlib.

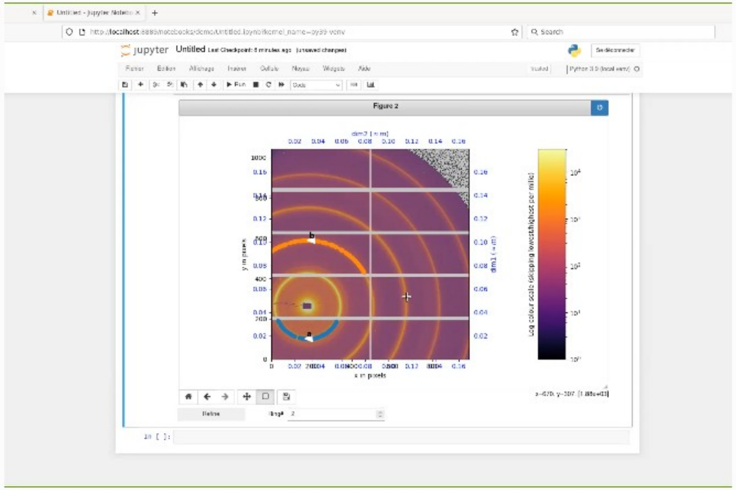
Despite this is in the `cookbook` section, this **tutorial** requires advanced Python programming knowledge and some good understanding of `PyFAI`.

This tutorial is also available as a video:

[1]:
```
#Video of this tutorial
from IPython.display import Video

Video("http://www.silx.org/pub/pyFAI/video/Calibration_Jupyter.mp4", width=800)
```

[1]:



The basic idea is to port directly the original `pyFAI-calib` tool which was done with `matplotlib` into the Jupyter notebooks. Most credits go **Philipp Hans** for the adaptation of the origin PeakPicker class to Jupyter.

The PeakPicker widget has been refactored and the Calibration tool adapted for the notebook usage. Several external tools were used with the following version:

- **Contributed to ESRF pyFAI library**

  Ring finding + calibration + accelerated integration

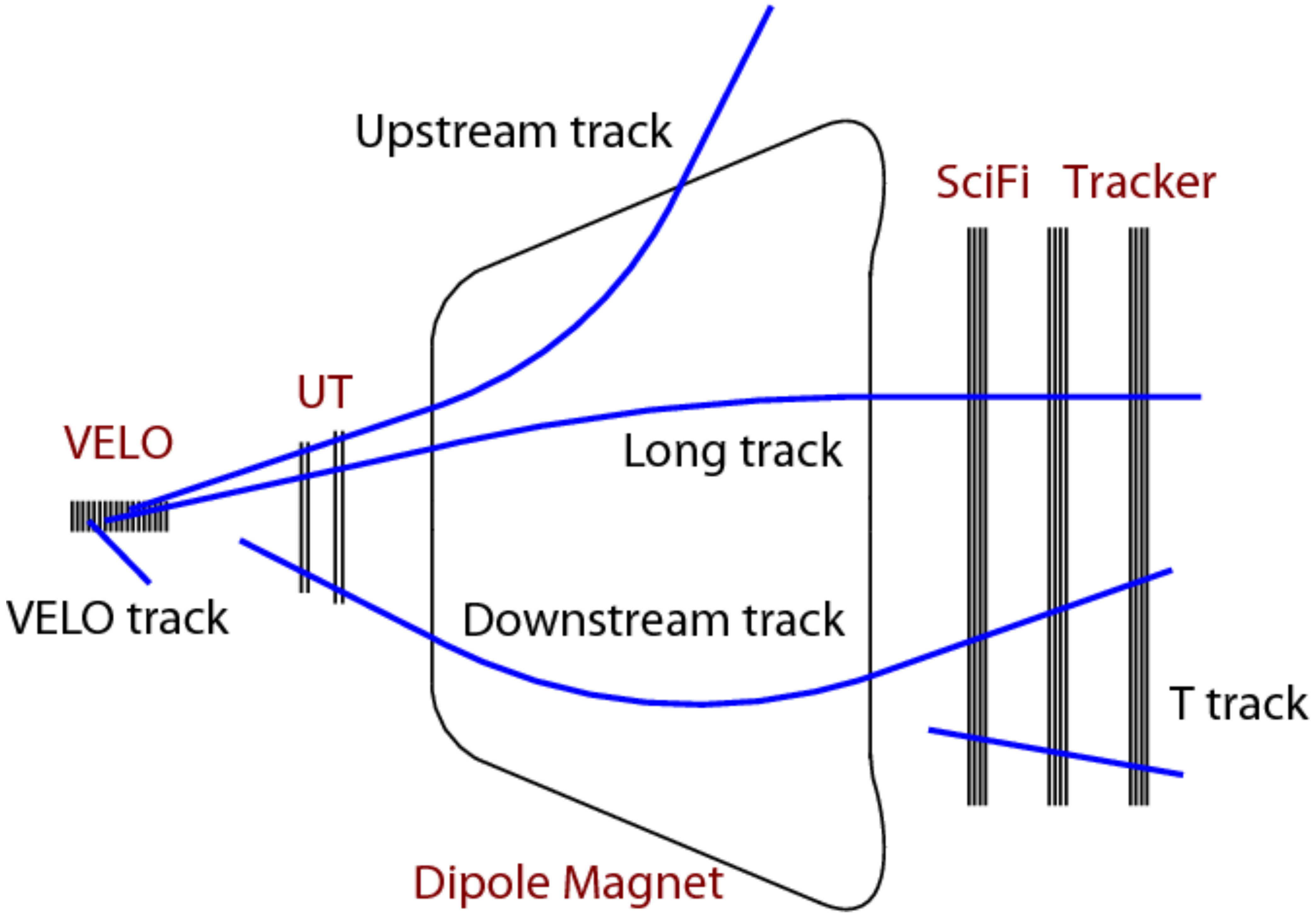
“Application of Generative Models for Event Selection and Commissioning of the Long-Lived Particle Reconstruction Algorithm in the LHCb Trigger Systems”

ESC@SESAME

Sabin Hashmi

OUTLINE

1. Small Recap.
2. LHCb Particle Tracking System
3. Real-Time Trigger Systems
4. Algorithm Designs and Data Processing
5. Neural Network Designs.

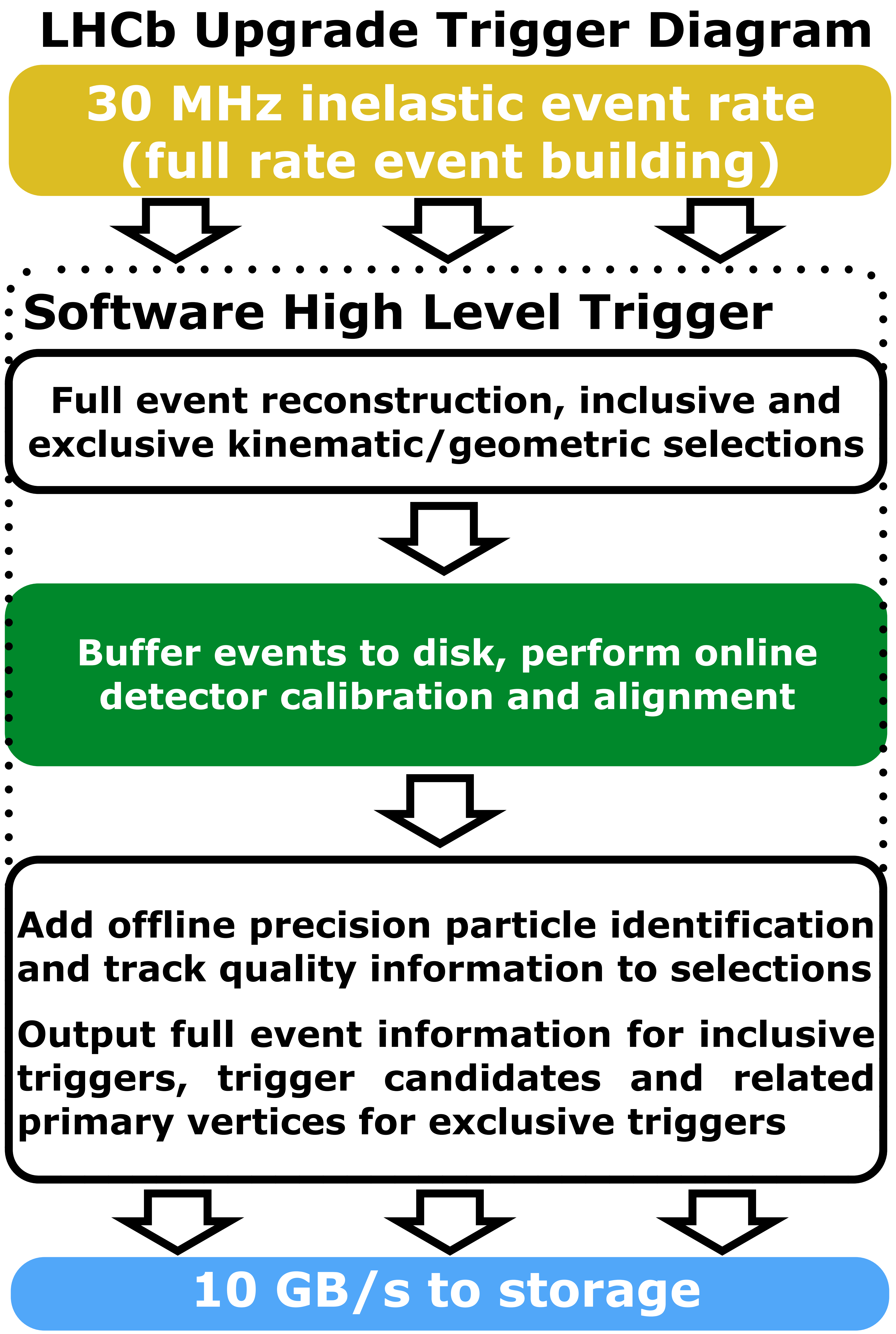


ON A NUTSHELL

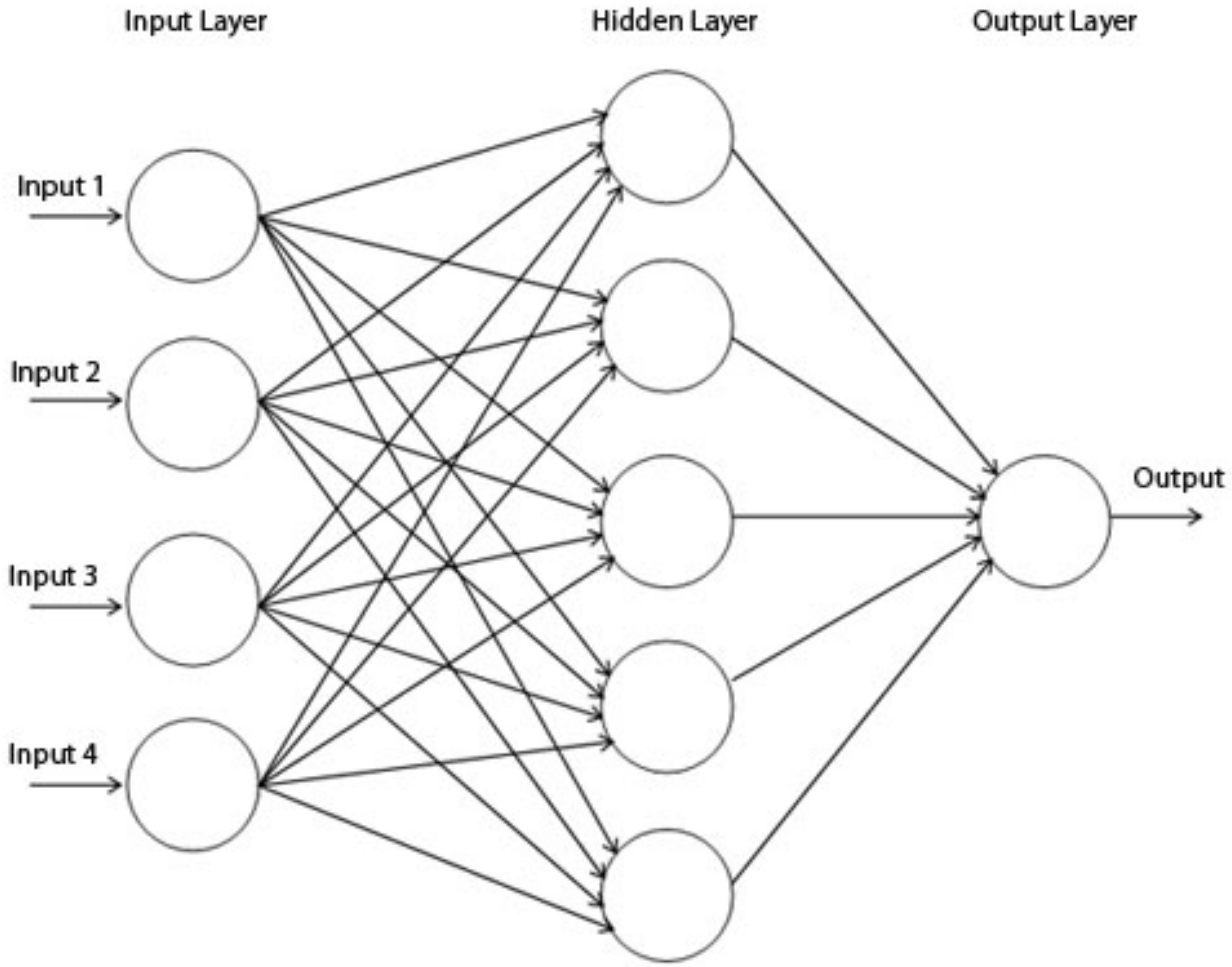
- LHCb Experiment and it's objectives.?
  - LHCb Experiment is a General Purpose Forward Detector, that primarily designed to study beauty quarks from Standard Model of Particles.
  - LHCb focuses on the research in resolving the mystery of Matter-Antimatter Distribution in the Universe
- Design of LHCb Experiment.
  - LHCb consists of 3 Major Detectors, Vertex Locator (VELO), Upstream Tracker (UT), Scintillating Fibre Tracker (SciFi Tracker).
- Upgrades and Recent Developments of LHCb Experiment.
  - High Precision Read out systems.
  - Replacement of Readout Electronics to Overcome Hardware Trigger (L0) event rate of 1MHz to 30MHz with new software trigger systems.
  - And, many more.
- Applications of the research within the experiment.
  - Developing Machine Learning Based Trigger System for the efficient track reconstruction of Downstream Tracks produced from Long-Lived Particle Decays.

REAL-TIME TRIGGER SYSTEM

- Proton-Proton Crossing Rate is once in every 25[ns] (40MHz)
- Older Read-out had a bottle neck of 1MHz due to the hardware limitations.
- Upgrade-1 or Run-3 started from mid-2022, with a delay due to multiple factors.
- This is a new approach, to implement a software based trigger system to produce track samples more efficiently and with more purity.
- High Level Trigger (HLT) is split into two different types based on it's purpose.
  - HLT-1 : This produce a Partial Reconstruction of Tracks, from Upgrade-1, this is done using Graphical Processing Units (GPUs) under the "Allen" project
  - HLT-2 : This produce the Full-event reconstruction.
- Picking Downstream Tracks are like finding a needle in a Hay-stack due to it's nature.
- "No Storage of RAW data"



ALGORITHM DESIGNS



- There are three projects designed to be completed this year.
- The first algorithm is designed to filter the track segments(Seeds) that gets extrapolated to other detectors to reconstruct the complete tracks.
  - Objective : Filter the Real Seed Tracks and the Ghost Tracks. Small improvements can significantly reduce the complexity of track reconstruction.
- The Second Algorithm is currently developed using Artificial Neural Network with PyTorch, a Deep Learning Framework.
  - Objective : Cherry Pick the actual Downstream Tracks. that will help to have quality track samples.
- Third Algorithm is in it's very initial stage of development.
  - Objective : This is a new approach that helps for the detector calibration of using Pre-Trained Machine Learning Models and Automation Pipelines.

Thank You.!