**ALICE 3 - A next-generation heavy-ion experiment**

ALICE 3 is a future experiment proposed by the ALICE Collaboration, which will utilize cutting-edge silicon technologies to:

- study heavy-ion collisions with unprecedented impact parameter resolution,
- collect significantly higher luminosities compared to those collected with the current detector during Runs 3 and 4,
- going to a pseudorapidity region up to $|\eta| < 4$.

**TIME OF FLIGHT (TOF) DETECTOR**

- **Requirements:**
  - Rad. hardness
  - outer TOF: NIEL $\sim 6.2 \times 10^6 \text{MeV cm}^2 / \text{mg}$ / month
  - inner TOF: NIEL $\sim 1.3 \times 10^7 \text{MeV cm}^2 / \text{mg}$ / month
  - Time resolution of $20 \text{ps}$

**Extensive R&D on the most advanced silicon technologies**

**LGADs - SiPMs - CMOS sensors**

**Very thin LGAD**

- (25 & 35 μm)
- were tested for the first time in a test beam setup.
- Potential to offer both the time resolution required and a complete coverage in a single layer with a monolithic design → simpler and cheaper assembly.

**Extensive R&D**

- with the goal to significantly pushing the time resolution well beyond current values.
- A detailed simulation work is already ongoing to optimize the sensor design.

**SiPMs with different protection layers**

- (thickness & material) were tested and compared.
- Increased response is related to Cherenkov light produced in the protection layer
- Possibility to detect and distinguish photons & MIPs at the same time

**In-deep investigat**

- on the Cherenkov effect
- Improvement as a function of the number of fired pixels
- Time res. < 20 ps for fired pixels ≥ 6 (majority of cases)

**The new double-LGAD concept**

- was introduced and tested for the first time. It consists of summing up the signals generated by two layers of LGAD using a single front-end amplifier.
- > improved of the time resolution by going to a thinner LGAD design:
  - 25 μm → 25 ps (120 V)
  - 35 μm → 22 ps (240 V)
- > higher (doubled) charge at the input of the amplifier for all the thicknesses → advantage for the electronics.
- > consistent improvement of the time resolution for the d-LGAD compared to the single LGADs
- > time resolution of $\sim 20 \text{ps}$ for all thicknesses (25, 35, 50 μm)

**Ongoing:**

- study of even thinner LGADs (15 & 20 μm) in single and double config.
- Simulations show that thinner layouts with a gain layer could allow this technology to reach the ALICE 3 time performance requirements while maintaining a reasonable power consumption.
- Ongoing: analysis of data taken with the first structures produced.
- Ongoing: study of SiPMs with a larger area and pitch to cover the full Cherenkov cone, considering different resins.