# STOPGAP!

# A proposed ToF Extension for the Belle II TOP

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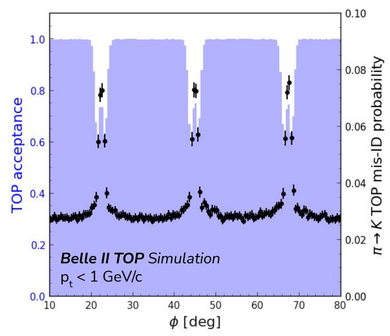
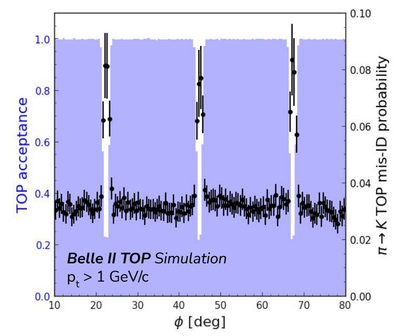
## 1. The problem

The Belle II TOP detector provides PID measuring the time of propagation of the Cherenkov light in 16 fused silica bars arranged around the interaction point in a barrel-like shape.

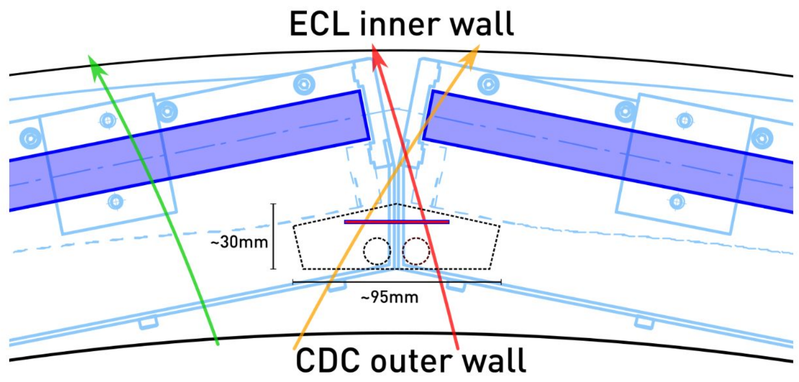
**Gaps between the bars** cause a **5% loss in acceptance** and a **degraded PID performance for the 4% of particles** crossing the bars close the their edges.




## 2. The solution

The gaps are located where the TOP bars are the furthest away from the outer wall of the tracking system (CDC), **leaving few cm in the radial direction** for the whole length of the detector.

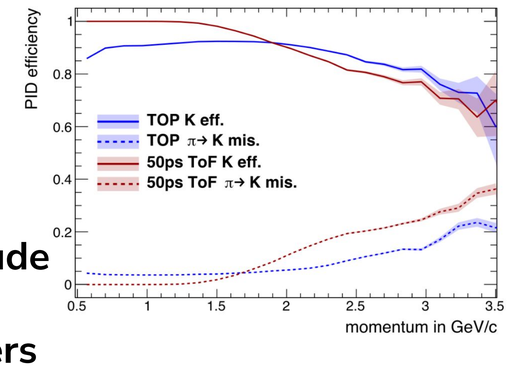



**This space can be used to install a supplemental instrumentation** consisting of one or more layers of timing detectors with minimal mechanical support and limited cooling needs, providing **PID via a Time-of-flight** measurement: : **STOPGAP**

## 3. The requirements

STOPGAP must perform at least as well as the TOP detector. This requires a **time resolution of 30 - 50 ps per track**. The pixel **granularity should be of few mm** to match the tracking resolution, but can **can be as large as 1 cm** without degradation of the performances.

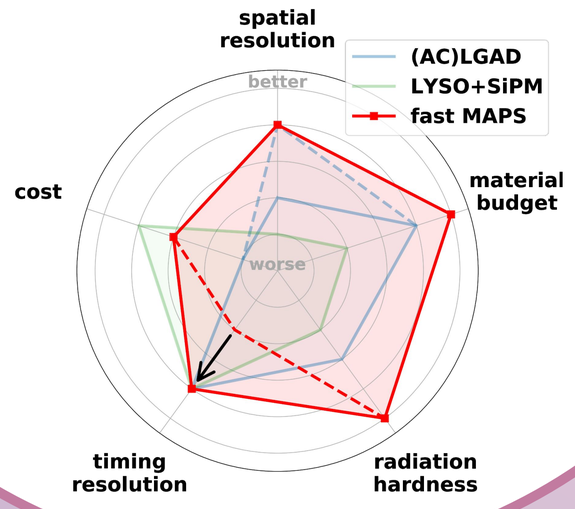
Simulations indicate a **background occupancy of 0.6 % /cm$^2$**, a NIEL of **1x10$^9$ n$_{eq}$/cm$^2$** and a total cumulative dose of **0.16 krad**. These figures are **orders of magnitude below the expectations for the next-generation colliders**




Being located in front of the electromagnetic calorimeter, the material budget has to be kept as low as possible and **below 0.2 X$_0$**

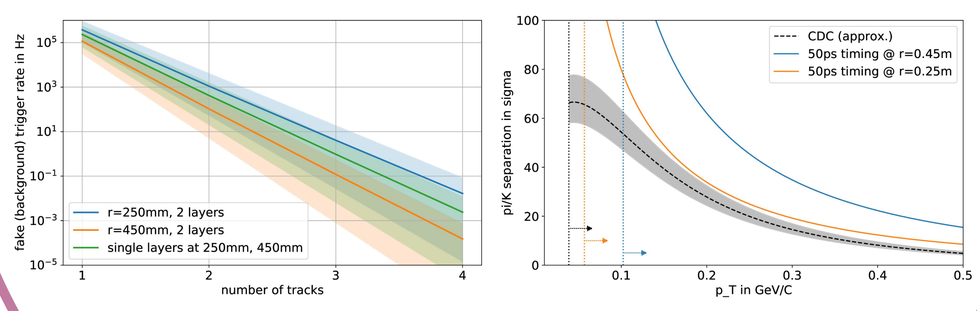
## 4. The Design

With a total area of 2 m$^2$, the cost-effectiveness of the chosen technology is critical. On the other end, **the modest background and granularity requirements make STOPGAP the ideal demonstrator for new technologies.** Recent **fast MAPS R&D** shows promise to reach down to the required timing resolutions with cost effective sensors produced in standard CMOS technologies.




## 5. What next

STOPGAP is part of the **global effort to design an upgrade of the Belle II experiment.** The targeted sensor technologies could also be used to construct **a full timing layer at lower radius.** Such a timing layer would provide low momentum particle identification, improved event start time tagging and even standalone track trigger capabilities.







Do you want to know more? **Get in touch:**
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## Bibliography

https://l.infn.it/stopgap

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