



# Upgrade of the ALICE Trigger Detectors using MCPs



## ALICE

Overview

Upgrade

New FIT Detector

## Microchannel Plates

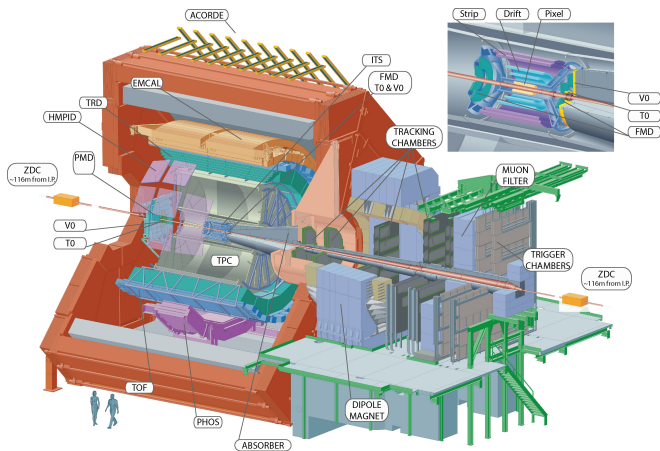
Readiness

Operation

Radiator

## FIT — again

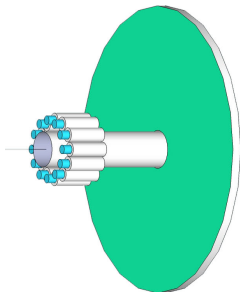
# Current



## Upgrades needed after 2018

- ▶ After Long–shutdown II, luminosity will be *much* higher
- ▶ ITS/TPC needs faster read-out (ITS more pixel, TPC switch to GEMs)
- ▶ MUON needs front tracker (Si-pixel, FMD will disappear)
- ▶ Trigger needs to be faster and more efficient
  - ▶ V0 and T0 will disappear
  - ▶ New *Fast Interaction Trigger* detector based on *MicroChannel Plates*.

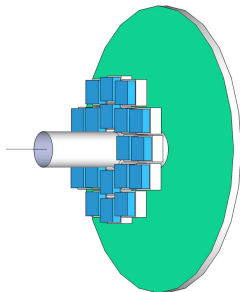
## The Old and New



### Current configuration

T0 Quartz radiators glued to  
PMTs

V0 Scintillator slaps



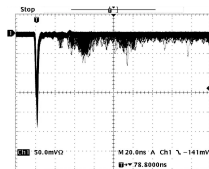
### Upgraded configuration

FIT Radiators with MCP  
backend

# So Why Upgrade?

## V0

- ▶ Good performance for pp
- ▶ Issues with after-pulses
  - ▶ Effect centrality (amount of nuclear overlap) determination in PbPb
  - ▶ Will increase with luminosity



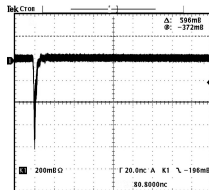
## T0

- ▶ Poor performance in pp due to limited acceptance
- ▶ Good timing resolution for PbPb ( $< 50$  ps).
- ▶ Issues with after-pulses

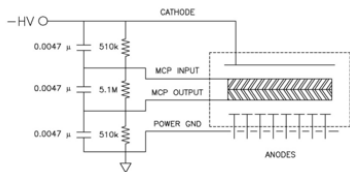
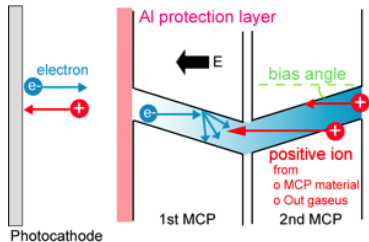
# Mediate these issues and unify

## Are we ready for MCPs

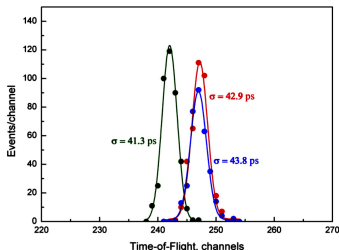
- ▶ Yes! R&D efforts for Mill-Spec has made it possible!
- ▶ We can get the same or better timing resolution
- ▶ No issues with after pulses
- ▶ Cost-effective way of extending T0 acceptance
- ▶ Commercially available
- ▶ Relatively in-expensive (total FIT cost  $\approx 1.5 \times 10^6$  CHF  $\approx 9 \times 10^6$  DKK, 1/3 of this for the MCPs)



# Operation of MCP

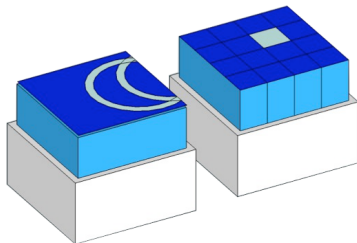
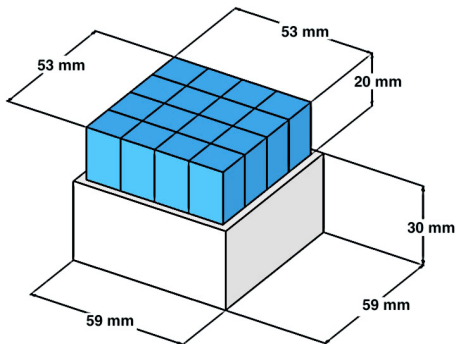


- ▶  $\epsilon_{\text{quantum}} \approx 10\%$
- ▶ Typical gain  $\approx 10^5$
- ▶ 2 cm quartz give  $\approx 1000 \gamma/\text{MIP}$
- ▶ Thus,  $\approx 10^7 \gamma/\text{MIP}$  reach the anodes





# Optimize the Radiator



- ▶ One solid quartz → light diffuse over entire surface → larger gain
- ▶ Segmented quartz → light focused in cell → lower gain, better spatial resolution.

# How to FIT

- ▶ Simulations show trigger efficiency  $> 93\%$  for Minimum-Bias pp, and  $> 99\%$  for peripheral PbPb.
- ▶ Plenty of challenges
  - ▶ Exact geometry and integration
  - ▶ Radiation hard electronics ( $\approx 10$  krad for Run III of LHC)

