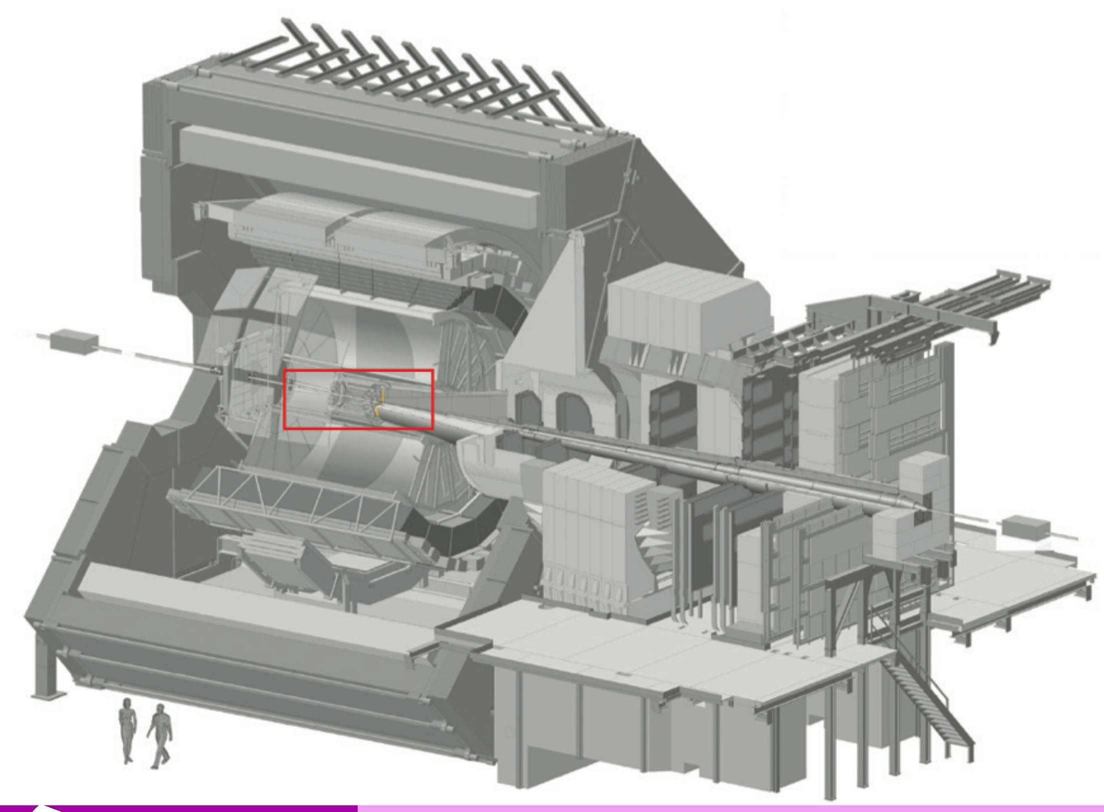
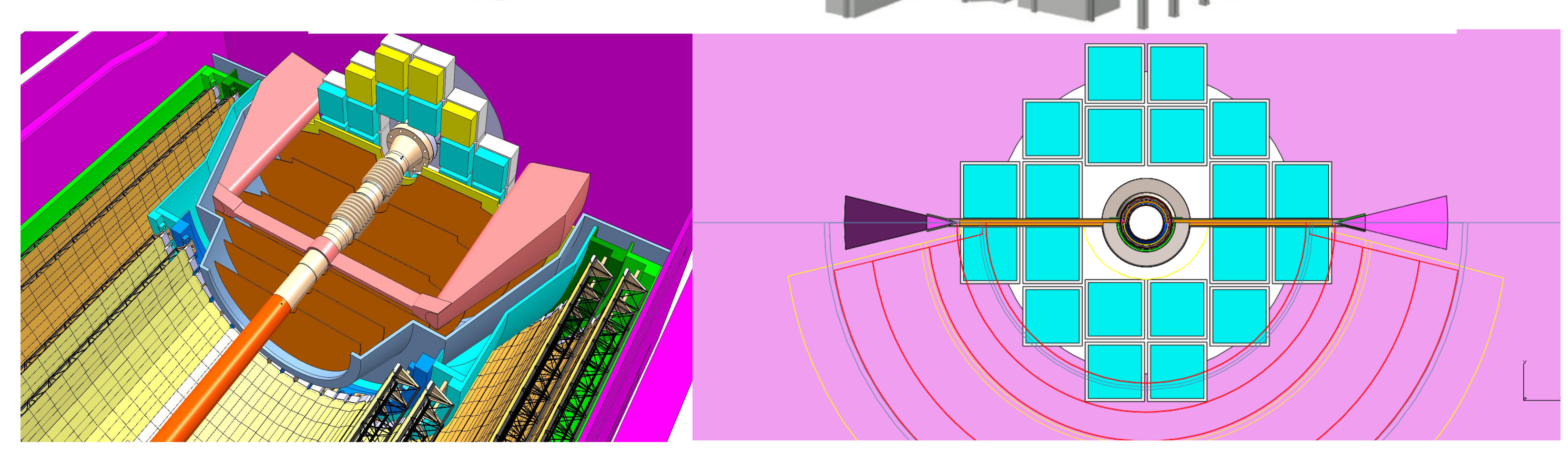
ALICE FIT DETECTOR

FAST INTERACTION TRIGGER

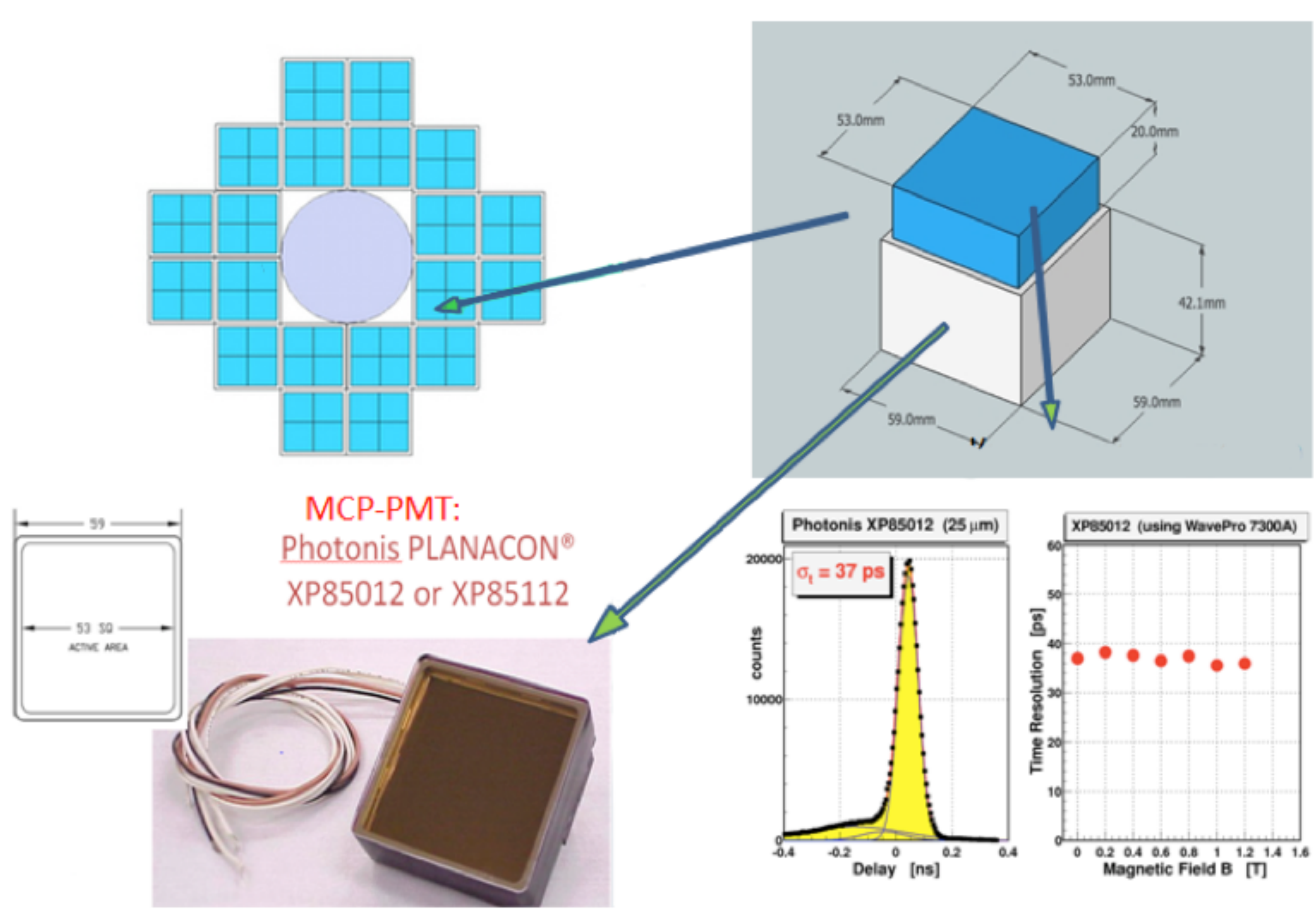
As a result of the LHC upgrade after the Long Shutdown 2, the expected luminosity and collision rate during the so called Run 3 will considerably exceed the design parameters for several of the key ALICE detectors systems including the forward trigger detectors. Furthermore, the introduction of a new Muon Forward Tracker significantly reduces the C-side pseudorapidity coverage and the space envelope available for the upgraded Fast Interaction Trigger (FIT) detector. At the same time, FIT is expected to match and even exceed the functionality and performance currently secured by three ALICE sub-detectors: the time zero detector (T0), the VZERO system, and the Forward Multiplicity Detector (FMD). There are two ways to upgrade current system - improved T0-Plus and V0-Plus. In this poster T0-Plus detector is represented. The harsh conditions of Run 3 would accelerate the aging and radiation damage (detectable already during Run 1) of the FIT detector if we were to use standard PMTs. The solution came thanks to the latest developments in MCP-PMT technology providing compact photo sensors with excellent characteristics and stability





SYSTEM DESCRIPTION

The demand to maximize the efficiency for Minimum Bias events requires efficient coverage of the available space with detector modules. The envelopes defined by detector integration are a minimum inner radius of 50-60 mm and a maximum outer radius of 170-200 mm. Each MCP-PMT module will be divided into 4 equal parts by cutting the quartz radiator into 4 and arranging the 64 anode sectors into the corresponding 4 groups. As a result, each array on the A and on the C-side will function as 20 x 4=80 independent detector units.



REQUIRED FUNCTIONALITY FOR FIT

The upgraded trigger detector needs to provide ALICE with on-line:

- Minimum Bias trigger with efficiency comparable to the current V0
- Vertex determination performance at the level of the current T0
- Event Multiplicity determination capable of selecting and triggering on central as well as on semi-central collisions
- time resolution of better than 50 ps (current T0 performance)
- Precise collision time for TOF (required off line)
- Reduced signal latency (to be implemented already during LS1)
- Event plane determination
- Reliable and stable operation, capable of handling the LHC´s higher luminosity and bunch crossing frequency after LS2
- Minimal aging over the lifetime of upgraded ALICE
- No after pulses or other spurious signals
- Readout electronics compatible with TOF detector's DRM&TRM
- Direct feedback to LHC on luminosity and beam condition
- Evaluation and rejection of beam-induced background

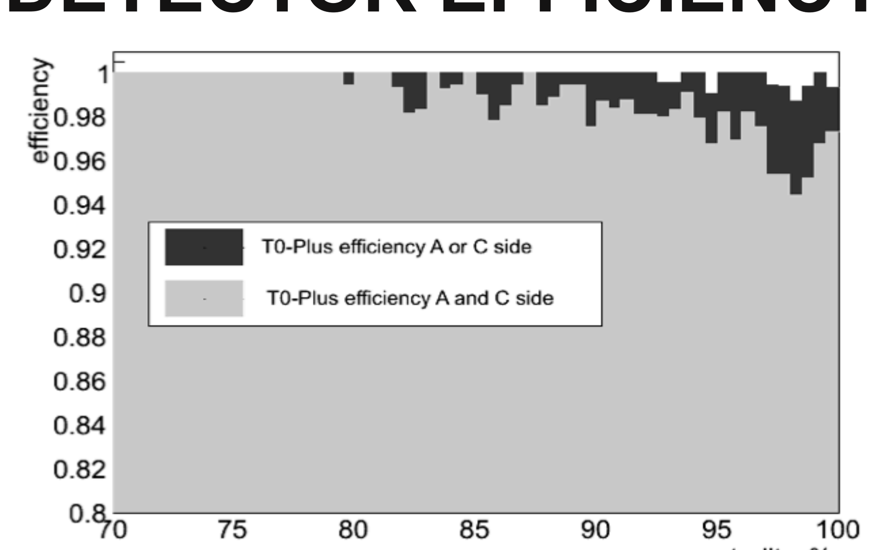
DETECTOR CONCEPT

Relativistic charged particles passing through an optical medium with refractive index greater than unity emit a cone of light known as Cherenkov radiation. In case of a quartz radiator with refractive index n = 1.458 the emission angle of photons is limited to θ/2 = 46.70. These forward emitted photons are reflected from the polished walls of the radiator and are focused on the MCP-PMT to which the radiator is optically coupled with special grease. T0-Plus detector modules and electronics are calibrated with remotely operated fast blue laser (401 nm) delivering the light via optical splitter and fibers to each MCP-PMT.

MCP-PMT XP85012 PLANACON

The XP85012 Planacon consists of a sealed, rectangular vacuum box of about 59 x 59 x 28 mm3 housing a pair of microchannel plates in a chevron configuration. The pore size is 25μm with the length to diameter ratio of 40:1. There are two front window options available: Schott 8337B or UVFS(-Q). The spectral range is 200-650 nm with peak sensitivity around 380 nm and an average quantum efficiency of 22%. A gain of 105 is typically reached at 1800 V, with the maximum possible gain on the order of 107. The cathode is subdivided into 64 square sections that can be read out individually or combined into bigger blocks. Both the ambient operating temperature range and the behaviour in the magnetic field conform to the ALICE conditions inside the L3 magnet. Planacon has the largest relative (80%) and absolute (53 mm x 53 mm) active area and the lowest price per surface of all the commercially available MCP-PMTs, making it the prime choice for the T0 upgrade.

DETECTOR EFFICIENCY



Dependence of the efficiency on the event centrality for PbPb collisions at ps = 5.5 TeV

	A	C	A&C	A|C
pp @ 14 TeV				
V0*	0.88	0.88	0.83	0.93
T0-Plus* R_{min}=50 mm	0.89	0.89	0.84	0.94
T0-Plus* R_{min}=60 mm	0.88	0.88	0.83	0.93
T0-Plus Detailed geometry R_{min}=60 mm	0.88	0.86	0.80	0.93
PbPb @ 5.5 TeV (b>13 fm; 70-100% centrality)				
T0-Plus Detailed geometry R_{min}=60 mm	0.97	0.98	0.95	0.996

Efficiency comparison between the current V0 and the proposed T0-Plus. Asterisks indicates that the simulations were done using a simplified geometry.