

Pixel trigger in CMS

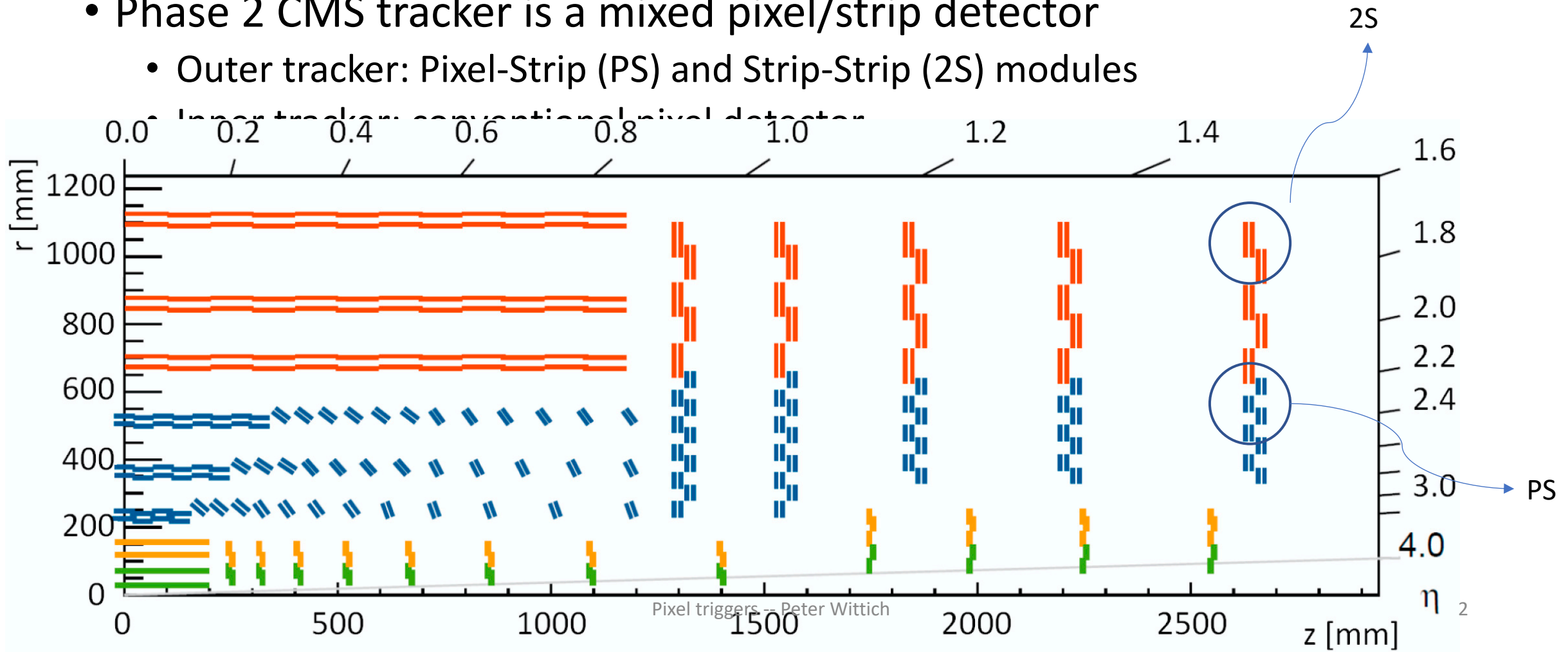
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Trigger in CMS for Phase 2: track trigger

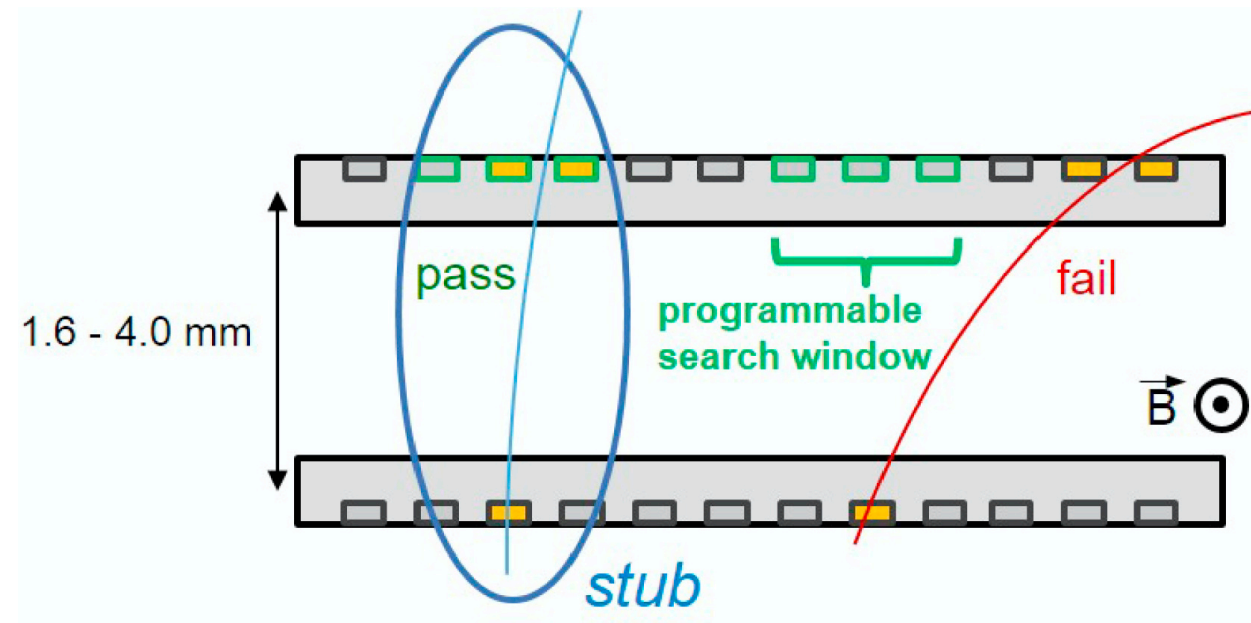
- Big change for CMS in Phase 2: add information from solid state tracking detector to the hardware trigger
- Phase 2 CMS tracker is a mixed pixel/strip detector
 - Outer tracker: Pixel-Strip (PS) and Strip-Strip (2S) modules



Track trigger uses OT

- Physics goals:
 - Better turn-on curves for muons, other high pt tracks
 - Associate jets with vertices
 - Better MET turn-on (PUPPI clean-up of stray energy to pile-up)
- Requirements:
 - Low-ish PT threshold (2 or 3 GeV/c)
 - Good z_0 determination (1 mm)
 - High efficiency
- No specification on d_0 resolution
 - Initial studies all assumed $d_0=0$ to improve pt resolution

PT modules



- Front-end data reduction via special modules that make PT cut
- Factor of 10 reduction
- Enables L1TT with outer tracker
- Data rate still 20-40 Tbps

Physics goals of run 4:

- Higgs physics, new physics searches, forward physics
- No explicit goal to do B physics
- Many new physics models predict displaced tracks
 - Seems like a good place for a pixel trigger

Could CMS pursue a pixel trigger?

- Idea has been floated several times, mainly studied by one group of proponents
- Use cases:
 - electron tracking. Offline electron tracking uses the innermost pixel layers in looking for the track of the electron before it has radiated. Emulate with an ecal-seeded tracking pass (ROI-based)
 - B tagging. OT distance from beam line means not enough d_0 resolution for $c\tau \sim b$ lifetime
 - Note that very long lived tracks (few mm – 5 cm $c\tau$) can be reco'd by OT
- Technical issues?
 - Large number of readout channels means likely only possible as a ROI-seeded trigger
 - Latency window would be very tight but possibly doable

doi:[10.1088/1748-0221/10/10/C10001](https://doi.org/10.1088/1748-0221/10/10/C10001)

<https://doi.org/10.22323/1.282.0243>

CMS decided against pursuing this

- We had recently (18 months ago) come up with an idea of how to pursue this from a technical perspective
 - Special joint FIFO-RAM object (destructive read)
 - Seeded by L1T (3-4 us after collision)
- Re-examined idea of electron tracking improvements
- Concluded that it wasn't obvious you couldn't get the same performance gains with a special OT-only tracking pass
- Idea was abandoned again
- Nota bene: sunk due to lack of a compelling physics case