**Scintillator Studies for the new TOTEM T2 Telescope**

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**TOTEM in Run3**

**TOTEM Physics motivation at 14 TeV:**
- Differential elastic cross section
- Total cross-section
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\[ \sigma_{\text{tot}} = \frac{N_{\text{el}}}{dN_{\text{el}}/d\eta} \]

Luminosity-independent total pp cross-section measurement

**Roman Pot (RP) stations:**
- Measure low (1) protons
- Located at ~220 m from IPS
- Tracking detector technologies

**The TOTEM T2 Upgrade**

The original T1/T2 telescopes (radiation damaged) are now removed and a new T2 telescope (nT2) system, based on scintillators and fibers, is planned specifically for a high-\(B^*\) run (elastic scattering and total cross-section measurement) at nominal LHC energy. Even if these scintillators have modest radiation tolerance, they will definitely survive during the limited duration (few days) of high-\(B^*\) (low luminosity) run. With a pseudorapidity coverage of \(|\eta| < 6.5\), the new (disposable) T2 telescope will detect more than 90\% of the inelastic events at a center-of-mass energy of 14 TeV [2].

**nT2 R&D on Scintillators**

- Cosmic ray test facility established at Bat.226 for direct comparison of scintillators and proposed light collection configurations for nT2 telescope.
- The aim of this R&D on scintillators:
  - Find the easiest and fastest production solution
  - Find the best way to extract the light from the scintillator
- More than 20 configurations were tested and a decision was made between plaquette, and scintillator + groove systems.

**References**


**Readout, DAQ and trigger scheme of nT2:**

- The new T2 will partially use the existing infrastructure, UV, HG, DCS/DSS and signal cables in existing cable chains, inherited from old T2-GEN.
- The nT2 will be read out by multi-channel SPMs/MPPCs (Multi Pixel Photon Counter) from Hamamatsu Photonics K.K.
- S13361 series MPPC arrays are purchased, waiting for delivery.
- The mezzanine design for the MPPCs is already ongoing.
- The data flow for the nT2 will follow same standard path as TOTEM, already interfaced to the CMS DQA.
- The nT2 will provide 4 bits that will be included in the CMS L1 trigger menu for special runs as in the past.

**Next steps:**

- Three different Scintillator from different producer, Saint Gobain, Eljen, Turkish Atomic Energy Authority, will be tested.
- Due to the WLS fibers attenuation length, WLS fibers need to be spliced with clear fiber. After splicing, signal quality measurements will be performed both at Bat.226 using cosmic rays and at DESY-II test beam facility in June 2020.