The High Granularity Timing Detector (HGTD) is a detector composed of silicon layers with pads of 1.3x1.3mm² that is proposed to be put in front of the end cap of ATLAS for the HL-LHC. The high granularity and excellent timing resolution adds new capabilities for physics analyses at the HL-LHC.

**Pile-up Mitigation**

- **HGTD**: Coverage : 2.4 < |η| < 4.0
- **End-caps**: z = ± 3.5m
- **30ps resolution per MIP**
- Can assign a time to each track
- Time measurement resolves vertices merged in space

**Silicon Sensors**

- 1.3x1.3 mm² pads
- LGAD sensors
- Moderate gain = 20
- Thin sensors ≈ 50 µm
- Good time resolution

**Object reconstruction : Jets**

- **Pileup**: Can contaminate the jets of interest
- Can also produce additional jets:
  - As hard QCD process
  - As particles from multiple vertices
- **Solution**: association of jets with tracks and primary vertices
- Improved by timing information
- With σ(t) = 30 ps, rejection improved by factor of 4

**Test Beam**

- Beam test campaign at CERN in Autumn 2016
- Gain 20 : σ1 = 40ps
- Gain 40 : σ1 = 27ps
- Very good efficiency and time resolution uniformity

**Object reconstruction : b-tagging**

- **b-jets** → displaced vertex → large z0 window → very sensitive to pileup
- **HGTD**: reduction of the PU contamination → Improvement of the b-tagging efficiency
- 70% efficiency → rejection improved by a factor of 2

**Object reconstruction : Lepton**

- **Isolation efficiency**: probability that no PU track with pT>1GeV is within dR = 0.2 from the electron
- Needed to separate HS electrons from electrons coming from decays, conversions or fakes
- **ITK** : only the track from the primary vertex
- **HGTD+ITK** : tracks with a time compatible with the vertex

**Luminosity**

- **HGTD**: measurement of the luminosity at each bunch crossing
- Number of HGTD hits ∝ number of interactions per crossing (µ)
- Good linearity → precision of a few % on µ

**Expected time resolution : 30 ps (60ps after irradiation)**