STCT Test on LGAD Sensor at USTC

Aonan Wang, Chihao Li, Yifan Yang

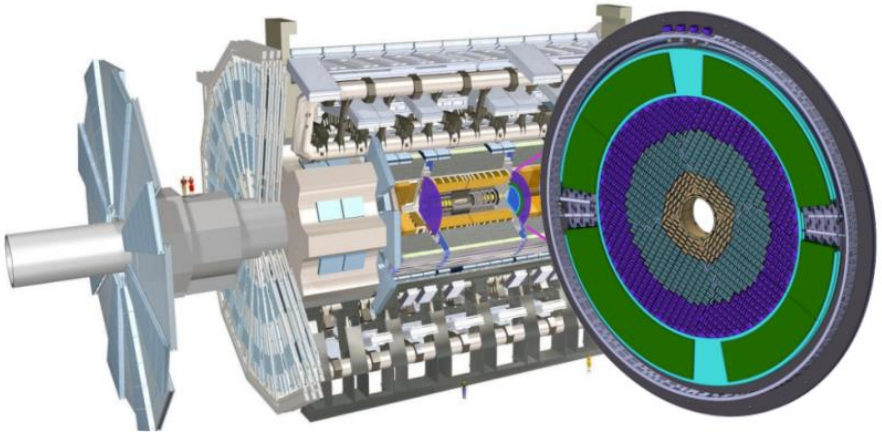
University of Science and Technology of China

LGAD Sensor for HGTD

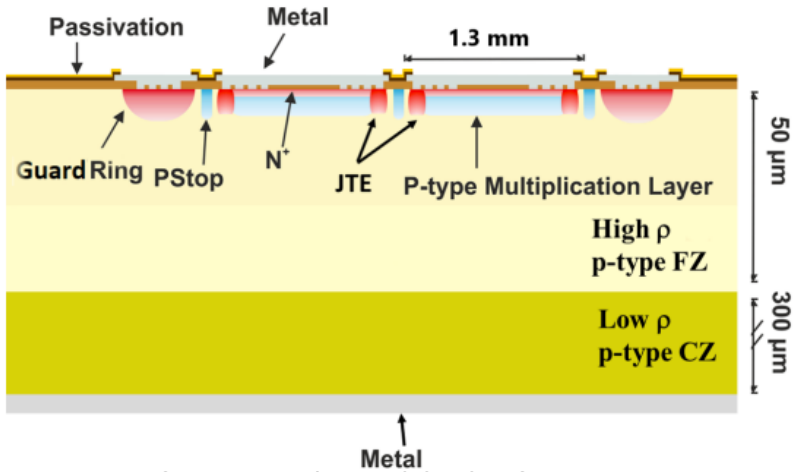
A major challenge for ATLAS ITk in HL-LHC is the pileup suppression, especially in the end-cap region.

HGTD (High-Granularity Timing Detector) is introduced to provide high-precision time measurements for charged particles. HGTD active area covers range $2.4 < |\eta| < 4.0$.

HGTD consists of silicon-based Low Gain Avalanche Detectors (LGADs). LGADs are low-gain and thin semiconductor detectors, providing good time resolution.



Position of HGTD in ATLAS

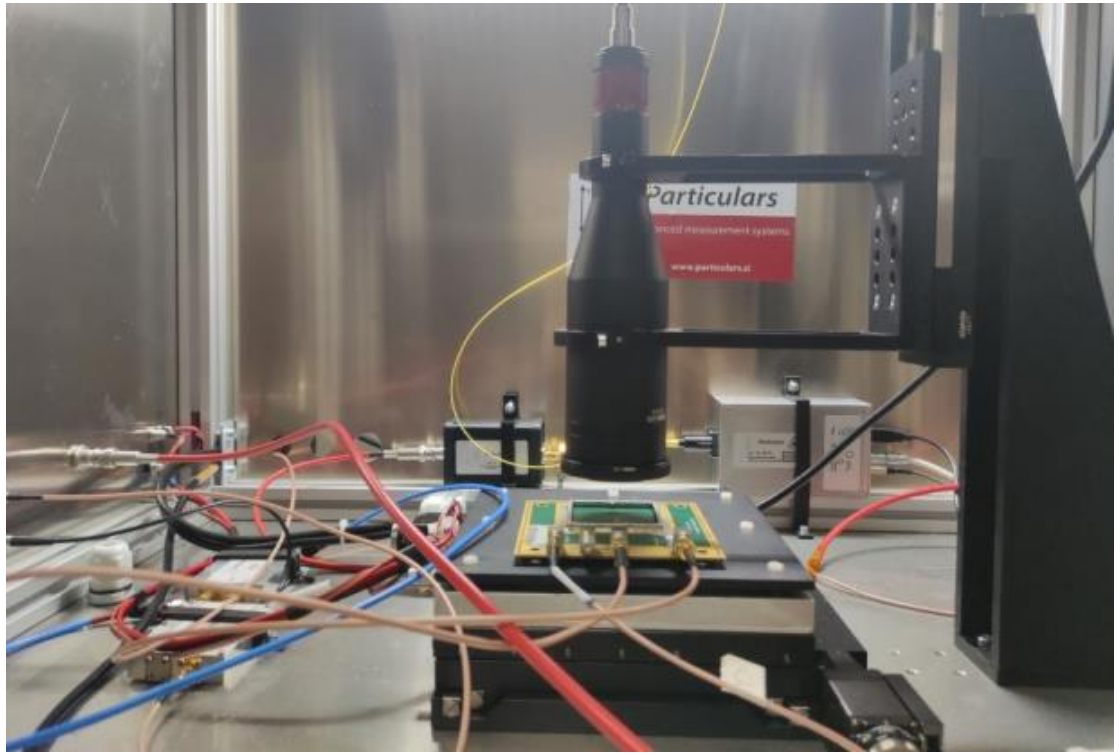


Cross section of 2×2 LGAD array

Introduction of STCT

Transient Current Technique (TCT) uses infrared laser to produce charge carriers in semiconductor detectors.

Scanning TCT (STCT) use beam perpendicular to sensor active surface and use stepper motors to focus the beam and scan test area.



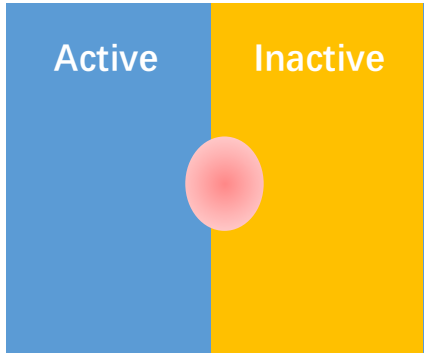
STCT system at USTC

STCT Beam Focusing

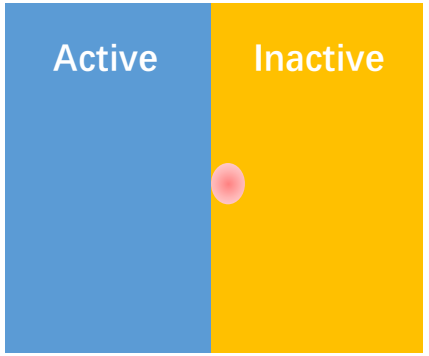
Laser beam should focus on the surface of test sensor to get best position resolution.

When beam center is on inactive area but near the edge with active area, beam not focused will have larger part on active area and produce larger signal than focused beam.

An x-z scan (x is defined as the horizontal direction perpendicular to edge and z is defined as vertical direction) can focus the beam very well but also cost more time.

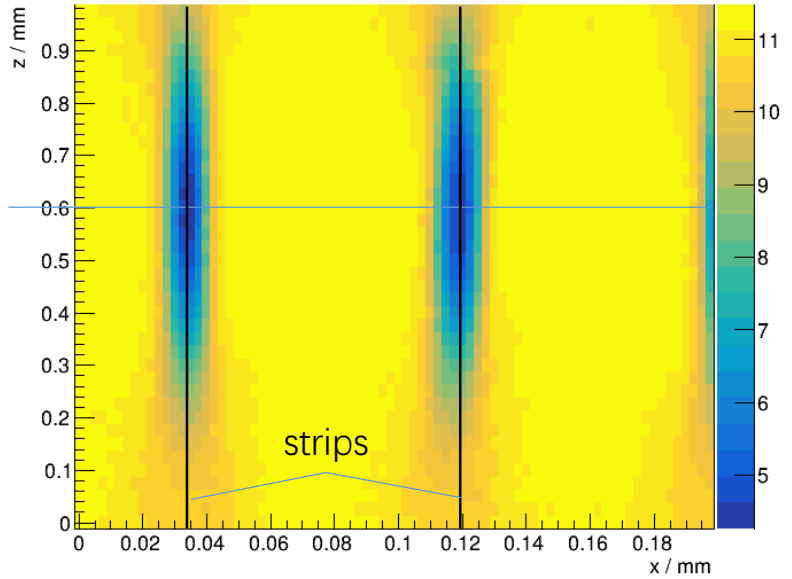


Not focused



Focused

Focused



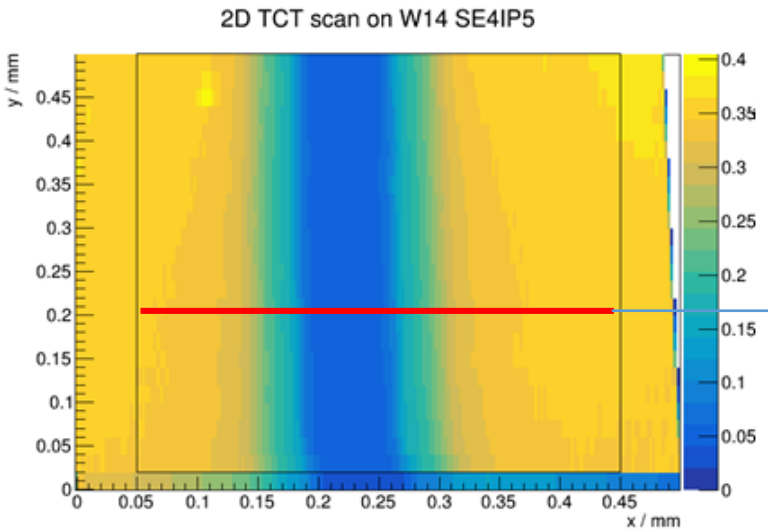
Signal amplitude from an x-z scan on sensor with mental strips that laser can not penetrate

STCT Test on Inter-Pad Gap

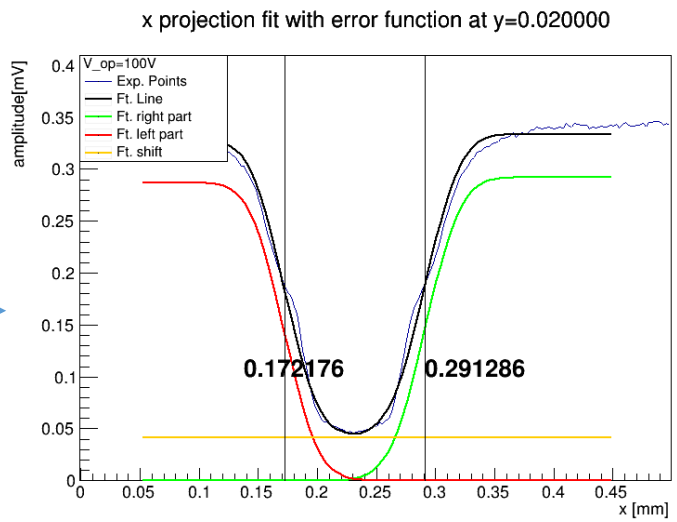
Inter-pad gap means the dead zone between active areas of 2 pads, its width has significance effect on fill factor of detector. STCT is used at USTC to measure the inter-pad width currently.

Amplitude distribution on direction perpendicular to gap is fitted with sum of two error function.

Gap width is defined as distance between middle of 2 error functions.



2D distribution of signal amplitude
(rotated to let gap parallel with y axis)



1D (x) distribution of signal amplitude (blue) and fitting with sum of 2 error functions (black)
Red, green and yellow line shows 2 error functions and constant from fitting