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Institut de recherche sur les lois fondamentales de l'Univers

WADAPT

Wireless data (and power) transmission

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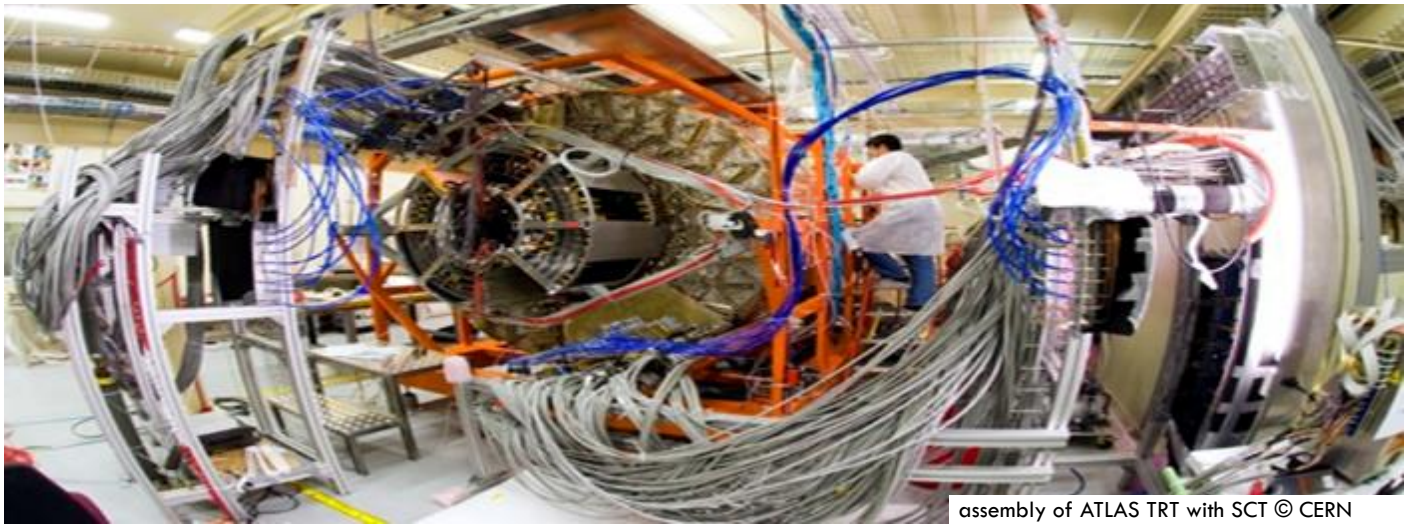
A massive cable plant

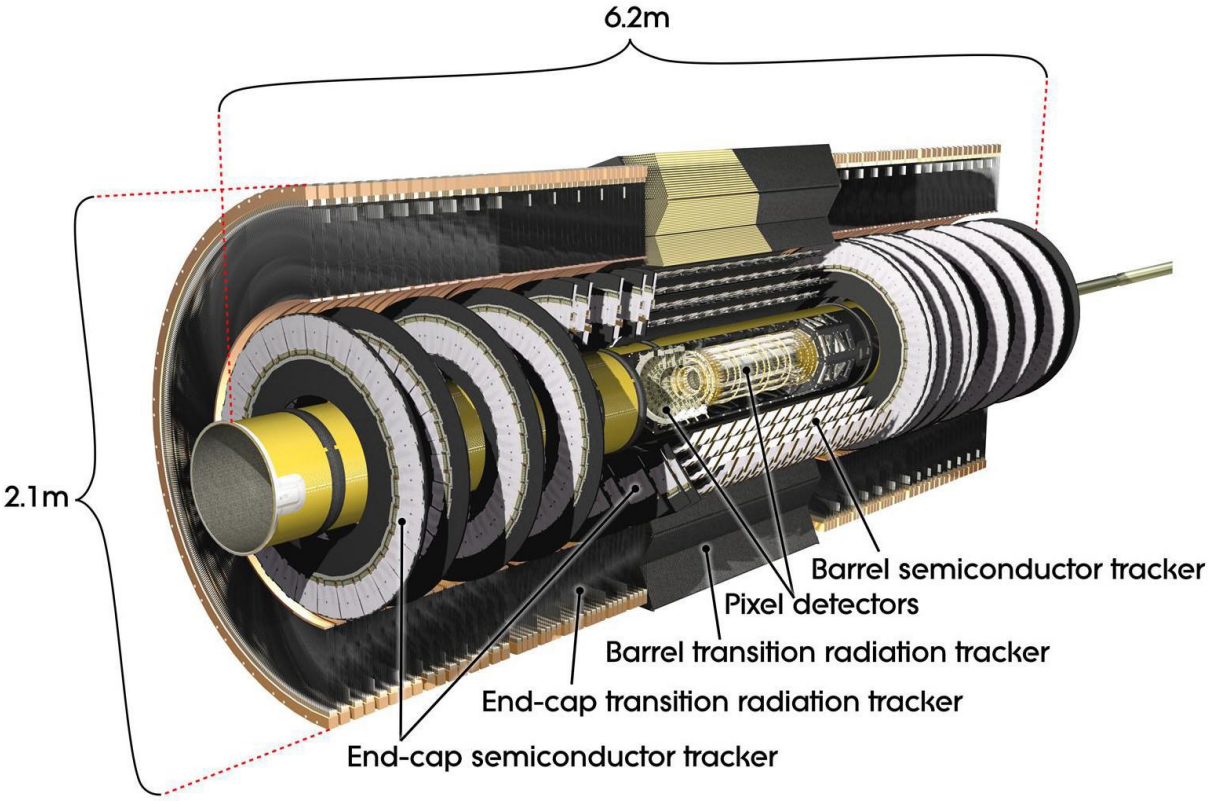


assembly of ATLAS TRT with SCT © CERN

- **<u>Impact on the measurements</u>**
  - Multiple scattering and nuclear interactions
  - Dead-zone areas
- **<u>Impact on the installation and the operation</u>**
  - Cables and connectors are fragile
  - Cable path is not so flexible
  - Design constraints

Why wireless?

- **Minimize material budget** of cables/connectors
- Enable fast data processing

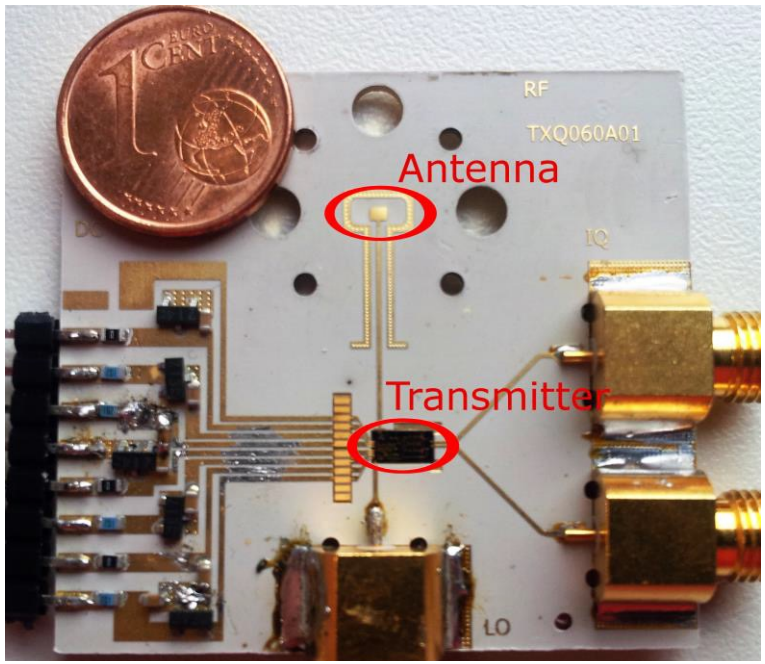


ATLAS inner tracker © ATLAS/CERN

- More **flexible transceiver placement**
- Direct communication between layers possible
- Point-to-Multipoint links
- **Data follows event topology enabling fast triggering**

Millimeter-waves technology

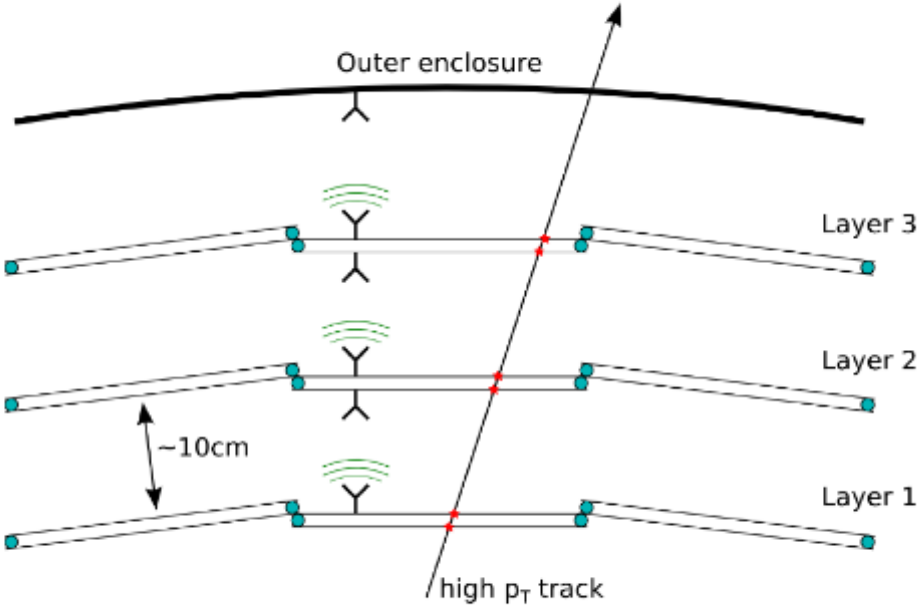
- 30 to 300 giga-Hertz
- Wavelength (λ) of a few mm (e.g. 5mm @60GHz)
- Multiple Gbits/s (Several GHz of bandwidth)
- High “natural” signal attenuation (68dB@1m at 60Ghz)



60GHz transmitter from GOTMIC AB (Picture : © Universtität Heidelberg)

- Compact and low power system
- High integration
  - On-chip antenna
- High density
- Lots of developments in the industry

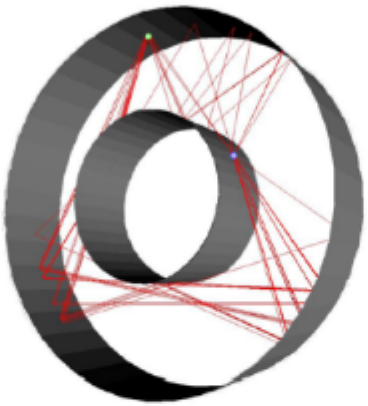
Study for ATLAS silicon tracker from Heidelberg university



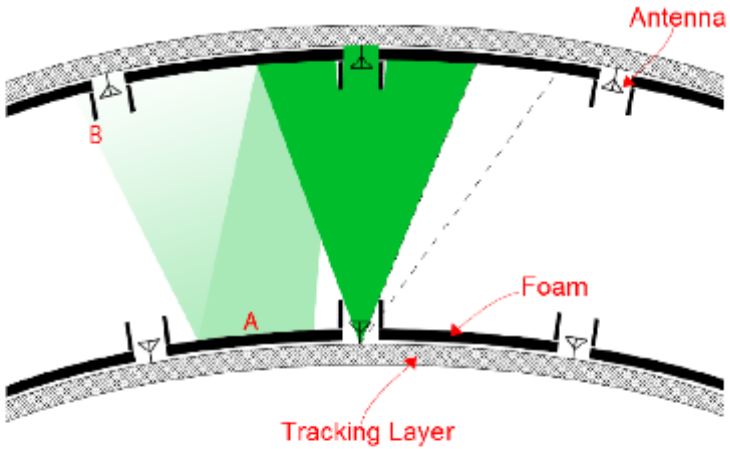
- **60 GHz wireless readout system**
- **Building a 60Ghz demonstrator**
- Simple On-Off Keying modulation
- 4.5Gbps @1m
- 240mW power consumption
- 130nm SiGe Bi-CMOS HBT 8HP technology

Concept from R.Brenner et Al. (Uppsala Uni.); Pictures: Universität Heidelberg

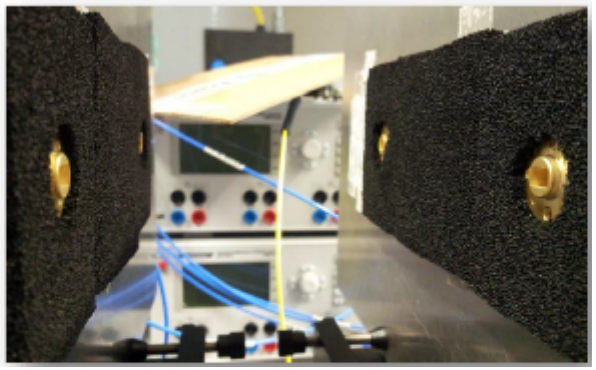
- **No signal penetration** through detector layers
  SCT detector modules attenuate transmission by > 55 dB
- **D**etector layer is an **highly reflective environment but**
- **By means of antennas, polarisation, and graphite foam, a high link density can be achieved**
  link pitch < 5 cm for S/N>20



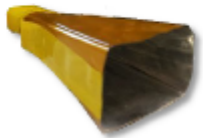
Study for ATLAS silicon tracker from Heidelberg university



- **Valuable studies achieved!**
  - Bit Error Rate < 4×10^{-15}
  - Material properties at 60GHz
  - No significant influence on SCT electronics
  - **Crosstalk mitigation**



shielding: Graphite foam cover



high directivity: Aluminized Kapton horn antennas

Future:

- **60Ghz demonstrator**
- **high density integration**
- **On-chip antenna**
- **Operation in extreme environment**
- **Efficiency improvement**

A Millimeter wave readout system

Challenging but doable

Outcomes for HEP and more

Extend the existing collaboration

Draft available

- https://archive.org/details/WADAPTDRAFTV0