Design, Development and Testing of 60 GHz Wireless Links for ATLAS Detector Data Readout

UPPSALA UNIVERSITET

Imran Aziz[1,2*], Yasin Alekajbaf[1], Dragos Dancila[1], Kristiaan Pelckmans[1], Abhinav Jain[3], Richard Brenner[1]

[1]Department of Physics and Astronomy, Uppsala University, Sweden. [2]Mirpur University of Science and Technology (MUST), Mirpur Azad Kashmir, Pakistan. [3]Department of Electrical Engineering, Uppsala University, Sweden.

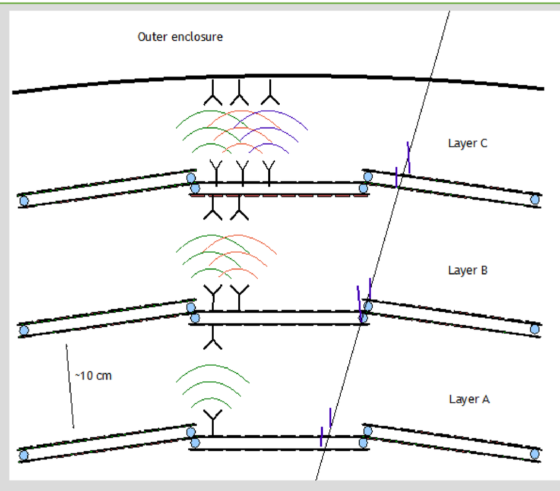
* **imran.aziz@physics.uu.se**

Introduction and Motivation

Motivations to propose the replacement of ATLAS wired readout links with the wireless:

- ❖Cost reduction
- ❖Simplified installation and repair
- ❖Reduction in dead material
- ❖Reduced latency: Radial readout instead of axial
- ❖Simplified broadcast: If a signal to be sent to many
- ❖Neuromorphic tracking in topological radial networks

(*a*)



(*b*)

Fig. (1) (*a*) *ATLAS inner detectors: cables contribute significantly in active detector volume* (*b*) *Proposed 60 GHz wireless links to totally / partially replace cables*

Challenges with Proposed Solution

- ❖ One of the involved challenges is that the tracking layers at the detector are almost hermetic, acting as a Faraday cage, that allows multiple links in the volume without severe crosstalk, but doesn't allow propagating the signal between the layers.
- ❖ For propagation between the layers, we have designed and developed an active repeater board, which is passed through a couple of millimetres (mm) wide slit between the modules on each layer.

Active Repeater: Design and Testing

Fig. 2. *Antenna design with its radiation pattern and S11 (simulations)*

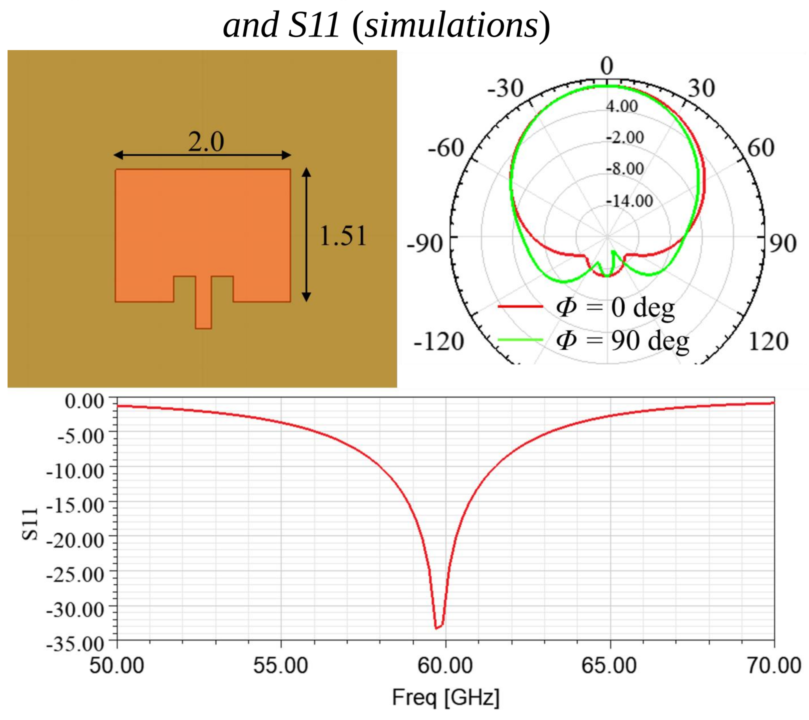


Fig. 3. *Fabricated active repeater board (a) amplifier is wire-bonded on the board (b).*

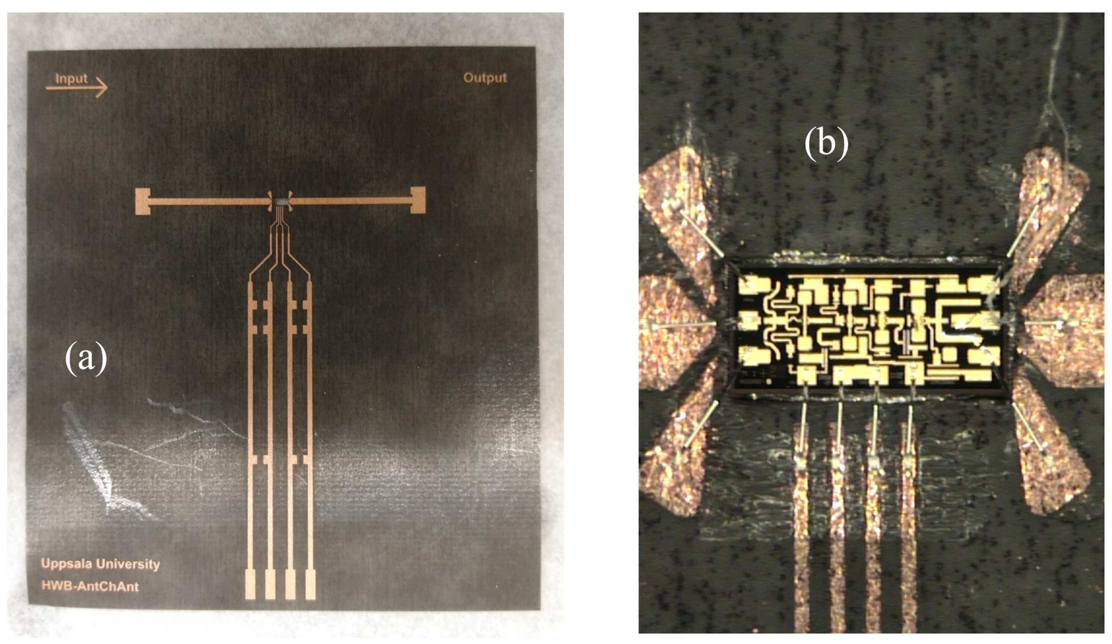
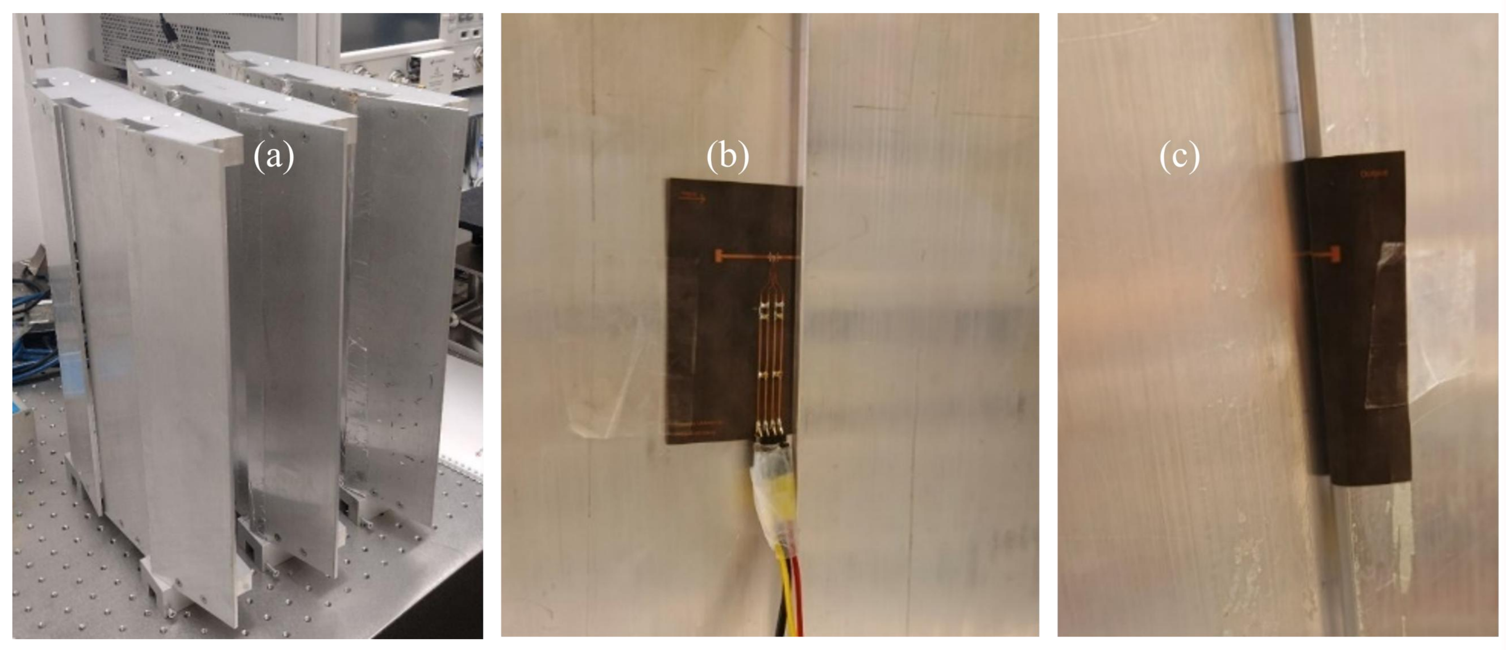


Fig. 4. *Test setup (a) Mockup (b) Repeater board mounted on the mockup, input antenna can be seen on the left (c) output antenna, transmitting the amplified signal on other side of the layer*



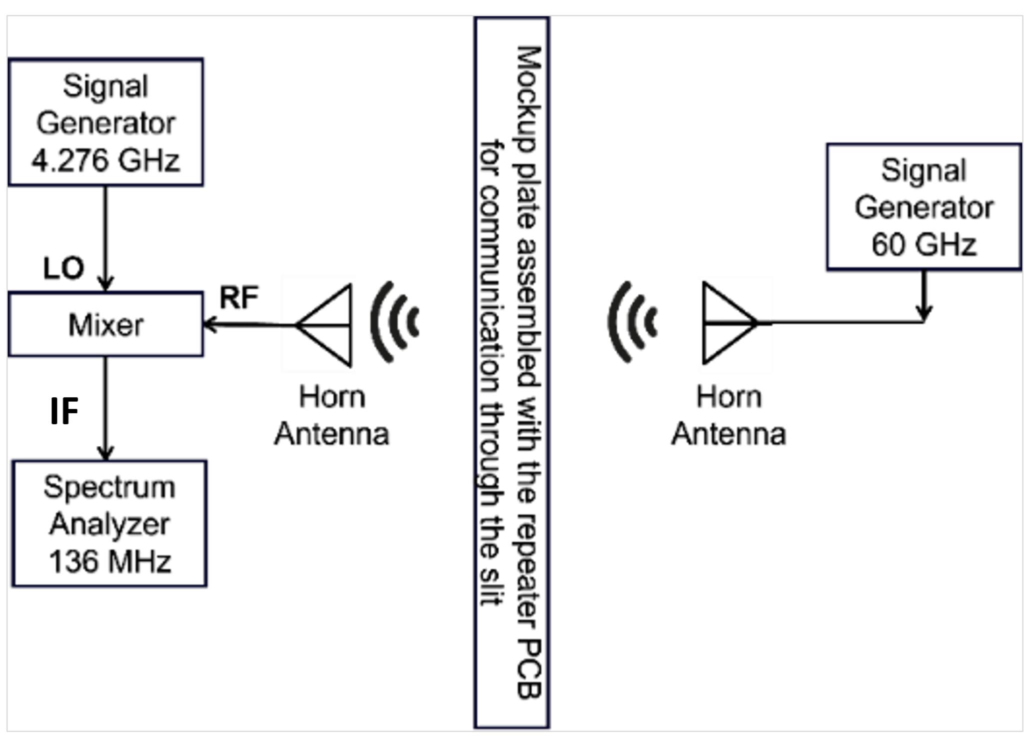


Fig. 5. *Measurement setup schematic for propagation through the tracking layer with the help of active repeater board. The RX patch antenna on the repeater board, mounted on the mockup, receives the signals from the horn antenna on the right, and the TX patch antenna re-transmits the signal to the horn antenna on the left.*

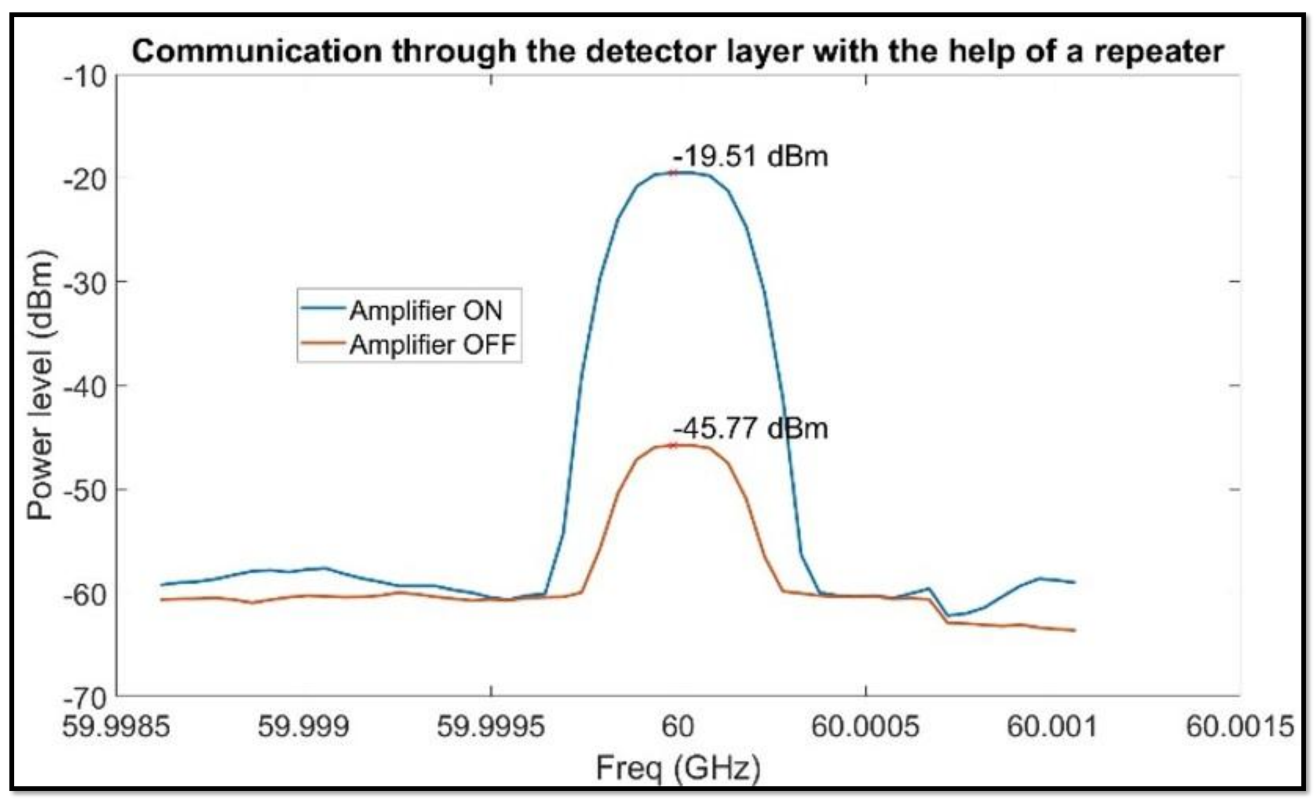


Fig. 6. *Corrected power levels when the amplifier is ON (blue) and when the amplifier is OFF (orange). The distance between the horn antenna and the repeater board is 20cm.*

Conclusion and Future Works

- ❖ For a 20 cm distance between the horn antenna and the repeater board, the RX level is -19.5 dBm, while for the same setup, when the amplifier the OFF, the RX level is -45.8 dBm.
- ❖ The results represent a significant milestone towards the implementation of 60 GHz wireless links for the detector data readout.
- ❖ In the next step, we are working on integrating the ST 60 GHz transceiver chip with the amplifier and antenna to design a complete 60 GHz wireless link.
- ❖ The ST transceiver chip shall be fed with 5 Gbps data through an RF-SoC (radio frequency Silicon on chip).

WADAPT Collaboration: **W**ireless **A**llowing **D**ata **A**nd **P**ower **T**ransfer