

Expression of Interest

K.K. Gan, S. Smith, B. Tar,
M. Ziolkowski, W. Stroh, J. Winter, S. Heidbrink

18 October 2023



Outline

- Digital Design Capabilities
- Analog Design Capabilities
- Facility
- Past Accomplishments
- Possible area of interest

Digital Design

- Digital block design capabilities
 - Verilog, VHDL, and implementation on FPGAs for verification and testing
- Designed and fabricated 3 digital blocks in TSMC 65 nm
 - All radiation-hard and have triple-redundant registers
 - Registers are placed away ($20\text{ }\mu\text{m}$) from each other
- Automized the whole process via customized Perl scripts
- Capable of using all possible technology options

Analog Design

- Skills
 - High-speed transceivers, low-power circuit design, radiation-hard circuits
- Designed, fabricated and tested a complete VCSEL driver in TSMC 65 nm for 1.28 Gbps and 5.12 Gbps
 - B. Tar, K.K. Gan, P. Buchholz, S. Heidbrink, W. Stroh, J. Winter, M. Ziolkowski, "Radiation-Hard Miniature Optical Engine with High Bandwidth," Elsevier Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, vol.978, Oct. 2020.

Facility

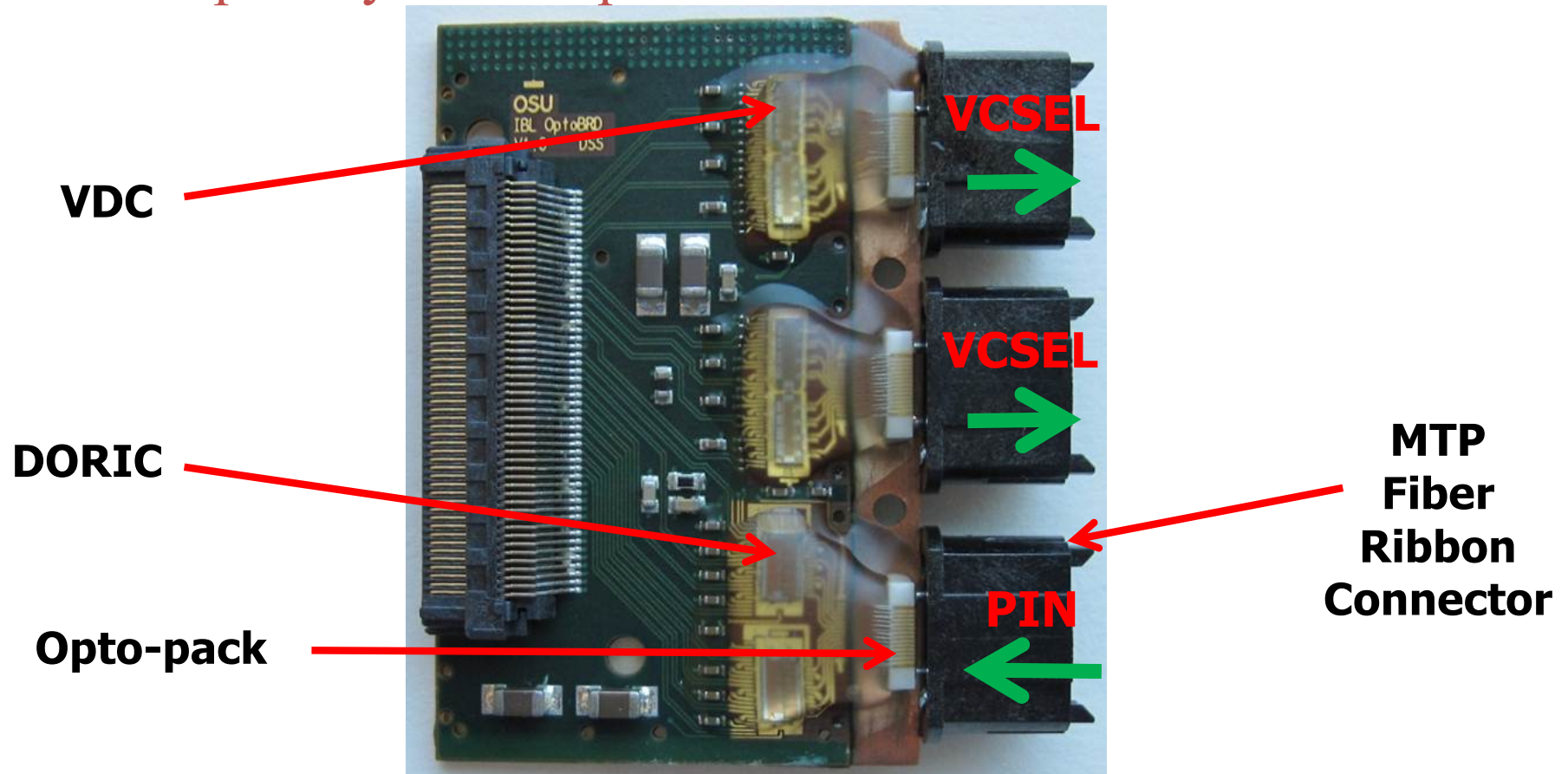
- Fully automated wedge/ball bonder – F&K G5
- Semi automated ball bonder – West Bond 4KE
- Automated Probe station – Cascade Microtech PA200
- High-speed oscilloscopes – LeCroy SDAzi-A 25 GHz
- Environmental chambers for temperature cycling

Past Accomplishments

- Built three generations of ATLAS Pixel optical links
 - Radiation-hard receiver and transmitter ASICs
 - Many irradiation champions at CERN test beams
 - Multiple long-term reliability studies
 - 400 opto-boards for each generation

Opto-Boards with VCSEL/PIN Arrays

- Opto-boards transmit and receive data optically to/from pixel detector



3 cm

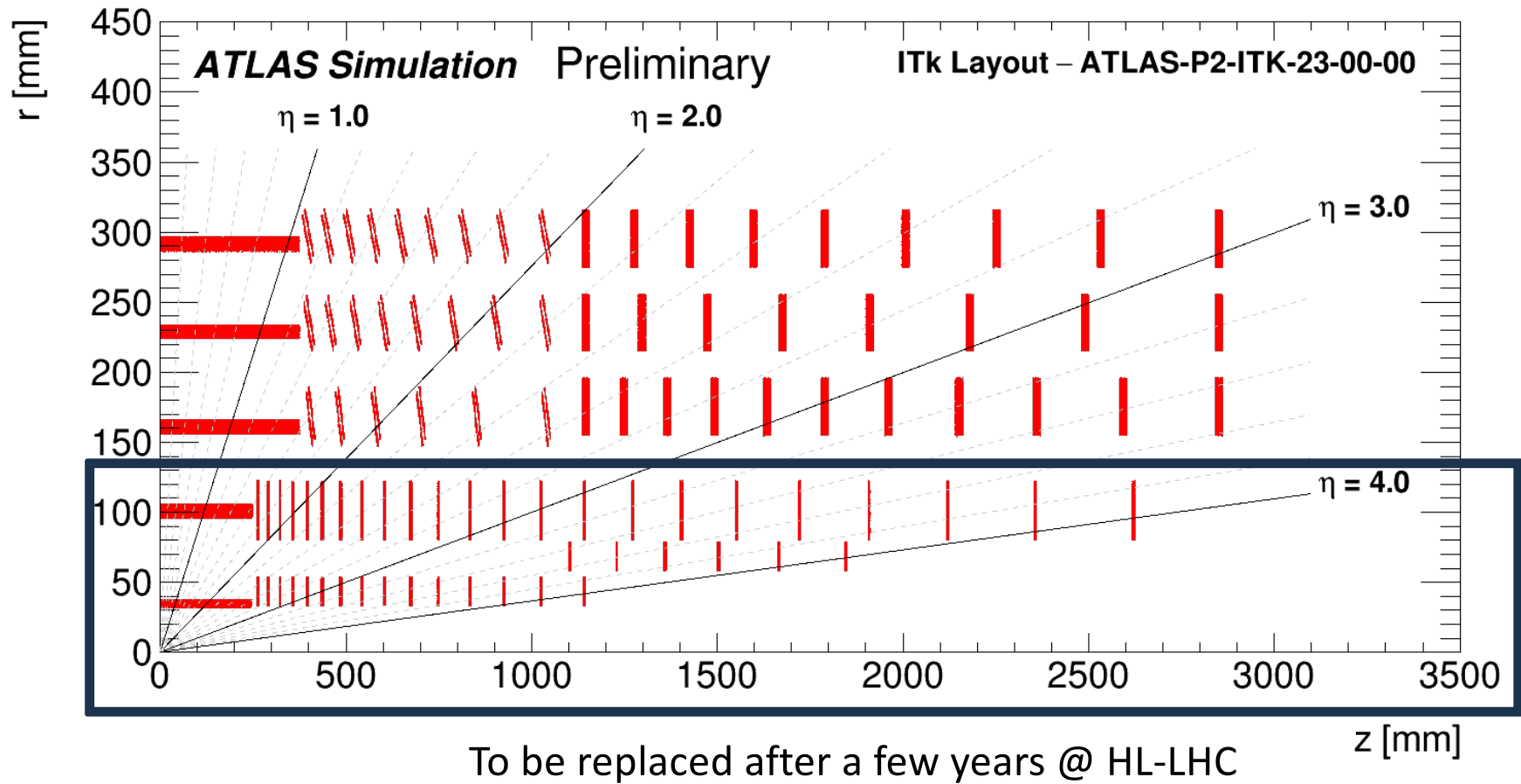
WADAPT

18 October 2023

Wireless Transmission in Next Upgrade?

- Inner pixel system of ATLAS ITK will need to be replaced after several years of operation at HL-LHC
 - Currently 1.28 Gb/s signals are transmitted via 6 m of Twinax before transition to optical links
 - Would love to replace Twinax by wireless transmission
 - Extremely challenging to transmit 1000 links @ Gb/s due to interference inside 25 cm diameter cylinder
 - If not feasible, the technology would still find application in the less challenging e+e- collider

ATLAS ITK Pixel Detector



18 October 2023

WADAPT

How We Can Contribute

- Package 4: Proof of concept demonstrator with commercial products (24 m)
 - we have the equipment and expertise to conduct this research
- Package 6: Design an integrated multi-channel readout ASIC (T0-T0+36 m)
 - we are equipped to design Analog and Digital blocks