The design of the CIC

- Concentrator IC (CMS upgrade for the High Luminosity LHC)
- TSMC 65n technology
- flipchip (bumps) + wirebond pads (for testing purposes) without encapsulation
- radiation tolerance: ~100Mrad TID in worst case
- Single Event Transient and Upset resistant
- 3 IRs full time from 2017 to 2019 (IP2I)
- three foundry submissions (2018, 2019, 2021)
- punctual support from CERN ASICS group (management, design and tools)
- wafers production already started: 30K diced and tested chips to be integrated in the CMS OT Tracker



Photograph of two CMS Outer Tracker Strip-to-strip (2S) modules: the CICs are highlighted



Design methodology at IP2I



The CIC design followed a Digital On Top methodology:

- fully digital core design (data handling, store and forward)
 - RTL code written in System Verilog and firstly used for design specs validation
- few analogue blocks (phase data alignment and sLVS transmitters and receivers) designed within CMS collaboration

Design methodology at IP2I

The CIC design followed a Digital On Top methodology:

• fully digital core design (data handling, store and forward) • RTL code written in System Verilog and firstly used for design **Specifications** specs validation • few analogue blocks (phase data alignment and sLVS transmitters Physics simulations and receivers) designed within CMS collaboration **RTL** design Verilog/System Verilog HDL design periphery IO with full custom ESD and IOs (behavioural model + Verilog/Python functional Test Bench "flat" (no hierarchy) digital synthetizable code) implementation with single core supply: Virtuoso test benches IPs characterization standard and low VT standard cell Liberate AMS families TCL scripts **Synthesis** SDC constraints (Flat) physical implementation TCL scripts System Verilog SDC constraints Gate level simulations (UVM) Verification Test Bench Floorplanning, power plan, Clock and reset distribution Power analysis TCL scripts Optimization Timing closure Signoff TCL scripts GDS + verification Calibre

(many) questions

