



Darkside-20k

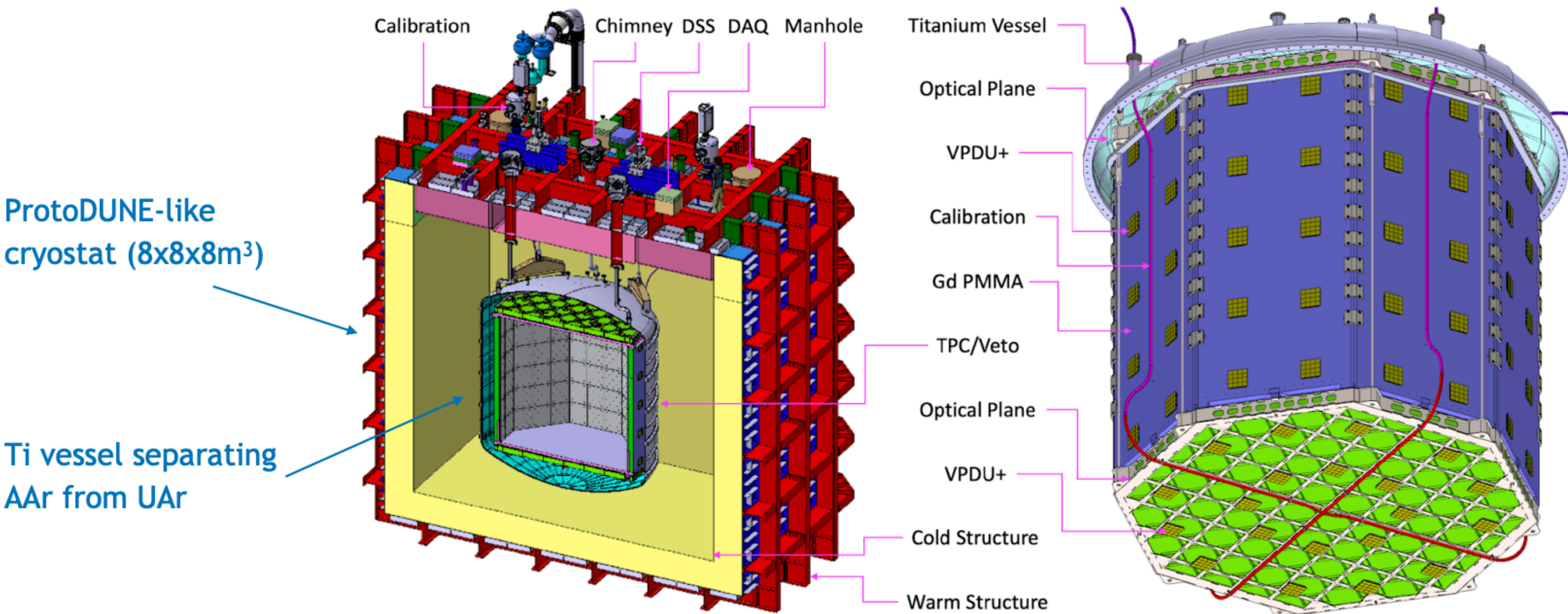
darkside
two-phase argon TPC for Dark Matter Direct Detection





- Experiment overview
- People
- Production plan and part flow
- vTile assembly
- Cold testing
- Summary and Future

The Darkside-20k experiment



20m² of silicon fabricated by LFoundry in partnership with FBK, Trento.

Experiment at LNGS and cryostat operated at 87K

TPC

- 50 ton of underground LAr
- Gd-loaded acrylic (PMMA) walls to capture neutrons
- Walls coated with TPB as WL shifter
- 2112 channels, each grouping 96 SiPMs

Inner Veto

- 35 ton of underground LAr (single-phase)
- 480 channels, each grouping 96 SiPMs

Outer Veto

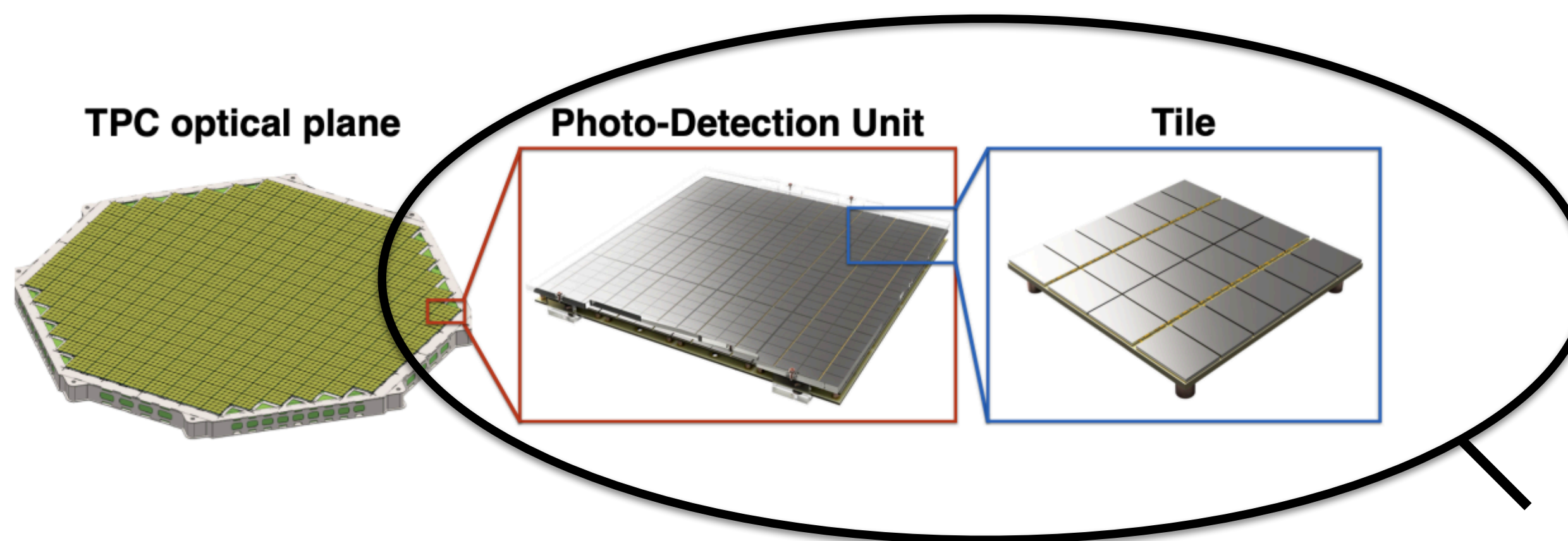
- 700 ton of atmospheric LAr (single-phase)
- 32 channels, each grouping 384 SiPM (PRELIMINARY)



Darkside-20k in Liverpool

- Research staff/academics: Joost Vossebeld, Kostas Mavrokoridis, Tim Jones, Gianluigi Casse, Adam Roberts, Alan Taylor, Jon Taylor
- Technical staff: Liam Boynton, Paul Sinclair, Dan Hollywood, T. Lee, P. Timko
- PhD students: Sudikshan Ravinthiran, Alan Taylor

Thanks to Alan and Adam for a lot of the technical work shown in these slides

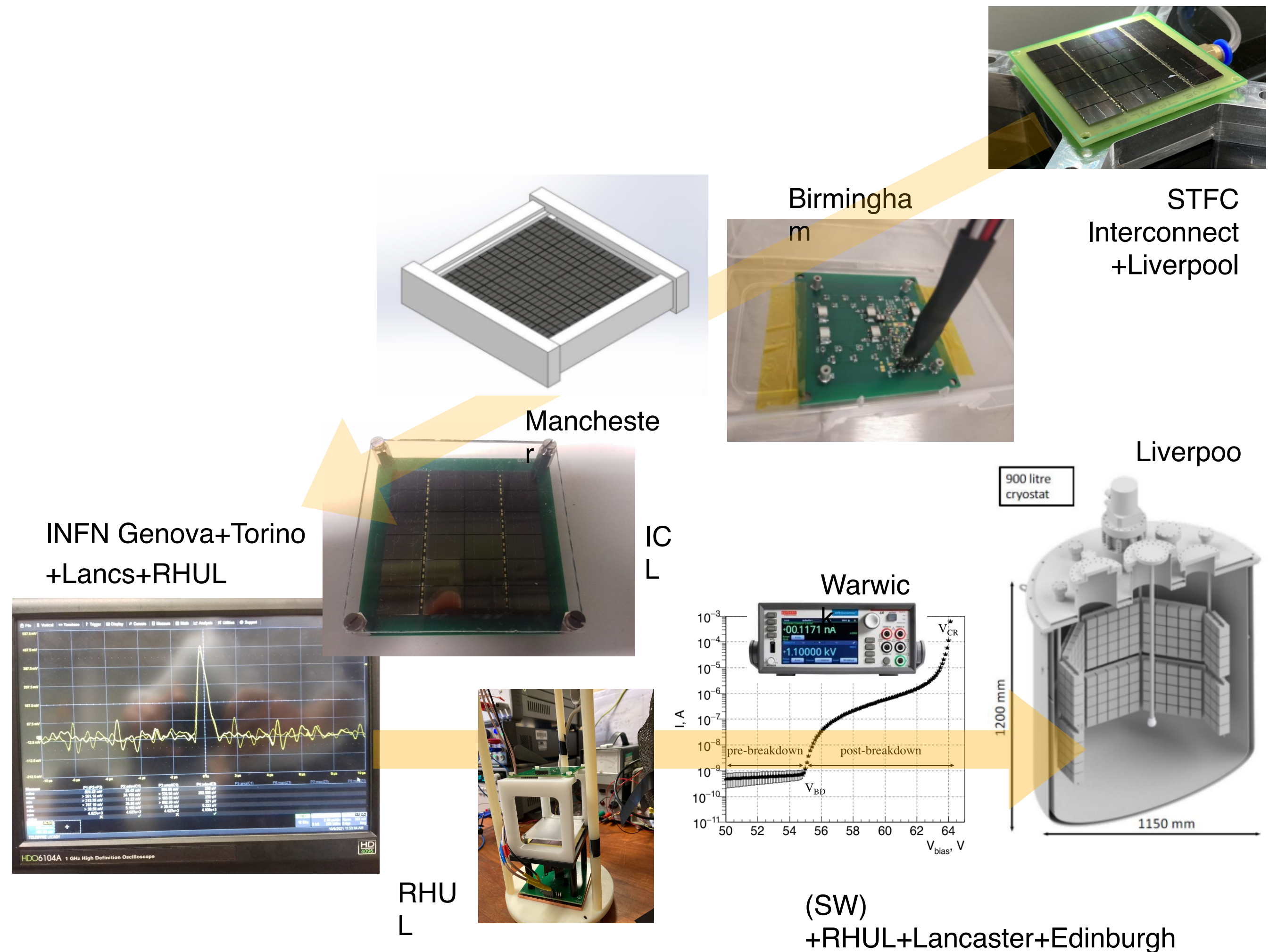


Liverpool involvement

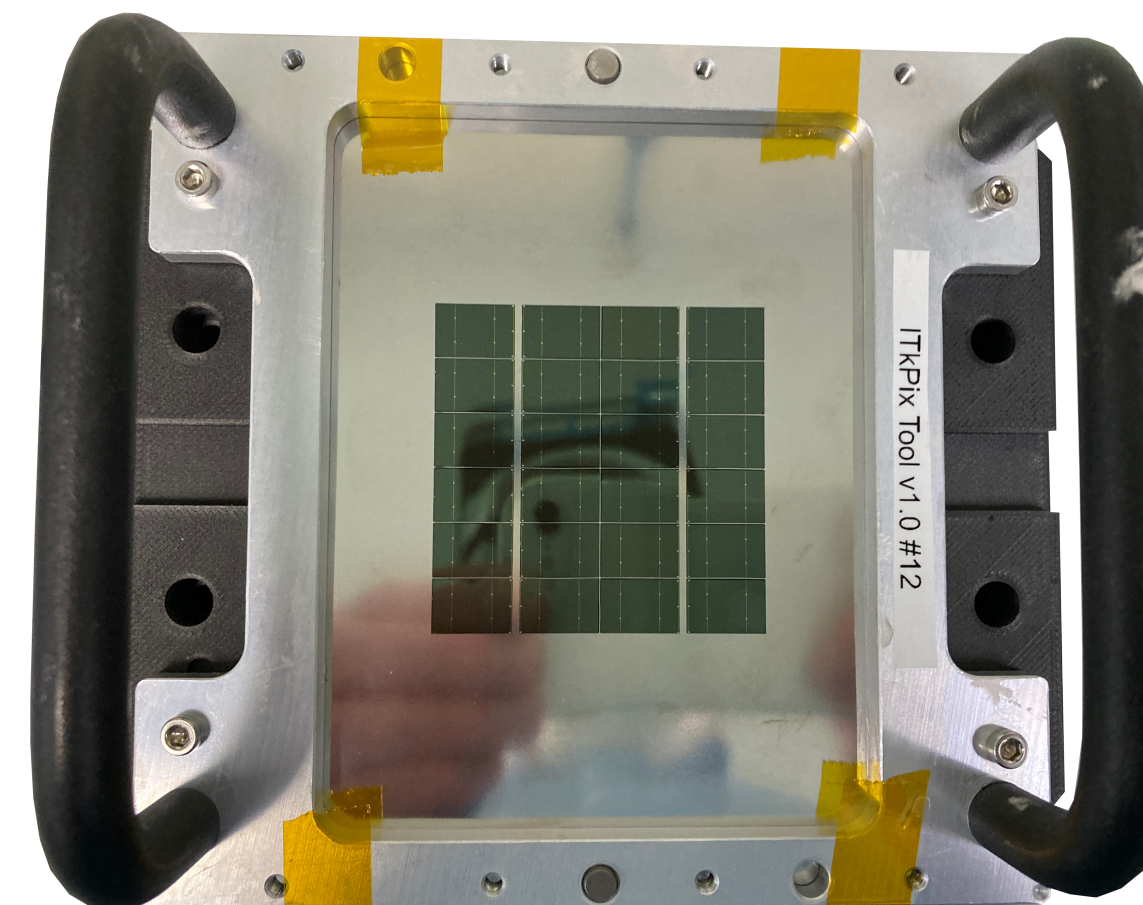
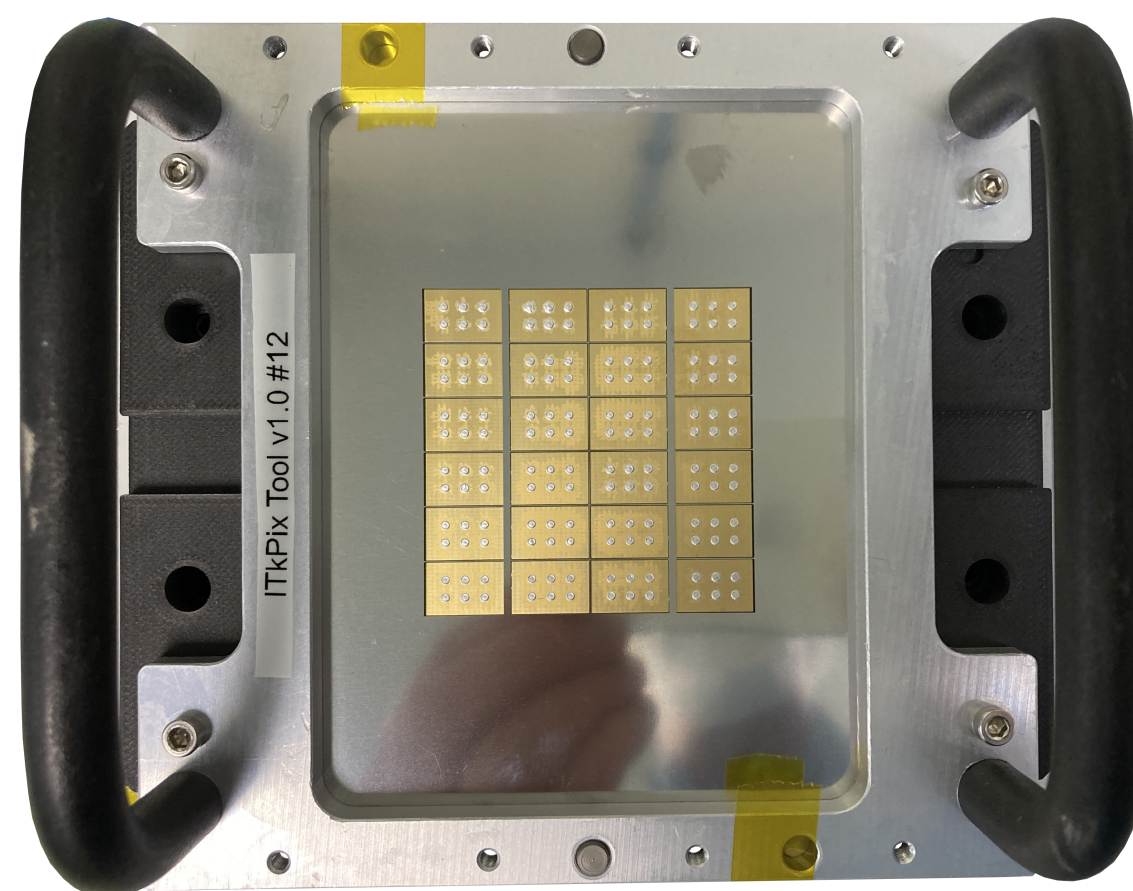
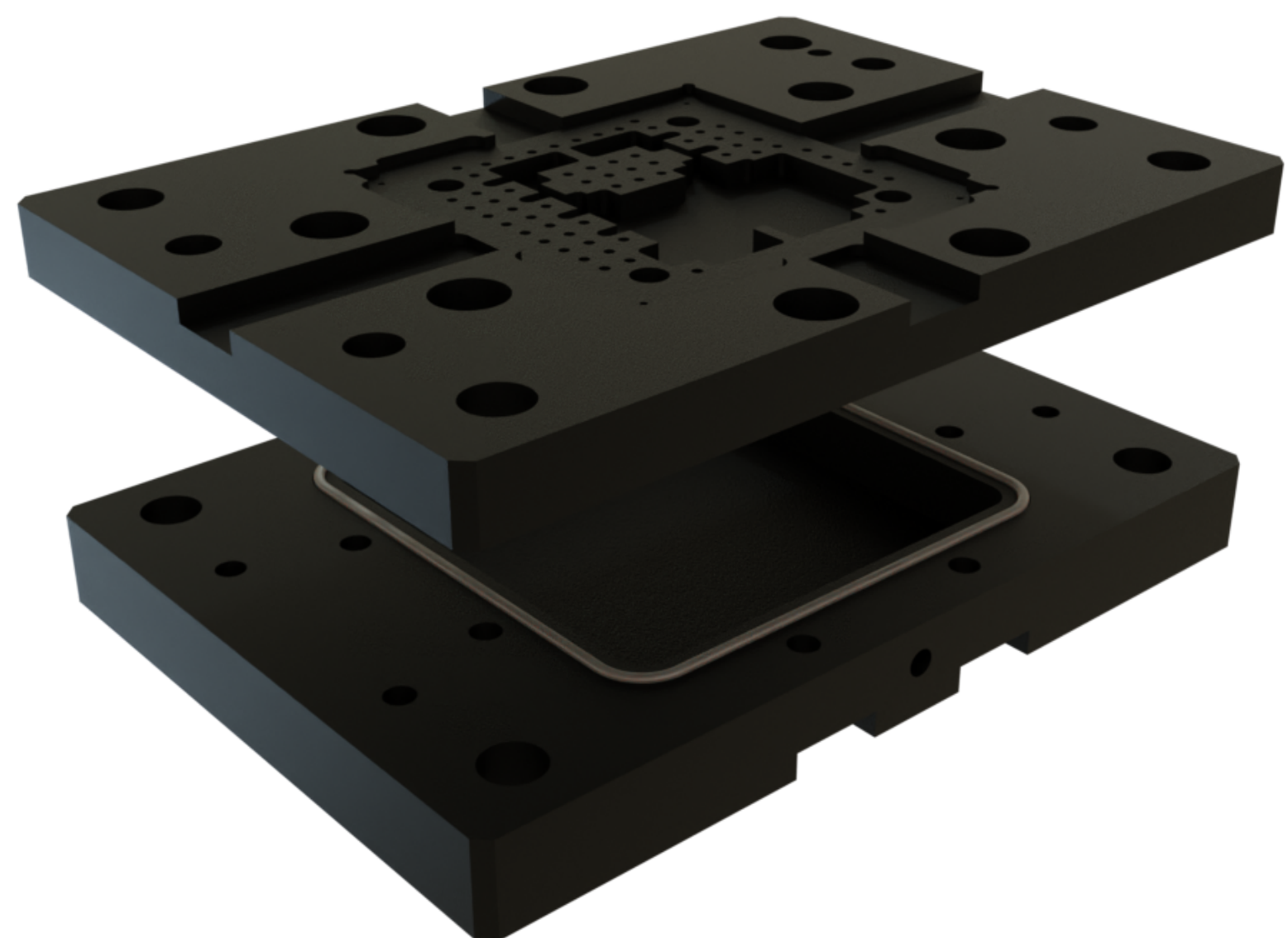


UK veto tile production flow

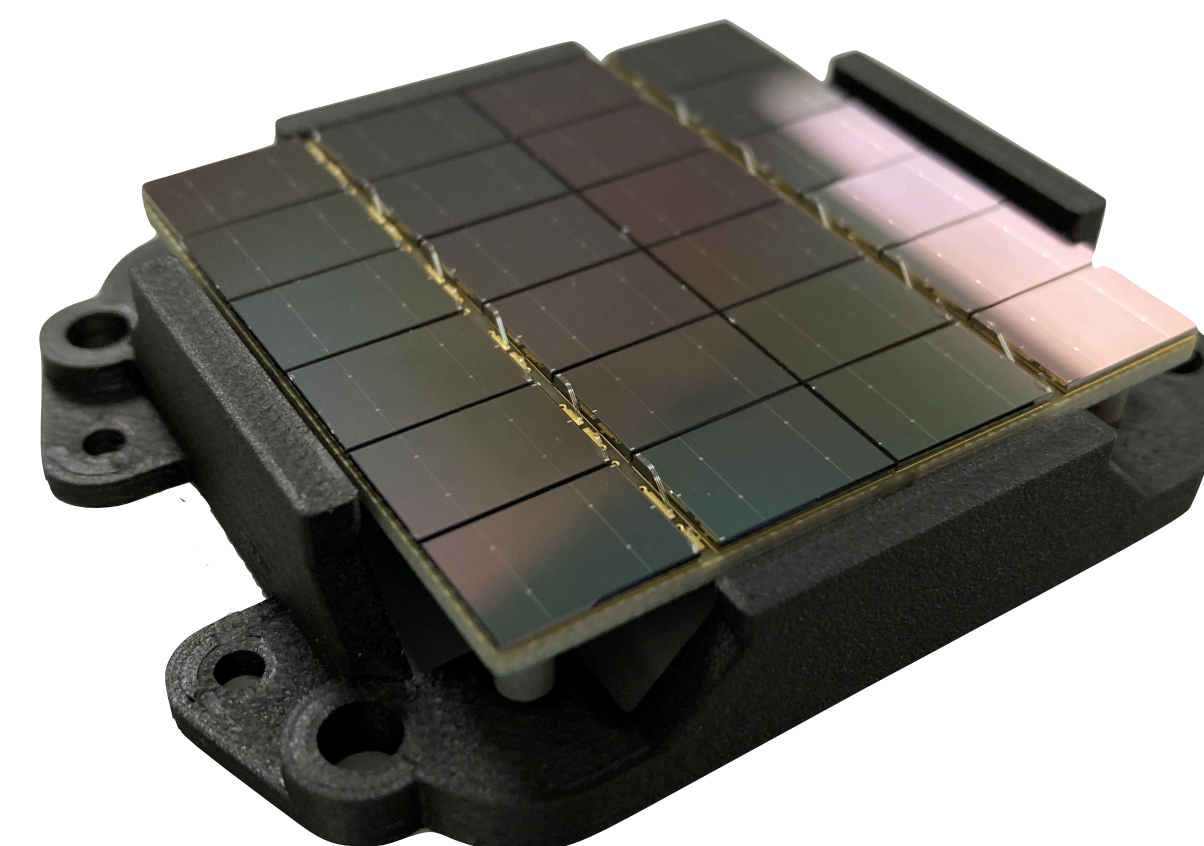
| Object | Location | Activity |
|--------------|---|-------------------------|
| ASIC | IMEC | production |
| ASIC | Alter Technologies | packaging |
| ASIC | Birmingham | Test, prior to assembly |
| SiPM | NOA | cryoprobe test |
| vPCB | Stevenage Circuits, Ltd | production |
| vPCB | Liverpool, possibly Stevanage (under investigation) | QR code engraving |
| vPCB | Birmingham | assembly and test |
| vTile | STFC/LSDC | Assembly and test |
| vTile | RHUL | cold test, single tiles |
| vMotherboard | INFN | production |
| vPDU | Manchester | assembly and warm test |
| vPDU | Liverpool/Naples | cold test, PDU |



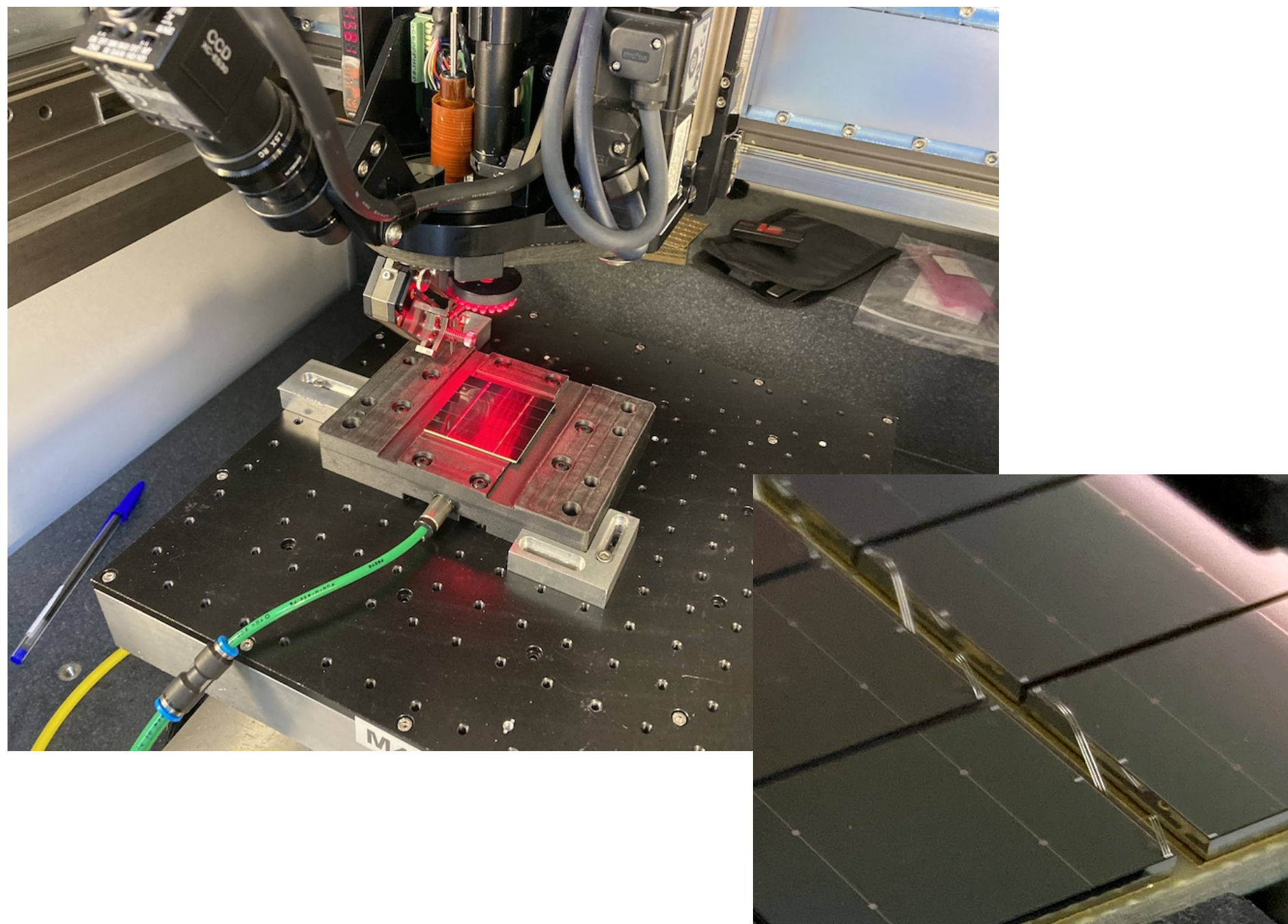
vTile assembly



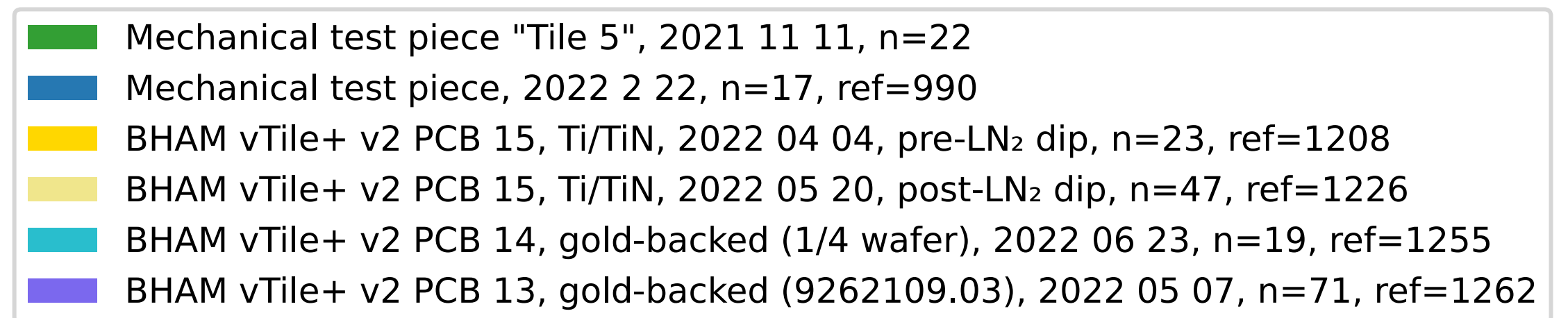
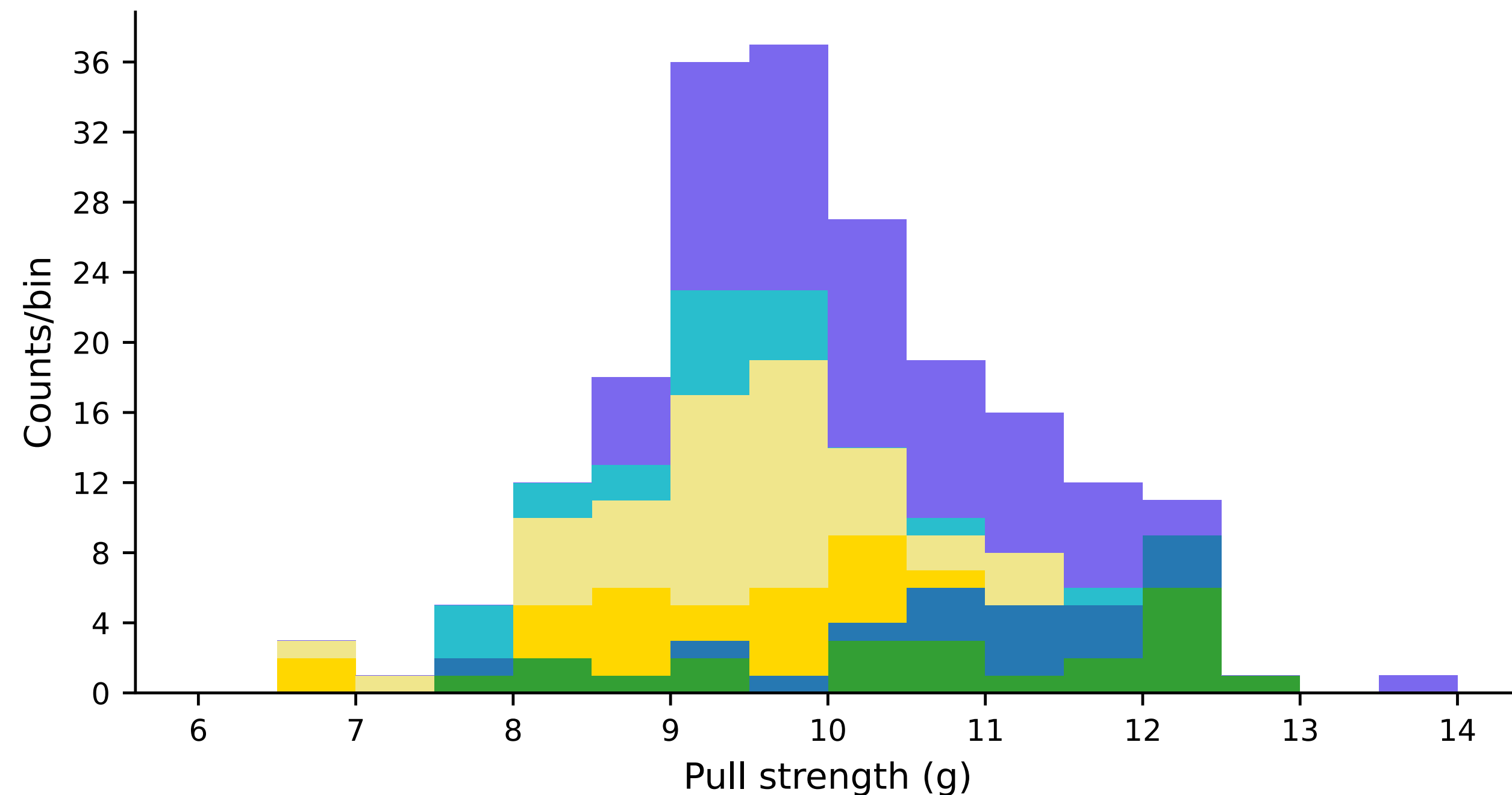
- Custom vacuum tooling 3D printed in AML and machined flat in DFF
- Solder stencils used for deposition of indium solder paste and placement of SiPM dies onto PCB
- After reflow in a dedicated oven, the tile is ready for metrology and wire bonding
- Handling brackets designed and printed for visual inspection and testing



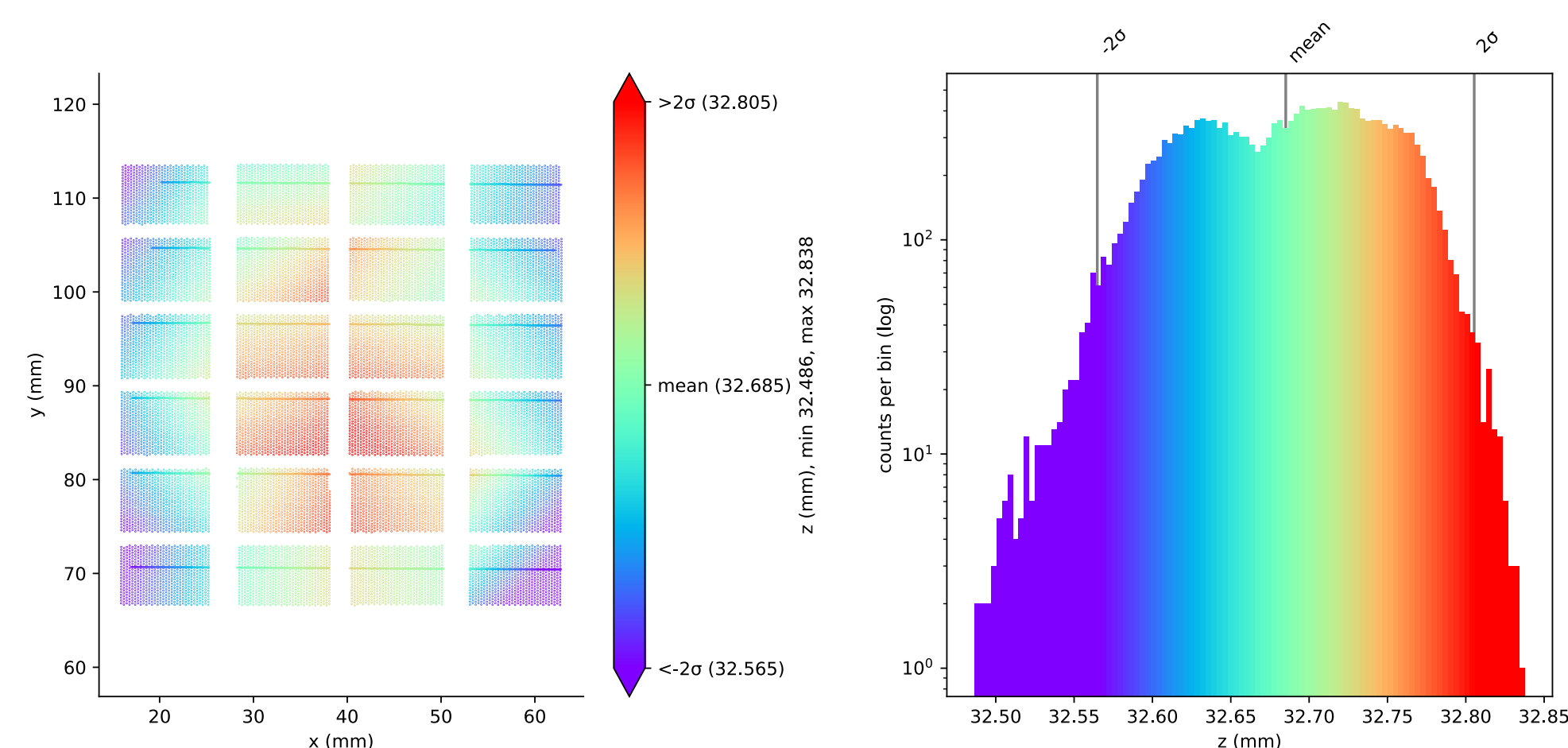
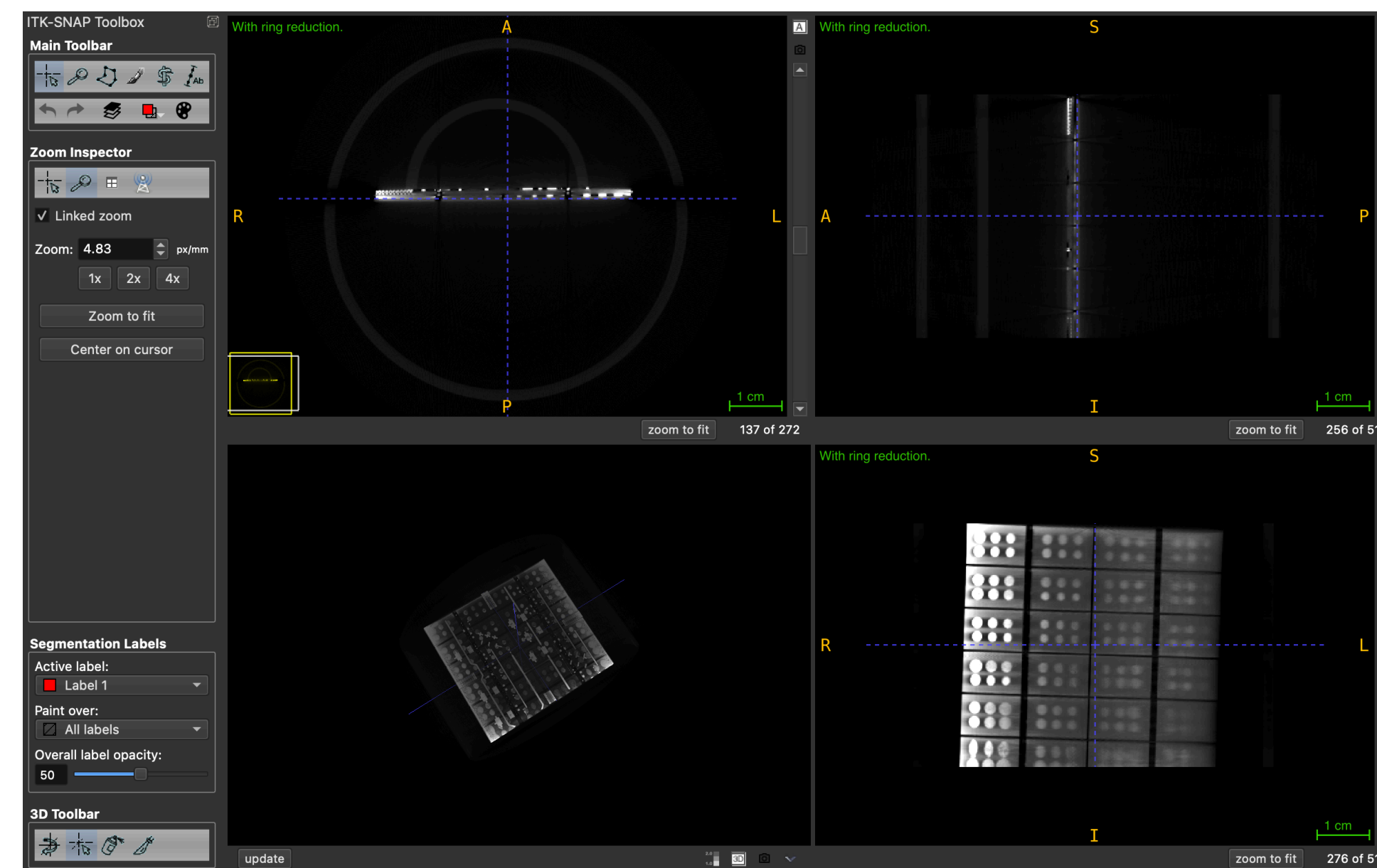
Tile assembly - wire bonding



- Wire bonds from SiPM pad to PCB pad
- pull tests show excellent results and pad lifts have not yet been observed

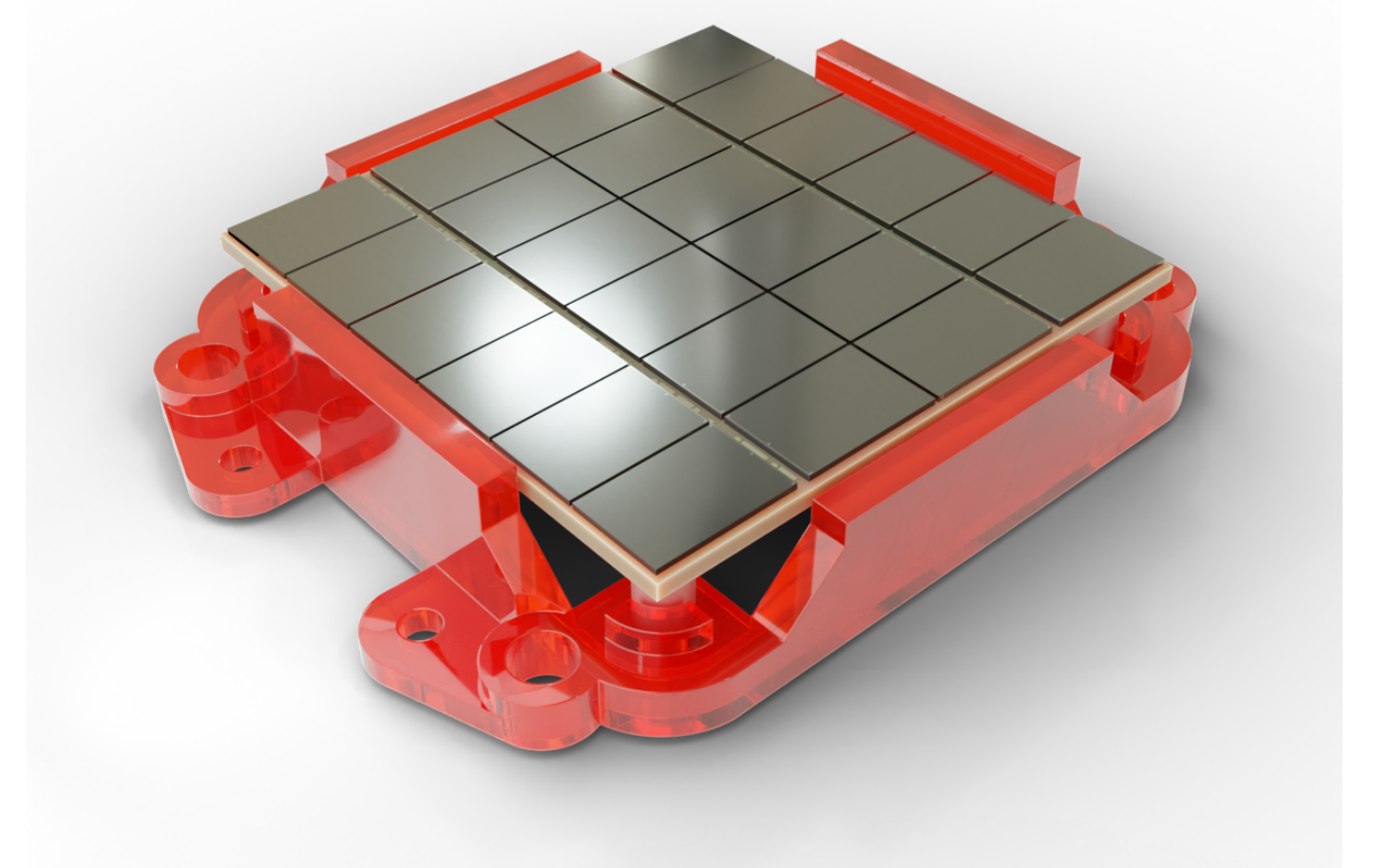
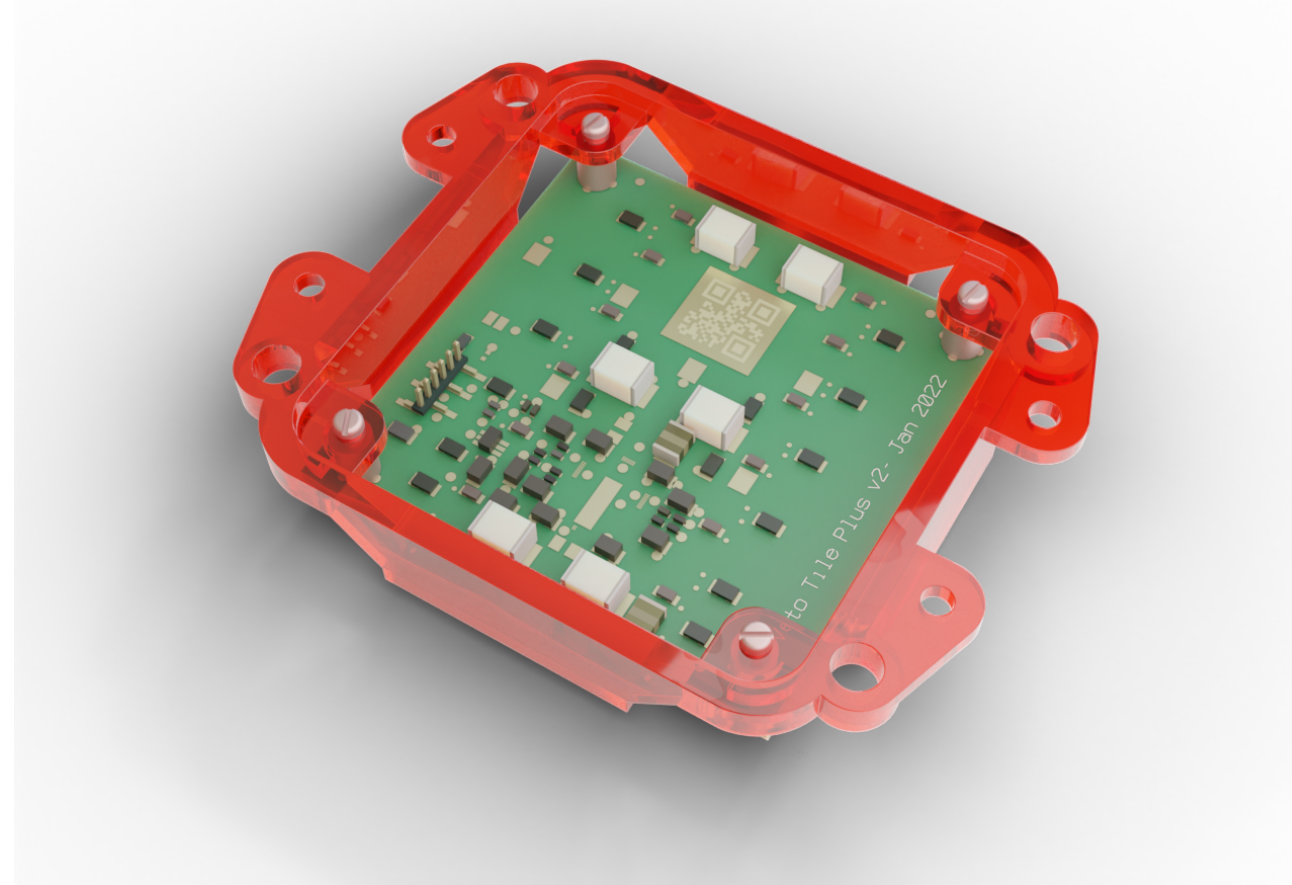
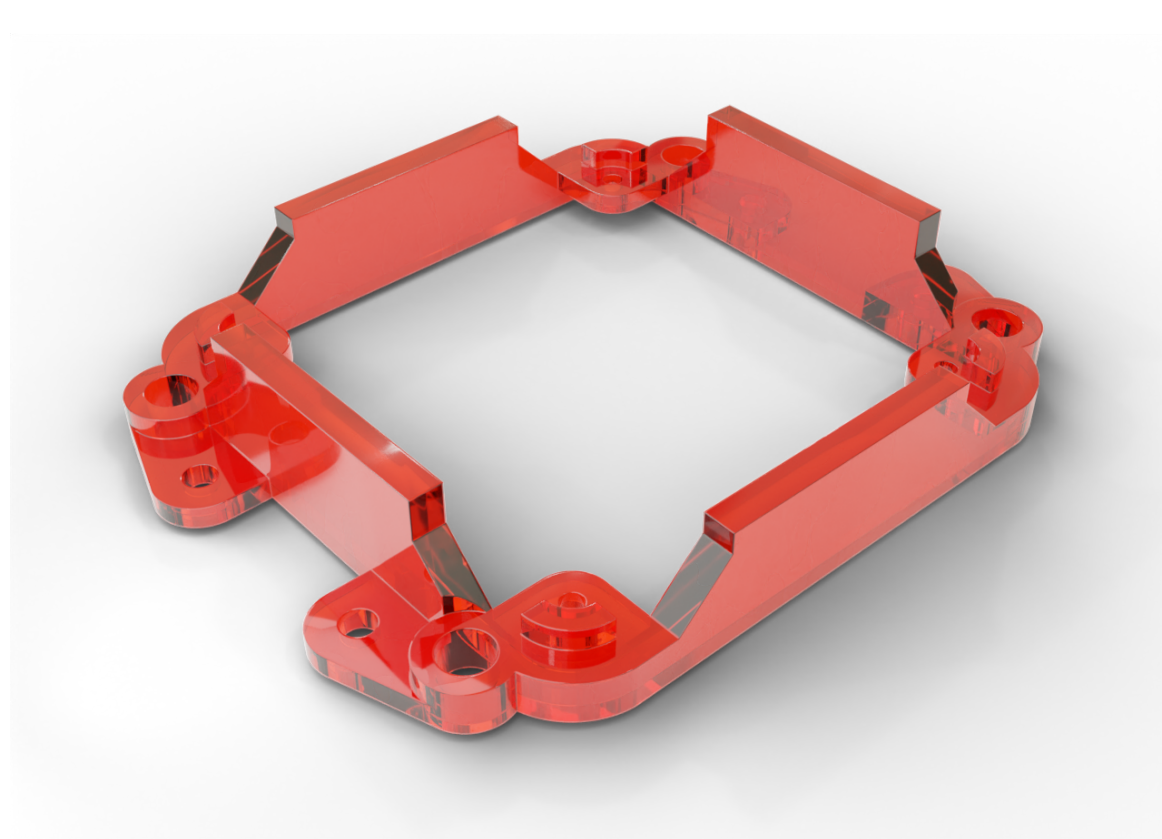


- Visual inspection of assembled vTiles carried out on a high resolution flat bed scanner
- Metrology carried out using the laser measurement attached to the smartscope in the LSDC
- CT scans being investigated for QC of the indium solder distributions between the silicon and the PCB
- Itk-snap software for viewing CT scan data

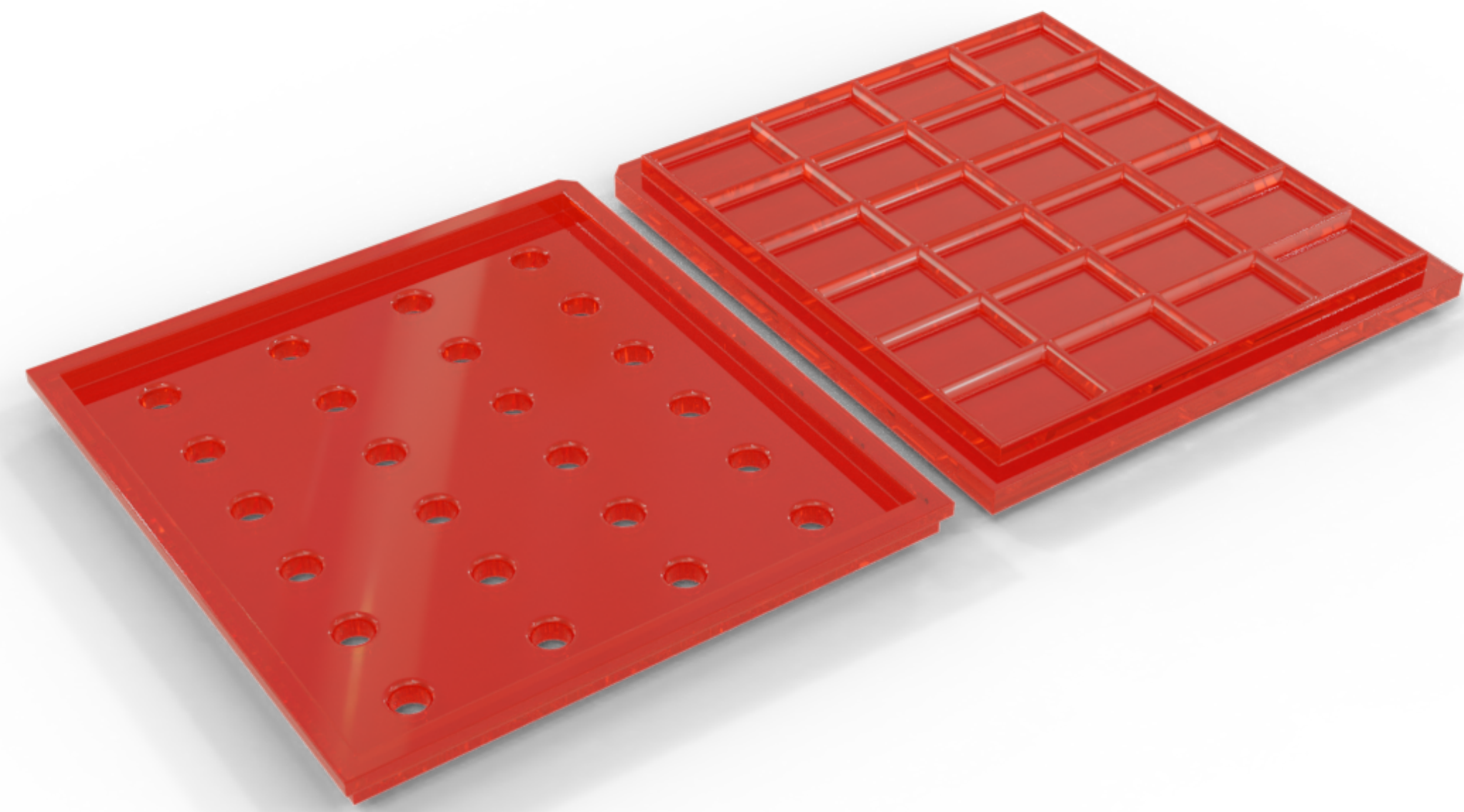




Tile assembly - handling and storage



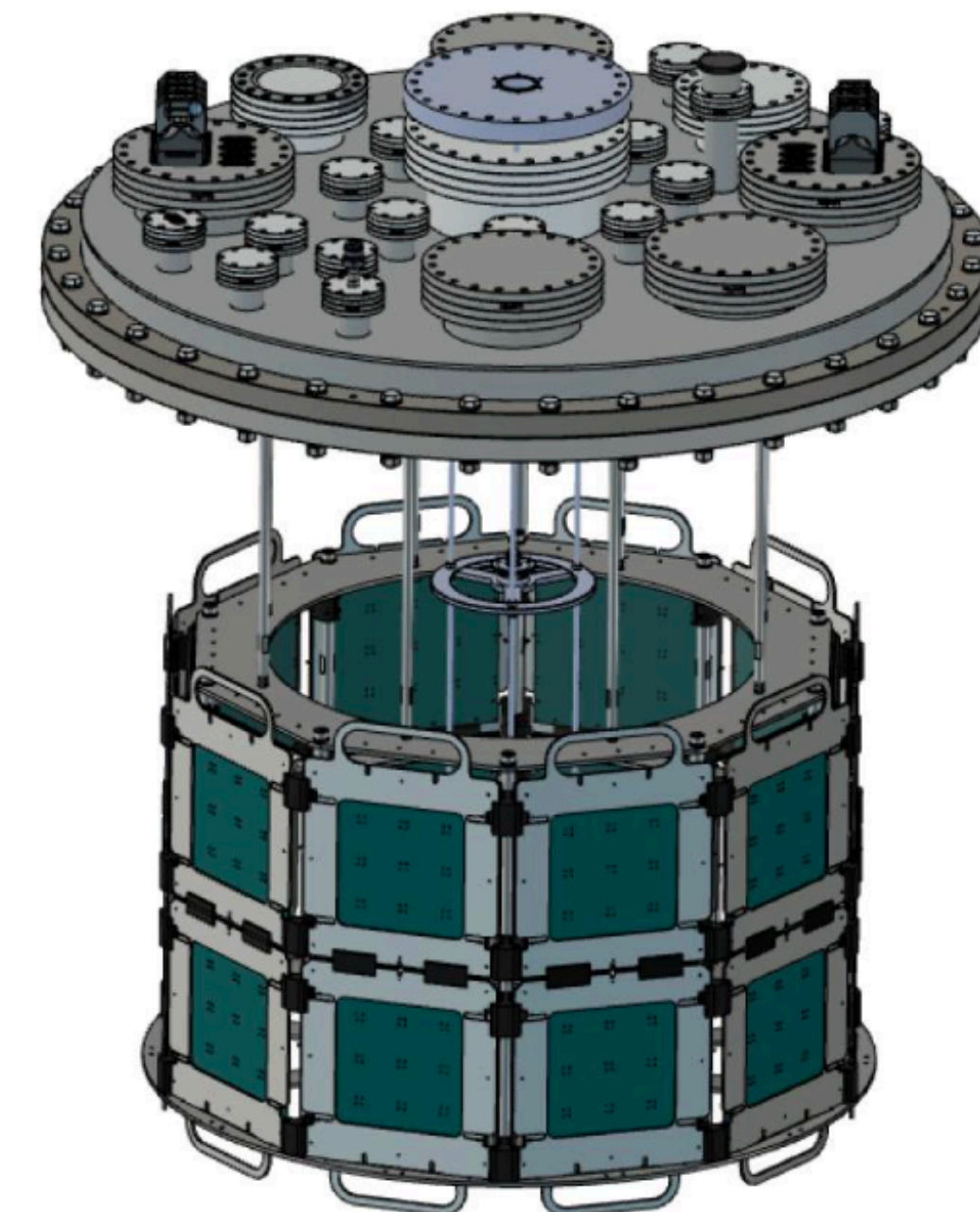
- New ABS resin material investigated for production of the tile handling brackets and the bare SiPM storage trays
- Prevents contamination from CF that were sometimes present after use of Onyx material from FDM printer





Goals of the Liverpool Cold Test site

- Vessel for cold testing of 20 vPDUs per cooldown.
- Central optical calibration system courtesy of Warwick
- VX2745 digitiser, 3x CAEN A2551 LV supplies, 1x CAEN A1541 HV supply.





Cryostat current status

- The main bulk of the mechanics are assembled.
- Need to finish installation of PDU holders, thermocouples, heater etc
- Thermocouples will be installed in four locations, bottom ring, middle ring, top ring and flange underside for feedback during filling/venting.
- MIDAS control of digitisers and LV supplies is essentially ready.
- Testing of full chain using FR4 PDU can happen soon to verify cabling, adapter boards, etc



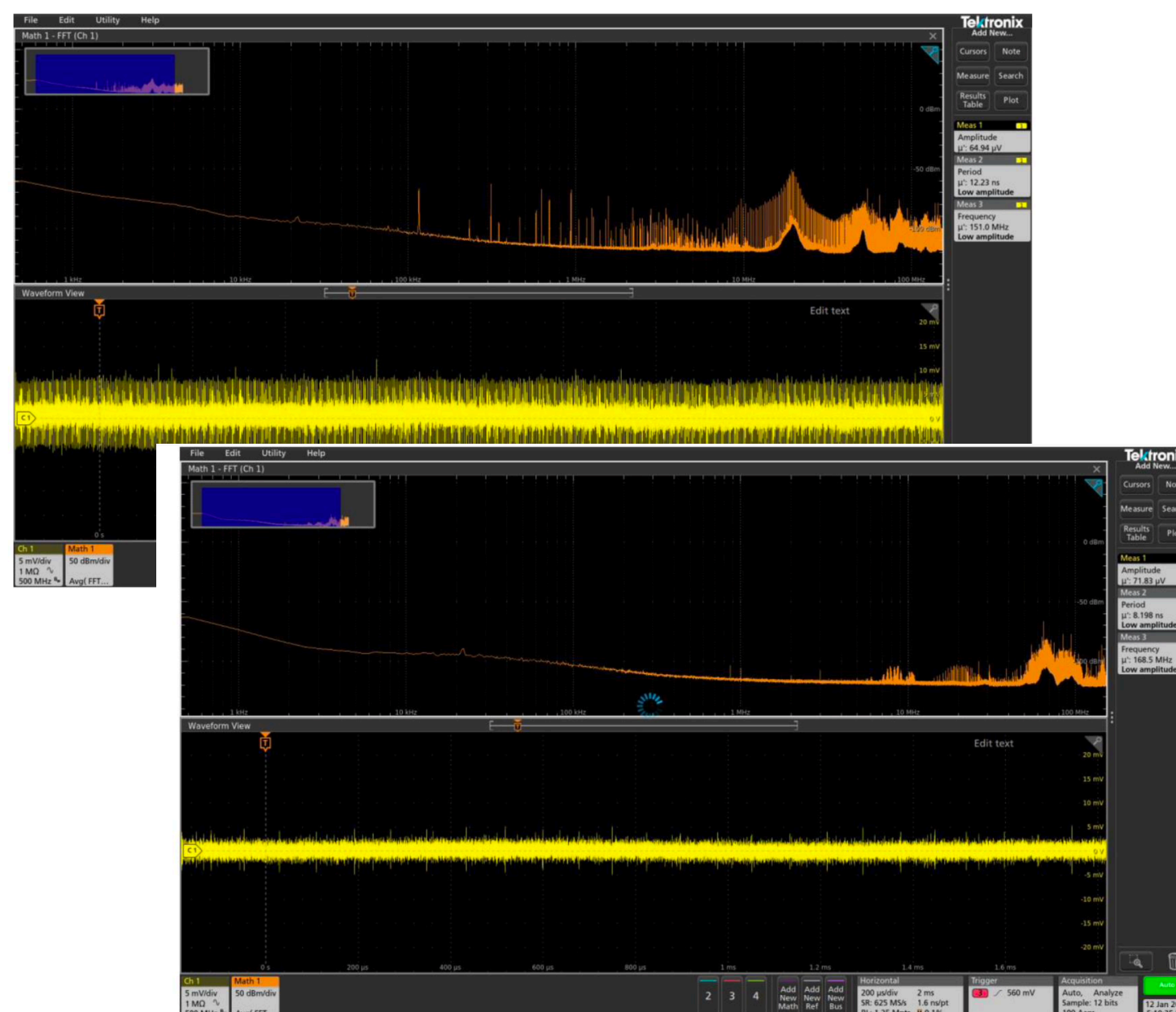
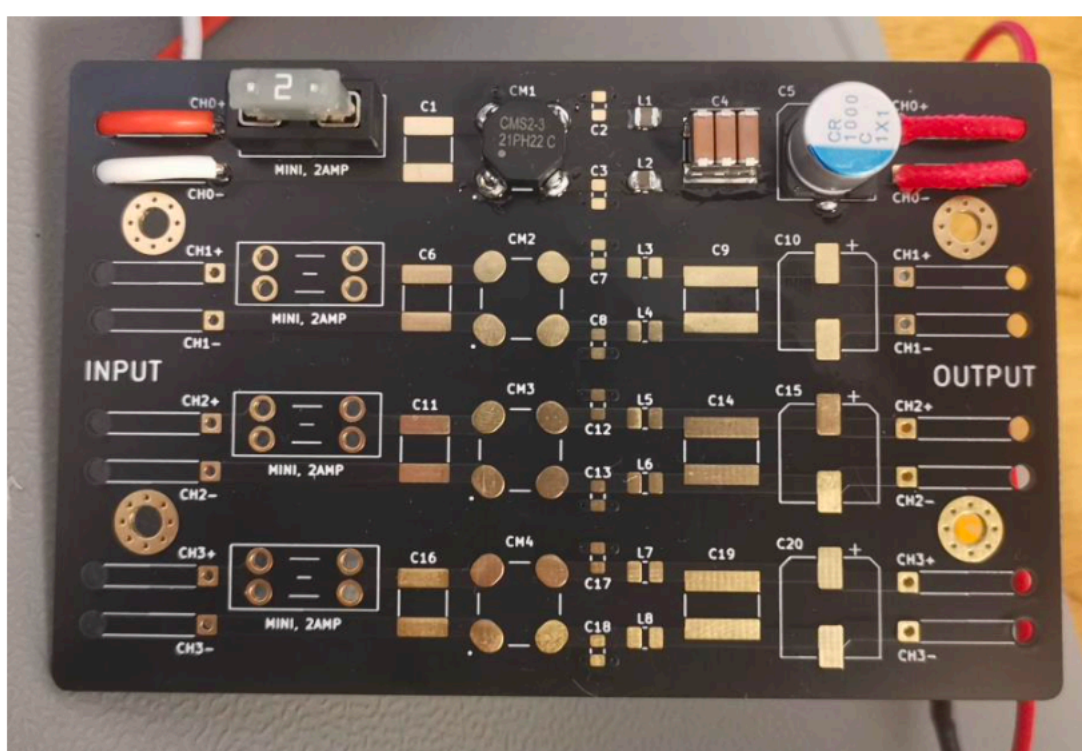
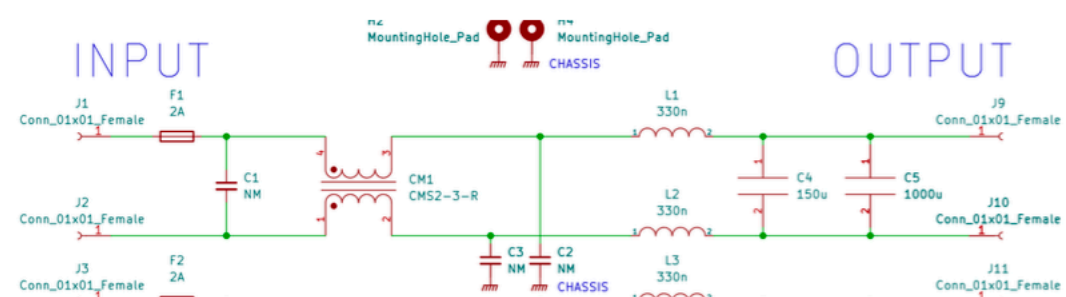


Figure 2: Filtered, 7V/1A

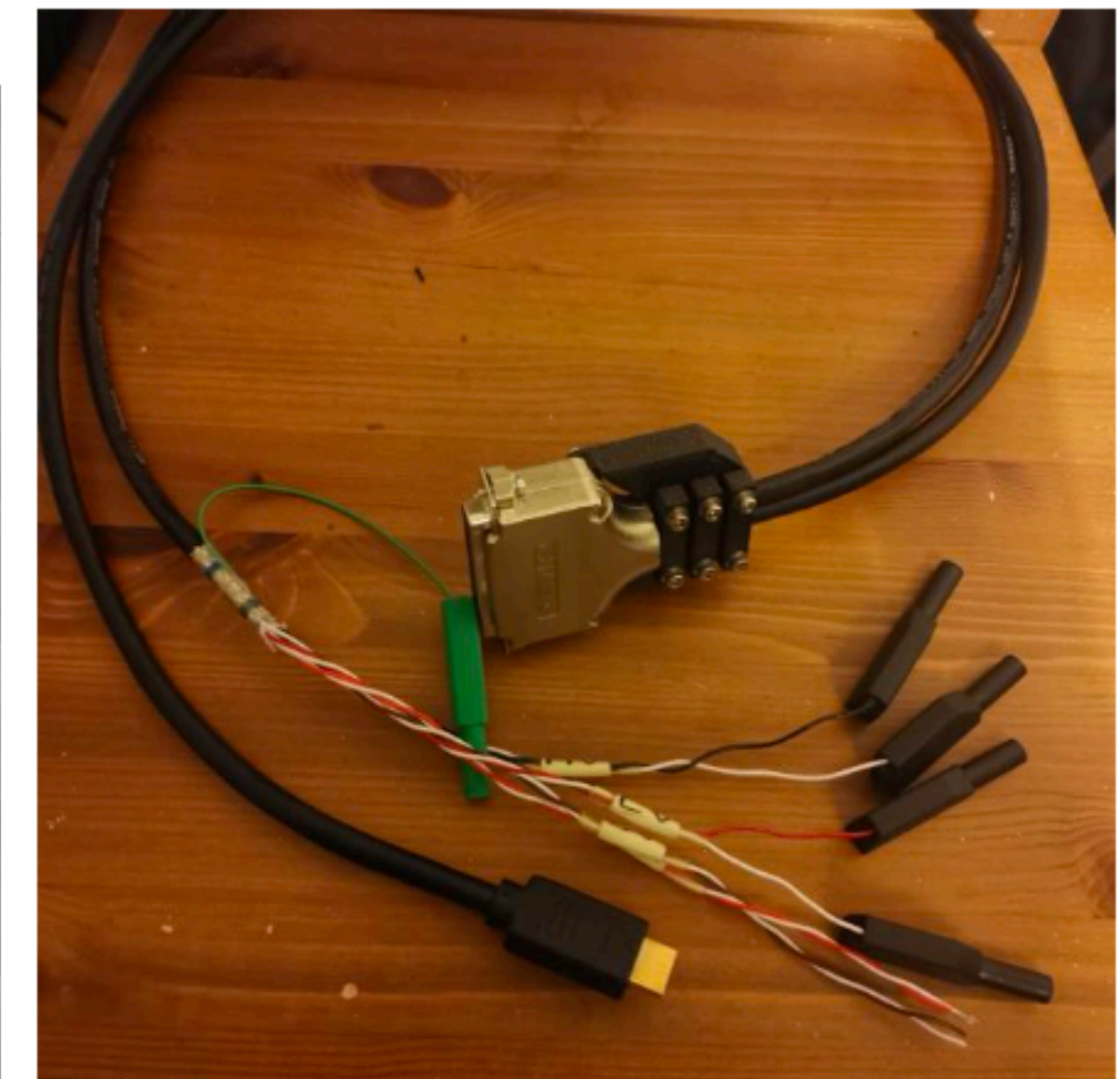
- Due to poor availability of the LTC6820 demo board, a custom steering module board has been developed.
- Enough boards to equip each of the test sites with this same board for a common software/hardware chain.
- Hardware seems to be generally working fine, software, Midas integration etc is being worked on.
- See Martin's talk for more details.

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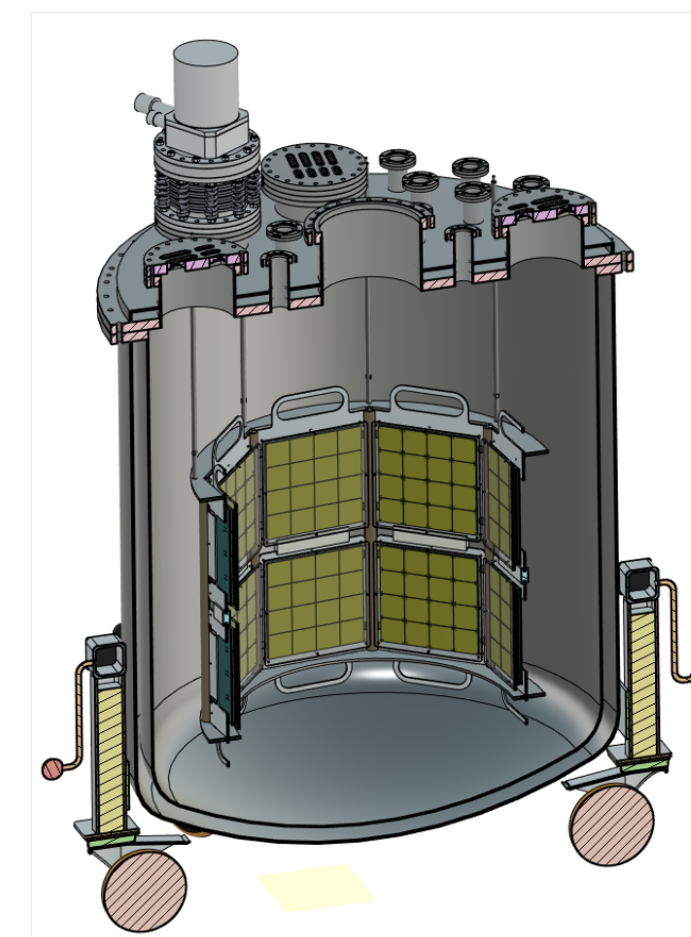


- We have bought tooling (crimp tools, etc) to assemble high quality dsub style cabling.
- All test stands are using common D50 vacuum feedthroughs for compatibility.
- Liverpool plans to assemble cables for all of the cold test site locations.

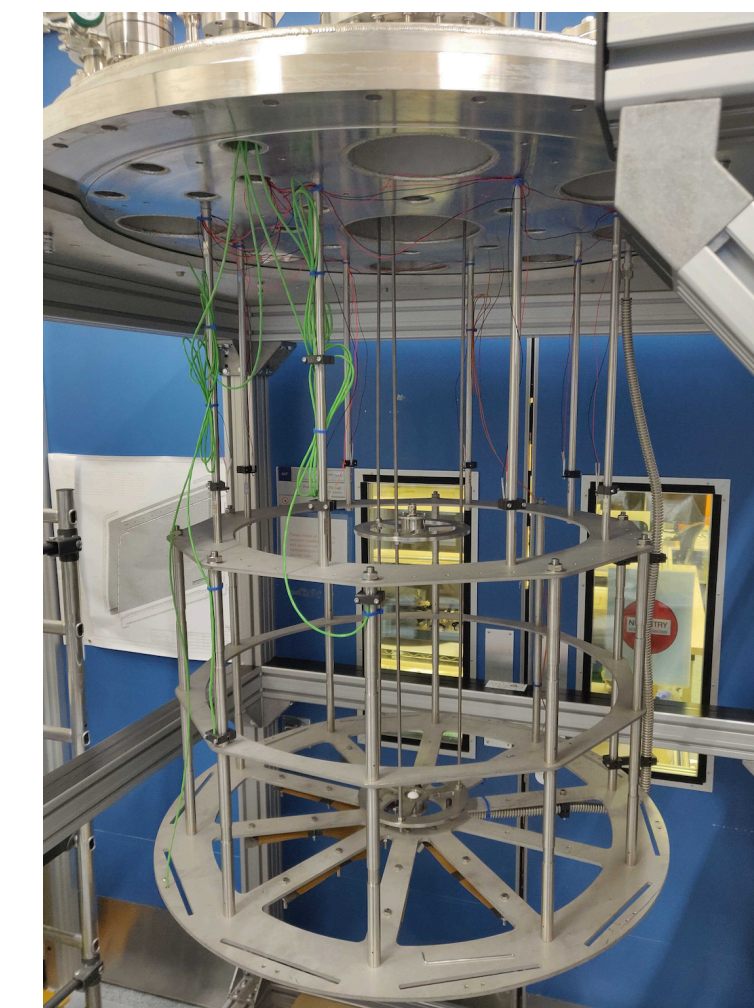


Summary and plans for this year

- vTile design finalised: PCB, mounting pillars and wirebond pattern, radio-assay
- Cryo-probed diced wafers of SiPMs arriving from LNGS and
- vTile pre-production is underway in the LSDC and new staff have been trained in assembly and wire bonding
- Cryostat ready for reception of vPDU3 for first cold tests - some open questions on additional filtering (HV) and feedthroughs will start to be addressed with these tests
- Additional technical effort for production phase to begin soon



How it started...



How it's going

