

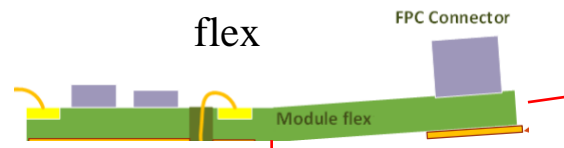


Automatic High-Granularity Timing Detector Module Assembly with Gantry System

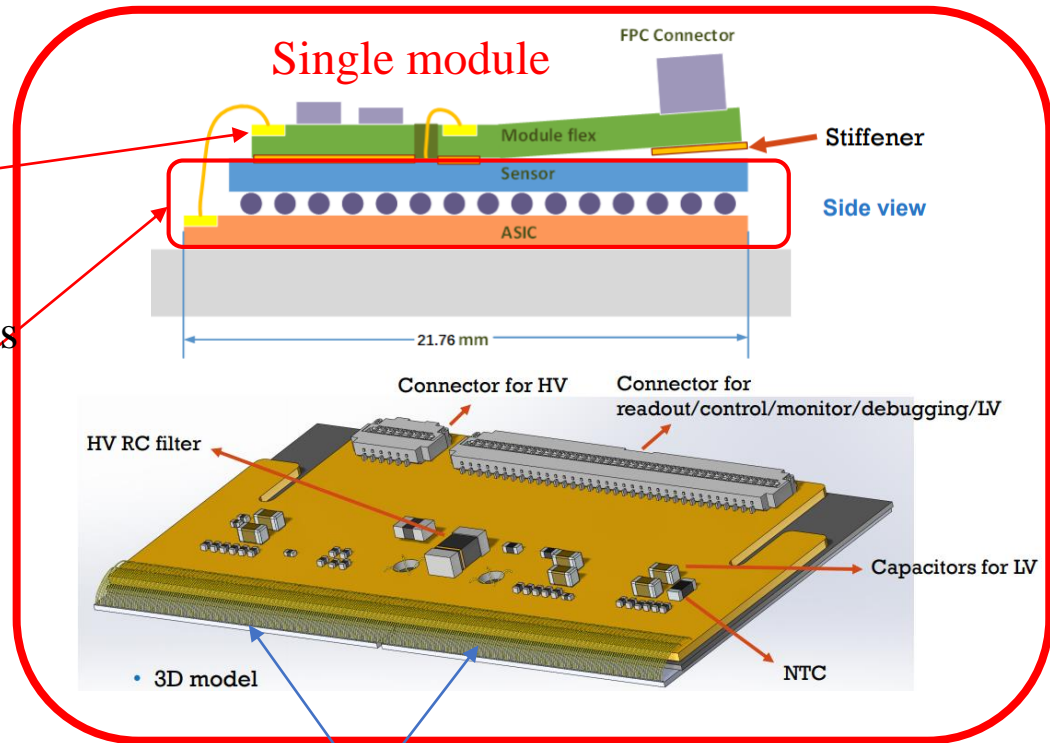
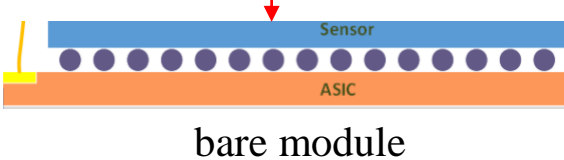
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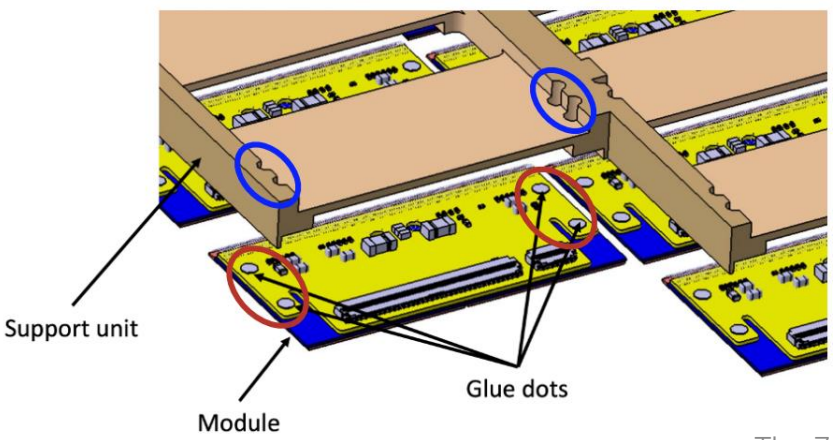
HGTD module assembly



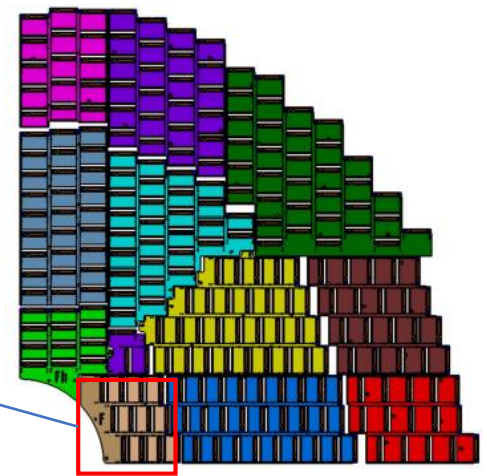
1. glue the flex on the two bare modules



2. glue the module on the support units



2 bare modules

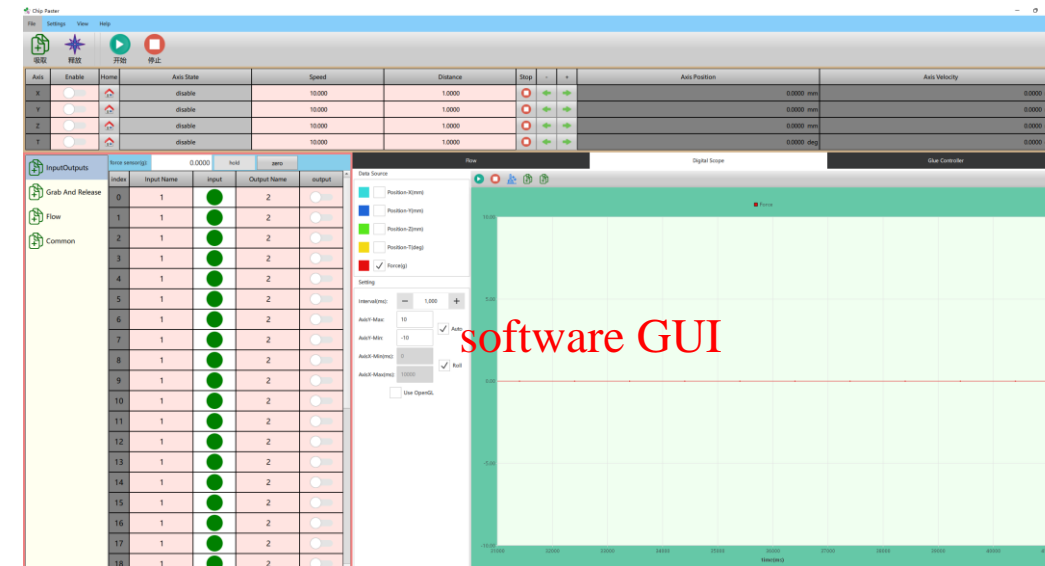
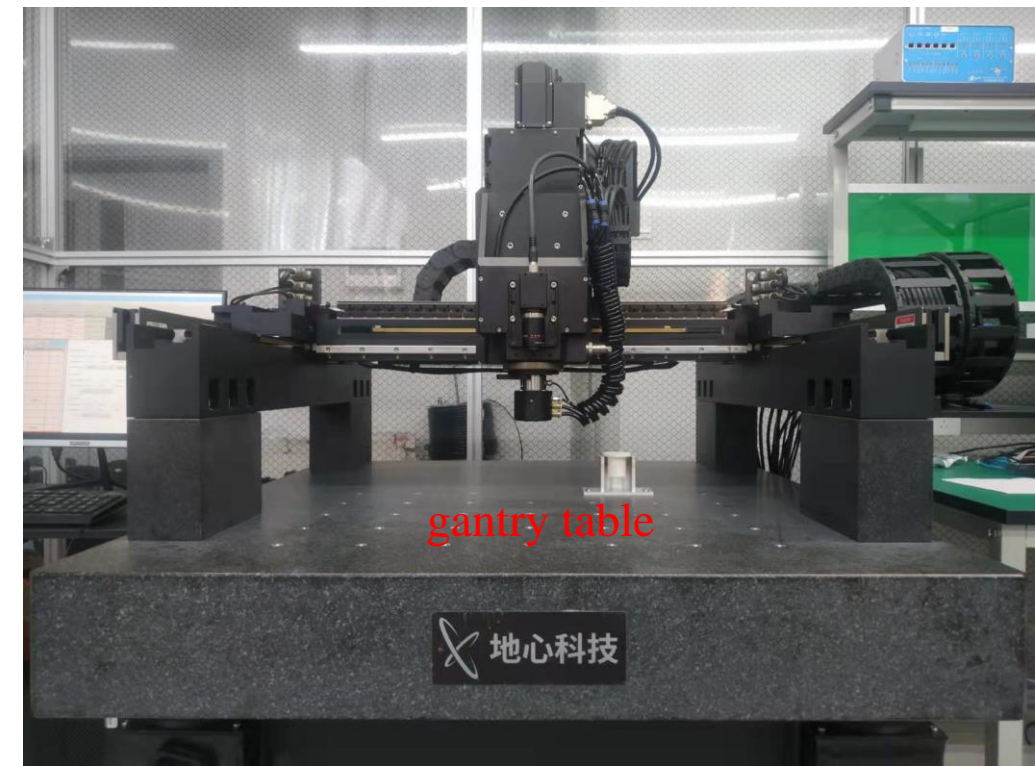


Specification of the module mass and dimension

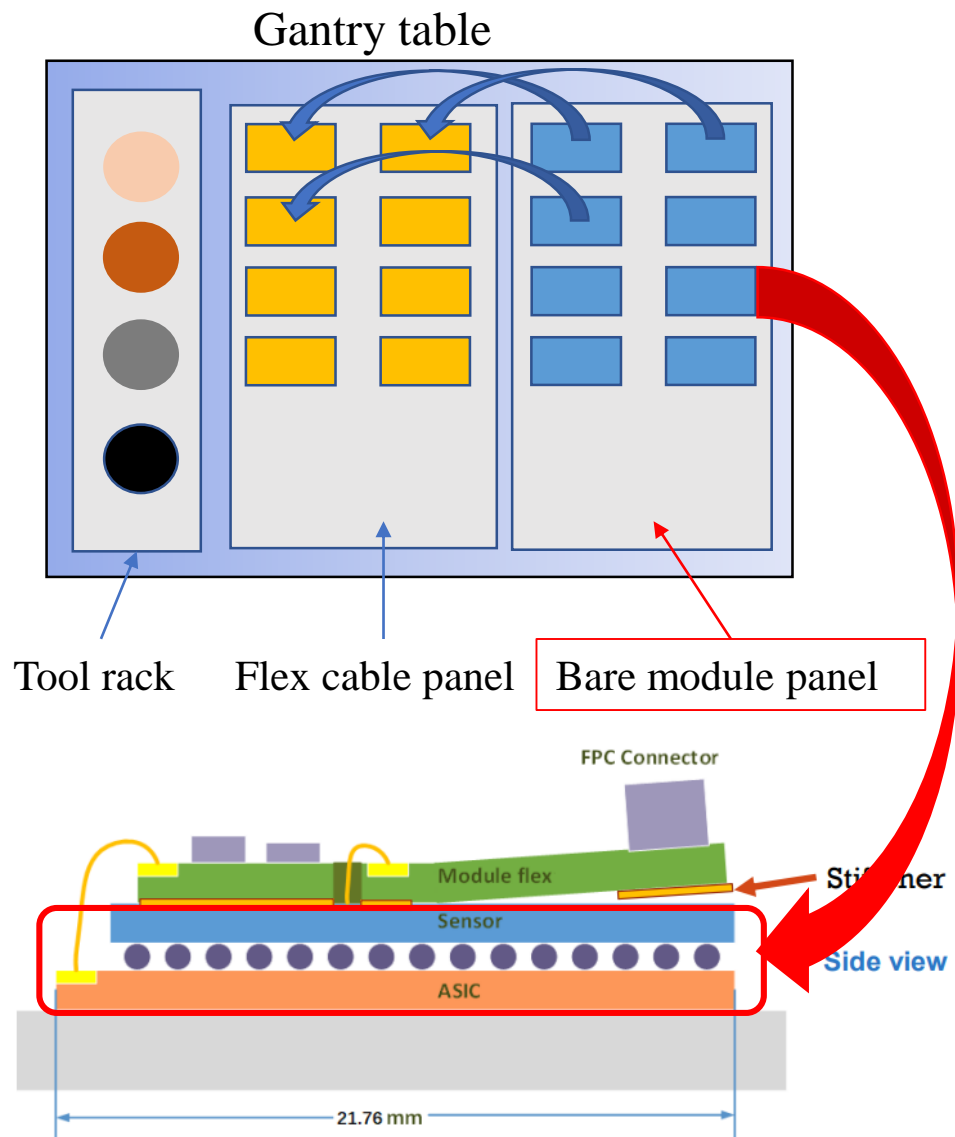
Module weight	3.0 g
Nominal thickness of the module	2.52 mm
Maximum thickness of the module	3.32 mm
Maximum width of the module	40.6 mm
Nominal gap between two bare modules	200 μm
Minimum gap between two bare modules	50 μm

The gantry system at IHEP

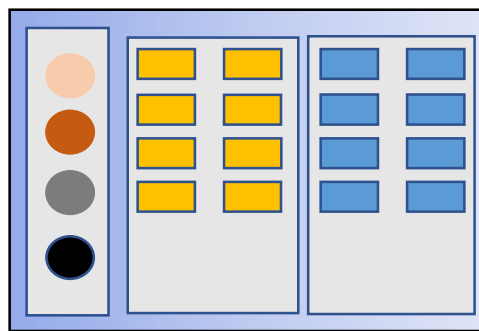
- Robotic pick-and-place for systematic module assembly (gantry), consists of:
 - Coretech gantry positioning system with ACS motion controller (500 mm * 500 mm * 150 mm * 340° travel, repositioning resolution ~ 1μm)
 - Integrated with Keyence vision system, pressure sensor, multi-channel electro-valves (maximum 32), Nordson EFD Glue Dispensing controller, flexible vacuum and air pressure piping system, and custom picking and gluing tools
 - Controlled with GUI based on C++ and Qt



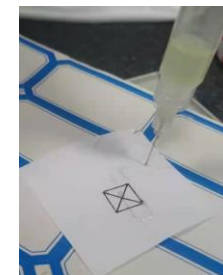
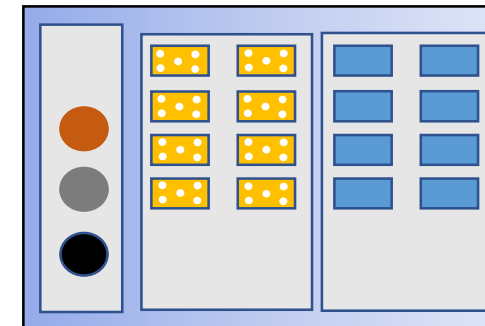
Example: Gluing of the bare module on the flex cable



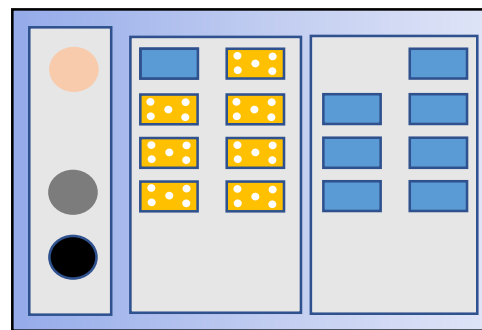
Prepare the tools, flex and bare module



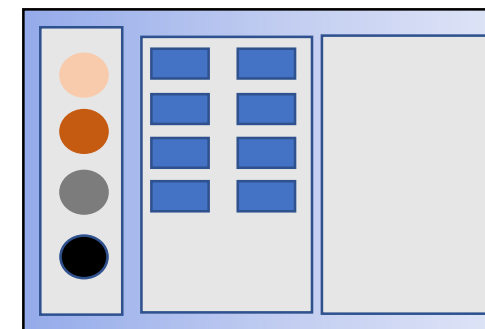
Dispense glue on the flex



Pick the bare module and place it on the flex



Finish picking and placing, put tools back on the rack



Current status at IHEP

- Gantry system has already been installed with all hardware components in a clean room:
 - Vacuum system, air pressure system and vision system
- Positioning resolution validation was done with laser interferometer ($< 1\mu m$)
- Pick-and-place utilizing the vision system works very well ([video link](#))
- Software developing is ongoing
 - Glue dispensing function is integrated



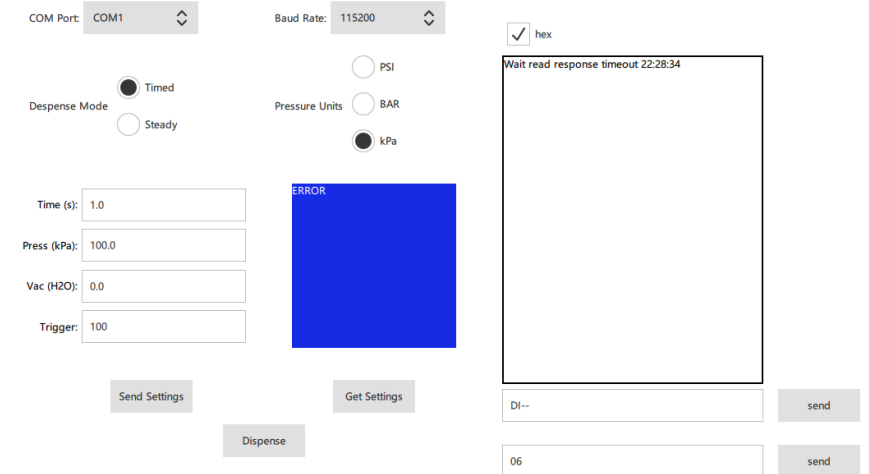
Picking tool



Picking dummy sensor



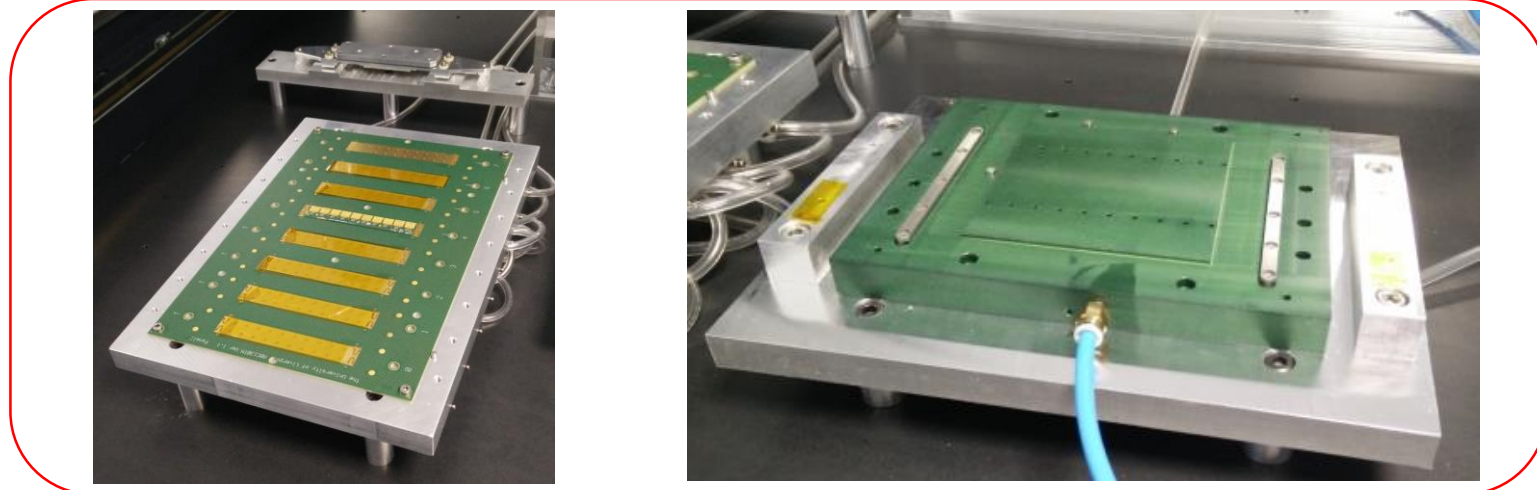
Placing dummy sensor



Dispenser controller integration

Summary and outlook

- A high precision positioning gantry system has been built in IHEP for automatic HGTD module assembly
- We performed basic testing for the gantry that satisfied the module assembly requirements.
- Outlook:
 - Develop the standard procedure for the automatic HGTD module assembly (QT)
 - Design more custom tools and vacuum chucks
 - Continue to improve the user-friendly control software



Vacuum chucks for itk module assembly