



In2p3



# CAPTINNOV platform goals and deployment status

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Some slides with courtesy of D. Attié (CEA/IRFU)



# Motivations of CAPTINNOV group

- Expertise for R&D project pre-evaluation before submission to selection committee
  - In the field of semiconductor sensors / circuits
- Develop informal relationship within the instrumentation/electronics community of P2IO labs
  - Share technical information and possibly share hardware, tools, facilities...
  - Contributions based on goodwill
- Propose common projects, in particular concerning facilities
  - Answered to P2IO call for platform proposal
  - High end, high quality tools for detector & chip characterization and integration
  - Best performance wrt. existing tools (CERN, Carnot network, ...)
  - Not existing in close area institutes



# CAPTINNOV Members

CAPTINNOV = “innovative sensors”

CSNSM



IAS

IMNC



IPNO

Irfu

LAL



LLR







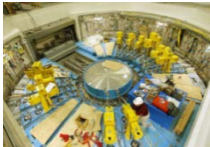
LPT

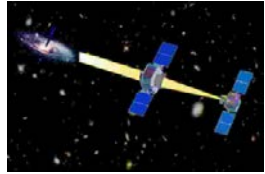


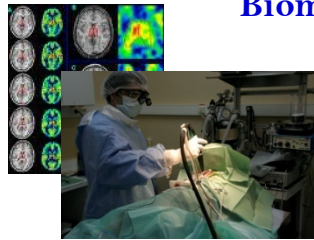
CAPTINNOV : One representative of each lab.

Users welcome



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Applications	Challenges	Fields of research	Experiments/R&D
 <p style="color: blue; font-weight: bold; margin-left: 10px;">Calorimetry &amp; Trajectory</p>	<ul style="list-style-type: none"> <li>▪ High granularity (<math>10^7</math> channels)</li> <li>▪ Large size</li> <li>▪ High B field (<math>\rightarrow 4</math> T)</li> <li>▪ High rate</li> <li>▪ Radiative environment</li> <li>▪ Material « budget »</li> </ul>	<ul style="list-style-type: none"> <li>▪ semiconductors</li> <li>▪ Gaseous</li> <li>▪ Low pressure</li> <li>▪ scintillators</li> <li>▪ Photodetectors</li> <li>▪ Microelectronics</li> </ul>	<ul style="list-style-type: none"> <li>▪ ATLAS, CMS, ALICE</li> <li>▪ ILC</li> <li>▪ COMPASS</li> <li>▪ CLAS12</li> <li>▪ Spiral(2)</li> <li>▪ ...</li> </ul>
 <p style="color: blue; font-weight: bold; margin-left: 10px;">Neutrinos</p>	<ul style="list-style-type: none"> <li>▪ High number of channels (<math>10^5</math>)</li> <li>▪ Low background</li> <li>▪ Single photon sensitivity</li> </ul>	<ul style="list-style-type: none"> <li>▪ gaseous</li> <li>▪ Photodetectors</li> <li>▪ Microelectronics</li> </ul>	<ul style="list-style-type: none"> <li>▪ T2K</li> <li>▪ Double Chooz</li> <li>▪ ANTARES</li> <li>▪ SuperNemo</li> </ul>
 <p style="color: blue; font-weight: bold; margin-left: 10px;">Particle Id</p>	<ul style="list-style-type: none"> <li>▪ Single photon sensitivity</li> <li>▪ precise timing</li> <li>▪ Digital treatment</li> </ul>	<ul style="list-style-type: none"> <li>▪ semiconductors</li> <li>▪ Gaseous</li> <li>▪ Digitization</li> </ul>	<ul style="list-style-type: none"> <li>▪ SuperB</li> <li>▪ Fasia</li> <li>▪ ...</li> </ul>
 <p style="color: blue; font-weight: bold; margin-left: 10px;"><math>\gamma</math> spectroscopy Nuclear phys</p>	<ul style="list-style-type: none"> <li>▪ High resolution Detectors</li> <li>▪ Low noise <math>\rightarrow</math> cooling</li> <li>▪ Digital treatment</li> </ul>	<ul style="list-style-type: none"> <li>▪ Semiconductors</li> <li>▪ Low noise FE</li> <li>▪ Digitization</li> </ul>	<ul style="list-style-type: none"> <li>▪ AGATA</li> <li>▪ S<sup>3</sup></li> <li>▪ ...</li> </ul>
 <p style="color: blue; font-weight: bold; margin-left: 10px;">Neutron detection</p>	<ul style="list-style-type: none"> <li>▪ Large size <math>&gt; 1</math> m<sup>2</sup></li> <li>▪ Precision Mechanics</li> <li>▪ résolution spatiale <math>&lt; 1</math> mm</li> <li>▪ Good S/B</li> <li>▪ Timing</li> </ul>	<ul style="list-style-type: none"> <li>▪ photodetectors</li> <li>▪ gaseous</li> </ul>	<ul style="list-style-type: none"> <li>▪ CLAS12</li> <li>▪ Demin</li> <li>▪ Sedine</li> <li>▪ NFS</li> </ul>

Applications	Challenges	Fields of research	Experiments/R&D
 <p><b>Spaceborn spectro-imagers</b></p>	<ul style="list-style-type: none"> <li>▪ Low noise</li> <li>▪ Space environment</li> <li>▪ Miniaturisation</li> <li>▪ Low power</li> <li>▪ Large number of channels</li> </ul>	<ul style="list-style-type: none"> <li>▪ semiconductors</li> <li>▪ Microelectronics</li> <li>▪ Scintillators</li> </ul>	<ul style="list-style-type: none"> <li>▪ MACSI</li> <li>▪ Solar orbiter</li> <li>▪ Compton camera</li> </ul>
 <p><b>Dark matter search</b></p>	<ul style="list-style-type: none"> <li>▪ Low background</li> <li>▪ Low noise</li> <li>▪ Ultra low temperature</li> <li>▪ Material purity</li> </ul>	<ul style="list-style-type: none"> <li>▪ Bolometers</li> <li>▪ Gaseous photodetectors</li> <li>▪ Low noise electronics</li> </ul>	<ul style="list-style-type: none"> <li>▪ T2K</li> <li>▪ Double Chooz</li> <li>▪ OPERA</li> <li>▪ SuperNemo</li> </ul>
 <p><b>Cosmic Rays</b></p>	<ul style="list-style-type: none"> <li>▪ Single photon sensitivity</li> <li>▪ High efficiency</li> <li>▪ precise timing</li> <li>▪ Digital treatment</li> </ul>	<ul style="list-style-type: none"> <li>▪ Photodetectors</li> <li>▪ Ultrafast digitizers</li> <li>▪ Antennas</li> </ul>	<ul style="list-style-type: none"> <li>▪ Auger</li> <li>▪ H.E.S.S.(2)</li> <li>▪ Codalema</li> </ul>
 <p><b>Biomedical</b></p>	<ul style="list-style-type: none"> <li>▪ Spatial resolution(mm)</li> <li>▪ Detection efficiency</li> <li>▪ B Field (IRM PET)</li> <li>▪ miniaturisation</li> <li>▪ Ergonomy</li> </ul>	<ul style="list-style-type: none"> <li>▪ Scintillators</li> <li>▪ Photodetectors</li> <li>▪ Semiconductors</li> </ul>	<ul style="list-style-type: none"> <li>▪ ART</li> <li>▪ CALIPSO</li> </ul>

- Number of people from P2IO labs involved in Captinnov: 193
- Many international collaborations: CERN, FERMILAB, SLAC, INFN, DESY, PSI, KEK, ESA.... and networks: AIDA, RD51, NUPNET, ...
- National collaborations: Labex Univearth, ... technical platforms (PTA, Minerve), Universities and other labs of CNRS
- Strong collaborations from detection team P2IO in Physics experiences: (HL-)LHC, ILC, AGATA, Spiral(-2), Auger, Edelweiss(-II/III), Super-B, Planck, T2K, etc.

	Bolometers		Photo-detectors		Gaseous detectors		Semi-conductors		Scintillators		Electronics		Mechanics	Vaccum	Cryogenics	Optics	
	R&D	Test	R&D	Test	R&D	Test	R&D	Test	R&D	Test	R&D	Test	R&D	Test	R&D	Test	
CSNSM	█	█					█	█				█	█	█	█		
IAS	█	█										█	█	█	█	█	
IMNC				█						█	█	█					
IPN			█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
IRFU	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
LAL				█	█	█	█	█			█	█	█	█			█
LLR				█	█	█	█	█		█	█	█	█				

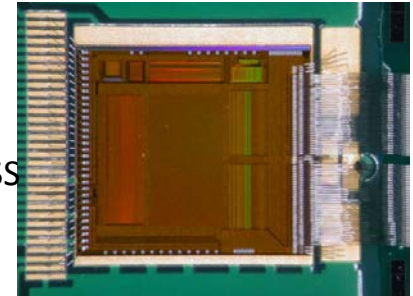
**CAPTINNOV platform**

# Examples of potential needs

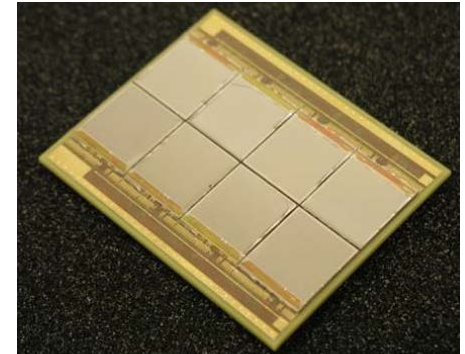
Characterization of fine pitch, large size components is a key issue

Can concern semiconductor detector or chips, hybrids, printed circuits

APV chip for COMPASS  
Double row bonding



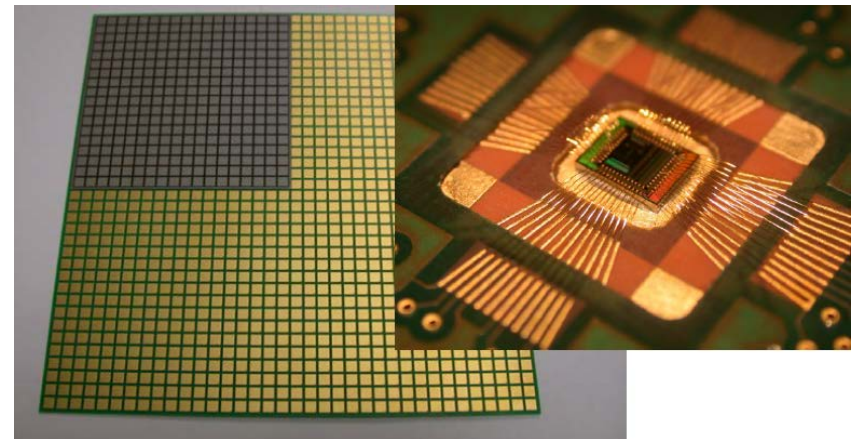
AFTER front end board (ILC TPC), 13x6 cm<sup>2</sup>



R&D development may require fast modification-measure process and home expertise

Needs are not always affordable for sub-contractors

- Size
- Precision
- R&D cycles



ILC – Si-W ECAL detector module : 18x18 cm, 1024 PIN ASIC bonded within the PCB thickness



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# CAPTINNOV PLATFORM

Proposal for sharing top level equipment

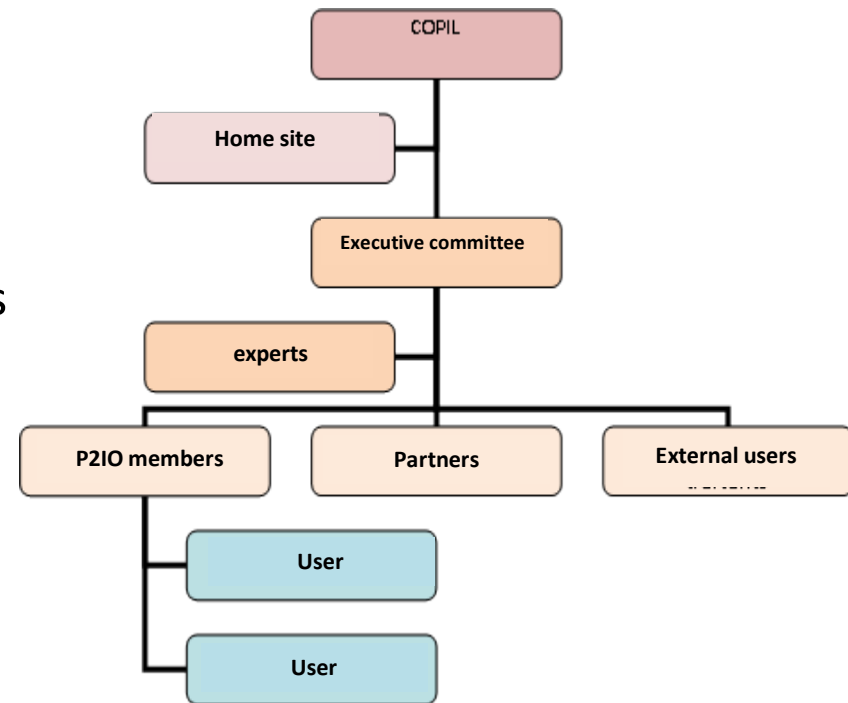
Intended for electronics/detector integration and high precision testing

Priorities given to a **probe station** and a **bonding machine** at first : consensus

Can be extended thanks to next calls for projects

Platform concept:

- equipment located in best environment
- free/easy access to site(s)
- opened to every P2IO members, partners and external structures
- Coordination by an executive committee
- (Moderate) User support thanks to trained/expert persons



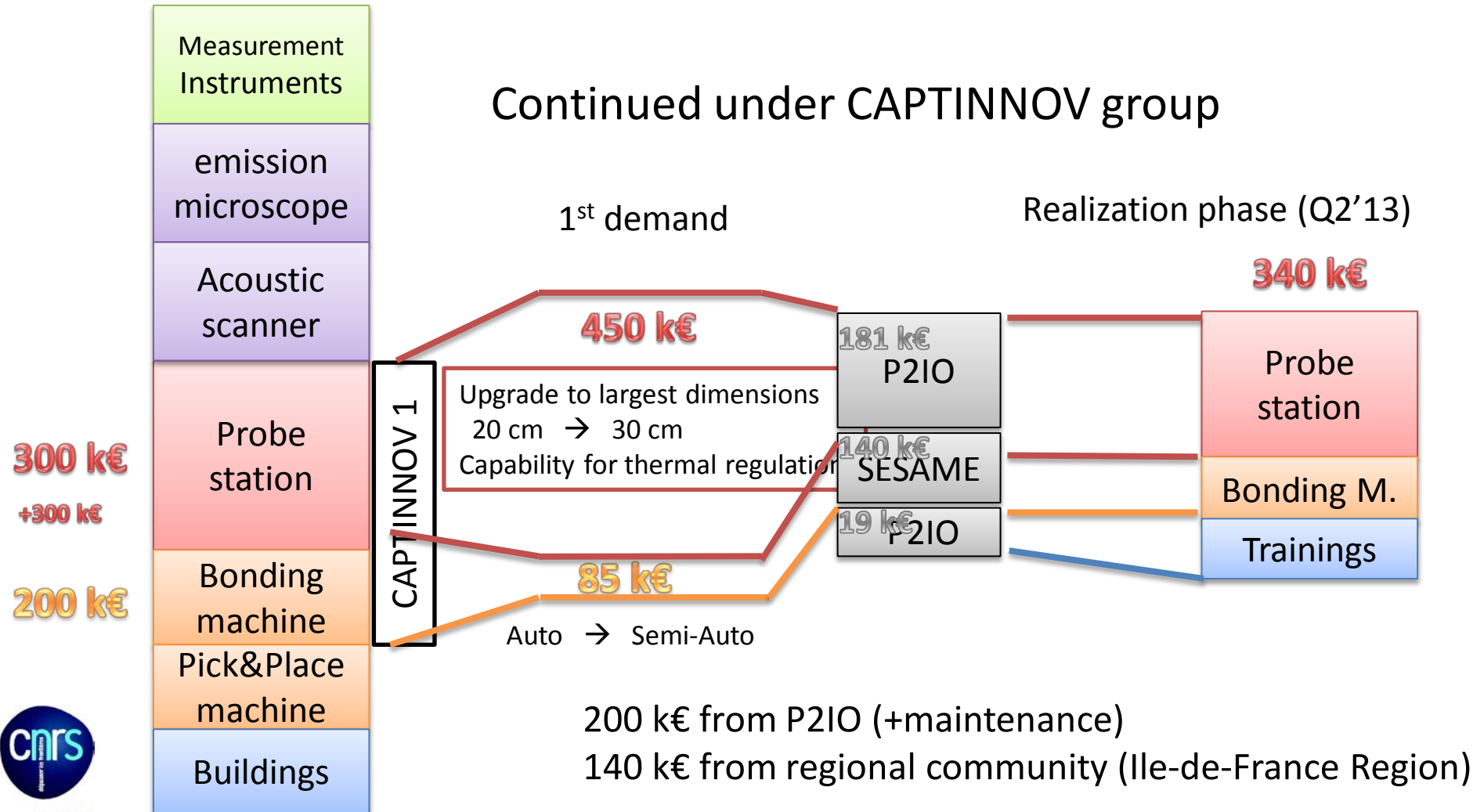


# Funding

(original) EQUIPEX project

: 2 – 3 M€, 4 FTE

Continued under CAPTINNOV group



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200 k€ from P2IO (+maintenance)

140 k€ from regional community (Ile-de-France Region)

LIR

# Realization phase

Budget confirmed end of January'13

European call of offer closed end of June'13

Main selection criteria:

Allow to test or bond large size components (30cm)

High precision : measurements at 10fA, 10fF levels

Flexible, single component or medium size batch

Automation: scan test points, pattern recognition for initial reference point

Equipment's **ordered end of July'13**

Bonding machine is to be delivered soon

Clean rooms are in preparation

Main issue is now to finalize a platform convention (management, access rules, terms of use, ...)

to be agreed at the P2IO level



# Bonding machine : DELVOTEK 5632

Semi-automated machine: fully programmable step mode, controlled z axis positioning, pattern recognition unit

Several heads available for various type of bonding  
wedge or ball ; gold or aluminum ; wire or ribbon  
mechanical pull/shear tests (require additional head, not ordered)  
deep access head allow bonding in cavities or close to components  
360° operations  
online wire shape control (angle, tense, bending)  
manual operation allowed

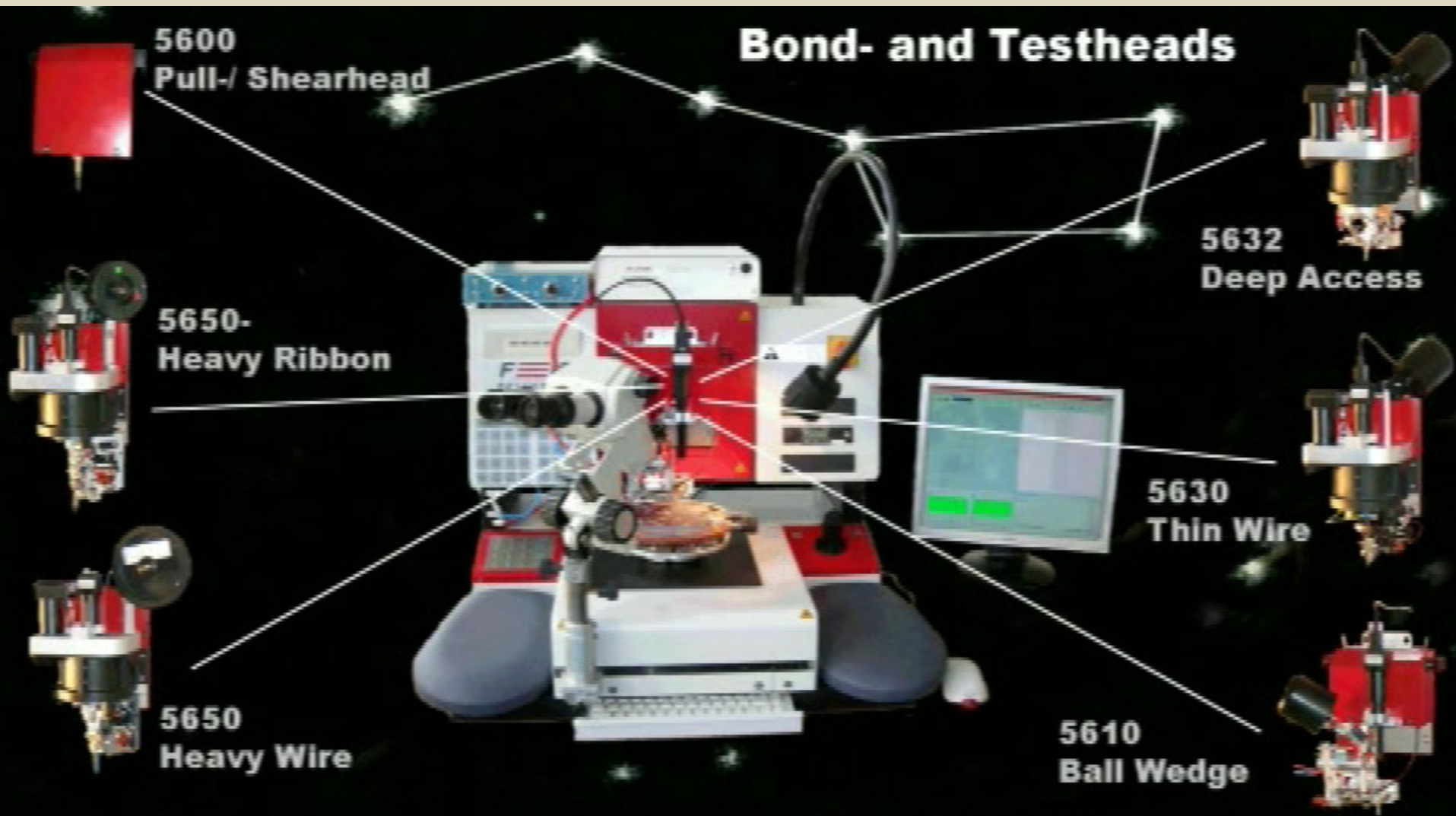
Installed at CEA/orme des meurisiers  
in a clean room

Offer includes training and 2 yr warranty



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# Bonding machine



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# Probe station : SIGNATONE WL350

Choice made within 2 offers, have chosen complete thermal system  
against full automation and performance (100 fA – 5fA announced, 100 fF levels)  
Partly-automated machine: open software allows any kind of programming

Features:

**30cm** workholder in a **micro chamber** : black box & faraday cage, triaxial connectors  
Any kind of characterization (DC, AC -50GHz, S, noise, 1/f)  
Large choice of DC & RF probes

Wafer level tests or single die  
Probe card holder for specific probe configuration  
Micrometric resolution  
12° spin correction

**Temperature control -60° to 200°**

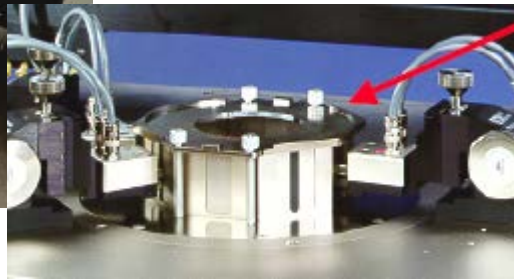
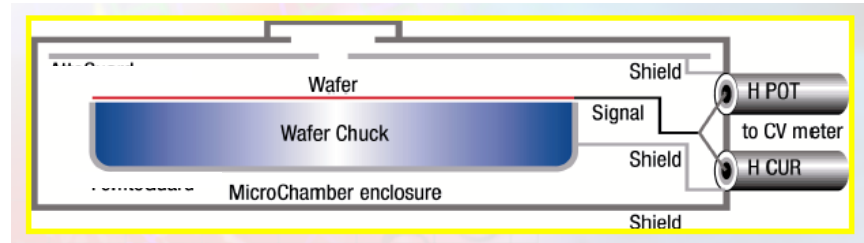
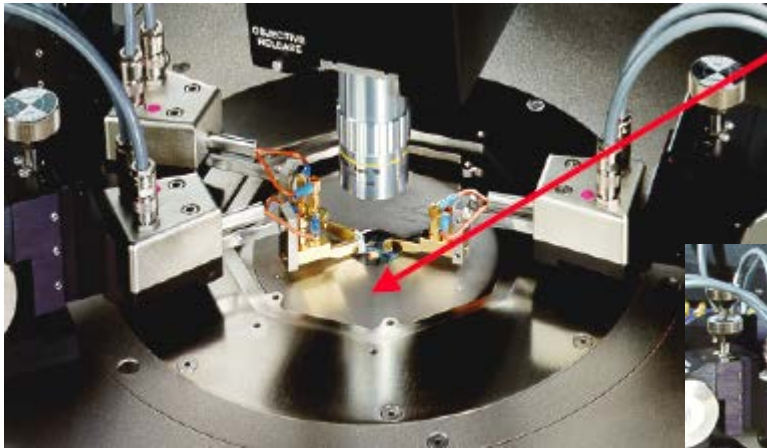


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Will be installed in a clean room at LAL

LAL

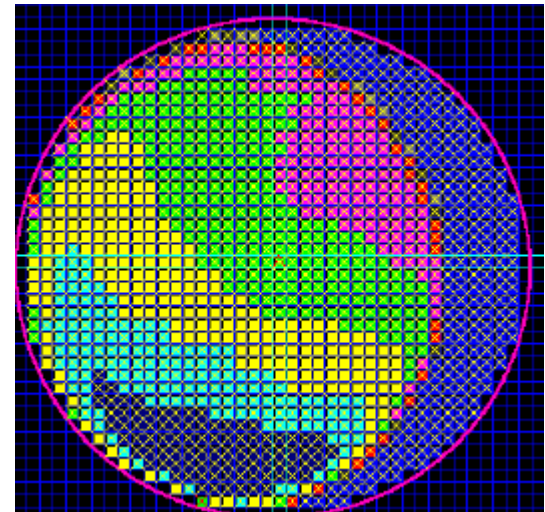
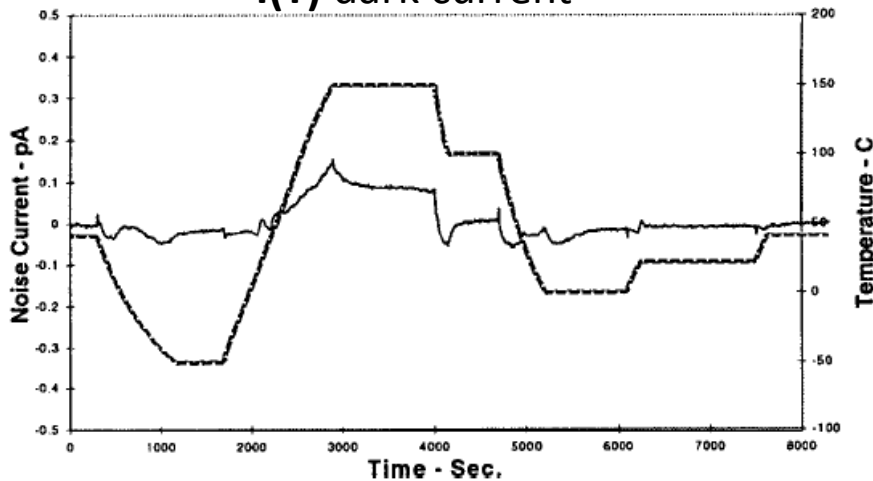
# Application example



Microchamber encloses Probes and device under test

I(V), C(V) at wafer level

I(T) dark current



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*LIR*

And also : functional tests of complex ASICs

# CAPTINNOV Extras

CAPTINNOV also took care of:

## Training

Some training courses included in the offers

## Hardware pool

Will (try to) share probes and measurement hardware

## Software options

Automation capability or user friendly control environment

## Planning of user access and maintenance operations

Coordinated by dedicated experts (wish)

All this will require annual funding and goodwill of everybody



A first set of high quality machines have been ordered

Funds spend, bonding machine is to be delivered in forthcoming days

High potential for R&D, a large set of project are already

interested in : ATLAS pixels (vertex) and 3D electronics; ATF2 (diamond sensors); ILC TPC & large micromegas R&D, Compton telescope (DSSD detector + ASICs) ; ILC ECAL (large PIN diode matrices, SoC ASICs, big production tests, ...,...,....)

The platform can be completed later on

Organization, rules, access and installation are on-going

Will be based on goodwill

Good start of the CAPTINNOV activities thanks to this common platform, hope this will continue on R&D projects.