



EU Funds and CSN5 Project

Nanni
Genova, 19 June 2014

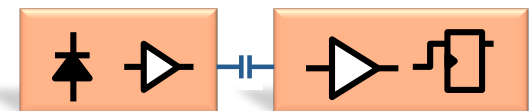


EU funds: AIDA-2

CSN5 project

Indico agenda:

<https://agenda.infn.it/conferenceDisplay.py?confId=8261>



HV/HR - CMOS

EU FUNDS- AIDA-2

Genova will be beneficiary in two WP's

- **WP3**: Microelectronics/Interconnections
 - Task 3.2 : 65 nm chips for trackers (CERN) : Fine pitch, low power, advanced digital processing
 - Task 3.3 : SiGe 180nm for calorimeters/gaseous (IN2P3) Highly integrated charge and time measurement
 - **Task 3.4** : interconnections between different technologies (INFN) 20 μm TSVs for pixels, TSV post-processing of tasks 1&2, chip to wafer bonding
- **WP6**: High-voltage/High-resistivity CMOS sensors (HV/HR-CMOS)
 - Task 6.2 : Simulation
 - Task 6.3 : Sensor Development
 - **Task 6.4** : Hybridisation

 *Being beneficiary, get (little money) and must find matching funds:*

- Beneficiary EU funds: **24 k€** (WP3) + **50 k€** (WP6) → hope 2 year fellowship
- Matching funds from FTE: Nanni 15 %, Alessandro + Ettore + Giuseppe 15 % and material from CSN1/5 for 5 k€ / year.
- Matching funds are approximately 60%, EU funds 40%

WP3, WP6 Beneficiary

AIDA 2 - WP Name - Task 3.2: 65 nm chips

Beneficiary short name*	Institute
CERN	CERN
INFN	PAVIA
INFN	TORINO
INFN	MILANO
IN2P3	CPPM
IN2P3	OMEGA/LAL/LPNHE
AGH	AGH-Krakow

AIDA 2 - WP Name - Task 3.3: SiGe chips

Beneficiary short name*	Institute
IN2P3	OMEGA
IN2P3	CPPM
CEA	SACLAY
AGH	AGH-Krakow
UHEIDELBERG	University of Heidelberg

AIDA 2 - WP Name - Task 3.4: Interconnection and TSV

Beneficiary short name*	Institute
INFN	PAVIA
INFN	GENOVA
INFN	PERUGIA
IN2P3	CPPM
IN2P3	LAL
UBONN	University of Bonn
UU	University of Uppsala
UGLAS	University of Glasgow
MPG	MPI Munich

AIDA 2 - HV-CMOS - Task 6.2: Simulation

Beneficiary short name*	Institute
CPPM	Marseille
Bonn	
STFC	RAL

AIDA 2 - HV-CMOS - Task 6.3: Sensor development

Beneficiary short name*	Institute
Bonn	
KIT	Karlsruhe
CEA	Saclay
STFC	RAL
Glasgow	
Liverpool	
CPPM	Marseille

AIDA 2 - HV-CMOS - Task 6.4: Hybridisation

Beneficiary short name*	Institute
IFAE	Barcelona
Liverpool	
INFN	Genova



WP3 & WP6 – Genova’s Task

WP3 – Task 4

AIDA 2 - WP Name - Task 3.4: Interconnection and TSV

For input data, only fill the white areas below
Please fill out the Beneficiary and Institute short name columns (see example below for CERN and INFN)

Beneficiary short name*	Institute	Person - months	Monthly personnel costs	Personnel direct costs	Travel direct costs	Equipment and consumables	Other direct costs	Sub-contracting costs	Material direct costs	Total direct costs	Total indirect costs**	Total costs (direct + indirect)	EC requested funding
INFN	PAVIA	20.00	6 000.00	120 000.00	10 000.00	150 000.00			160 000.00	280 000.00	70 000.00	350 000.00	140 000.00
INFN	GENOVA	4.00	6 000.00	24 000.00	2 000.00	24 000.00			26 000.00	50 000.00	12 500.00	62 500.00	24 000.00
INFN	PERUGIA	4.00	6 000.00	24 000.00	2 000.00	24 000.00			26 000.00	50 000.00	12 500.00	62 500.00	24 000.00
IN2P3	CPPM	4.00	6 000.00	24 000.00	2 000.00	24 000.00			26 000.00	50 000.00	12 500.00	62 500.00	24 000.00
IN2P3	LAL	4.00	6 000.00	24 000.00	2 000.00	24 000.00			26 000.00	50 000.00	12 500.00	62 500.00	24 000.00
UBONN	University of Bonn	4.00	6 000.00	24 000.00	2 000.00	24 000.00			26 000.00	50 000.00	12 500.00	62 500.00	24 000.00
UU	University of Uppsala	4.00	6 000.00	24 000.00	2 000.00	24 000.00			26 000.00	50 000.00	12 500.00	62 500.00	24 000.00
UGLAS	University of Glasgow	6.00	6 000.00	36 000.00	2 000.00	46 000.00			48 000.00	84 000.00	21 000.00	105 000.00	42 000.00
MPG	MPI Munich	4.00	6 000.00	24 000.00	2 000.00	24 000.00			26 000.00	50 000.00	12 500.00	62 500.00	24 000.00
Beneficiary 7	Institute 7			0.00					0.00	0.00	0.00	0.00	0.00
Beneficiary 8	Institute 8			0.00					0.00	0.00	0.00	0.00	0.00
Total		54.00	54 000.00	324 000.00	26 000.00	364 000.00	0.00	0.00	390 000.00	714 000.00	178 500.00	892 500.00	350 000.00

WP6 – Task 4

AIDA 2 - HV-CMOS - Task 6.4: Hybridisation

For input data, only fill the white areas below
Please fill out the Beneficiary and Institute short name columns (see example below for CERN and INFN)

Beneficiary short name*	Institute	Person - months	Monthly personnel costs	Personnel direct costs	Travel direct costs	Equipment and consumables	Other direct costs	Sub-contracting costs	Material direct costs	Total direct costs	Total indirect costs**	Total costs (direct + indirect)	EC requested funding
IFAE	Barcelona	24.00	4 000.00	96 000.00	4 000.00	5 000.00			9 000.00	105 000.00	26 250.00	131 250.00	52 000.00
Liverpool		23.00	5 800.00	133 400.00	4 000.00	5 000.00			9 000.00	142 400.00	35 600.00	178 000.00	70 000.00
INFN	Genova	16.00	5 800.00	92 800.00	4 000.00	5 000.00			9 000.00	101 800.00	25 450.00	127 250.00	50 000.00
				0.00					0.00	0.00	0.00	0.00	0.00
				0.00					0.00	0.00	0.00	0.00	0.00
				0.00					0.00	0.00	0.00	0.00	0.00
				0.00					0.00	0.00	0.00	0.00	0.00
				0.00					0.00	0.00	0.00	0.00	0.00
				0.00					0.00	0.00	0.00	0.00	0.00
				0.00					0.00	0.00	0.00	0.00	0.00
Total		63.00	15 600.00	322 200.00	12 000.00	15 000.00	0.00	0.00	27 000.00	349 200.00	87 300.00	436 500.00	172 000.00

- **Task 6.4 Hybridisation**

This task will be lead by Liverpool with participation of IFAE and Genova.

- **Subtask 6.4.1 Development of capacitive interconnections.** *Perform basic R&D on capacitive interconnection for electrical test structures and using different adhesives and gluing techniques. Optimise gluing process for precise alignment, high and uniform capacitance and sufficient yield and reproducibility. Investigate methods for stress compensation to improve flatness. Characterize glued test-structure assemblies mechanically and electrically. Investigate alternative DC interconnection techniques, such as anisotropic adhesives or glue-embedded metal balls. Give feedback to sensor and readout-ASIC designers concerning optimal pad layouts.*

- **Subtask 6.4.2 Production of sensor assemblies.** *Use results from task 6.4.1 and sensors produced in task 6.3.1 to produce assemblies of sensors and readout ASICs for all participating projects. Mount assemblies on test boards provided by the participating projects. Make wire-bond connections between chips and PCBs.*

- **Subtask 6.4.3 Preparation for industrialization.** *Investigate options for hybridization of large-area assemblies. Adapt the interconnection technology for larger surface areas and make it suitable for mass production with high yield. Investigate wafer-to-wafer bonding options. Select industrial partners for initial tests.*

Deliverable (number)	Deliverable name	WP number	Short name of lead participant	Type ¹	Dissemination level ²	Delivery date ³
D6.1	Final report	6.1	KIT	R	PU	M46
D6.2	TCAD libraries	6.2.1	CPPM	OTHER	CO	M40
D6.3	Optimized sensor layout	6.2.3	Bonn	R	PU	M46
D6.4	Characterization results	6.3.2	RAL	R	PU	M46
D6.5	Radiation tolerance assessment	6.3.3	CPPM	R	PU	M46
D6.6	Optimized interconnection process	6.4.1	Liverpool	R	PU	M12
D6.7	Assemblies delivered	6.4.2	IFAE	DEM	PU	M40
D6.8	Recommendation for industrialization	6.4.3	Genova	R	PU	M46

¹ *Type* - use one of the following codes: **R** (document report, excluding the periodic and final report); **DEM** (demonstrator, pilot, prototype, plan designs); **DEC** (websites, patents filing, press & media actions, videos etc.); **OTHER** (software, technical diagram, etc.)

² *Dissemination level* - use one of the following codes: **PU** (public, fully open, e.g. web), **CO** (confidential, restricted under conditions set out in Model Grant Agreement), **CI** (classified, information as referred to in Commission Decision 2001/844/EC)

³ Measured in months from the project start date (month 1) e.g. M36

WP5: (Genova not in here)

WP 5: Advanced Hybrid Pixel Detectors

- Task 5.2 TCAD simulations
- Task 5.3 Common process optimization for hybrid pixel sensors
- Task 5.4 Detector validation for tracking devices

AIDA 2 - WP Name - Task 5.2: TCAD SIMULATION

Beneficiary short name*	Institute
INFN	Perugia
INFN	Trento
CERN	LCD

AIDA 2 - WP Name - Task 5.3: Process optimization

Beneficiary short name*	Institute
CSIC	CNM
FBK	

AIDA 2 - WP Name - Task 5.4: Detector validation (3D and planar sensors)

Beneficiary short name*	Institute
CERN	LCD
MPG	MPP
Manchester	
INFN	Milano
INFN	Firenze

PROJECT IN CSN5 (HV/HR-CMOS)

- *CSN1 push has to CSN5 for R&D funds on HV/HR-CMOS*
 - Two activities individuated:
 - HV/HR-CMOS chip development with STMicroelectronics – BD8sP technology platform (180/160 nm)
 - Hybridization with R/O chip (FE-I4/RD53)
 - Sezioni INFN: GE, MI
 - Type of project:
 - Normal CSN5 project (no-Call), 3-years duration
 - 250÷300 k€ in 3 years

● *Chip design – activities*

- TCAD re-modelling/re-checking of technology (mainly at STM)
- MPC/MPW with custom substrates –
 - 1st year: test block (Amp/Disc/etc) to irradiate and evaluate performance – CCPD array (1 or 2 pixel flavours) – simple shift register for chip configuration
 - 2nd year: further optimization of blocks, consideration for hybridization (thinning, TVS on I/O pads?, ???)
 - 3rd year: sizable pixel matrix ($\sim 1 \text{ cm}^2$) compatible with FE-I4 (or RD53?) – implement standard command decoder for configuration.
- Motivate the foundry selection: STM
 - STM has strongly qualified 70 V, 3-well technology, thin gate oxide (3.5 nm), which should be rad-hard
 - Strong liaison with Agrate R&D group (TCAD qualification of the changes in substrate material)
 - LFoundy option needs significant more work in qualifying for HV, aggressive in looking for collaboration, but they have only a process line and not an R&D line. Bonn is testing 150 nm process, INFN groups (TO/PD) what to access 110 nm – much more qualification work before real design (on PDK existing for 110 nm).

• *Hybridization activities*

- Develop the process in step:
 - 1st: test on single chip the SU8 for capacitive coupling
 - 2nd: develop a technique, compatible with SU8 capacitors for resistive connection of I/O pads (config signals, VDD/GND) to FE-I4/RD53 – can be indium bump-bonding, can be TSV to bring I/O pads to opposite side (the module would have both R/O and HV/HR-CMOS I/O's on same side) – test on single chip (?).
 - 3rd: develop process on full wafer (8" for HV-CMOS side, 8"-12" for R/O side) – look for industries for wafer processing: Selex?
- Part of the activities are in synergy with the AIDA2 Genova tasks
 - Money from CSN5 can be part of the matching funds for AIDA2
- **Interests and form of participation of LTD group**

Cost Envelopes – 3Y Project

● *HV/HR-CMOS Chip – main cost in the MPW runs*

- Assume 3 runs (1/Year): $60 \text{ k€}/\text{run} \times 3 = 180 \text{ k€}$
- Cadence Licences for Genova: $2 \text{ k€}/\text{y} \times 3 = 6 \text{ k€}$ (in the project?)
- Test boards for chip test and irradiation: $3\text{-}5 \text{ k€}/\text{y} \times 3 = 9\text{-}15 \text{ k€}$

● *Hybridization*

- Test on single chip devices (consumables for Genova): $8\text{-}10 \text{ k€}/\text{Y} \times 3 = 24\text{-}30 \text{ k€}$
- Wafer processing in industry: $20 \text{ k€} (2016) - 40 \text{ k€} (2017) = 60 \text{ k€}$
- Dummy wafers: $5 \text{ k€} (2015) - 10 \text{ k€} (2016) = 15 \text{ k€}$
- R/O wafers (FE-I4/RD53): $15 \text{ k€} = 15 \text{ k€}$

- **Total: 309-321 k€**

Comment: in CSN1 the plan for HCV/HR-CMOS was accounted for **212.5 k€** - some retuning of the above numbers is needed.

R&D Proposal on CCPD with HV/HR-CMOS

INFN Group V

Genova, Milano

ABSTRACT

We propose to prototype an active CCPD (Capacitive Coupled Pixel Detector) by developing, testing and characterizing an HV/HR-CMOS design and its integration with a pixel detector chip for R/O. Initially the R/O chip will be the ATLAS FE-14 and will be then moved to the RD53 design, when this will become available.

Follow proposal guideline used for last year ACTIVE Call

- Lighter version

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Participants

- *Two INFN groups (at the moment): GE, MI*
 - Names below are from ACTIVE Call: who is still in, who is coming new?
 - What about LTD Group?
- *Decide on national/local responsible.*

No.	Sezione	First Name	Family Name	Role	FTE
1	GE	Giovanni	Darbo	DR	0.3
2	GE	Andrea	Favareto	Assegnista	0
3	GE	Claudia	Gemme	RIC	0
4	GE	Elisa	Guido	Assegnista	0
5	GE	Leonardo	Rossi	DR	0
6	GE	XXX	YYY	0	0
7	MI	Gianluca	Alimonti	RIC	0
8	MI	Attilio	Andreazza	PA	0
9	MI	Tommaso	Lari	RIC	0
10	MI	Chiara	Meroni	DR	0
11	MI	Mauro	Citterio	DT	0
12	MI	Valentino	Liberali	PA	0
13	MI	Alberto	Stabile	0	0
14	MI	XXX	XXX	0	0
Total					0.3