



Introduction to the ENSAR2 JRA2 - PSeGe

A.Gadea (IFIC-Valencia) for the PSeGe Collaboration

**4th Position Sensitive Germanium Detectors and applications Workshop
16th –17th September 2019 INFN-LNL, Legnaro (Padova), Italy**





- **ENSAR2 (project number: 654002) is the integrating activity for European nuclear scientists on the fields of Nuclear Structure, Nuclear Reactions and Applications of Nuclear Science.**
- **Its core aim is to provide access to eleven of the complementary world-class large-scale facilities: GANIL-SPIRAL2 (F), INFN (LNL & LNS) (I), CERN-ISOLDE (CH), JYFL (FI), ALTO (F), GSI (D), KVI-CART (NL), NLC (IFJ PAN-Krakow & HIL-Warsaw) (PL), IFIN-HH/ELI-NP (RO) and to the theoretical physics facility: ECT* (I).**
- **It provides as well Network and Joint Research Activities funding.**
- **ENSAR2 ends on March 1st, 2020. Will apply for an extension but with no extra funding**
- **ENSAR2 is funded by the European Commission within its HORIZON2020 Programme under the specific programme 'Infrastructures'.**

The present project is contributing to the R&D of detector technology for position-sensitive HPGe detector arrays. R&D on key areas as detector technology. **The work of the JRA2 is proceedings according to plan.**

Participants:

- IFIC-CSIC: personnel funds for Task3
- INFN-LNL: personnel funds for Task 1
- Uni. Cologne: personnel funds for Task 1
- GSI: personnel funds for Task 2
- Uni. Liverpool: networking funds for Task 4
- CNRS: networking funds for Task 4

Associated partners:

KTH & University of Uppsala, Sweden, ELI-NP, Romania, University of Milan, Italy, STFC, UK, University of Salamanca & University of Valencia, Spain, CEA-Saclay, France

Task 1: New technologies on passivation and segmentation

R&D of segmented contacts in HPGe detectors and of the passivation of the boundary regions between contacts, charge collection and electric-field exploration via 2D scans.

Task 2: R&D on novel Ge-detector geometries for ultimate position resolution and efficiency

Modeling and simulation of electrical-field distributions, evaluation of the 3D position resolution obtainable, production of a prototype detector in cooperation with the industrial partner, experimental determination of the performance figures with the produced prototype.

Task 3: R&D on segmented p-type coaxial detectors

R&D on basic properties of the dopants producing high hole-barrier n-contacts, evaluation of the barrier and study of segmentation with these materials.

Task 4: Demonstration of imaging applications and associated detector technologies

- 4.1: Demonstration of imaging applications
- 4.2: Detector encapsulation techniques
- 4.3: R&D on associated Detector technologies
- 4.4: PSA and neutron-gamma discrimination

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Participant	Personnel Costs/€	Other Direct Costs/€	Indirect Costs / €	Requested grant / €	Spending M1-36 / €	To be Spend M36-48 / €
CSIC	70,000 €		17,500 €	87,500 €	35,053 €	34,947 €
INFN	82,000 €	0	20,500 €	102,500 €	82,000 €	0 €
University Cologne	70,000 €	12000	20,500 €	102,500 €	82,000 €	0 €
GSI	70,000 €	0	17,500 €	87,500 €	70,000 €	0 €
University of Liverpool		48000	12,000 €	60,000 €	29,000 €	19,000 €
CNRS		24000	6,000 €	30,000 €	9,309 €	14,691 €
Total JRA2	292,000 €	84000	94,000	470,000 €	307,362 €	68,638 €

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- 4.4: PSA and neutron-gamma discrimination

- About **82%** expended in the 36 months review.
- Publications:
 - Maggioni, G et al., Eur. Phys. J. A 54 (2018) 34
 - Maggioni, G et al., Mater Sci Semicond Process. 75,118
 - Sgarbossa, F. et al, Nanotechnology 29 (2018) 465702
 - Boldrini, V. et al., J. Phys. D 52 (2019) 035104

Deliverables JRA2 PSeGe

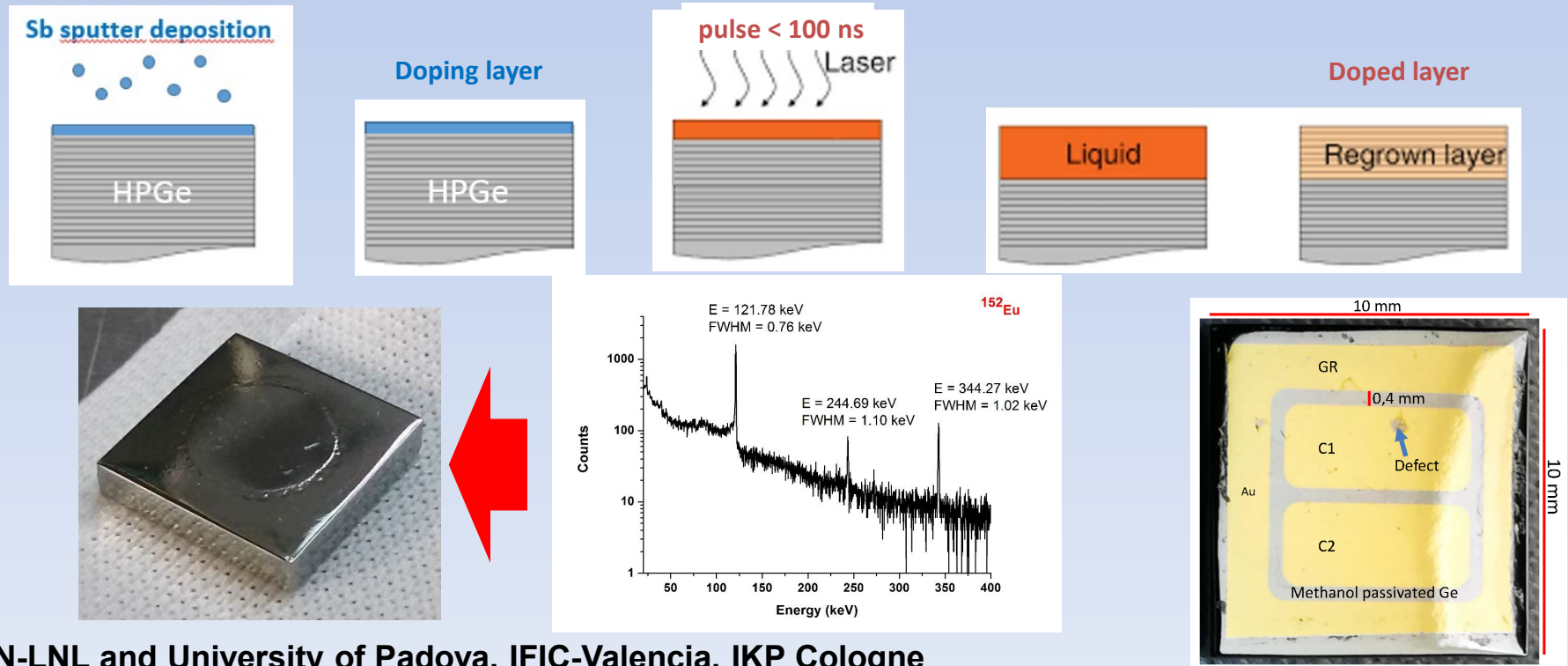


Deliverable Number ¹⁴	Deliverable Title	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D10.1	Results of the JRA2 kick-off meeting	Report	Public	12 ✓
D10.2	Advancement report for the Segmentation and Geometry tasks	Report	Public	30 ✓
D10.3	Advancement report for the p-type task	Report	Public	30 ✓
D10.4	Advancement report for the Imaging task	Report	Public	30 ✓
D10.5	Final report for the Segmentation and Geometry tasks	Report	Public	48
D10.6	Final report for the p-type task	Report	Public	48
D10.7	Final report for the Imaging task	Report	Public	48

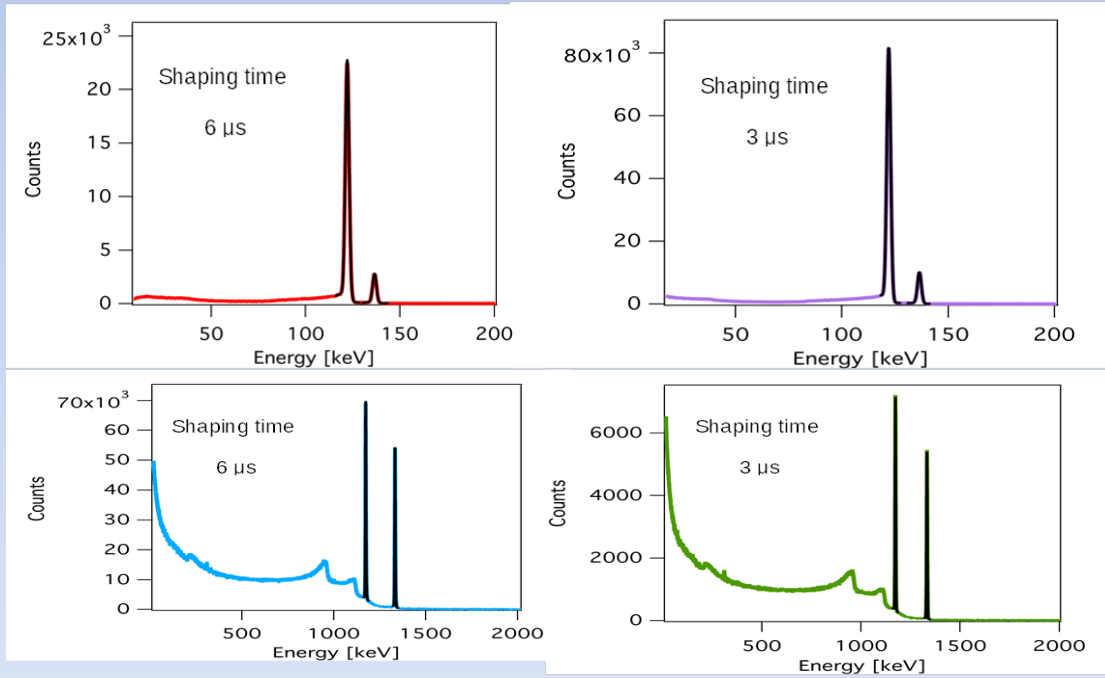
(30 Months: August 2018)

- **Task 1: New technologies on passivation and segmentation**
 - Personnel Contracts completed in 2018.
 - New contact (in collaboration with Task 3) and passivation technologies developed.
- **Task 3: R&D on segmented p-type coaxial Ge detectors**
 - Ongoing contract for a pre-doctoral collaborator Stefano Bertoldo.

LASER THERMAL ANNEALING



- **Task 2: R&D on novel Ge-detector geometries for ultimate position resolution and efficiency**
 - Personnel Contract completed
 - Completed the characterization of the prototype of quasiplanar geometry for position sensitive Ge detectors.



Shaping time (μs)	3	6
Energy (keV)	122	122
FWHM (keV)	2.13(1)	2.35(1)

Shaping time (μs)	3	6
Energy (keV)	1332	1332
FWHM (keV)	4.53(1)	4.32(1)

- **Task 4: Demonstration of imaging applications and associated detector technologies**



- Organized 4 workshops on Detector R&D, Applications and associated technologies. Web page of the 4th one : <https://agenda.infn.it/event/19438/>
- Training sessions on advanced detector technology organized.

The screenshot shows the event page for the 20th AGATA Week and 4th Position Sensitive Germanium Detectors and Application Workshop. The header is yellow and contains the event title and dates: 16-19 September 2019 at INFN Laboratori Nazionali di Legnaro. A navigation menu on the left lists 'Overview', 'Organizing Committee', 'Final Program', 'Registration', 'Participant List', 'Accommodation', 'Venue and Travel', and 'Contact'. The main content area features two images: a photograph of a detector assembly and a 3D CAD model of a detector. Text in the center announces the event, organized by INFN-LNL, University and INFN Padova, from Monday 16th to Thursday 19th September 2019. Logos for INFN Legnaro, Dipartimento di Fisica e Astronomia at the University of Padua, and INFN Padova are shown. At the bottom, it mentions support from the ENSAR2-INFRAIA H2020 Program and logos for Horizon 2020, ENSAR2, the European Union, NuSpIn, and PSeGe.

ERINS Grant Request

- the application for the successor grant of ENSAR2, called ERINS done in April 2019. Evaluated over the threshold but rejected.
- ERINS Coordinator A.Bracco (INFN and Uni. Milano)
- PSeGe continuation within one NA and one JRA on Detector technology.
 - **NA1-NUSREB:** Nuclear Spectroscopy and Reaction Dynamics with Exotic Beams
 - **JRA5-DETNA:** Detector Development for the European Nuclear Facilities and Applications
 - **Task 4:** collaboration with an EU industrial partner and realize in R&D developments performed in the PSeGe JRA.
 - **Task 5:** deliver the improved characterization techniques and PSA algorithms required to fully realise the performance of highly segmented germanium detectors

Workshop Programme

14:00 – 14:30

PSeGe Workshop Registration

16/09/2019 Monday Afternoon

14:30 PSeGe Workshop Welcome and Presentation

14:55 New technologies on passivation and segmentation

25'+10' "Segmentation of PLM contacts in HPGe detectors"
W. Raniero, INFN

20'+10' HPGe Detectors Manufacturing for Ultra Low Background Applications
V. Gostillo, Baltic Scientific Instruments Ltd.

16:00 -16:30

Coffee Break

R&D on segmented p-type coaxial detectors

25'+10' "n-type heavy doping of Ge by Sb deposition and pulsed laser melting (PLM)"
C. Carraro (Uni. Padova & INFN)

25'+10' "Preliminary comparison of simulated and measured signals from segmented detectors"
S. Bertoldo (IFIC-CSIC & INFN)

Discussion

Workshop Programme

17/09/2019 Tuesday Morning

9:00	R&D on novel Ge-detector geometries for ultimate position resolution and efficiency
25'+5'	Results obtained with the quasi-planar prototype I.Kojouharov, GSI Darmstadt
	Demonstration of imaging applications and associated detector technologies
25'+5'	"Pulse-Shape Analysis and position resolution in highly segmented HPGe AGATA detectors". P.Reiter / L. Lewandowski IKP-Cologne
25'+5'	"New encapsulation technique for MINIBALL" P.Reiter IKP-Cologne

10:30 -11:00

Coffee Break

25'+5'	Imaging with planar germanium detectors A. Caffrey, Uni. Liverpool
25'+5'	Cryogenic detector systems: recent work, M. Borri, STFC Daresbury Laboratory
25'+5'	Versatile acquisition systems for segmented detectors: CAEN case history P. Garosi CAEN
	Discussion



Summary:

- The PSeGe activity is proceeding towards completion.
- Prototypes in Task 1, i.e. new passivation techniques, Task 2, i.e. new geometries, and Task 3, i.e. p-type contacts, exist or are being produced. Promising n-contacts based on Sb for p-type Segmented Ge detectors.
- Networking funds allow the organization of the workshops and training visits to the Laboratories with Ge detectors experts.
- Waiting for the next call to submit an improved ERINS proposal