

# THE MEDINET NETWORK

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# ENSAR2 in Horizon 2020

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- European Nuclear Science and Applications Research- 2
- Funded by the EC under 'Infrastructures', budget of 10 M€ in four years from March 2016 to February 2020.
- Coordinating Institution: GANIL (CAEN, France)
- Coordinator: Muhsin Harakeh, KVI-CART Groningen & GANIL

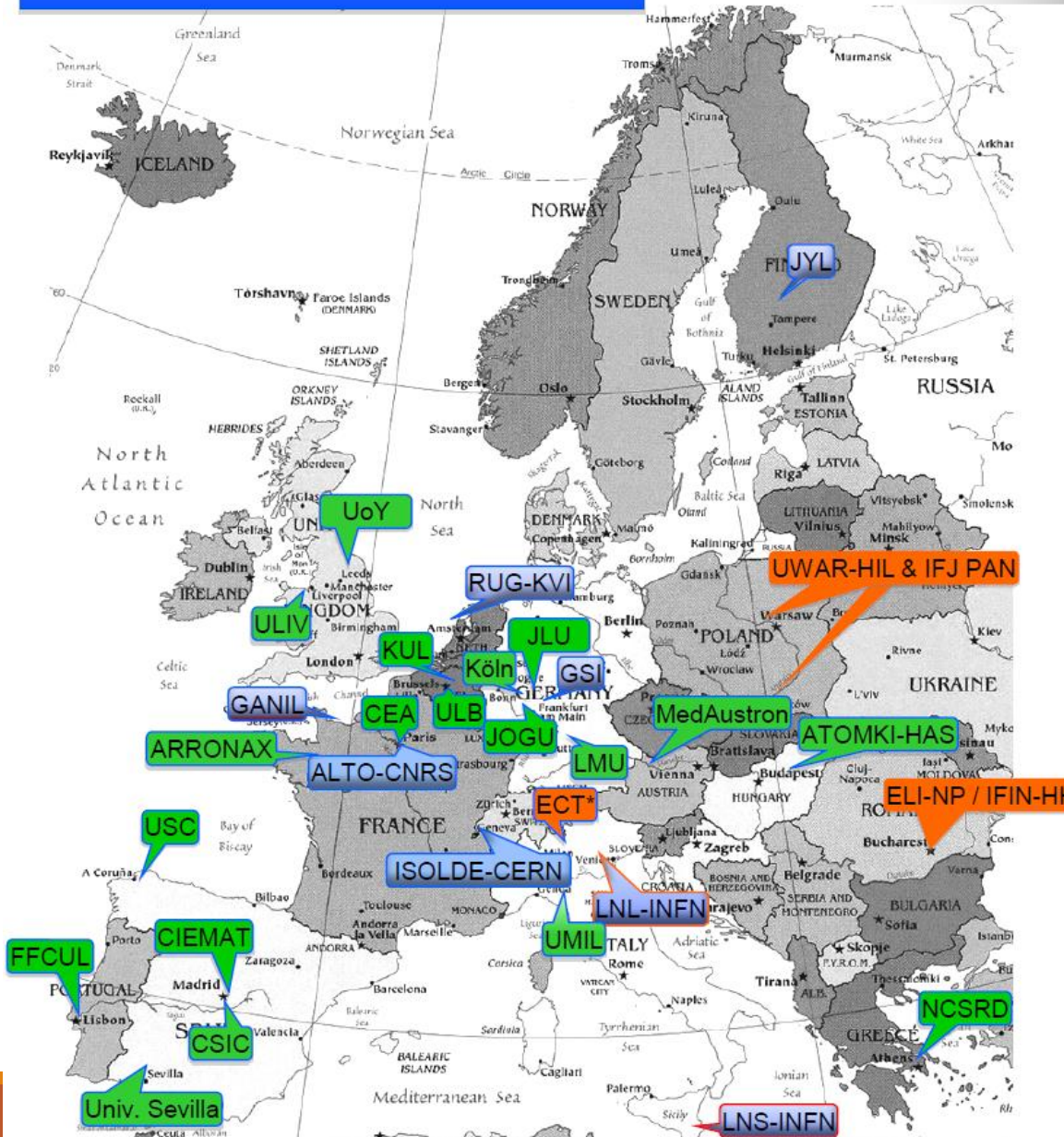
Integrating Activity for European nuclear scientists who are performing research in three of these major subfields:

Nuclear Structure

Nuclear Reactions

**Applications of Nuclear Science**





7 ⇒ 10 TNA Facilities

30 ⇒ 30 beneficiaries  
15 countries

Community: 2700-3000  
scientists and highly qualified  
engineers

# ENSAR2 in Horizon 2020

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**Its core aim is to provide access to the complementary world-class large-scale facilities:**

- These facilities provide stable and radioactive ion beams of excellent qualities ranging in energies from tens of keV/u to a few GeV/u and intense photon beams up to 20 MeV energy.
- The stable-ion beams range from protons to uranium.
- The high-intensity, high-energy photon beams are produced by laser back-scattering from high-energy electron beams.

# Transnational Access activities (TA's)

N°	Facility	Location
WP16	GANIL-SPIRAL2	Caen (France)
WP17	LNL-LNS	Legnaro, Catania (Italy)
WP18	ISOLDE	Geneva (Switzerland)
WP19	JYFL	Jyväskylä (Finland)
WP20	ALTO	Orsay (France)
WP21	GSI	Darmstadt (Germany)
WP22	KVI-CART	Groningen (Netherlands)
WP23	NLC (IFJ PAN & SLCJ)	Krakow, Warsaw (Poland)
WP24	IFIN-HH / ELI-NP	Bucharest (Romania)
WP25	ECT*	Trento (Italy)

**Close collaboration with infrastructures outside Europe:**  
**Canada: TRIUMF**  
**China: IMP Lanzhou**  
**Japan: RIKEN & RCNP**  
**Russia: Dubna/JINR**  
**South Africa: iThemba**  
**United States: NSCL & ANL**

→ Other activities: Detector innovation, Theoretical support, MC Simulations, sources and accelerator technologies

# Joint Research Activities (JRA's)

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<b>N°</b>	<b>Project</b>	<b>Title</b>
WP9	PASPAG	Phoswich Scintillator Assemblies: Application to the Simultaneous Detection of Particle and Gamma Radiations
WP10	PSeGe	R&D on Positive-Sensitive Germanium Detectors for Nuclear Structure and Applications
WP11	TheoS	Theoretical Support for Nuclear Facilities in Europe
WP12	RESIST	Resonance Laser Ionisation Techniques for Separators
WP13	SATNuRSE	Simulations and Analysis Tools for Nuclear Reactions and Structure in Europe
WP14	EURISOL	EURISOL
WP15	TechIBA	Technologies for High Intensity Beams and Applications

# Networking activities (NA's)

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<b>N°</b>	<b>Project</b>	<b>Title</b>
WP1	FISCO2	Financial and Scientific Coordination - 2
WP2	NUSPRASEN	Nuclear Structure Physics, Reactions, Astrophysics and Super Heavy Elements Network
WP3	MIDAS	Minimisation of Destructive Plasma Processes in ECRIS
WP4	NUSPIN	Nuclear Spectroscopy Instrumentation
WP5	MediNet	Medical Network
WP6	GDS	Gas-Filled Detectors and Systems
WP7	ENSAF	European Network of Small-Scale Accelerator Facilities
WP8	NUPIA	Nuclear Physics Innovation

# The goals of **MediNet**

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**MediNet Task 1**: Research on Detector Instrumentation for Radiation Therapy  
(14 initial + 3 associated groups; P. Thirolf, LMU)

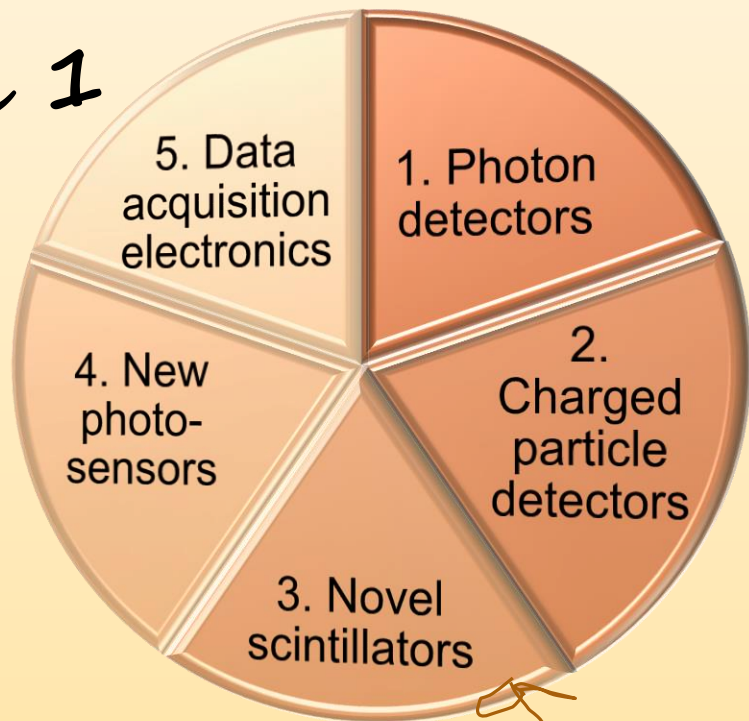
- R&D on improved detection techniques (particles/photons/electronics)
- provide a training ground for students: mobility program/exchange
- coordinate experimental efforts

**MediNet Task 2**: Nuclear Tools for Ion-Beam Therapy  
(11 initial + 9 associated groups; G. Magrin, MedAustron)

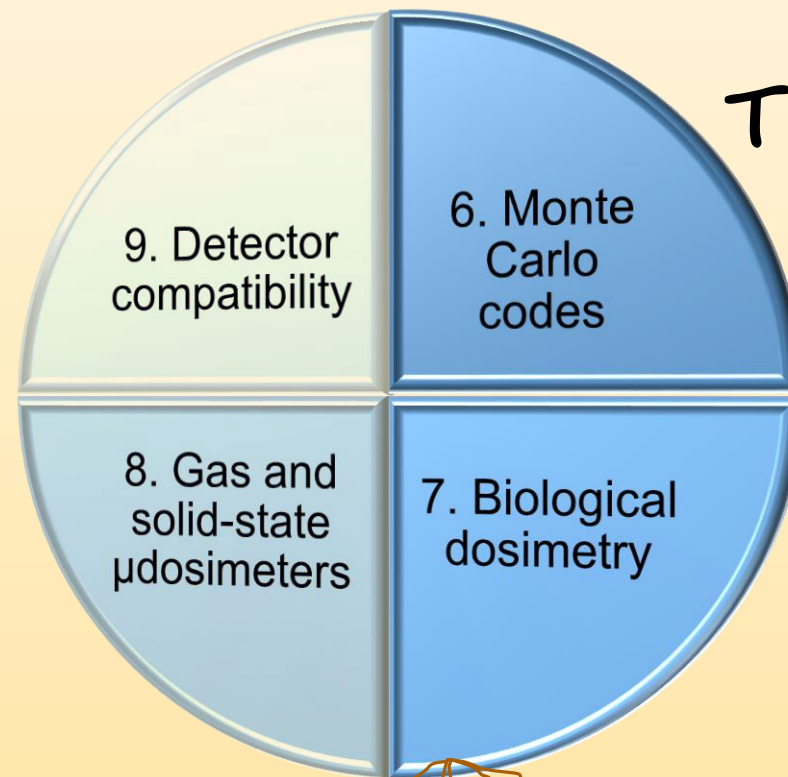
- Radiation quality in Ion Beam Therapy: Detectors, Biological assessments, Monte Carlo GEANT4 simulation
- Promote radiation quality in the community of establishes and foreseen ion-beam therapy centers



# Task 1



# Task 2



# Present MediNet (NA5) Participant Groups

- **Task 1 sites:**  
14 initial  
3 later

- **Task 2 sites:**  
11 initial  
9 later



CNRS: IPN Lyon, France  
CNRS: LPC Clermont-Ferrand, France  
CNRS: LPSC Grenoble, France  
CSIC/IFIC and University of Valencia, Spain  
Delft University of Technology, The Netherlands  
GSI Darmstadt, Germany  
KVI-CART/Univ. Of Groningen, The Netherlands  
LIP, University of Coimbra, Portugal  
LMU Munich, Germany  
NCBJ, National Centre for Nuclear Research, Otwock-Świerk, Poland  
OncoRay + TU Dresden, Germany  
Univ. Giessen (JLU), Germany  
University Complutense + Univ. Carlos III, Madrid, Spain  
University of Pisa, Italy  
University of Rome "La Sapienza", Italy  
Austrian Institute of Technology, Vienna, Austria;  
Centre d'Etudes Nucleaires de Bordeaux-Gradignan, France;  
EBG MedAustron, Austria

ENLIGHT  
IFJ Krakow, Poland  
Institut f. Medizintechnik , University of Luebeck , Germany;  
Laboratori Nazionali del Sud, Catania, Italy  
Laboratori Nazionali di Legnaro, Italy  
NuPECC  
SCK•CEN Belgian Nuclear Research Centre, Boeretang, Belgium;  
Techincal University Vienna, Vienna, Austria;  
TIFPA, Trento, Italy;  
Universidad Complutense, Madrid, Spain;  
Universidad de Santiago, Spain;  
Universidad de Sevilla, Spain;  
Universiteit Hasselt - Campus Diepenbeek, Belgium.  
University of Siegen, Germany  
VINS Belgrade University, Serbia  
Warsaw University, Poland

# MediNet and the role of the EC Networks

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**FROM: <https://ec.europa.eu/research/infrastructures/pdf/wp2013.pdf>**

- joint management of access provision and pooling of distributed resources;*
- dissemination and /or exploitation of project results and knowledge, outreach toward industry, contribution to socio-economic impacts, promotion of innovation;*
- strengthening of virtual research communities;*
- definition of common standards, protocols and interoperability; benchmarking;*
- development and maintenance of common databases for the purpose of networking and management of the users and infrastructures;*
- spreading of good practices, consultancy and training courses to new users;*
- foresight studies for new instrumentation, methods, concepts and/or technologies;*
- promotion of clustering and coordinated actions amongst related projects;*
- coordination with national or international related initiatives and support to the deployment of global and sustainable approaches in the field;*
- promotion of long term sustainability, including the involvement of funders and the preparation of a business plan beyond the end of the project.*

# MediNet and the role of the EC Networks

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1. *foresight studies for **new instrumentation**, methods, concepts and/or technologies;*
2. *spreading of **good practices**, consultancy and training courses to new users;*
3. *definition of **common standards**, protocols and interoperability; benchmarking;*
4. ***dissemination** and /or exploitation of project results and knowledge, outreach toward industry, contribution to socio-economic impacts, promotion of innovation;*
5. *coordination with **national or international related initiatives** and support to the deployment of global and sustainable approaches in the field;*

# MediNet periodic Meeting

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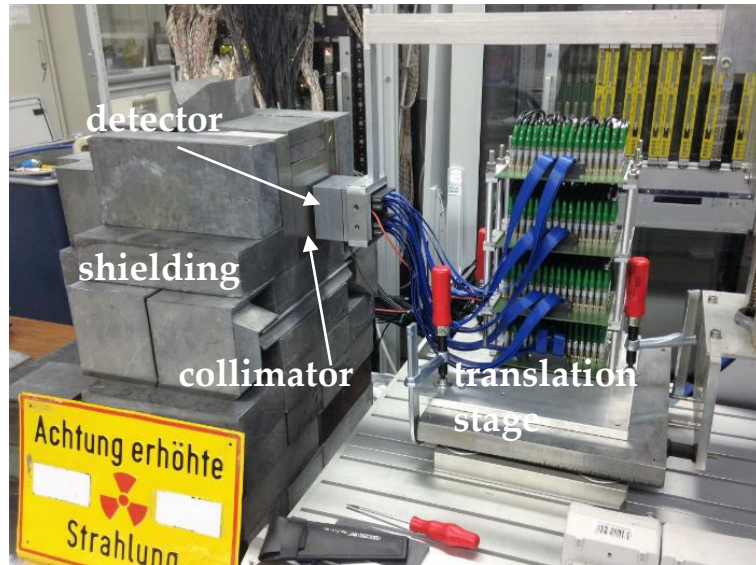
Midterm Meeting in Belgrade was featured in the 'ENLIGHT Highlights' publication June 2018



The periodic meetings are the occasion to create and strengthen formal and informal scientific collaborations

# Spatial resolution from monolithic absorber

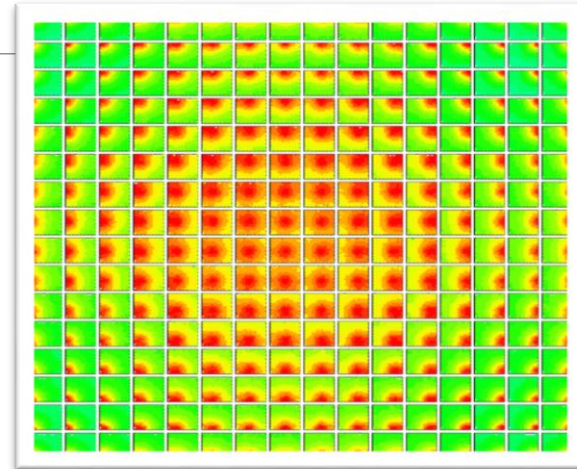
## ■ 2D scan of absorber with collimated $\gamma$ source



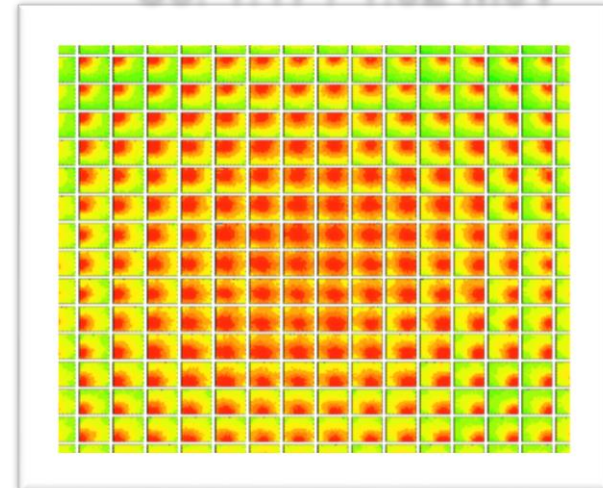
- $10^4$  irradiation positions
- 0.5 mm step size
- acquire 'reference library':  
2D light amplitudes

Each of the small rectangles shows 16x16 individual light amplitude values originating from the readout of the crystal by a (16x16) segmented multianode photomultiplier tube.

$^{137}\text{Cs}$ : 0.662 MeV

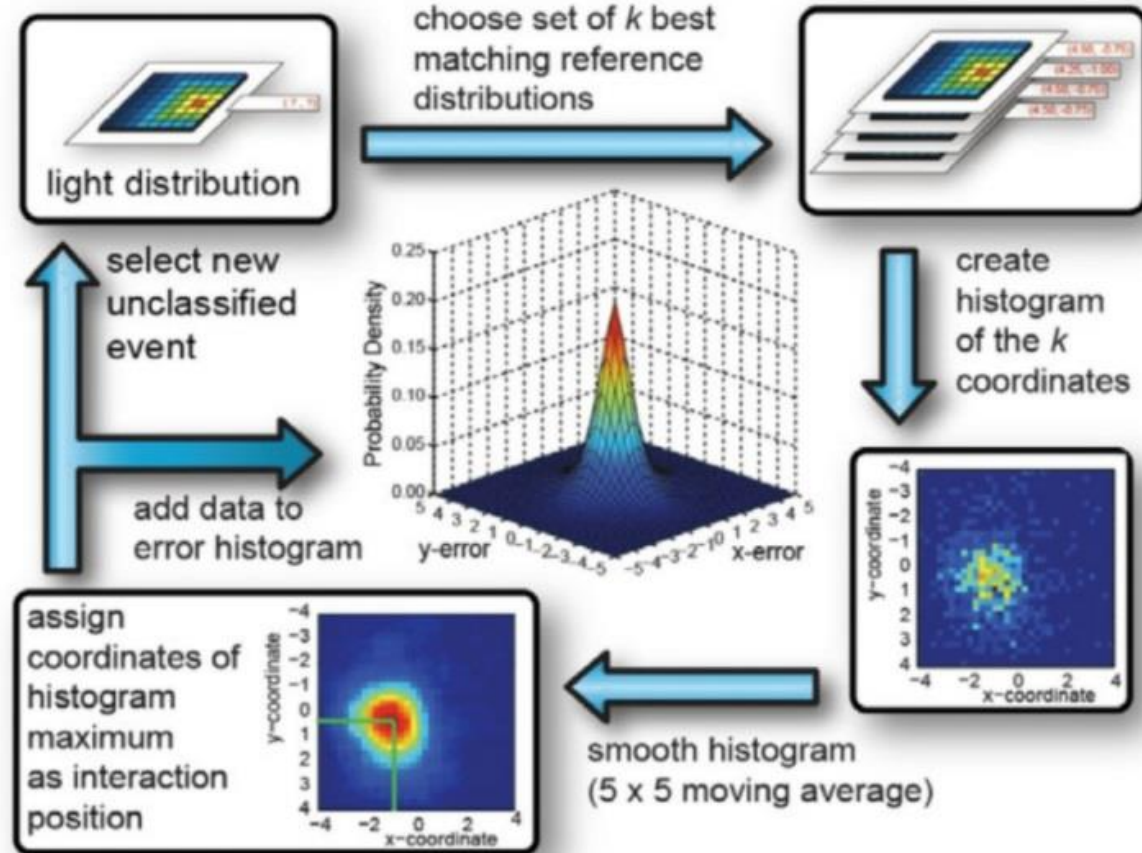


$^{60}\text{Co}$ : 1.17 / 1.32 MeV



# Spatial resolution from monolithic absorber

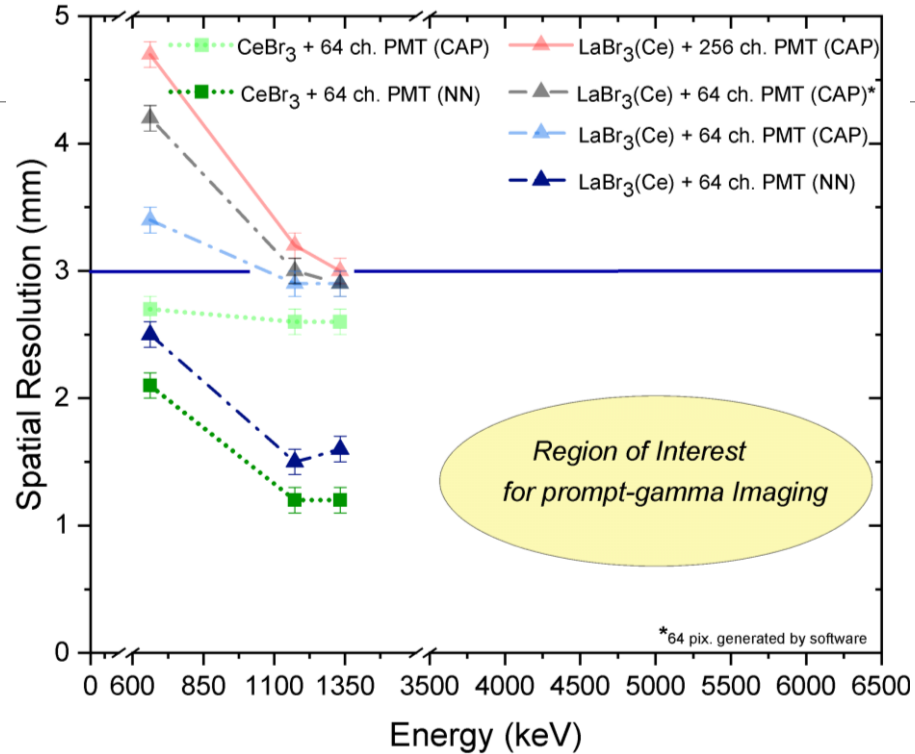
- spatial resolution: “k-nearest neighbor” (k-NN) algorithm



- spatial resolution:  
via error histogram:  
 $(x,y)_{\text{calc}} - (x,y)_{\text{true}}$
- recently:  
**neural networks**



# Spatial Resolution from Monolithic Scintillator



Energy [MeV]	Spatial resol. CAP* [mm]		Spatial resol. Neural Netw. [mm]	
	LaBr <sub>3</sub>	CeBr <sub>3</sub>	LaBr <sub>3</sub>	CeBr <sub>3</sub>
<b>0.662</b>	<b>3.4(1)</b>	<b>2.7(1)</b>	<b>2.5(1)</b>	<b>2.1(1)</b>
<b>1.17</b>	<b>2.9(1)</b>	<b>2.6(1)</b>	<b>1.5(1)</b>	<b>1.2(1)</b>
<b>1.33</b>	<b>2.9(1)</b>	<b>2.6(1)</b>	<b>1.6(1)</b>	<b>1.2(1)</b>

\*Categorical Average Pattern (improved k-NN)

## Findings:

- optimum spatial resolution obtained already with 64 PMT segments (vs. 256 channels)
- Neural Network position reconstruction outperforms k-NN algorithm (CAP version)
- Sub-1.5mm resolution achievable in large monolithic crystals

# Successful networking

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The activity profited from MediNet: Rita Viegas Regoa, Master student from the MediNet partner group in **Coimbra**, performed her experimental thesis work for seven months to to the MediNet partner group of Ludwig-Maximilians-Universität, **Munich**. She did all the reference library measurements that formed the basis of the neural network and k-NN computational activities. After graduation, Rita moved to the MediNet partner group in **Valencia** and now we are cooperating on readout optimization using SiPM arrays, where they are using the same hardware in different context.

A student from Dresden University will have an extended visit to the **Task 1 associate group in Lubeck** to learn about reconstruction techniques.

A Master student from **Task 2 associate group in Hasselt University** graduated on 21 June 2019 with a thesis in Monte Carlo simulation and experimental measurements on diamond microdosimeters, the result of knowledge exchange between Hasselt and MedAustron.

# Final MediNet Meeting

- Update about the groups research and networking activities
- Keynote speeches on developments on Medical Detectors and Techniques
- Poster sections

First official announcement of the:

## **One-day training in microdosimetry for beginner**

The chance is linked to the fact that three young researchers are starting their PhD in the field of “Microdosimetry applied to ion beam therapy in fall 2019 in three different Countries” and the scope is to create a common language, an possibly collaborations, and complementarity.

## MediNet Meeting 2019

October 7 - 9, 2019

MedAustron • Wiener Neustadt • Austria



Organizing Committee:  
Peter Thirolf • Markus Stock • Giulio Magrin

Local Organizing Committee:  
Petra Wurzer • Markus Stock • Giulio Magrin

MedAustron 



<https://medinet.medastron.at/index.php/Meeting2019>

# Preparing for the future:

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A proposal for the continuation of ENSAR2 was already submitted and it is waiting for the evaluation.  
An Evolution from MediNet to MediNext.

Learning from the experience.

- Avoid topics pre-determined five years in advance. The core activities are three topical conferences.
- Conference on "Novel accelerators and modalities for biomedical applications"
- Conference on "Radiobiological modelling and related studies"
- Conference on "New detectors addressing the new challenges"

Building on successful facts

- Student exchange will be a continuous activity
- Possibility of becoming a member and access meeting funds after the network is financed, based on interest and expertise of the group.

# 'Cavalieri dell'Ordine della Stella d'Italia'

2 June, 2019



Knighthood of  
International  
Collaborations

Ivan Petrovic and Alaksandra Ristic Fira were honored with the decoration of 'Cavaliere dell'Ordine della Stella d'Italia' (Knights of the Italian Star). The decoration was awarded for their merits gained during more than 20 years of activity in the field of scientific research, promotion of links, and collaboration and friendly relations with the Italian academic and scientific community. The activities of Ivan and Aleksandra within MediNet and ENSAR 2, in particular in collaboration with the INFN, Laboratori del Sud in Catania, are part of their prolific contributions to the Italian scientific community. **'We are very honored and happy'** said Aleksandra and Ivan after receiving the Italian star.