



European Research Infrastructures for Nuclear Science

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OUTLINE

- Introduction
 - Current activities at ENSAR2 and STRONG-2020
- What the ERINS project is?
- A short summary of the proposal

Integrating nuclear physics community - EU projects

Support for users and facilities



**Nuclear structure
reactions
and applications**

Contract 2016-2020 (10M€)

***New project ERINS under
evaluation***

- GANIL (France) - Coord.
- LNL-LNS (Italy)
- ISOLDE (CERN)
- JYFL (Finland)
- ALTO (CNRS, France)
- GSI (Germany)
- KVI (The Netherlands)
- NLC (HIL/IFJ PAN, Poland)
- IFIN-HH/ELI-NP (Romania)
- ECT* (Italy)



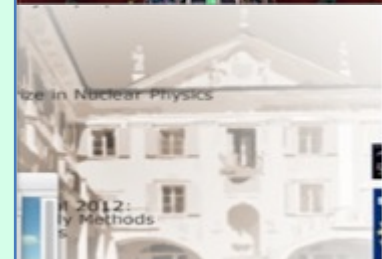
**Hadron physics
STRONG-2020**

Funded (10M€)

Grant Agreement signed on

May 24, 2019

- CERN
- LHC & fixed target exp.
- GSI/FAIR (Germany)
- LNF, Frascati (Italy)
- MAMI, Mainz (Germany)
- ECT*, Trento (Italy)
- ELSA, Bonn (Germany)
- COSY, Jülich (Germany)



Medical Network

The MediNet networking activity NA5 within ENSAR2 is dedicated to strengthen the application of nuclear-physics related knowledge, technology and expertise to advance tumor treatment and thus to address one of the questions of highest societal relevance

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

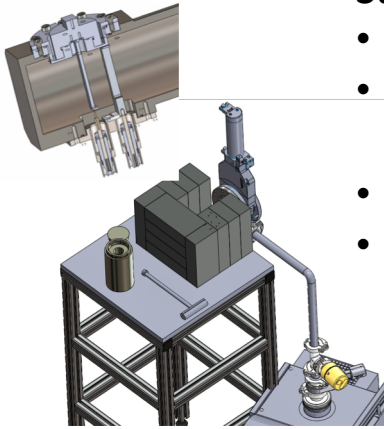
Task 2: Nuclear Tools for Ion Beam Therapy

(11 initial + 7 associated groups; G. Magrin / MedAustron)

- Radiation quality in Ion Beam Therapy
- Monte Carlo GEANT4 simulation
- Biological assessments

See talk of G. Magrin

Task RITMI (Radio Isotopes for Therapy and Medical Imaging)



Sub-Task 1 – Construction of a dedicated collection chamber

- Developed at ARRONAX (ENSAR2 postdoc Fabien Lafont), ILL, PSI and CERN.
- Constructed and tested at ILL and Approved by CERN-Safety Commission and Swiss Federal Office of Public Health
- Commissioning run at ISOLDE in September 2017
- Routine use in 2018 for several high-activity collections for preclinical experiments at PSI and for production of ion-implanted sources.

Sub-Task 2 – Production of ^{211}At isotopes with $^{209}\text{Bi}(\alpha, 2n)^{211}\text{At}$ with 28 MeV α beams

- Original plan modified: solid Bi target instead of innovative liquid → supplied from ARRONAX to GANIL for irradiation in the neutron convertor room of the NFS line and then back to ARRONAX for At extraction
- Scheduling under modification due to Spiral2 project delays

Sub-Task 3 – Production of Scandium isotopes ($^{43,44,47}\text{Sc}$)

- production of Sc radioisotopes measured with p, d and α beams at Warsaw, Swierk and ARRONAX Nantes.
- Production of the PET isotope ^{43}Sc by α beams on natural Ca targets is particularly promising.

STRONG-2020



The strong interaction at the frontier of knowledge: fundamental research and applications

JRA-TIIMM will deliver a new generation of detectors, which combine the MAPS (Monolithic Active Pixel Sensors) technology for particle tracking with energy deposition information. This type of detector will find applications in many large hadron physics experiments (like ALICE at CERN and STAR at BNL) but also in various areas of nuclear physics and, beyond physics, in the medical field of radiotherapy with hadrons.

Work package number	27	Lead Beneficiary			Istituto Nazionale di Fisica Nucleare	
Work package title	JRA9-Tracking and Ions Identifications with Minimal Material budget (TIIMM)					
Participant number	5	1	8	30		
Short name of participant	DKFZ	CNRS	GSI	INFN		
Person-months per participant:	3,6	4,4	4	29,4		
Start month	1	End month		48		



- What the ERINS project is ?

The Horizon 2020 Integrating Activity



ERINS is the follow up of ENSAR2

ENSAR2 ends on 28.02.2020

Some important dates:

Dedicated call for advanced communities

Opening date(s), deadline(s), indicative budget(s):²⁴

Topics (Type of Action)	Budgets (EUR million)		Deadlines
	2018	2019	
Opening: 05 Dec 2017			
INFRAIA-01-2018-2019 (RIA)	101.50		22 Mar 2018
Opening: 14 Nov 2018			
INFRAIA-01-2018-2019 (RIA)		125.00	20 Mar 2019
Overall indicative budget	101.50	125.00	

The ERINS proposal was submitted on March 20, 2019, evaluation results by August 2019

Main Goals and innovative aspects



Integrating Activities



- Further integration of key research infrastructures to take full advantage of new possibilities offered by nuclear physics facilities, some of them being new or undergoing major upgrades.
- The ongoing developments for current and future research are complex and require expertise and tools that are distributed in the different facilities.
- The integration of facilities of different size and specializations for science and training at regional levels.

ERINS will also target new users and stimulate new scientific activities to take full advantages of the new possibilities offered by the relevant ESFI infrastructures

The MoUs with infrastructures outside Europe is one of the tools to reach these objectives

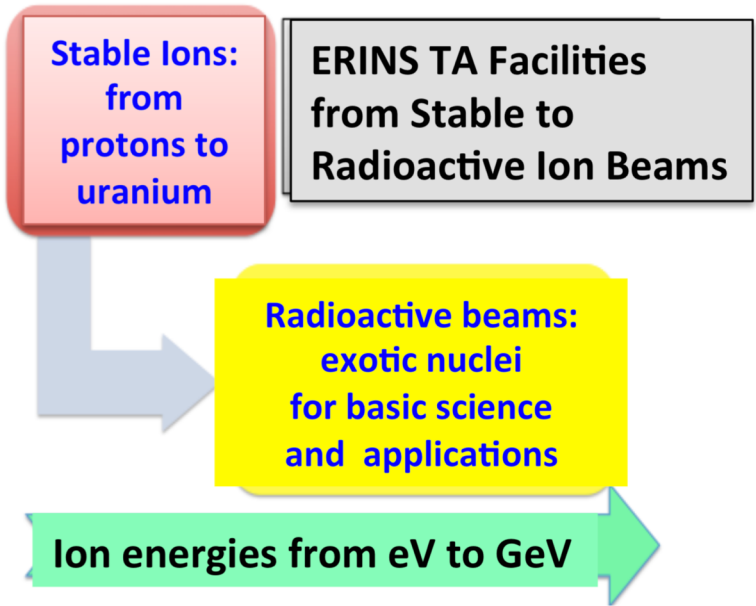
The IA



- A short summary of the proposal



Transnational Access



MoU s with laboratories
In Japan, China, USA ... as
in ENSAR2

- Joint ALTO/GANIL-SPIRAL2 (F)
- CERN-ISOLDE
- GSI (D)
- JYFL (FI)
- KVI-CART (NL)
- joint LNL-LNS (I)
- ECT* (I)
- joint NLC (PL)
- joint IFIN-HH/ELI-NP(RO)
and *new a joint multi-national facility* denoted as DSD (Hungary - Debrecen , Spain - Sevilla, Greece - Democritos).



Networking Activities

ERINS
NA

Strengthening links
in nuclear structure, reactions and
astrophysics

Preparation of scientific
programs for future facilities

Exploiting cutting-edge research
in applications

EuPhyINN reflects the growing need for specific nuclear structure studies connected to the field of neutrino, astro- and dark-matter physics.

RADPROBE intends to better exploit the available radioactive ions for condensed matter, materials science and biophysics research

MediNeXt focuses on the implications of next-generation particle accelerators for biomedical applications and related technologies

NUSREB aims to improve integration of the researchers working in nuclear spectroscopy and reaction

ENAN focuses on integration and collaboration of European scientists working in nuclear physics for astrophysics

DEEPEN examination of the opportunities offered by electron scattering on exotic nuclei to investigate their electromagnetic properties.



Networking Activity - MediNeXt

MediNeXt focuses on the implications of next-generation particle accelerators for biomedical applications and related technologies such as radiation therapy and studies of biological effectiveness. It supports ongoing biomedical research in many of the ERINS facilities by developing key technologies and supporting the local groups to best exploit the capabilities of the facilities.

			13-LUDWIG-MAXIMILIANS-UNIVERSITAET MUENCHEN
Work package title	NA5-MediNeXt: Medical Network		
Participant number	5	1	13
Short name of participant	GSI	INFN	LMU
Person months per participant	0	0	0
Start month	1	End month	48



Networking Activity - MediNeXt

Task 1: Organization and support of topical meetings, scientifically supported by the MediNeXt Network Assembly.

The 3 Topical Conferences :

- Conference on “Novel accelerators and modalities for biomedical applications” (leading partner: GSI)
- Conference on “Radiobiological modelling and related studies” (leading partners INFN-LNS (Catania) & ELI-Med)
- Conference on “New detectors addressing the new challenges” (leading partner: LMU Munich)

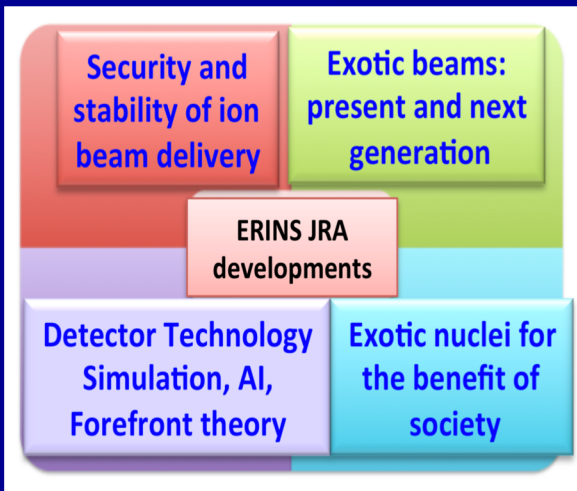
Task 2: Continuous networking activities:

- Exchange program for young/early career researchers during experimental campaigns and focused activities (lead partner: LMU).

The 31 member groups from 11 countries will form the start-up community of MediNeXt



Join Research Activities



IBIS developments of ion sources and innovative cryogenic model-based controls

ASTEX increase of the performance of gas cells for both the IFF and ISOL Radioactive Ion Beam production methods

App4RIB will make developments of beam purification techniques

ASPHODEL to lead cutting-edge R&D for EURISOL

DETNA : technological developments in several detector areas

MANI is focused on development of methods to perform test measurements of cross sections of nuclear reactions in laser-induced plasmas

CEANN : artificial neural networks and machine learning procedures in different experimental analysis

FIS-NN focuses on providing new insight into the microscopic nature of the nuclear force that underlines the structure of nuclei

LIONESS laser-based techniques and their application in medical and environmental-based science in the actinides and lanthanides.

MAIA production of radioisotopes for medical applications.



Join Research Activity - LIONESS

Task 5: *Laser ionization for the production of lanthanides or actinides for medical applications (CERN/ISOLDE)*

The production of RIBs of ^{149}Tb , ^{152}Tb , ^{155}Tb , ^{169}Er and ^{225}Ac , of interest to the medical community, relies partly on the high efficiency of the ionization schemes of laser ion sources. New ion source geometries and configurations will be developed.

- (CERN, Mainz): Two-step laser ionization of lanthanides for efficiency and selectivity
- (CERN, KU Leuven, Mainz): Study and optimization of a hot cavity ion throughput



Join Research Activity - MAIA

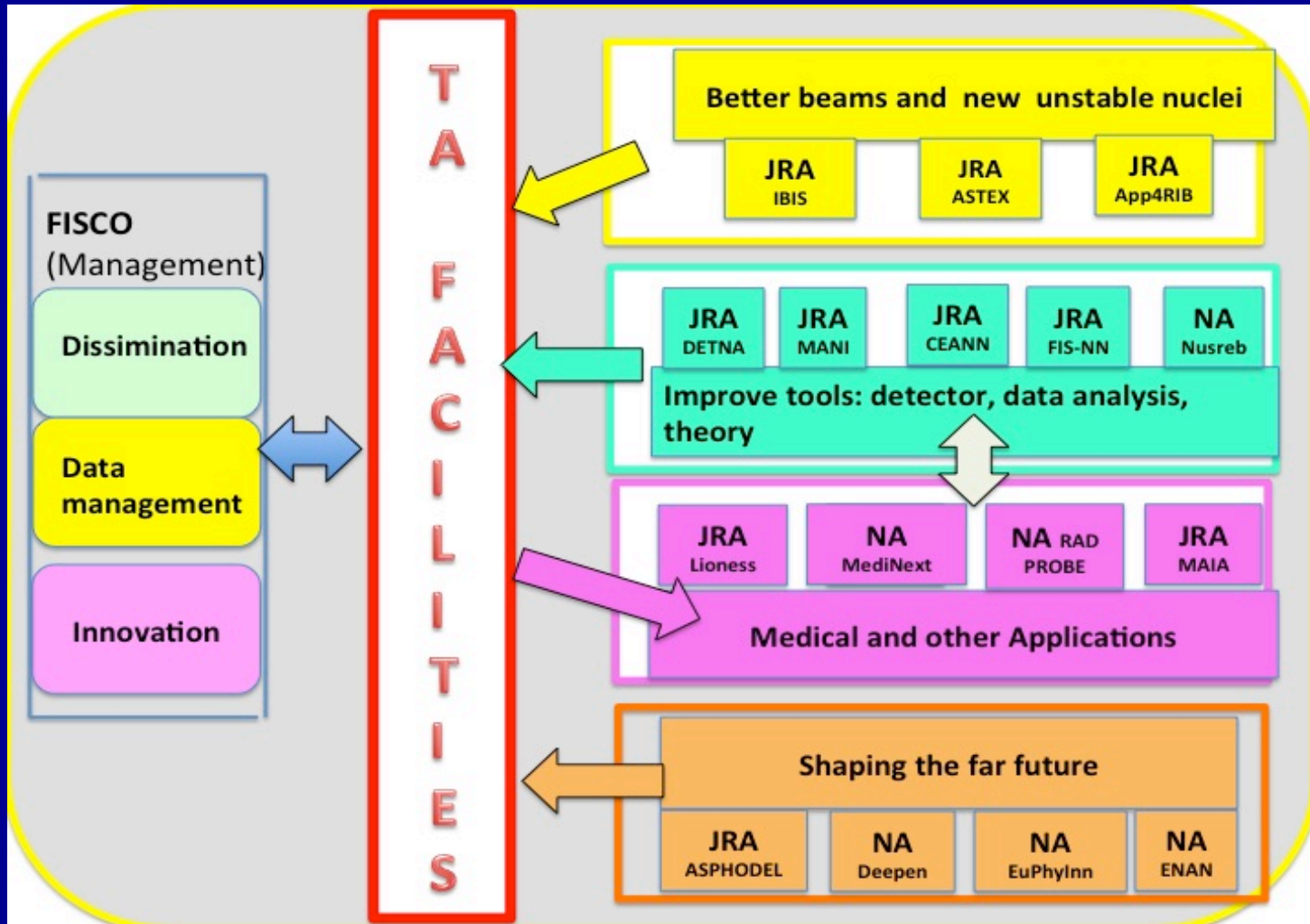
Work package number	27		Lead Beneficiary		1-ISTITUTO NAZIONALE DI FISICA NUCLEARE				
Work package title⁴	JRA10-MAIA: MedicAl Isotopes from Accelerators								
Participant number	1	16	9	11	2	30	8	24	
Short name of participant	INFN	USC	IFIN-HH	CEA	GANIL	NPI-CAS	UNIW ARSA W	CSIC	
Person months per participant⁵:	6	18	12	14	0	0	0	6	

Tasks:

- 1) Laser-plasma acceleration could be the enabling technology to produce on-demand doses of PET probes of interest at low cost, in an automated, user-friendly device of compact size.
- 2) Production methods of theranostic isotopes, interesting candidates are the scandium radioisotopes (^{43}Sc and ^{44}Sc as β^+ emitters with ^{47}Sc as β^- emitter). Innovative technologies, adapted at a later stage to industrial production of medical radioisotopes using ^{211}At .
- 3) Studies of mass separation of radioactive beams based on
 - selective ionization using lasers or different ion sources + use of electromagnetic separators, as in the case of ISOL-based production
 - chemical separation of different elements



Relation between the WPs





Beneficiaries

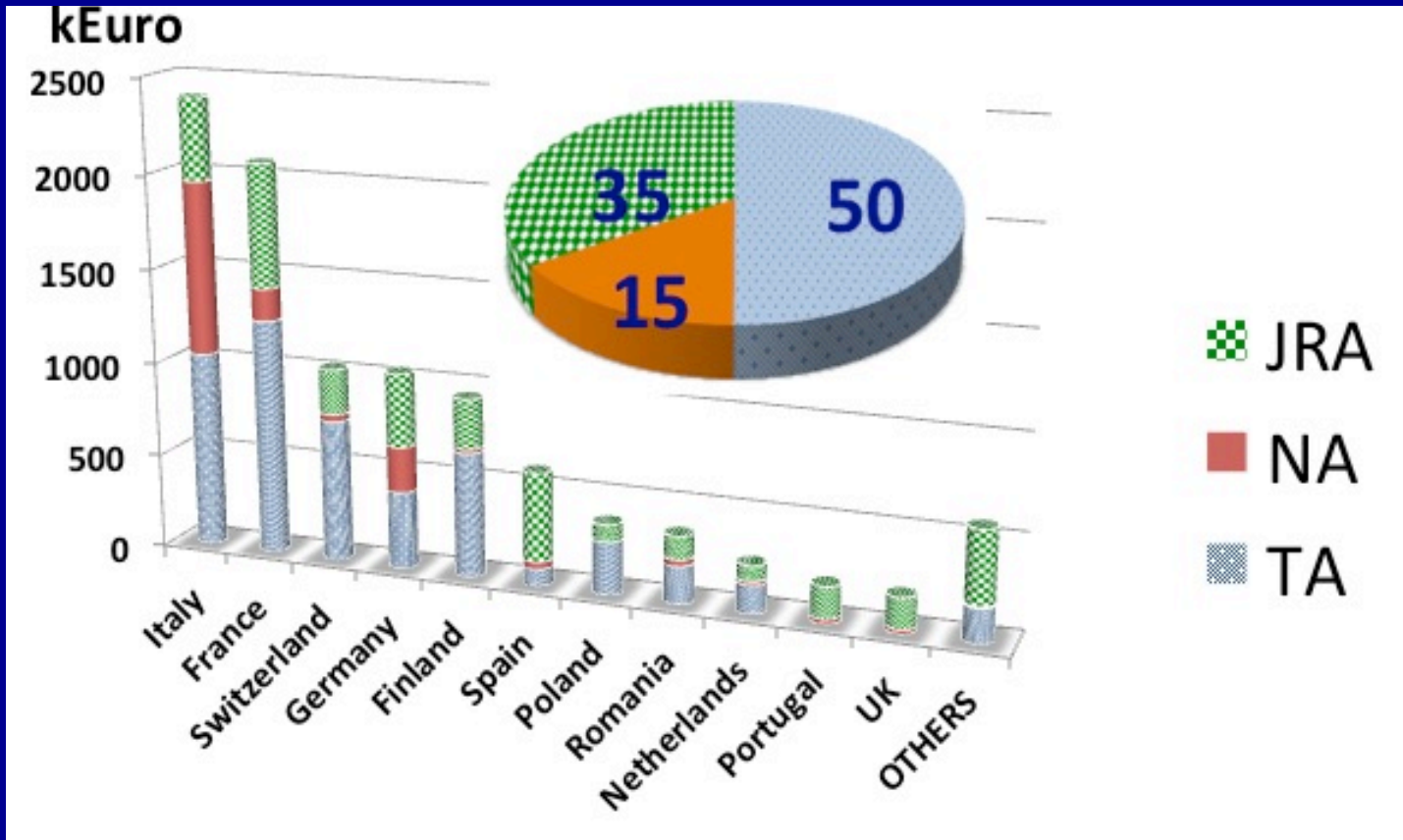
Participant No *	Participant organisation name	Country
1/INFN	ISTITUTO NAZIONALE DI FISICA NUCLEARE	Italy
2/GANIL	GRAND ACCELERATEUR NATIONAL D'IONS LOURDS	France
3/CERN	EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH	Switzerland
4/CNRS	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS	France
5/GSI	GSI HELMHOLTZZENTRUM FUER SCHWERIONENFORSCHUNG GMBH	Germany
6/RUG	RIJKSUNIVERSITEIT GRONINGEN	Netherlands
7/IFJ-PAN	THE HENRYK NIEWODNICZANSKI INSTITUTE OF NUCLEAR PHYSICS, POLISH ACADEMY OF SCIENCES	Poland
8/UNIWARSAW	UNIWERSYTET WARSZAWSKI	Poland
9/HH-IFIN	INSTITUTUL NATIONAL DE CERCETARE - DEZVOLTARE PENTRU FIZICA SI INGINERIE NUCLEARA "HORIA HULUBEI" (IFIN-HH)	Romania
10/FBK	FONDAZIONE BRUNO KESSLER	Italy
11/CEA	COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	France
12/JLU MUENCHEN	JUSTUS-LIEBIG-UNIVERSITAET GIESSEN	Germany
13/LMU	LUDWIG-MAXIMILIANS-UNIVERSITAET MUENCHEN	Germany
14/NCSR	NATIONAL CENTER FOR SCIENTIFIC RESEARCH "DEMOKRITOS"	Greece
15/IST	INSTITUTO SUPERIOR TECNICO	Portugal
16/USC	UNIVERSIDAD DE SANTIAGO DE COMPOSTELA	Spain
17/USE	UNIVERSIDAD DE SEVILLA	Spain
18/ATOMKI-HAS	MAGYAR TUDOMANYOS AKADEMIA ATOMMAGKUTATO INTEZETE	Hungary
19/KU Leuven	KATHOLIEKE UNIVERSITEIT LEUVEN	Belgium
20/UG	UNIVERSITAET GREIFSWALD	Germany
21/JGU	JOHANNES GUTENBERG UNIVERSITAET MAINZ	Germany
22/UoC	UNIVERSITAET ZU KOELN	Germany
23/U.MANCHESTER	THE UNIVERSITY OF MANCHESTER	United Kingdom
24/CSIC	AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS	Spain
25/CIEMAT	CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT	Spain
26/UPC	UNIVERSITAT POLITECNICA DE CATALUNYA	Spain
27/UGOT	GOETEBORGS UNIVERSITET	Sweden
28/ULIV	THE UNIVERSITY OF LIVERPOOL	United Kingdom
29/SNRC	SOREQ NUCLEAR RESEARCH CENTER	Israel
30/NPI-CAS	USTAV JADERNE FYZIKY AV CR	Czech Republic
31/SCK-CEN	STUDIECENTRUM VOOR KERNENERGIE/ CENTRE D'ETUDE DE L'ENERGIE NUCLEAIRE	Belgium
32/SURREY	UNIVERSITY OF SURREY	United Kingdom
33/JYU	JYVASKYLAN YLIOPISTO	Finland
34/ESS	EUROPEAN ESPALLATION SOURCE	Sweden

34 beneficiaries
17 countries

Coordinating institution
INFN - Italy



Total Budget 10M€



Requested in total 770 person.months +
own person.months about 1200



Final remarks

ERINS is an efficient tool to realize the Long Range Plan of NuPECC and the Roadmap of ESFRI

Our planned R&D in ERINS form coherent set of activities that together with NAs and experiments at TN facilities will be instrumental to define the sustainability path for our research infrastructures

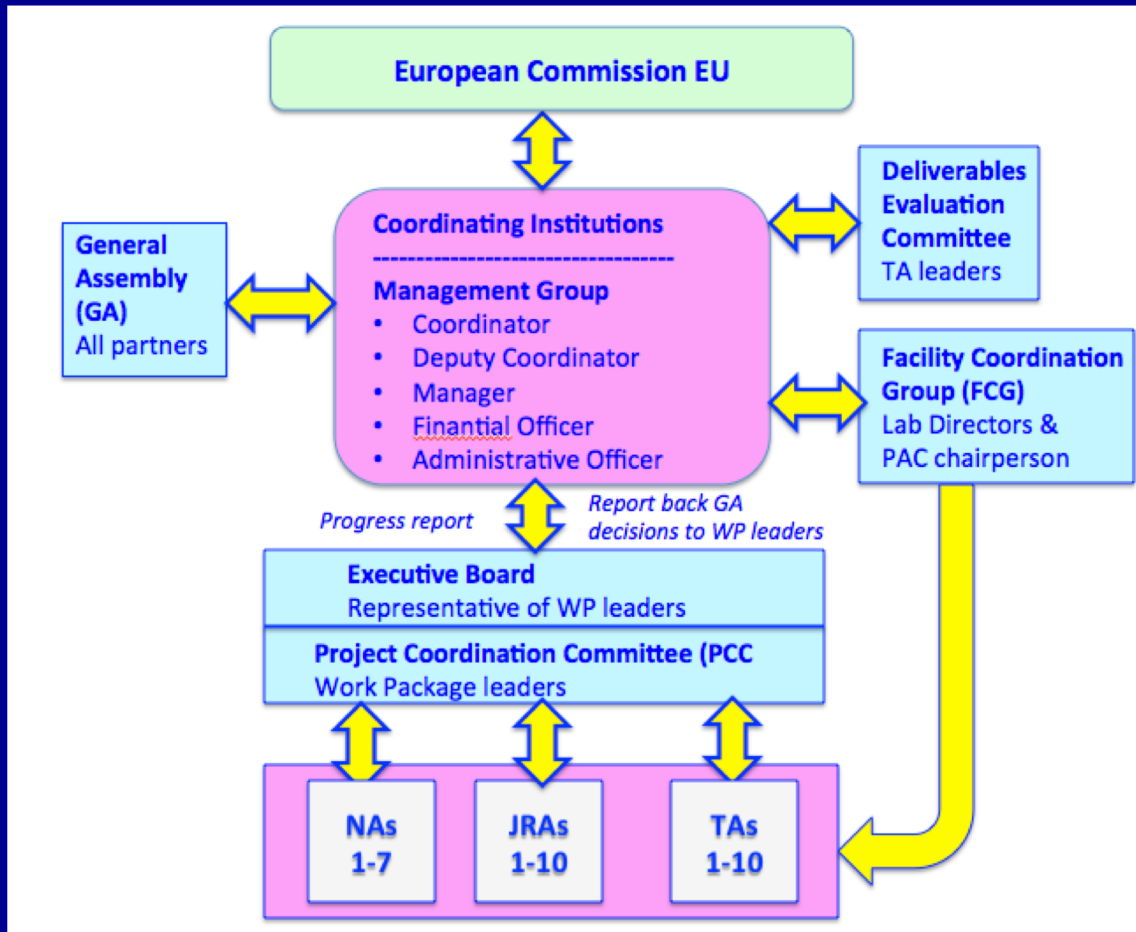
Important part of the ERINS proposal (JRA LIONESS and MAIA, NA MediNeXt) has a strong link to and impact on medical research

Proposal evaluation report expected by August 2019

**THANK YOU
FOR
YOUR ATTENTION**



Management structure



Important
role of
the FCG

Suggested (MH, ML) formulation for the 2018/19 call in H2020

Research Infrastructures for Nuclear Physics. This activity aims at further integrating the key research infrastructures for studying the properties of nuclear matter at extreme conditions, using advances in nuclear physics experimentation to open new vistas for fundamental research and employing them for new societal and industrial applications. It must present a long-term sustainable perspective on the integration of relevant facilities and related resources. Furthermore, it should also target new users and stimulate new scientific activities to take full advantage of new possibilities offered by relevant ESFRI infrastructures.

The IA



- How ERINS was constructed ?

The scientific committee

ECT*	Jochen Wambach	<u>jwambach@ectstar.eu</u>
ELI-NP	Dan Ghita	<u>dan.ghita@eli-np.ro</u>
FAIR-GSI	Christoph Scheidenberger	<u>C.Scheidenberger@gsi.de</u>
GANIL	Marek Lewitowicz	<u>Marek.Lewitowicz@ganil.fr</u>
IFJ-PAN	Adam Maj	<u>adam.maj@ifj.edu.pl</u>
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Advisor	Muhsin N. Harakeh	<u>m.n.harakeh@kvi.nl</u>
Coordinator	Angela Bracco	

Meetings and dead lines

6 October 2018 : In Catania open meeting with the community

13 November 2018 : Meeting of SSC at CERN and feedbacks to TNA's, NA's, JRA's was sent

5 December 2018- Meeting with B. Froissard in Bruxelles (with Marek and Muhsin)

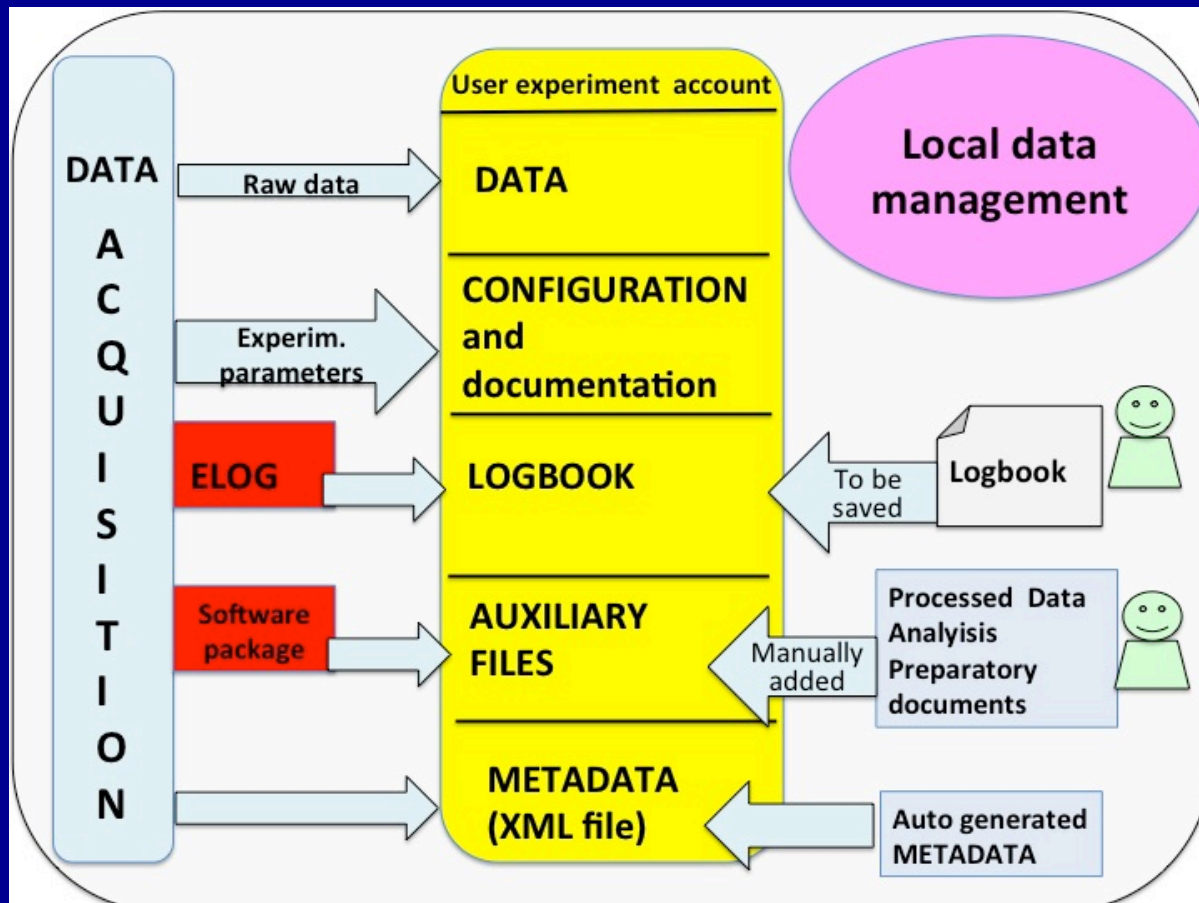
15 December : advanced draft of TNA's, NA's, JRA's to was sent to SC

11 January 2018 : Meeting of the SC in Orsay to discuss TA and the first draft of the proposal

30 January 2019 : Total draft distributed to the members of SC

Travel of AB to Jyvaskyla (great help from Paul!!) and several to Catania to write the proposal (with Carolina Rapicavoli to work in particular for the budget and various tables)

8 March 2019 : submission of the text and tables in the web page



Common developments

Deliverables

D5.3: Report on: “Nuclear Physics Instrumentation for Medicine”

submitted on time in month 36 (end of February 2019):

<https://medinet.medastron.at/images/3/37/D5.3-submitted.pdf>

D5.4: Report on: “Use of nuclear physics tools to support biological effectiveness assessment in ion-beam therapy”
due in month 45 (end of November 2019)

Milestones

the following Milestone to note:

**Midterm Meeting,
held in Belgrade, March 12-14,
2018, with 33 participants**



- the next milestone (MS18) will be the Final Meeting to be held in Q1/2020