EURISOL - Distributed Facility

M. Lewitowicz

for the EURISOL Steering Committee
What is EURISOL?
as defined in the 2005-2009 EU funded Design Study

2010: EURISOL endorsed by NuPECC as highest long term priority for low energy nuclear physics in Europe

>1 B€
**A possible schematic layout for a EURISOL facility**

**Secondary fragmentation target**

- H-, D+, ³He++
- Ion sources

- Spoke ISCL 264 MHz
- 8 HWRs ISCL 176 MHz
- 3 QWRs ISCL 88 MHz
- QWR ISCL 88 MHz

- β = 0.385
- β = 0.27
- β = 0.14
- β = 0.065

- 20-150 MeV/u (for ¹³²Sn)
- 9.3-62.5 MeV/u
- 2.1-19.9 MeV/u

- To high-energy experimental areas
- To medium-energy experimental areas
- To low-energy areas

**One of several 100-kW direct target stations**

- 4-MW target station
- 1+ ion source
- 1 GeV/q H-, H+, ³He++

- 3-spoke ISCL 325 MHz
- Elliptical ISCL 704 MHz

- β = 0.3
- β = 0.47

- >200 MeV/q
- D+, A/q=2

- RFQ 176 MHz

- β = 0.09, β = 0.15
- β = 0.3

- 100 keV
- 1.5 MeV/u
- 60 MeV/q
- 140 MeV/q

**To low-energy areas**

**Low-resolution mass-selector**

**High-resolution mass-selector**

**Charge breeder**

**Charge selector**

**n-generator**

**UCₓ target**

**RFQ**

**Elliptical ISCL 704 MHz**

**Elliptical ISCL 704 MHz**

**HWRs 176 MHz**

**3-spoke ISCL 325 MHz**

**RFQ 176 MHz**

**1 GeV/q H-, H+, ³He++**
Physics with ISOL RIB
Intensity & Energy domains

HI-ISOLDE, SPES, SPIRAL2, ISOL@MYRRHA
EURISOL-DF

EURISOL
EURISOL & EU ISOL facilities
Post-accelerated beam intensities

Ex.: At 1nb 1 nucl./day via fusion-evaporation
Background

• 2001-2005: EURISOL RTD
• 2005-2009: EURISOL Design Study (see http://www.eurisol.org)
• 2010: EURISOL endorsed by NuPECC as highest long term priority for low energy nuclear physics in Europe
• EURISOL Office
• EURISOL User Group: Update of the physics case
• EURISOL related R&D Initiatives
• Existing & planned ISOL facilities in Europe:
  • GANIL-SPIRAL2, HIE-ISOLDE, SPES, ISOL@MYRRHA, ALTO, JYFL
-> EURISOL MoU
The EURISOL MoU establishes a common understanding among the Parties of the collaborative effort required for the continued development of EURISOL, including more focused R&D and a more refined cost estimate.

Signatories: CERN, COPIN (Poland), BEC (Belgium), GANIL, INFN
The MOU is implemented by a Steering Committee with one representative per signatory. The members are:
   MJG Borge (CERN), M. Lewitowicz (GANIL, chair), A. Maj (COPIN),
   S. Pirrone (INFN), L. Popescu (BEC),
   A. Bracco (NuPECC representative) and Y. Blumenfeld (EURISOL JRA ENSAR2, invited)

-> EURISOL-DF Initiative from 2014
Goals of the EURISOL-DF project:

• Prepare strong scientific case for RIB science and applications
• **Support, upgrade, optimize and coordinate ISOL-based European facilities and projects as a necessary step towards EURISOL**
• Foster R&D on RIB production and Instrumentation towards EURISOL
• Get EURISOL-DF on the ESFRI list as a candidate project by 2018
• EURISOL as a single site facility as a long term goal
EURISOL – Distributed Facility (DF)

Members Initially:
- HIE-ISOLDE/CERN
- SPES-INFN
- SPIRAL2-GANIL

Candidate - future facility:
- ISOL@MYRRHA

EURISOL MoU member:
- COPIN Consortium Poland

JYFL will join soon

Participation of ALTO is under discussion
HIE-ISOLDE Facility

- ISOLDE is the CERN radioactive beam facility (approved 50 y ago!)
- Provides low energy or post-accelerated beams
- Run by an **international collaboration since 1965. Presently 13 members** (B, CERN, Dk, E, F, Ge, Gr, I, India, N, R, S, UK)
- > **500 Users from 100 Institutions, 50 experiments / year**

> >1300 isotopes

**Started Jan 2010**
**Budget 35 M€**
SPES Facility at LNL Legnaro

Existing facility

1. Building and infrastructures with 2 ISOL bunkers for radioactive beam and application area for radioisotopes and neutrons
2. Cyclotron 70 MeV protons with 2 independent exits
3. ISOL UCx target designed for $10^{13}$ f/s - direct production with $p$
4. Beam transport with High Resolution Mass Separation
5. Reacceleration with ALPI superconductive linac (10A MeV A=130)
6. Radioprotection, safety & controls

≥ 50 M€, first beams by 2019

70 MeV 0.75 mA Proton cyclotron
Phase 1 (2016-)
Increase the intensity of stable beams
High intense neutron source
(HI \leq 10^{15} \text{ pps}, \text{ p-Ni})

GANIL (HI \leq 10^{13} \text{ pps})

DESIR Phase 1+ (2020-)
Low energy facility

AGATA (2015-2018)

LINAC
33 MeV p, 40 MeV d (5 mA)
A/q=3 - 14.5 A MeV HI (1 mA)

Phase 2
RIB Production
up to 10^{14} \text{ FF/s}

SPIRAL1 ISOL upgrade
CIME: 1-20 AMeV
(9 AMeV pour Fr)

GANIL-SPIRAL2

SPIRAL1 Upgrade (2017-)
New light RIBs from beam/target fragmentation
- Driver-beam power on ISOL@MYRRHA target: 60-120 kW
- Low-energy RIBs
- Experimental programme complementary to other ISOL facilities – long-run experiments

L. Popescu (SCK•CEN)
EURISOL – Distributed Facility (DF) Initiative

Proposed EURISOL-DF scheme:

- EURISOL Science Case & Experiments
  - Dedicated beamtime for EURISOL-DF experiments
  - Dedicated EURISOL-DF Scientific Council & PAC
- R&D for EURISOL
  - Dedicated Technical Advisory Committee
- Legal entity (ERIC,...)

Interaction with EURISOL JRA in ENSAR 2 and EURISOL User group

JYFL will join soon

Discussions with GSI/NUSTAR, ALTO

Project to be submitted for the 2018 update of the ESFRI roadmap

http://www.eurisol.org/eurisol_df/
Schedule of main actions:

- Reports of the 5 Working Groups by **June 2016**
- Draft of the full EURISOL-DF proposal by **September 2016**
- EPS Conference dedicated to EURISOL-DF in **October 18-21, 2016**
- Submission of the EURISOL-DF project to ESFRI by **March 2017**
- *EC funded Preparatory Phase from 2018-2019 (if on the ESFRI roadmap)*
- Schedule to be re-adjusted if necessary to that of ESFRI roadmap 2018 update and to the NuPECC LRP preparation
PS Conference: Towards EURISOL Distributed Facility

EURISOL DF 2016

- 18-21 October 2016
- Leuven
- Expecte attendance: ≥ 200 participants

Promotiezaal KU Leuven
(385 places)

Jubileumzaal: coffee breaks, reception, lunch and poster session(s)
Timeline EURISOL-DF

2016 | I | 2017 | I | 2018 | I | 2019 | I | 2020

- **Stage 1 (4.3 MeV/n)**
- **Phase 1 (4 MeV/n) commissioning**
- **Phase 1 operation**
- **Phase 1+ (DESIR) construction**
- **Construction & commissioning**
- **Phase 1+ operation**
- **Operation**

**EURISOL-DF EU funded Preparatory Phase**

**EURISOL-DF**

**EPS Conf**

**Submiss ion**

**Ok from ESFRI**

**ESFRI list update proposal**
Going to the limits of mass, temperature, spin and isospin with heavy Radioactive Ion Beams

Each meeting:
40-70 participants
25-30 talks
2.5 days

Physics of the proton rich side of the nuclear chart

The formation and structure of r-process nuclei

Instrumentation York

EURISOL related R&D Initiatives

• EMILIE: Charge Breeding
• LIEBE: Pb-Bi target
• TIARA: Test Infrastructures
• EURISOL Joint Research Activity in ENSAR2
The EMILIE project

« Enhanced Multi-Ionization of short Lived Isotopes for EURISOL »
Charge breeding techniques for ISOL facilities

High charge states

Intense beams

Consortium of 8 European laboratories

EBIS beam debuncher

Longitudinal Paul trap for EBIS pulses debunching

Tests using the SHIRAC test bench

Tests at LPC Caen with pulsed 1+ beams during the fall of 2014

Prototype simulated by Emil Traykov (GANIL)
Design and Construction Yvan Merrer/P. Desrues (LPC Caen)
RF DC electronics and wiring J. F. Cam (LPC Caen)

Radioactive Ion Beam Facilities in Europe

9 Existing RIB Facilities:

5 In-flight fragmentation

4 ISOL

5 Facilities/upgrades under construction or commissioning

2 Projects under design

Community: 2700-3000 scientists and highly qualified engineers
EURISOL-DF working groups for the preparation of the ESFRI-list proposal:

• WG1: Science & applications (together with EURISOL User Group): Coordinator R. Raabe (Kick-off meeting by the end of Jan. 2016)

• WG2: Technical R&D – high power accelerators: Coordinator A. Facco (Kick-off meeting in Oct.)

• WG3: Technical R&D – RIB beam handling, targets and ion sources: Coordinator M. Borge (Kick-off meeting on Sept. 17)

• WG4: Technical R&D – spectrometers & detectors: Coordinator H. Savajols (Kick-off meeting end of 2015)

• WG5: EURISOL-DF & relationships with ESFRI & EC and its future legal structure: Coordinator: A. Bracco (Kick-off meeting on Oct. 26)