The ISOL@MYRRHA project at SCK•CEN

Lucia Popescu
SCK•CEN
lpopescu@sckcen.be

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Outline

- The MYRRHA project at SCK•CEN
- ISOL@MYRRHA conceptual design
- Facility characteristics
- Applications
- ISOL@MYRRHA Project

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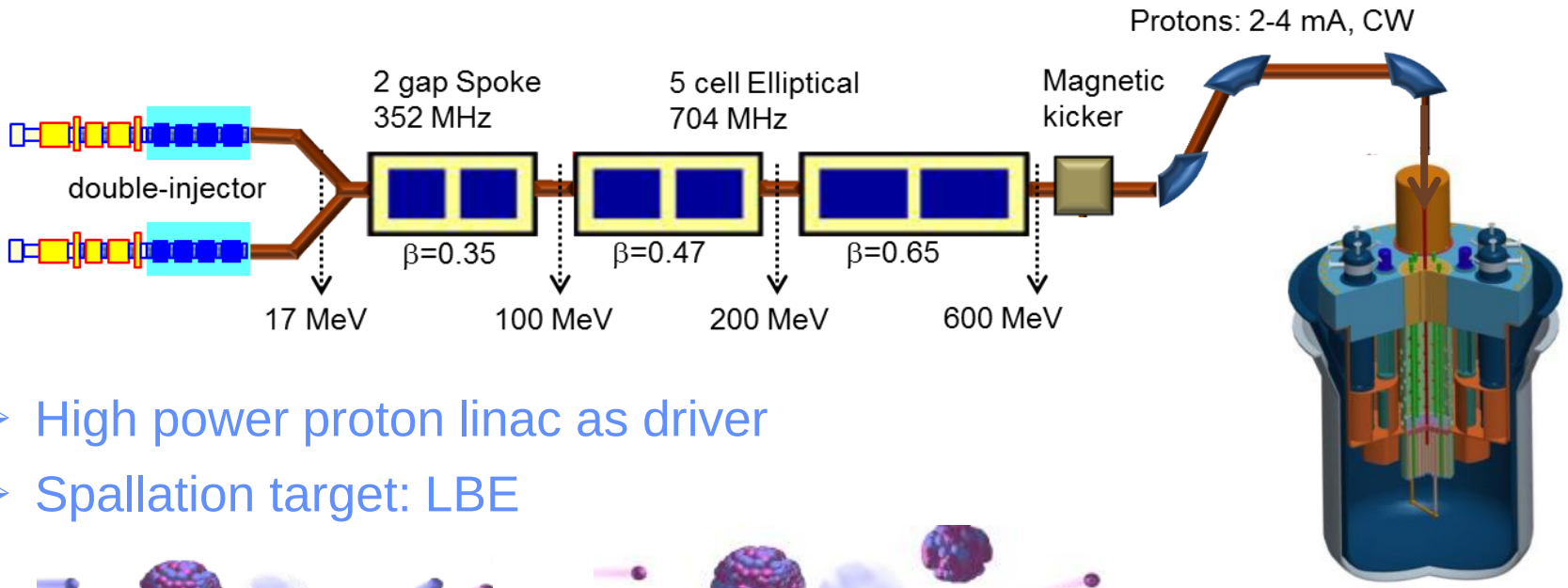
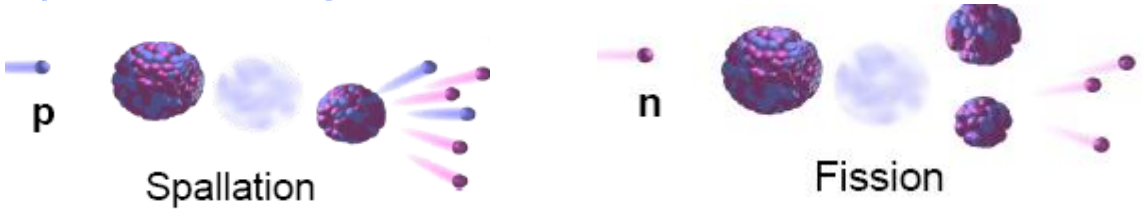
MYRRHA - Concept

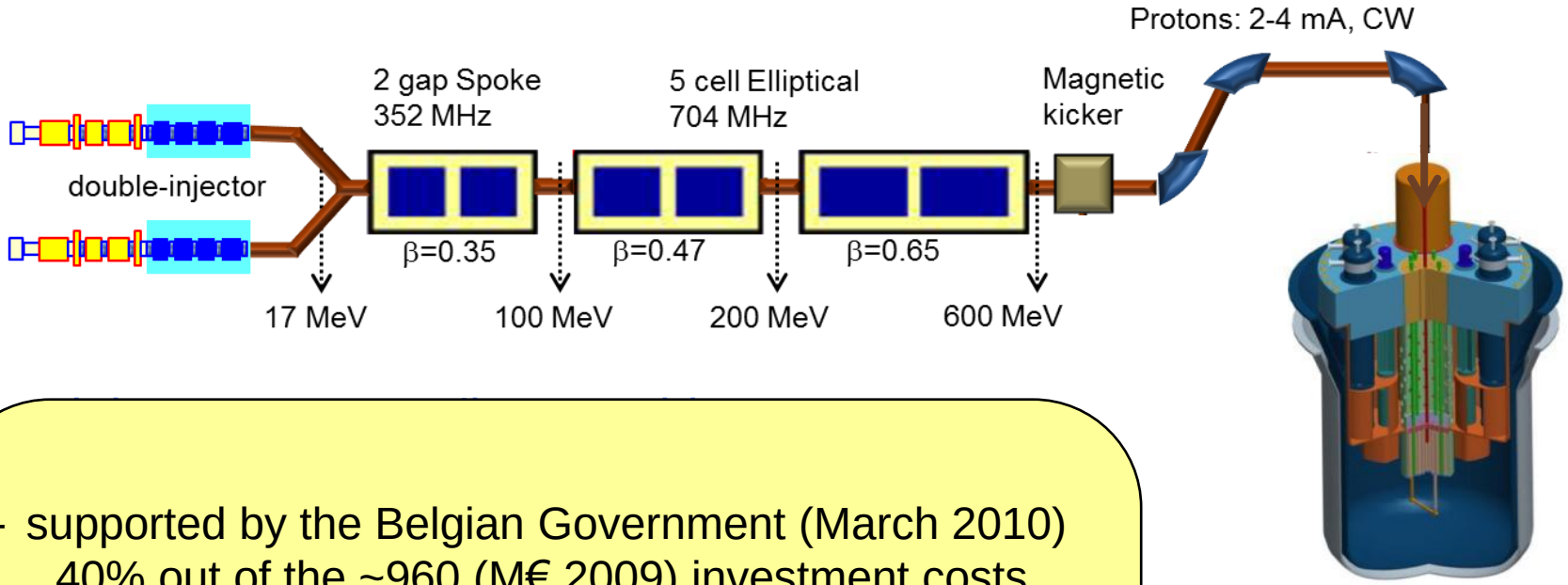


- High power proton linac as driver
- Spallation target: LBE



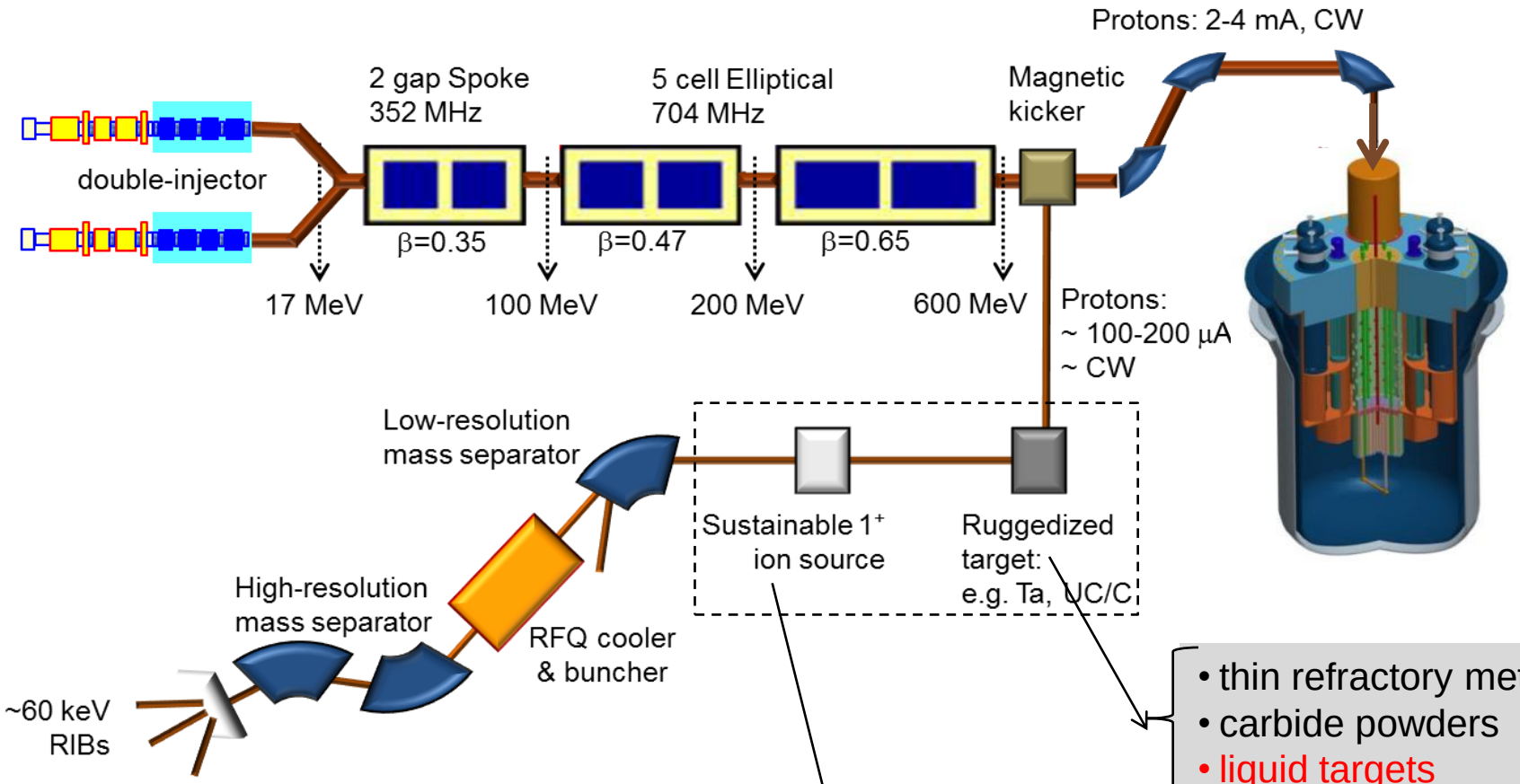
- Subcritical reactor
  - High power density 30-32% MOX core
  - Liquid metal cooled (LBE)
  - High flexibility

MYRRHA - Concept



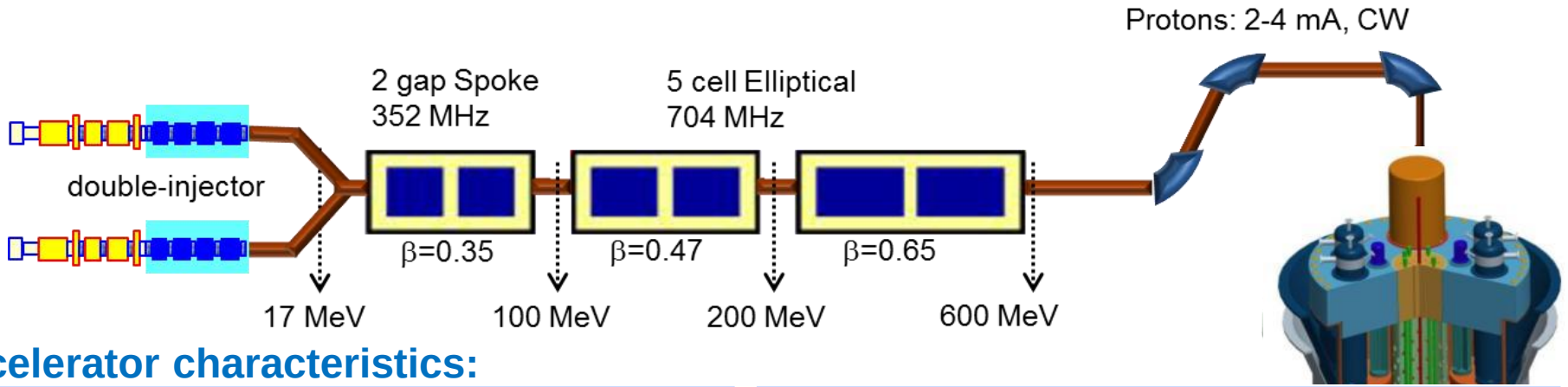
- supported by the Belgian Government (March 2010)
  40% out of the ~960 (M€ 2009) investment costs
- on the **ESFRI** roadmap (Nov. 2010)
- on the **ESNII** roadmap (Nov. 2010)
- on the **NuPECC** roadmap (Dec. 2010) – for the physics applications (ISOL@MYRRHA)

ISOL@MYRRHA - Concept



MYRRHA Proton Driver

Collaborative efforts within MAX FP7 project:
CNRS, ACS, ADEX, CEA, EA, FE-UCP, IAP, INFN, KUL, SCK•CEN, TED



Accelerator characteristics:

Fundamental parameters (ADS)	
Particle	p
Beam energy	600 MeV
Beam current	4 mA
Mode	CW
MTBF	> 250 h

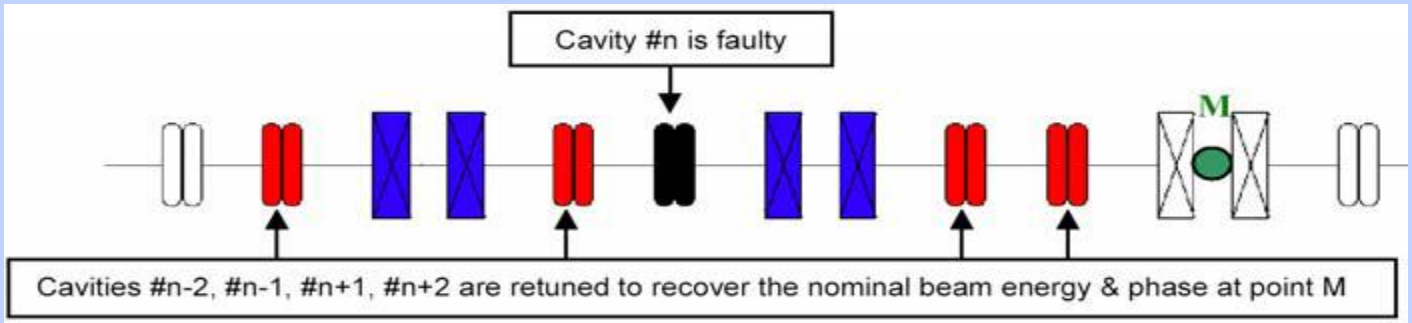
Failure= beam trip > 3s

implementation	
Superconducting linac	
frequency	176/352/704 MHz
Reliability = redundancy	Double injector
	"fault tolerant" scheme

MYRRHA Proton Driver

- implementation of reliability: 3 principles
  1. overrating
  2. redundancy → parallel scheme (double-injector)
  3. reparability (MTR<<MTBF) → serial scheme (modular high energy sections)
- principles to be applied to the basic linac layout, but also to much of the ancillary equipment

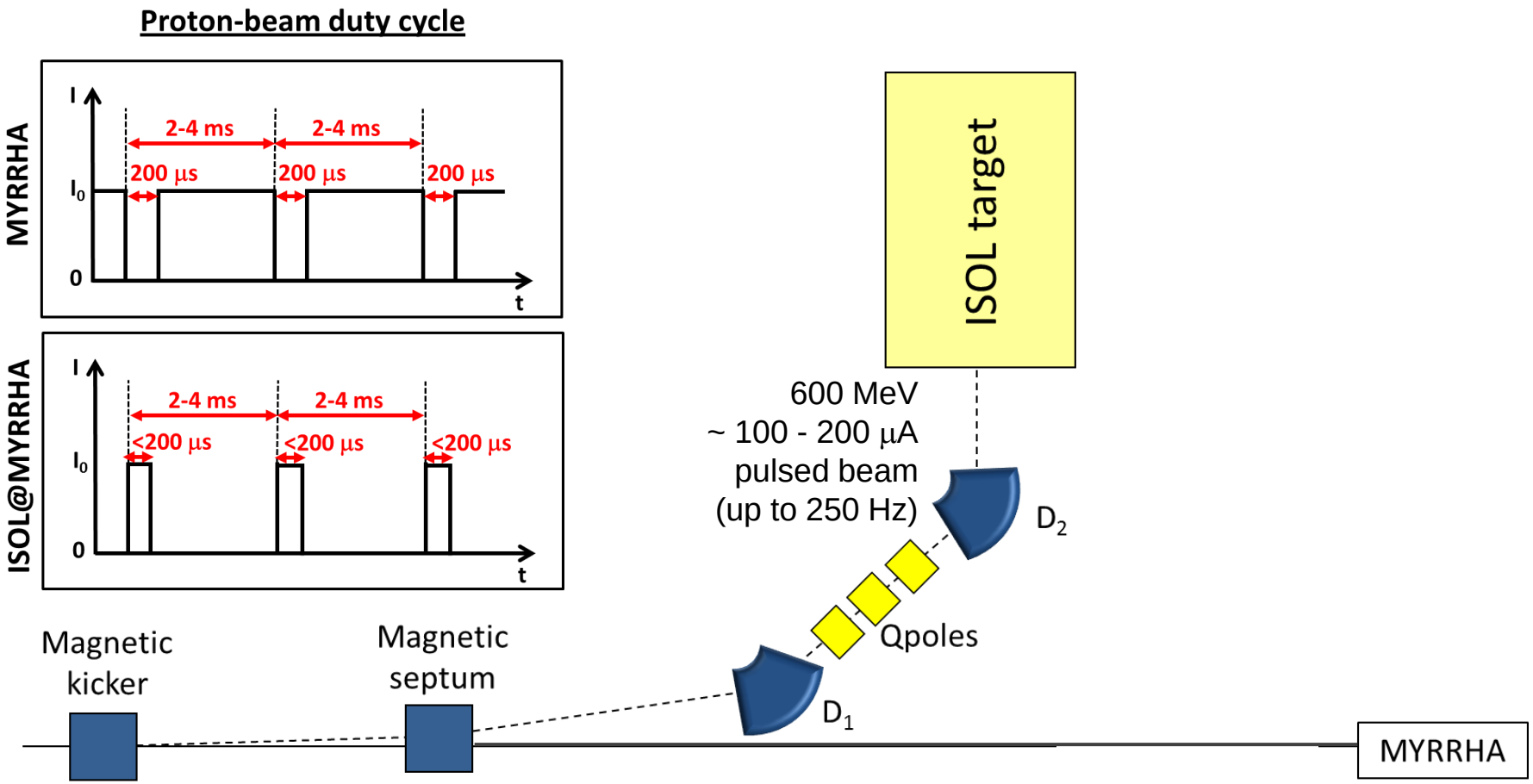
Principle of fault tolerance in the superconducting spoke linac



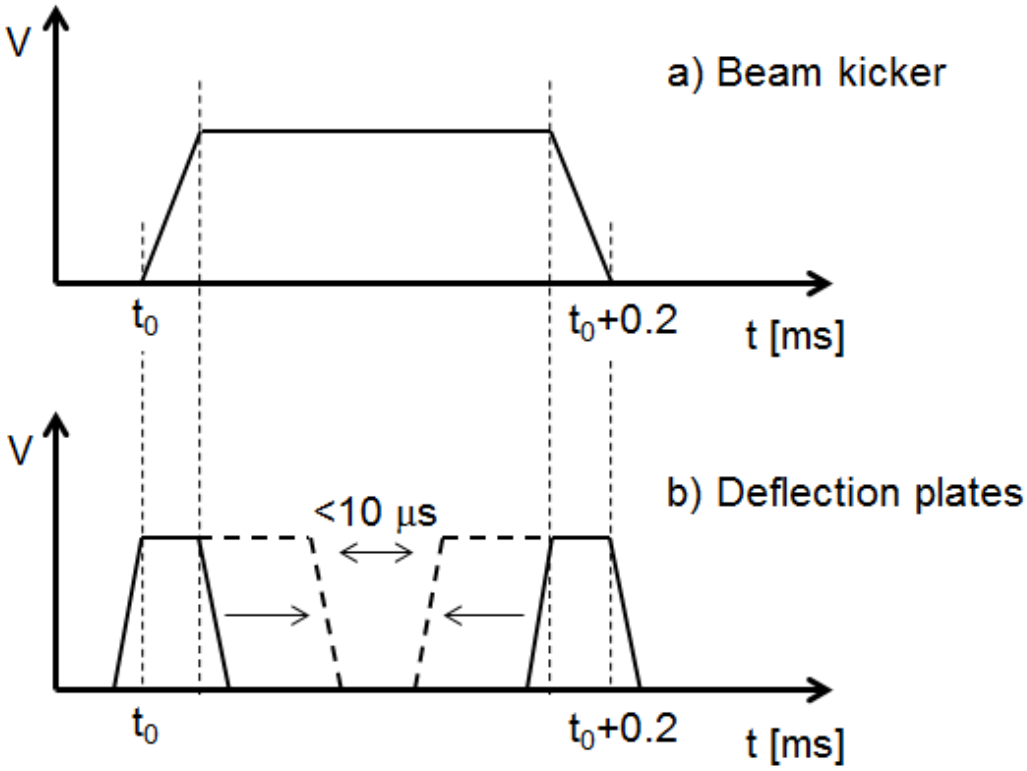
- Detection of an RF fault **< 3 sec**
- Change RF phase in neighboring cavities
- Increase RF field in neighboring cavities

Increase of 25% field level
-> 50% power margin required

Beam-Splitting System (Concept)



Beam-Splitting System (Concept)

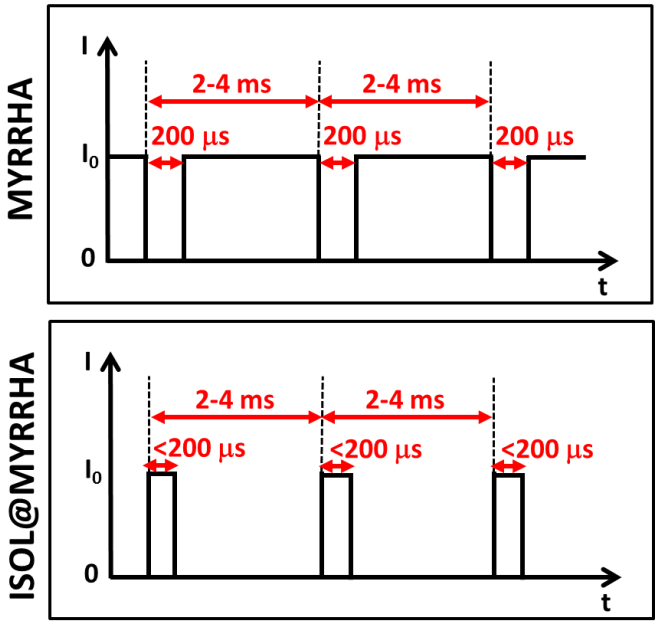


Time structure of (a) the beam-kicker voltage after the acceleration section (600 MeV)

Deflection-plate voltage in front of the RFQ entrance (30 keV)

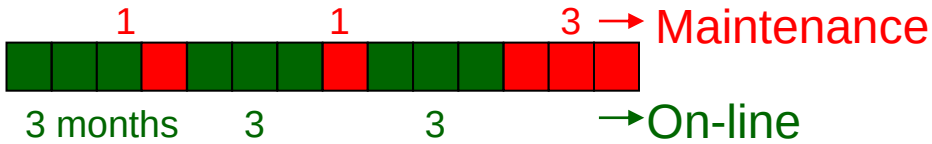
Beam-Splitting System (Concept)

Proton-beam duty cycle



Not in the present design

MYRRHA operation:



ISOL@MYRRHA Facility Characteristics

- based on proven technology (largely based on experience at ISOLDE and TRIUMF)
- keep open the possibilities for beams of higher intensity & energy
- can deliver:
  - pure RIB: selective ionization, chemistry, M/DM > 10.000
  - intense RIB (x100 compared to the present ISOLDE 'standard' RIB)
  - RIB of good ion optical quality
  - optimal experimental conditions/lay-out/support (green-field facility!)
  - **extended beam times with stable operation**

experiments
- need very high statistics;
- need many time-consuming systematic measurements;
- hunt for very rare events;
- have an inherent limited detection efficiency.

- complementary to ISOL and In-Flight facilities

ISOL@MYRRHA Applications

- Fundamental Interactions
  - ***Correlations (β-ν, ...), EDM***: Statistics + control systematic effects of setup
- Nuclear Physics
  - Rare decays: ***GTGR, $\beta_{xn/yp}$, cluster decay***
  - Extreme precision: e.g., ***crystal spectrometry***
- Atomic physics
  - ***QED tests in HCI***
  - ***Bohr-Weisskopf: A- and g-factors***
- Condensed Matter
  - Mössbauer, β-NMR, PAC, EC-SLI: **Systematic sample measurements**
- Biology
  - Mn, Fe, Ni, Cu, Zn β-NMR in proteins: **Systematic sample measurements**
- Medical Applications
  - Radiopharmacy

ISOL@MYRRHA Project at SCK•CEN

- ISOL@MYRRHA - an integral part of the MYRRHA project
  - Delivery of the proton beam by MYRRHA

  but
  - To be developed within a separate consortium
- Physics experiments (from the focal plane of the separator)
  - To be set up and run by users
  - Support by ISOL@MYRRHA physics group at SCK•CEN
- Conceptual design phase (2012-2014) followed by a basic design in the FEED-phase (2015-2017)
- R&D on target-ion-source systems and parasitic operation with MYRRHA

Project Schedule

2012-2014	Conceptual Design
2015-2017	Front End Engineering Design
2018	Awarding construction contracts
2019-2021	Manufacturing of components & construction
2022	Assembly & Installation
2023-2024	Commissioning
2025 -	Exploitation

Ongoing ISOL@MYRRHA Activities

Conceptual Design (2012-2014)

- Task1: Beam splitter
- Task2: Target Ion Source
- Task3: Beam preparation: RFQ Cooler & Buncher + Mass Separators
- Task4: Safety & Radioprotection
- Task5: Overall conceptual design

Topical workshops :

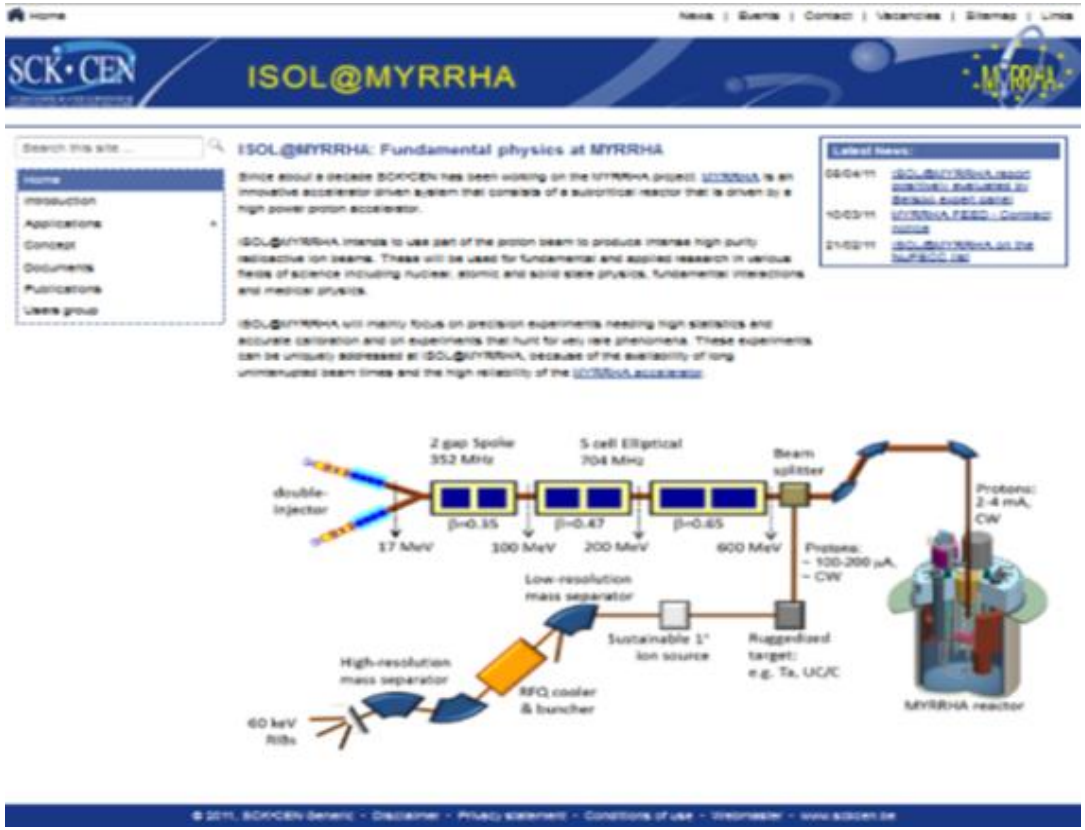
- Fundamental interactions (10/2011)
- Detailed decay spectroscopy (04/2012)
- RIB production
- Medical applications
- Laser spectroscopy and atomic physics
- Solid state and biology

Aim:

- Investigate scientific cases in more detail
- Identify unique opportunities
- Collect information on instrumentation
- Gather input for design study
- Set up a **Users Group**

Searching for national and international support

http://isolmyrrha.sckcen.be



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Registered Office: Avenue Herrmann-Debrouxlaan 40 – BE-1160 BRUSSEL
Operational Office: Boeretang 200 – BE-2400 MOL