



www.myrrha.be

MINERVA

1st Phase of MYRRHA and contribution to medical radioisotopes

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7th International Symposium on Medical Radioisotopes the Changing Landscape
May 9, 2019, Liège (BE)

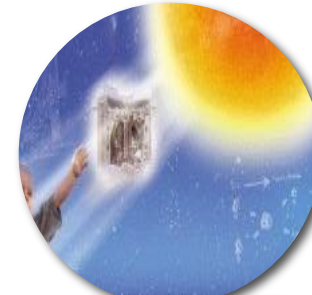
In Belgium, for Europe and beyond: sustainable & innovative applications from nuclear research



MYRRHA application portfolio



SNF*/ Waste



Fusion

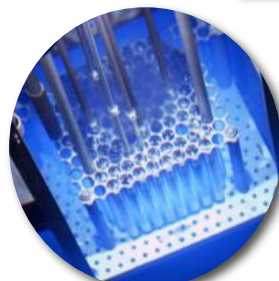


**Medical
Radioisotopes**



**Fundamental
research**

**Multipurpose
hybrid
Research
Reactor for
High-tech
Applications**



**Support
Fission GEN IV**



**Support to
SMR LFR**

*SNF = Spent Nuclear Fuel

Belgian Government decision on September 7, 2018

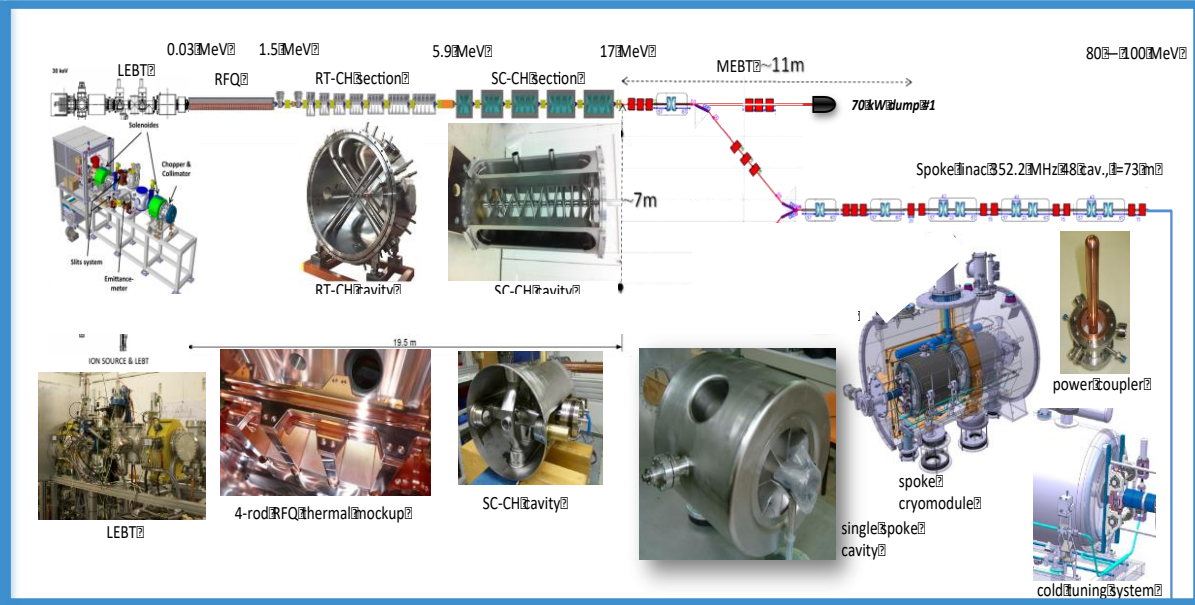
- **Decision to build** in Mol a new large research infrastructure MYRRHA
- Belgium **allocated budget** of 558 M€ for the period 2019 - 2038:
 - 287 MEUR investment (CapEx) for building MINERVA (Accelerator up 100 MeV + PTF) for 2019 - 2026
 - 115 MEUR for further design, R&D and Licensing for phases 2 (accelerator up to 600 MeV) & 3 (reactor) for 2019-2026.
 - 156 MEUR for OpEx of MINERVA for the period 2027-2038
- Establishment of an **International Non-Profit Organization**
 - in charge of the MYRRHA facility for welcoming international partners
- **Political support** for establishing MYRRHA international partnerships
 - Belgium mandates Vice Prime Minister Kris Peeters for promoting and negotiating international partnerships

MYRRHA's phased implementation strategy

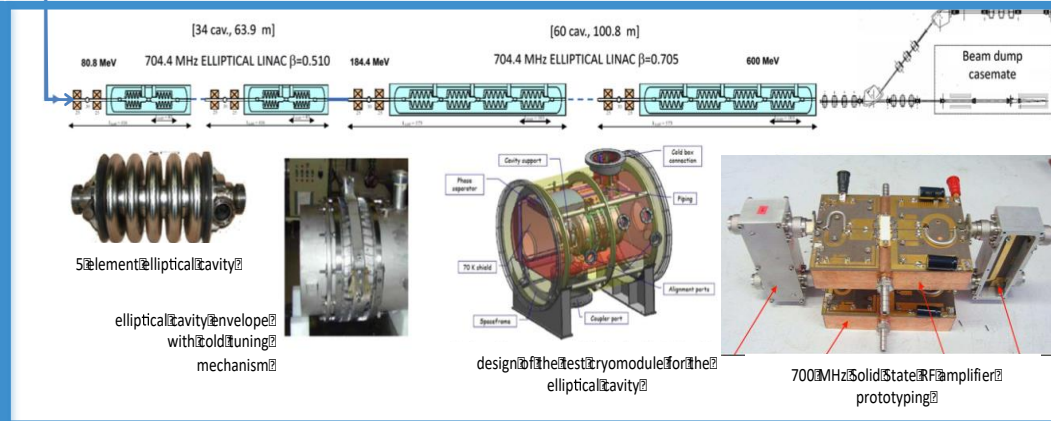
Benefits of phased approach:

- Optimised development management
- Spreading investment cost
- First R&D facility delivered in Mol end of 2026

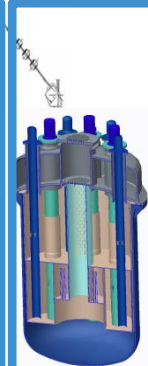
Phase 1 – 100 MeV



Phase 2 – 600 MeV



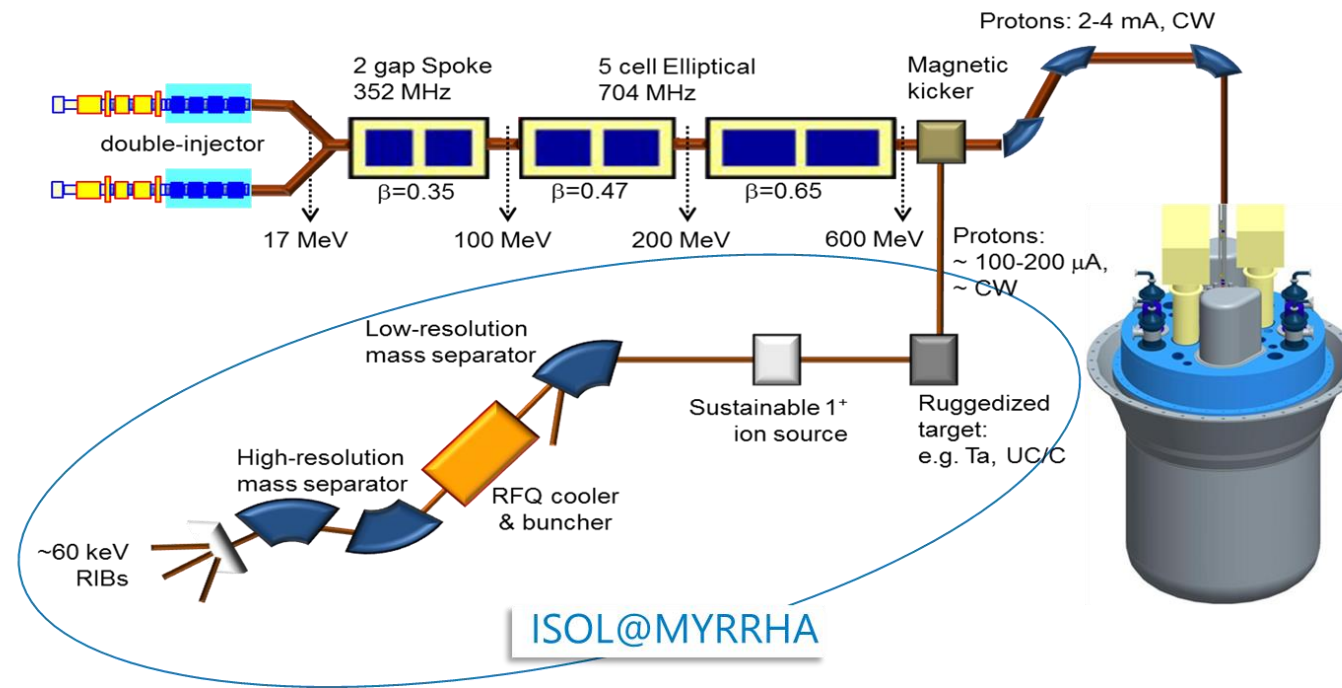
Phase 3 – Reactor



ISOL facility for the production of Radioactive Ion Beams

- Concept and Scientific Cases** developed within BriX:

The **B**elgian **r**esearch **i**nitiative on **eX**otic nuclei for atomic, nuclear and astrophysics studies



KU LEUVEN

ULB

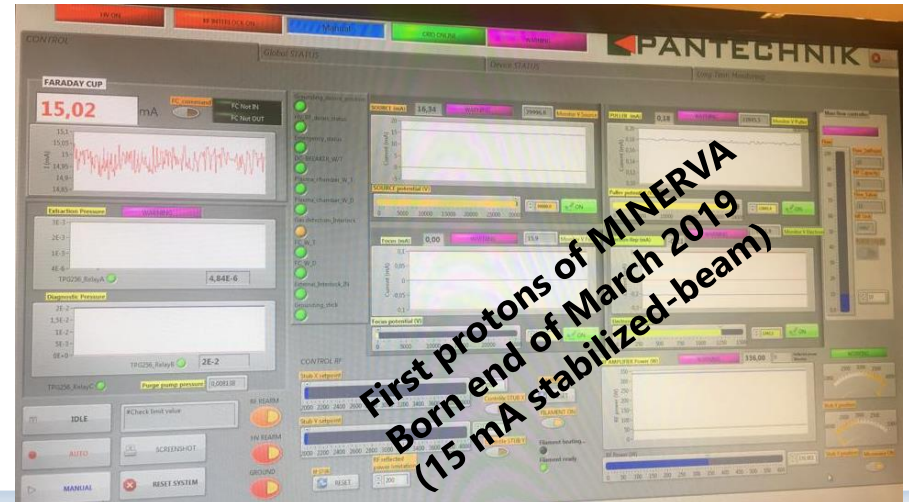


MYRRHA Phase 1

- Accelerator in Phase 1 = a subset of the MYRRHA accelerator
 - RT (until 17 MeV) & SC (single Spoke) linac, modular
 - Chosen energy cut-off = 100 MeV
 - Presently 1 injector (up to 17 MeV)
 - Relevant configuration for reliability check
 - Able to deliver adequate beam for operating a Proton Target Facility
- Layout is compatible with linac extension to 600 MeV
- Accelerator prototyping is ongoing, in parallel with integration activities
 - Broad collaboration : IN2P3 (labs IPNO, LPSC) + IAP + industry (NTG, IBA, Bevattech, Cosylab, JEMA)

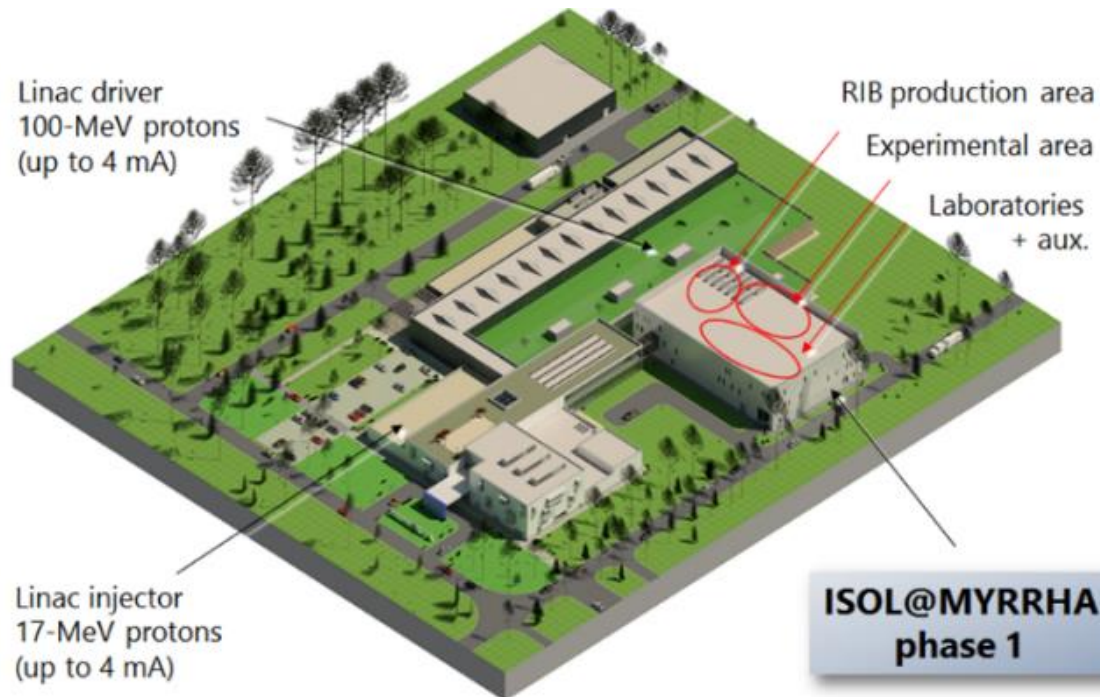


Current status

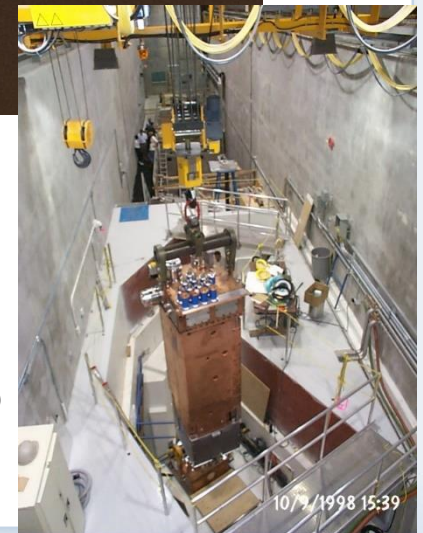
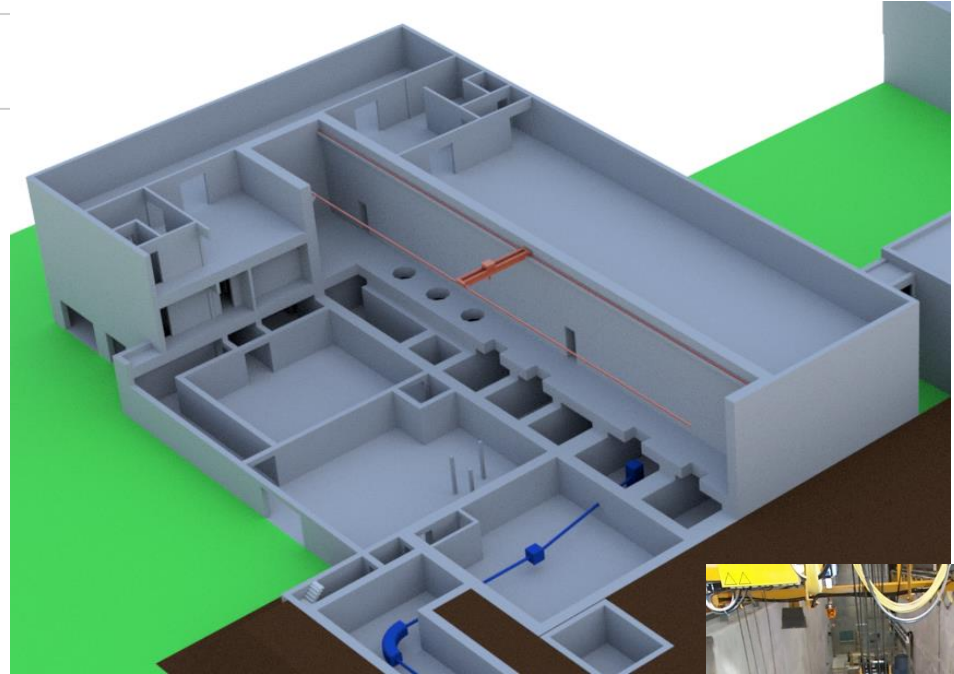
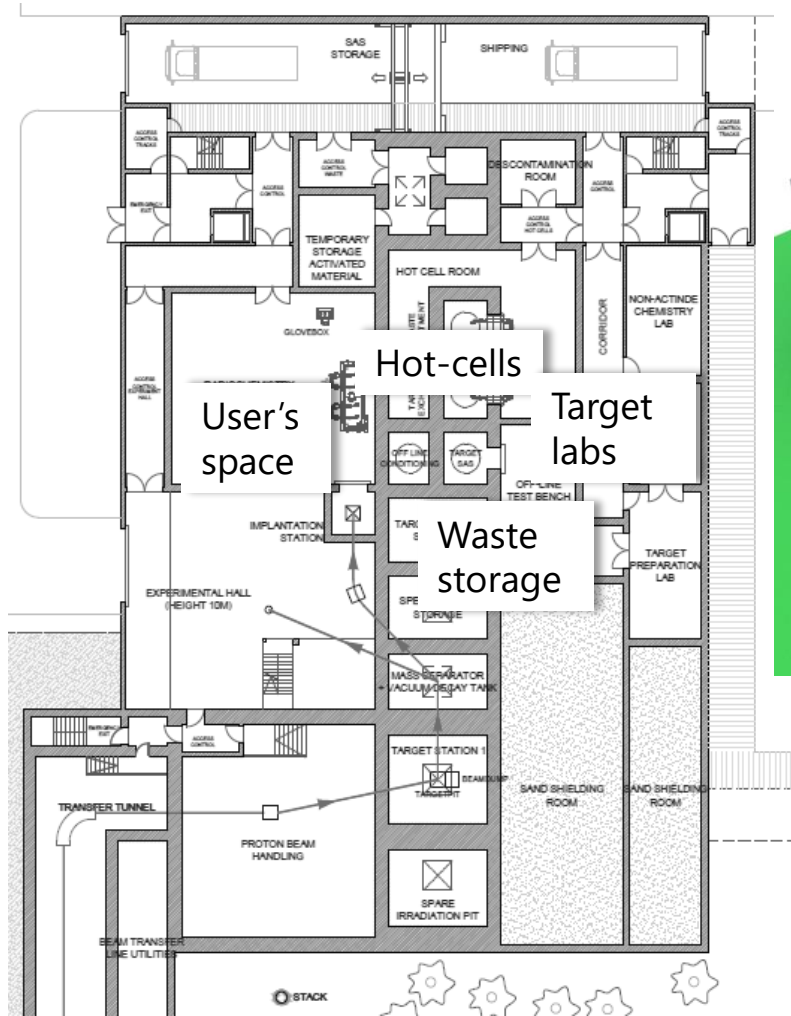


MYRRHA Phase 1

- Beam sharing allows for parallel activities:
 - Feeding the Proton Target Facility hosting **the ISOL** system (ISOL@MYRRHA phase 1)
 - Commissioning the linac for **reliability evaluation**
 - Material-irradiation capabilities for the **fusion** community
- Conceptual Design of the Proton Target Facility – to be finalized in 2019
- First Radioactive Ion Beams anticipated by 2027

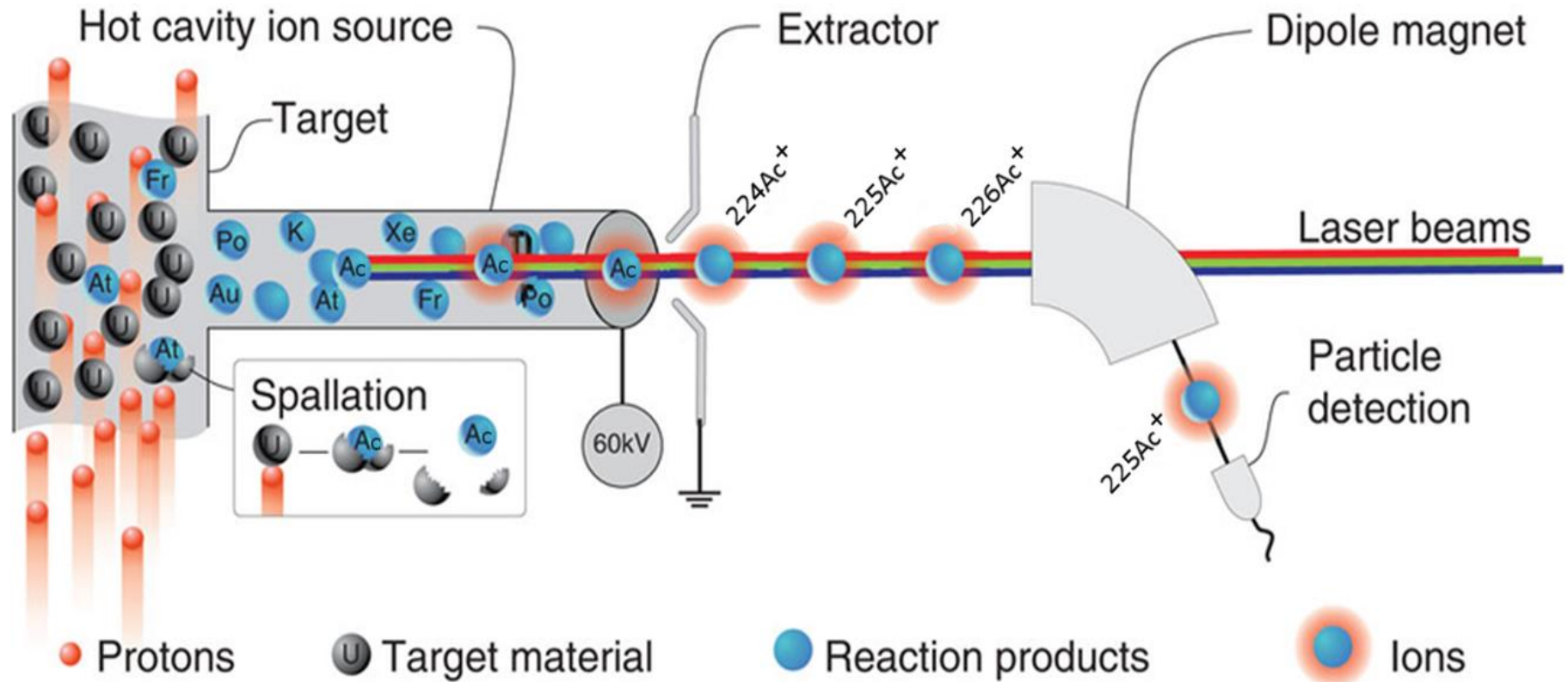


Proton Target Facility (PTF) Concept



Target module handling similar to ISAC facility @ TRIUMF, but remotely operated

Isotope Separation On-Line (ISOL) concept



S. Rothe et al., Nature Comm 4, 1835 (2013)

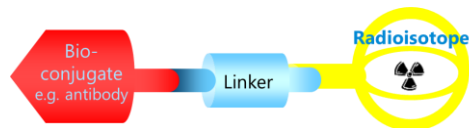
MYRRHA for nuclear medicine

Essential successful treatment development steps

Access to radionuclide



Radiopharmaceutical development



Pharma industry



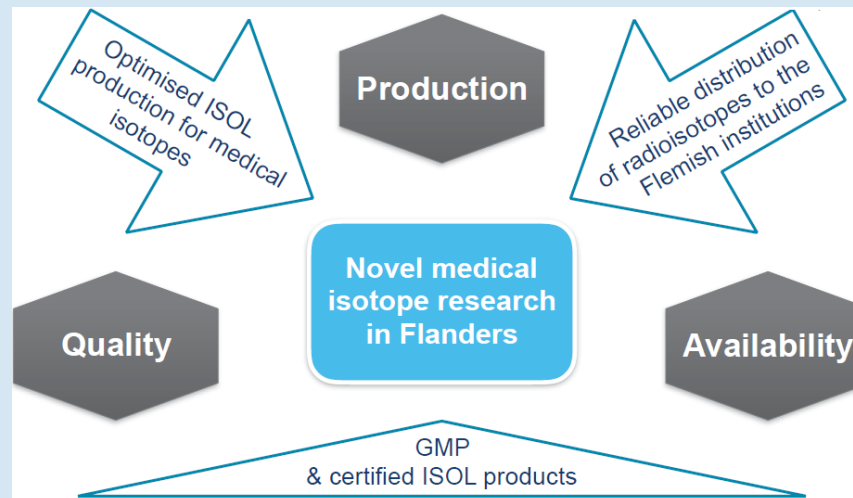
Top-qualified doctors and hospital facilities



- Tb-IRMA-V: **Tb ISOL** Radioisotopes for **M**edical **A**pplications in **V**laanderen
- Project funded with € 2.2 M by the Flemish Fund for Scientific Research (FWO)



Project Partners

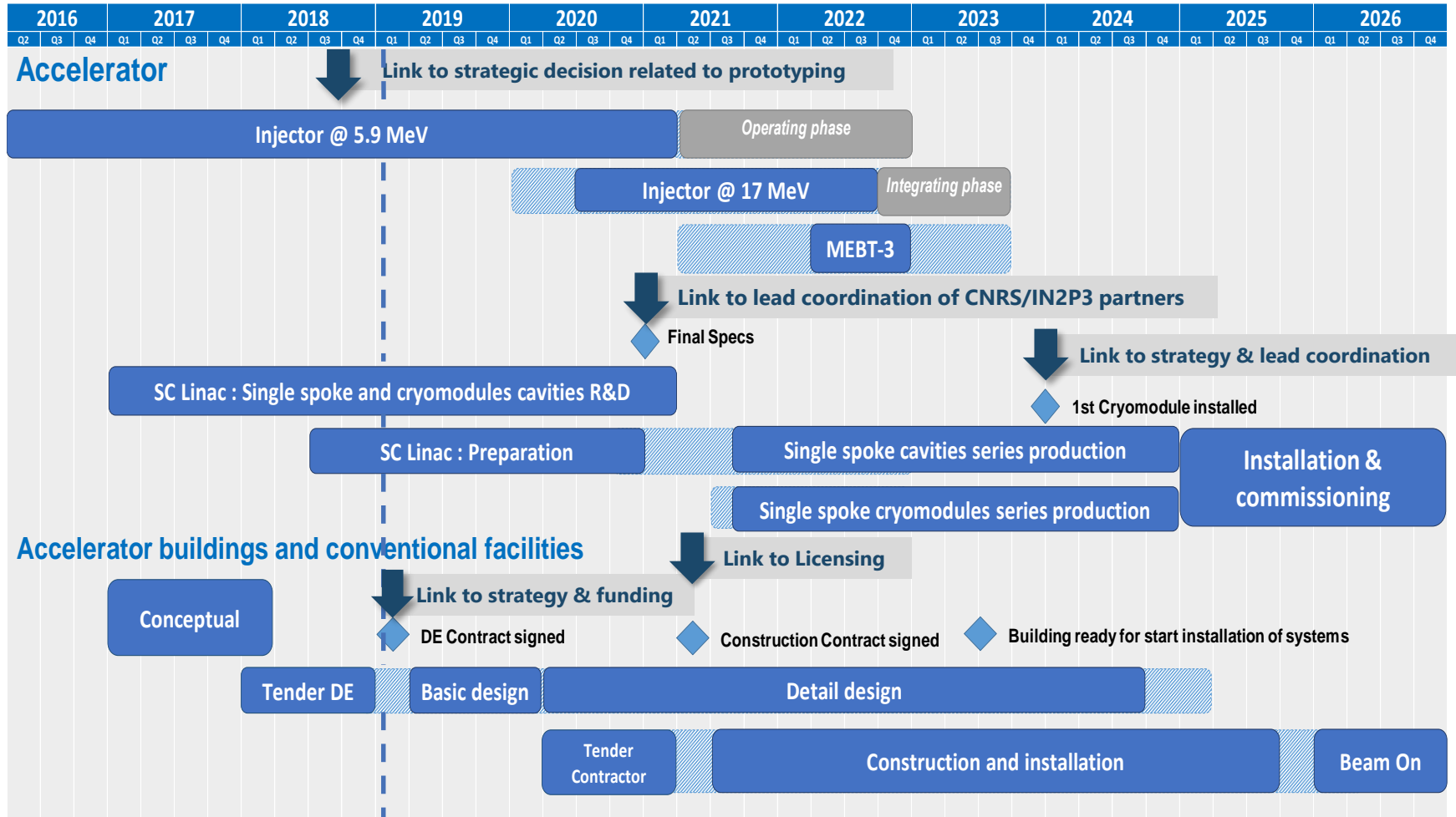


Advisory Board (future users)

Unique MYRRHA accelerator features

- Meets medical needs:
 - Highest Accelerator Productivity (primary beams up to 4 mA available)
 - Availability of isotopes = Number 1 limiting factor for clinical application of Radio-Immuno Therapy and Targeted Alpha Therapy
 - Highest Isotope Purity (through ISOL)
 - Radio-isotope purity crucial to optimize dose to the patient and minimize side effects
 - R&D isotopes sample production that are not commercially available or easy to produce with other means
 - Isotopes with ultimate specific activity for R&D
e.g. studies of efficacy versus specific activity.

MINERVA High-level planning



MYRRHA: already an international team



The MYRRHA team: 150 >> 230 FTE

Belgium is giving a strong message on its ambition to maintain a high level of expertise in nuclear know-how and offers MYRRHA for international collaboration

Positive full phase 1 ➔

**Breaking ground
in 2021!!!**



Messages to take with you

- Collaboration between technological projects (facilities) promoters and in close collaboration with medical users hands in hands from day one is a key for success
- High Accelerator Productivity via primary beams high intensity but also high reliability for addressing Number 1 limiting factor for clinical application of Radio-Immuno Therapy and Targeted Alpha Therapy
- Radio-isotope purity crucial to optimize dose to the patient and minimize side effects
- R&D isotopes sample production that are not commercially available can be produced by novel technics such as ISOL



www.myrrha.be

Needs its European partners as co-developers and future users

Needs talented young people today & tomorrow

Offers you making your Master or PhD thesis

Offers you job opportunities (hiring 80 persons in 2019)

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