The SPES project at INFN - LNL

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LNL – INFN Identity Card

CORE RESEARCH & ACTIVITIES

1. Study of Nuclear Structure and Dynamics
2. Applications of ion beams to biology, medicine and solid state physics

Existing facilities:

- A TANDEM accelerator operating at a maximum voltage of 16 MV
- A superconducting LINAC capable of accelerating ions up to a specific energy of 15 Mev /amu

Aim of SPES project

Main target: realization of a mid-range facility for the production of radioactive beams, as an intermediate step towards EURISOL.

The unstable beams produced by SPES would be reaccelerated by the existing linac ALPI

By side project:

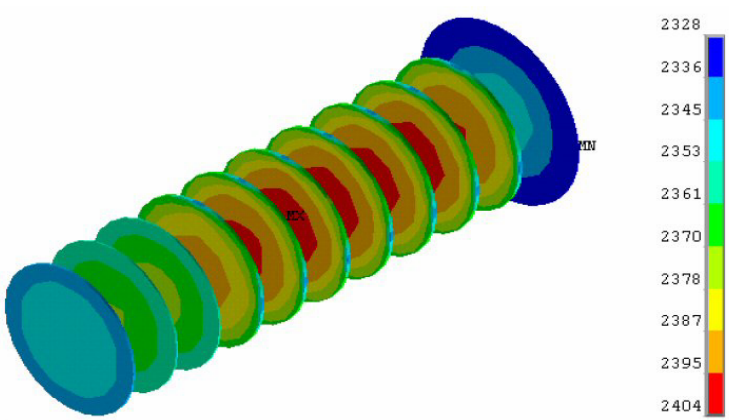
Use of first stage of the accelerator complex to provide proton beams to an experimental BNCT (Boron Neutron Capture Therapy) facility for the treatment of skin melanoma and other medical applications.

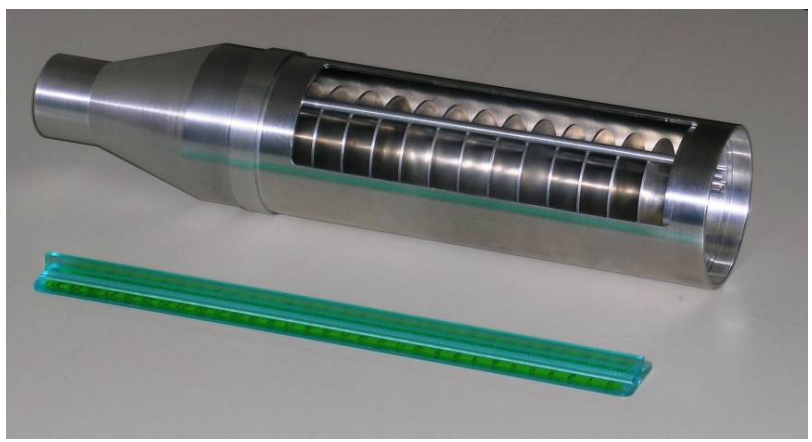
Brief story of SPES project

- 1999: conceptual proposal for the realization of a RIB facility at LNL.
- 2002: technical proposal for the construction of a machine capable of providing 1 to 5 mA of protons at a final energy 100 MeV.
- Most part of the accelerator would have been superconducting.
- Production of neutron rich unstable isotopes by means of a two stage target: a converter target (Be) and a production target (UCx).
- Beam power: 100 Kw
- Cost: 85 M€ ➔ NOT FUNDED

What did change in the meanwhile?

- Numerical simulations and preliminary tests have shown that the rate (10^{13} /s) of fission reactions required to produce the desired RIB intensity can be achieved at a much lower energy and current (40MeV @ 0.2 mA of proton's beam) by changing the design of production target.
- The new solution for the target: multi-foil, direct (no need of converter), fast release time of produced isotopes.
- The target can sustain 8 Kw of beam power since the energy is progressively released in subsequent foils.





SPES /2007 proposal

- Final energy reduced from 100Mev to 40 Mev
- Proton beam current reduced from 1 to 0.2 mA (pulsed)
- Superconducting option abandoned to reduce costs.

However:

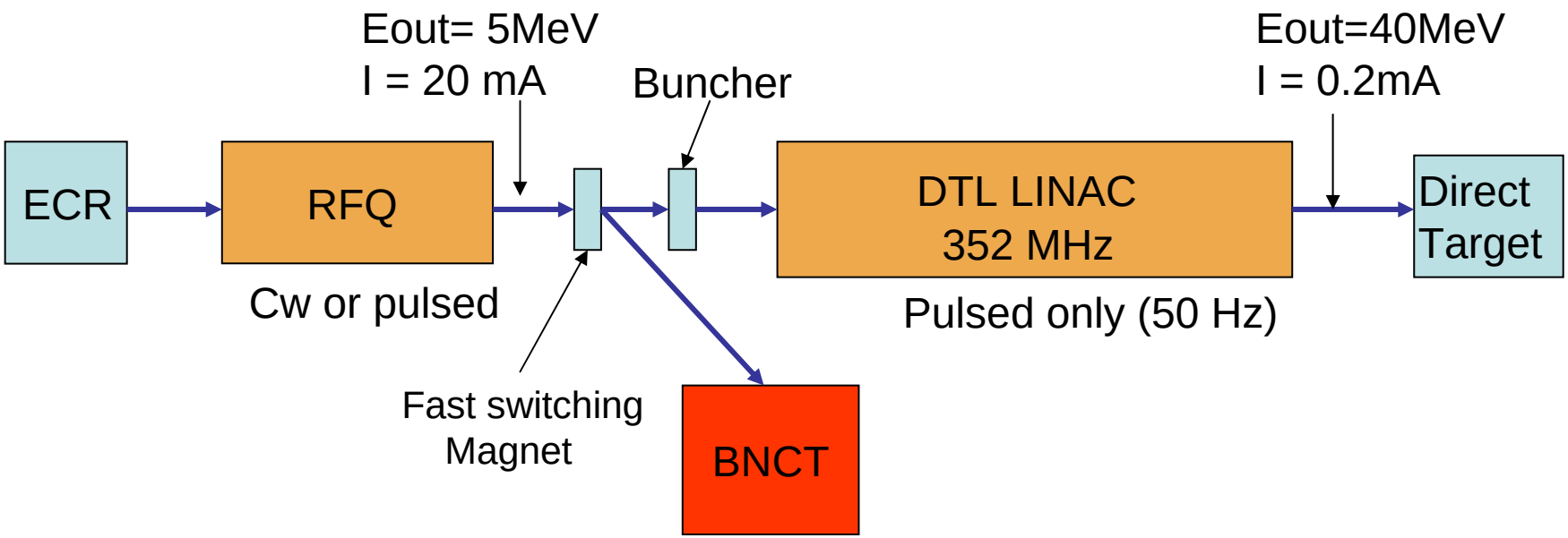
- The BNCT project remains included in the proposal.
- The accelerator complex we foresee to match the beam requirements for the BNCT and those for the RIB production is based on two sections:

  - a RFQ capable of accelerating protons to an energy of 5 MeV with a current of 20 mA c.w. (adequate for the BNCT)

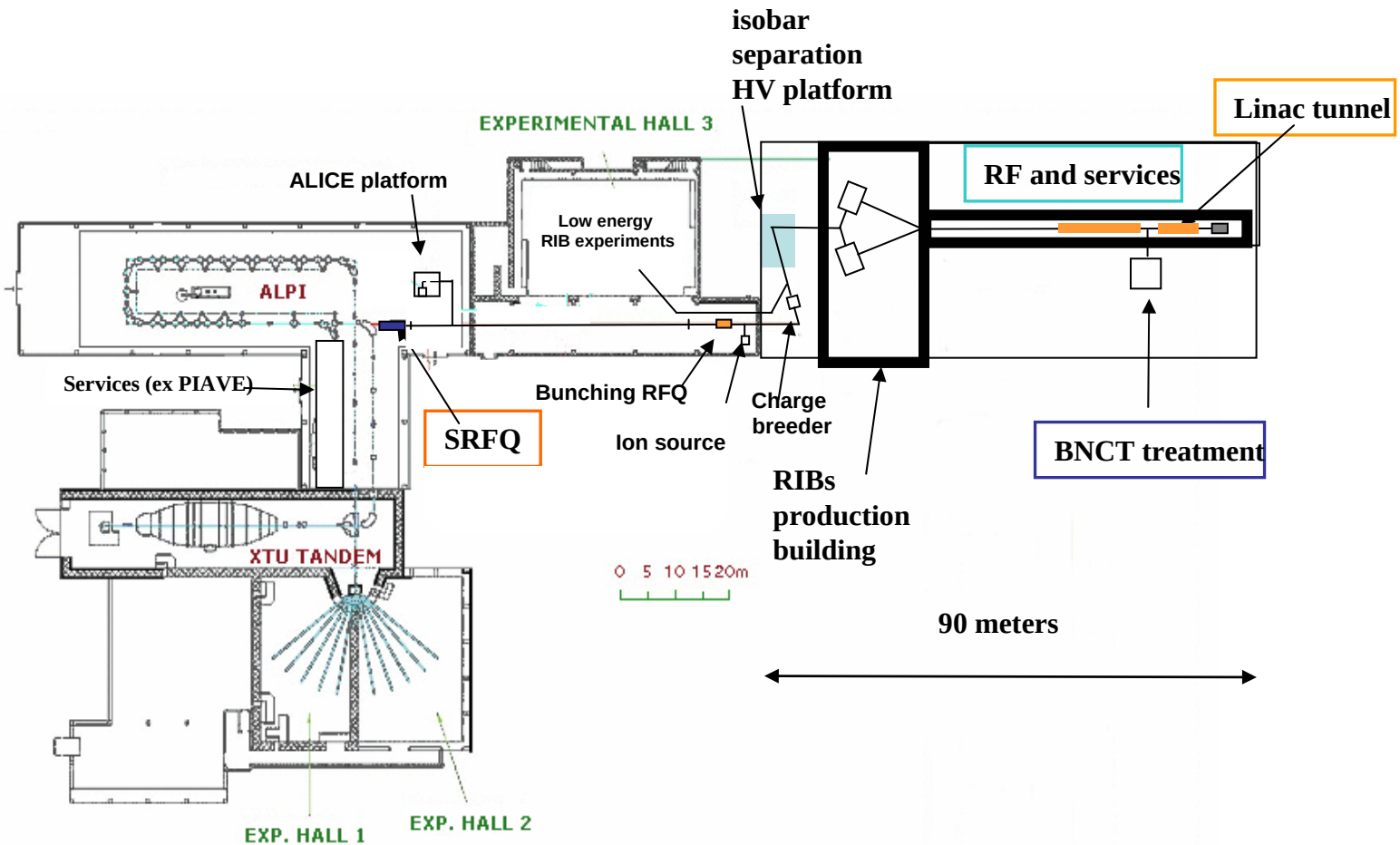
  - a DTL driver that will operate in pulsed mode at a repetition rate of 50 HZ and a duty cycle of 1% with an average current of 0.2 mA.

<u>Estimated cost: 45 M€</u>

SPES/2007: accelerator's layout



SPES building (preliminary layout)



Existing TANDEM-ALPI-PIAVE complex

The control system

- The main question: SECURITY

  Security is of crucial relevance in the following systems:

  - Access Control and Radioprotection system.
  - Beam Diagnostics & Dumping system (we have no experience in managing beams with KWs of power).

General criteria:

- rugged, conservative solutions
- fault tolerant schemes
- hardware interlocks
- use of PLCs where possible
- use of VME + VxWorks where the response time is important or the control task is complex

Considerations on PLCs usage

- The development of PLC code for either the Radioprotection System and (likely) for the Vacuum System will be committed to external companies (as it happened in the past).

- The choice of a particular brand and family of PLC has often been influenced by the experience of the company entrusted to realize the software (should be avoided!).

- What is the best way to interface a PLC to an Epics network ? Is OPC a suitable bridge?

Control system: hardware overview

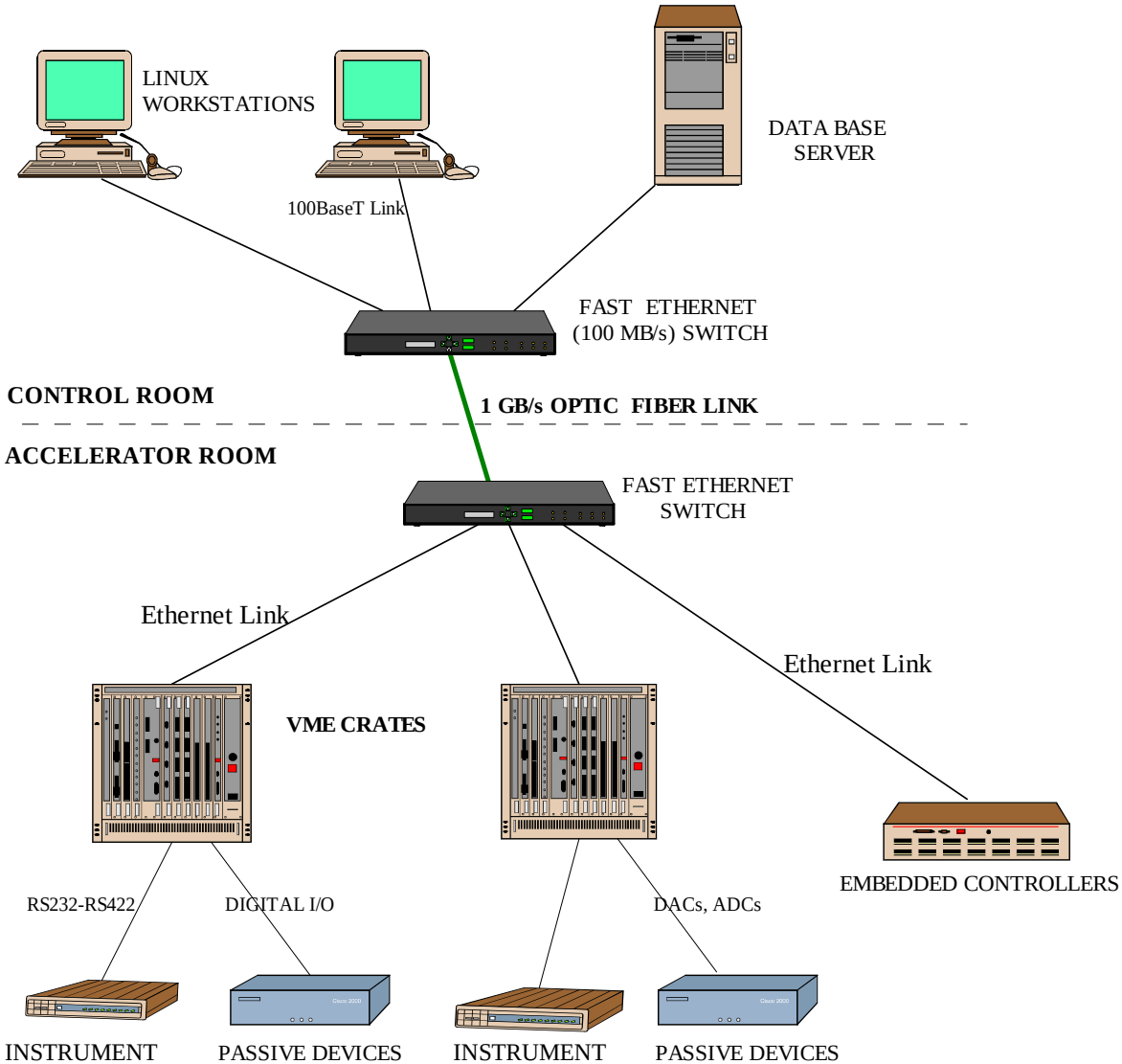


Fig.1 CONTROL SYSTEM: HARDWARE ARCHITECTURE

Hardware configuration

- Although many control tasks will be committed to embedded devices equipped with an Ethernet port, we still foresee a large number of serial (RS-232) I/O channels.

- Typical VME crate configuration:

  PowerPC processor (MVME3100 ?)

  Tews TIP866 IP based serial communication controller

  XYCOM boards for general purpose I/O.

- Micro-IOC based on PC-104 modules and running under Linux (i.e Slackware distribution, based on solid state disk) will also be used for dedicated control applications.

Conclusions

- The technical proposal will be presented to INFN management within next june.
- If funded, the project will start in 2008 and will last 5 years.
- We hope in the Epics Collaboration help to be successful with the SPES project !