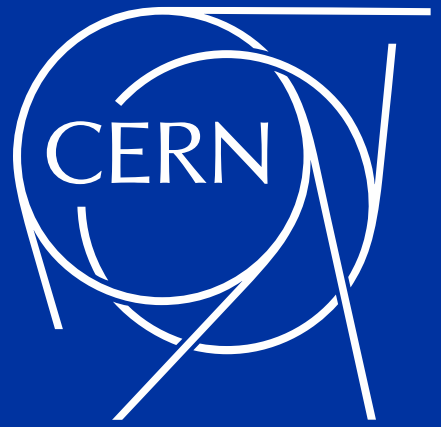


The Beam Switching Project

Sebastian Rothe

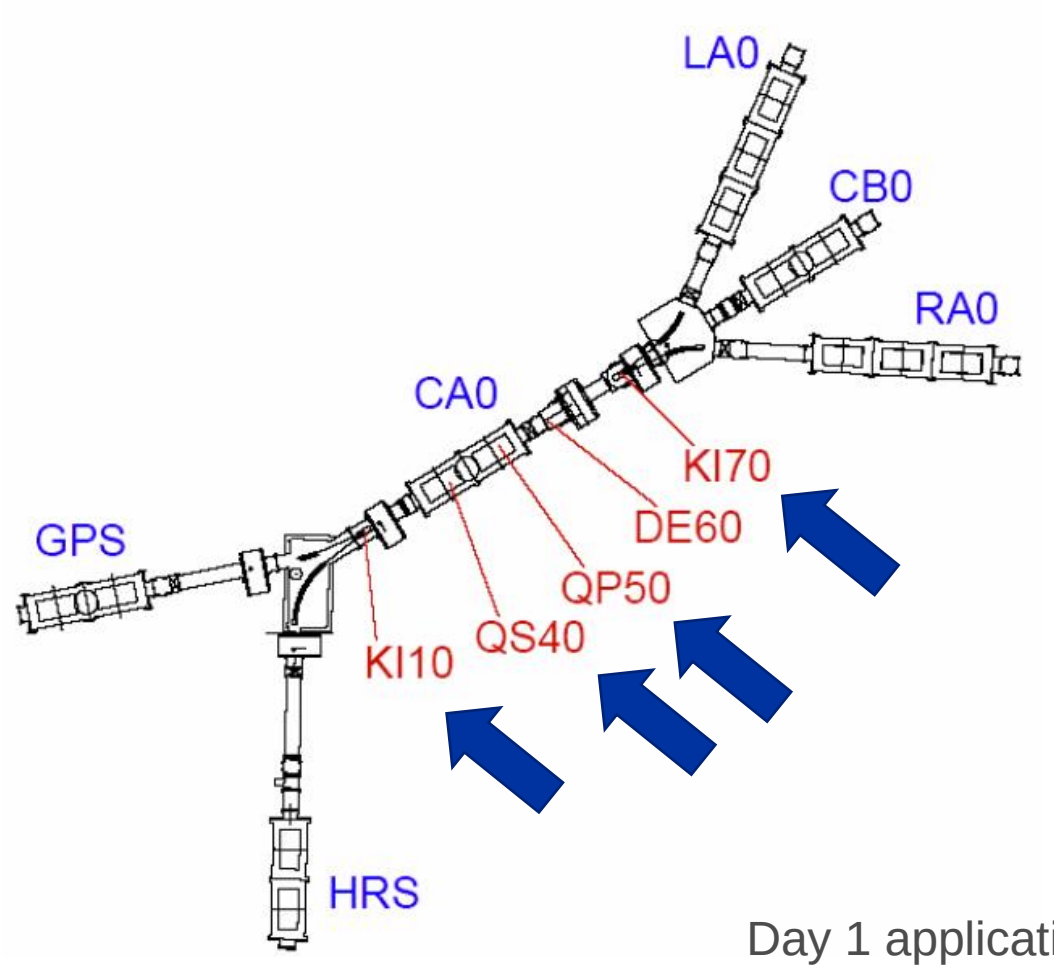
21 JUNE 2022

https://indico.cern.ch/event/1168692/

Alternating mode

Both FE deliver beam to multiple beamlines

More details see presentation in EPIC Workshop 2020



Constraints:
Beam parameters are different for HRS, GPS

Concept 1: (software solution) 16 Channels
Change settings each 1.2 s according to supercycle
Possible if powersupplies, controls are fast enough
-> can be safety issue if setpoints are not matched
-> cheaper

Concept 2: (hardware solution) 32 Channels
Double the set of HT supplies.
Tune CA0 individually for HRS,GPS
Use HT relays to alternate between the two settings
-> very robust
-> more expensive
-> programmatically simpler

Day 1 application: HIE ISOLDE tune while users still on other FE

2. Beam Switching Project: Proposal (2/3)

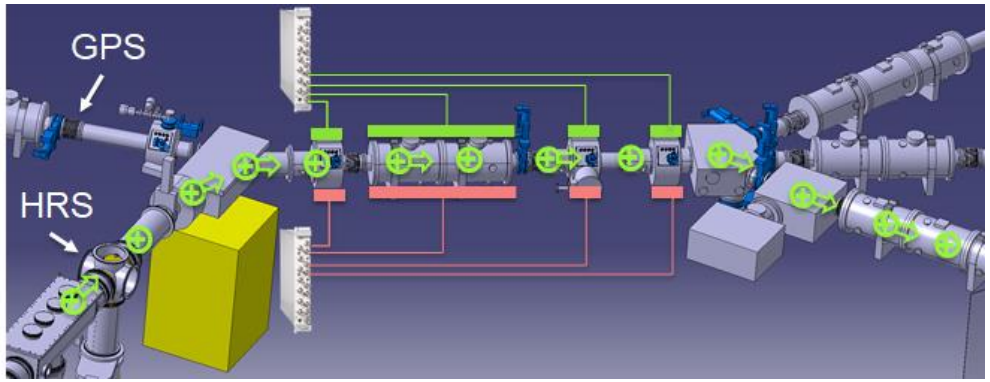


Fig 12. ISOLDE CA0 Beam Line, polarity option 1. CATIA ST0377154_01

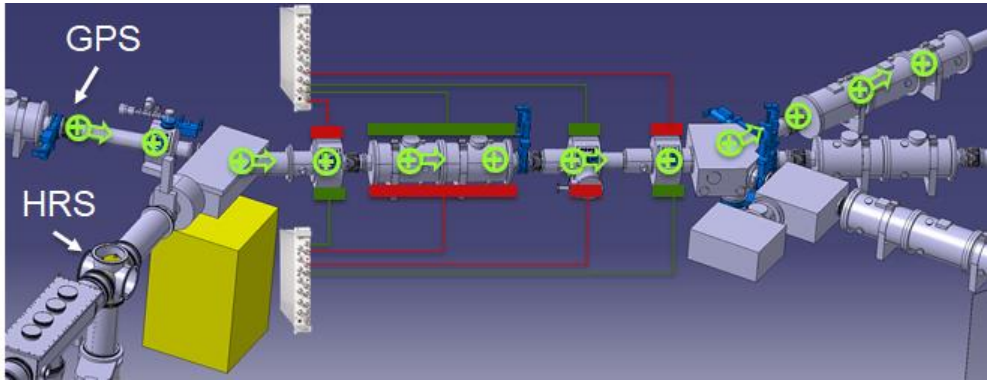
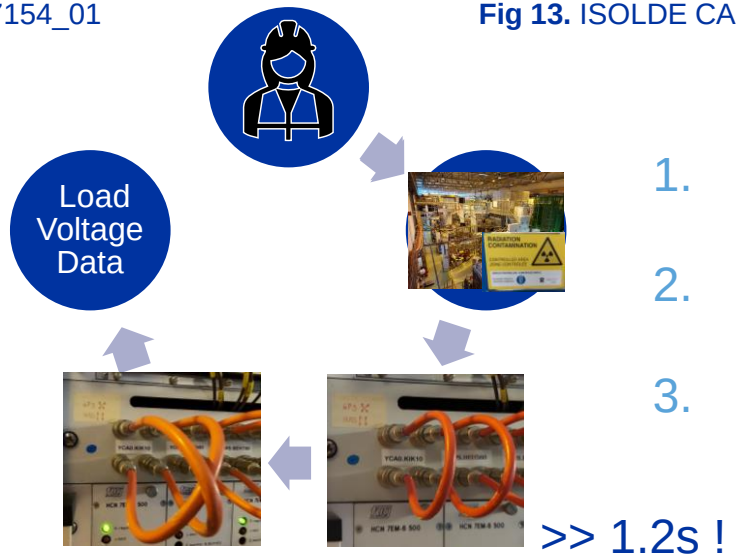


Fig 13. ISOLDE CA0 Beam Line, polarity option 2. CATIA ST0377154_01

- match tune and beam energy
- change deflectors polarity



1. Trained person entering at ISOLDE
2. Swap High Voltage cables
3. Load voltage set data

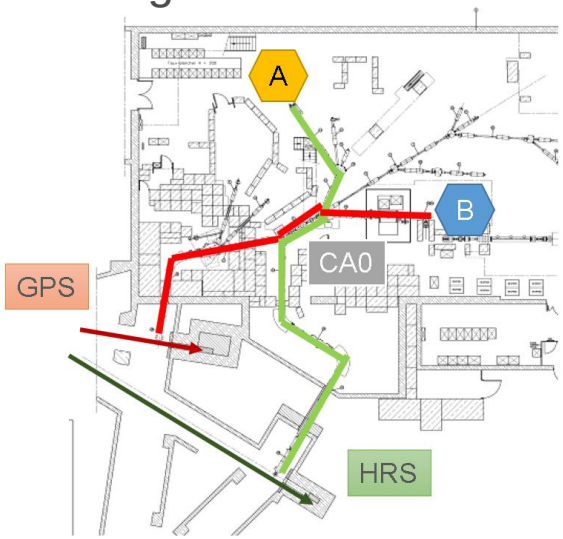
Fig 14. Cycle to change from Front Ends at ISOLDE

Yago Nel VILA GRACIA

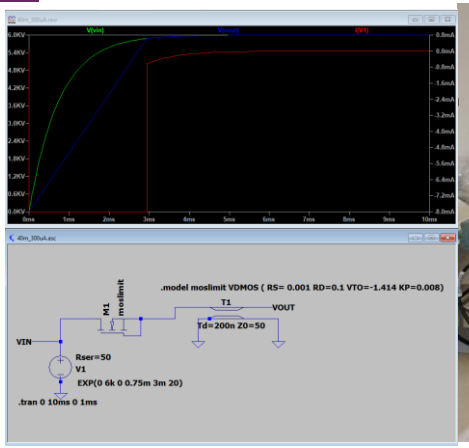
ISOLDE beamlines: Alternating operation

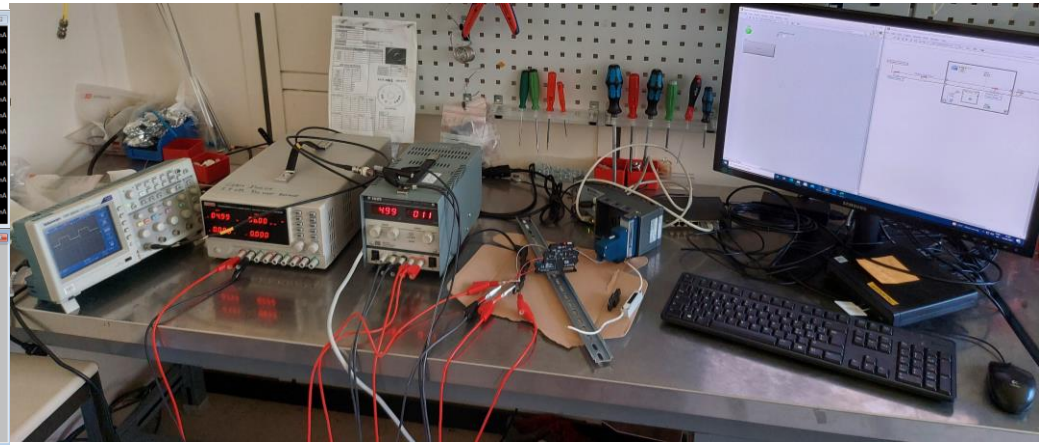
More details see presentation in EPIC Workshop 2020

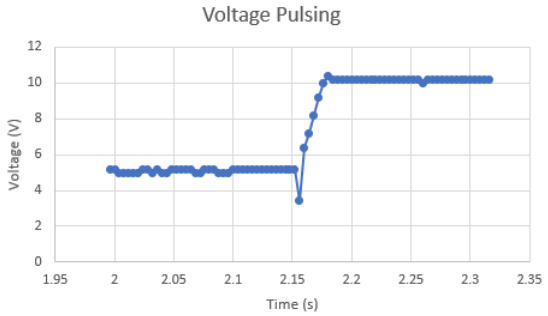
Alternating mode

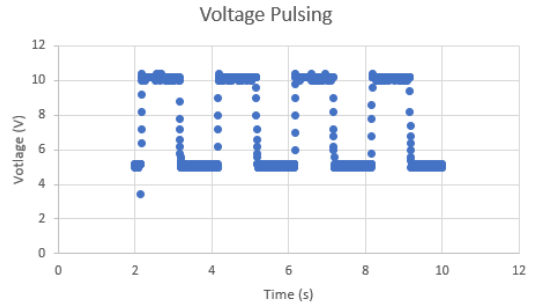


[TG06] M. Lindroos and T. Nilsson, "HIE-ISOLDE: the technical options," CERN-2006-003, (2006). (Chapter 7 by T. Giles)









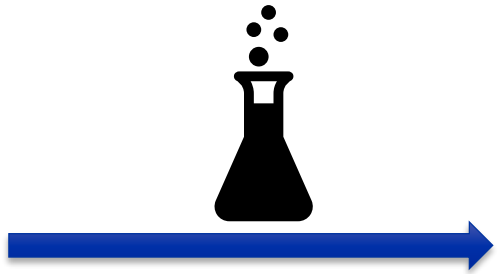
- Requires proof of concept + prototype
  - (**funded via ISOLDE collaboration**)
- Final design can be installed during a winter shutdown

- Initial prototype setup (simulation, first measurement)
- Functional specification drafted
- Project board to be appointed

2. Beam Switching Project: Feasibility Study

Requirements:

- 10-100 ms range charge/discharge 12kV
- Low inrush current in PSUs
- Location of hardware within ISOLDE



Functional Specifications.

EDMS: 2589396

Simulations:

- Electronic Simulator (LTSpice)
- Characteristics of components
  - Switch: Relay Type C
- Electronic circuit

Components:

- Match required components with market
- Purchase

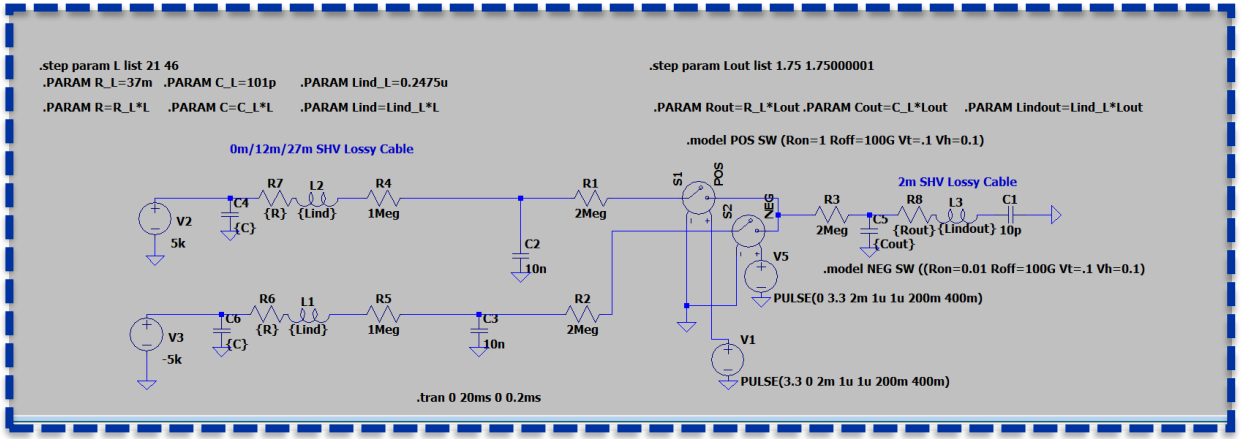


Fig 18. Electronic circuit proposed for the prototype. Simulation in LTSpice.

Yago Nel VILA GRACIA

2. Beam Switching Project: Feasibility Study

Design:

- Compact circuit (Eagle + KiCAD)
- High Voltage Spacing

Assembly:

- Compact and robust box

Component	Quantity per switch unit
Relay Type C, 10kV	1
HV Resistor: 1 MΩ	2
HV Resistor: 2 MΩ	4
HV Film Capacitor: 10 nF	2
PCB	1

Fig 20. Beam Switch Box finalized.

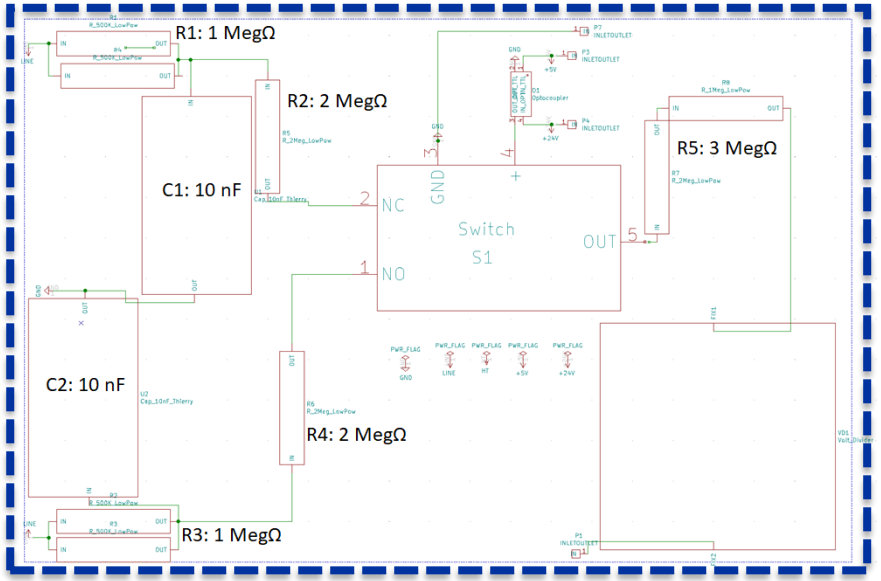


Fig 19. Electronic circuit design proposed for the prototype.

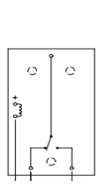
Collaboration with SY-ABT-BTE.

Special thanks to **Thierry Gharsa**

Yago Nel VILA GRACIA

2. Beam Switching Project: Offline 2 tests

Switch Box (Relay)



Behlke GHTS 60A (Solid State)

Electromechanical Relay

Simple	Slow (5-10ms)
Economical	Limited life (10 M cycles)
	Year: ~ 30 M secs

Solid State

Fast (100us)	High price
Long life	power dissipation
Commercial device	

Yago Nel VILA GRACIA

2. Beam Switching Project: Offline 2 tests

- Key variables:
  - Cable length PSU / Switch Box
  - Cable length Switch Box / Quadrupole (QP)
  - Sensitivity beam to QP Voltage
- Key readings:
  - Intensity reading in Faraday Cup (FC110)
  - Beam shape

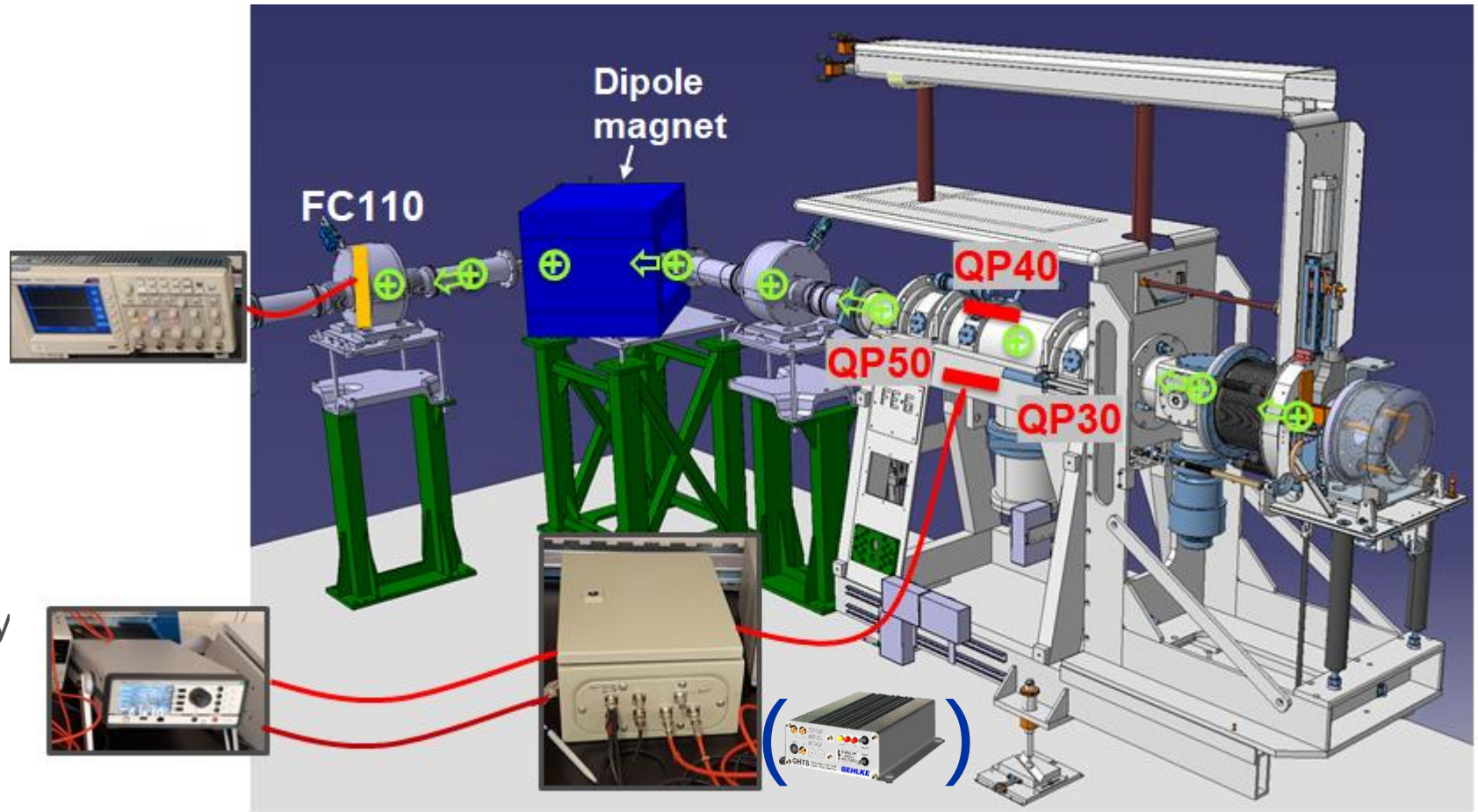


Fig 21. Setup in Offline 2 Facility to test the Switch technology. CATIA: ST0818019

Yago Nel VILA GRACIA

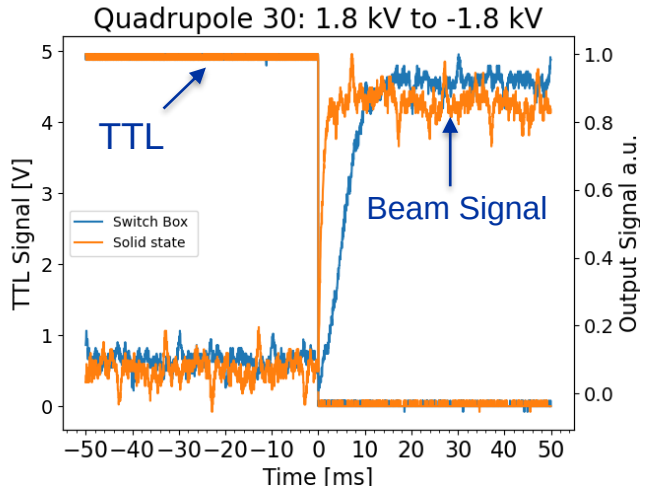
2. Beam Switching Project: Offline 2 tests

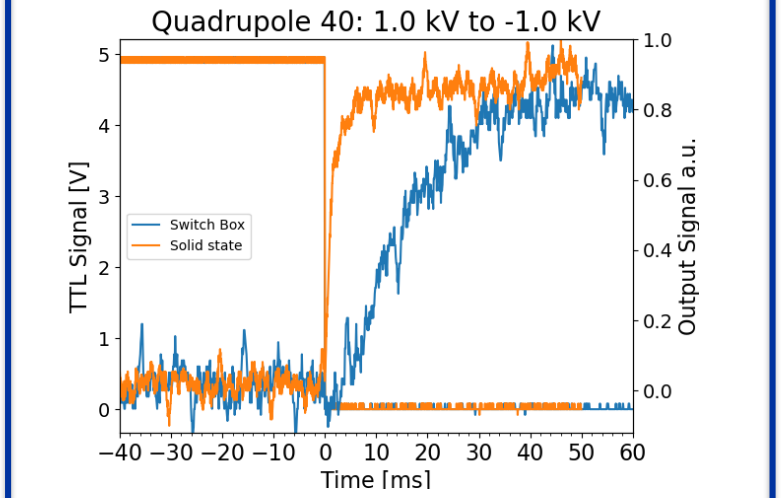
Yago Nel VILA GRACIA

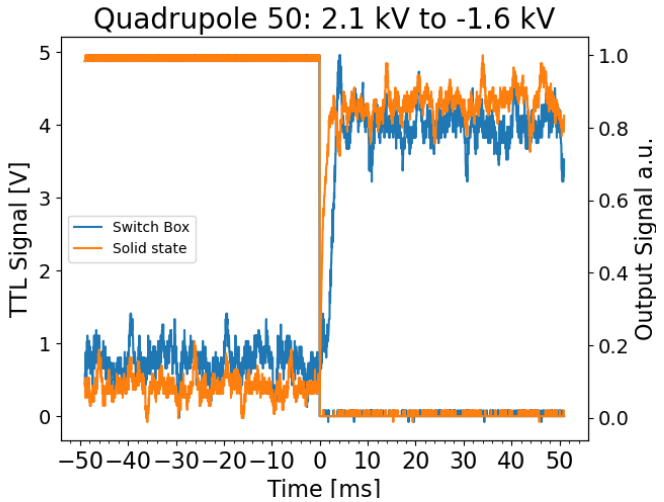
- Comparison of switching technologies: Offline 2 tests
  - Fast response acquired for both switches (range 10-100ms)
  - Solid state ~ 5 times faster than Switch box
  - Sensitivity beam to Quadrupoles confirmed

	Time (ms) to transmit 95% of beam	
Quadrupole	Switch Box	Solid State
QP30	10.12	**1.88**
QP40	30.8	**5.56**
QP50	3.16	**1.84**

Table 4. Beam switching results for Switch box and solid state







3. Conclusions

- Switch box design and test phase successful
- Both technologies fulfill initial requirements
- Solid state switch has a better performance

12 Switches	Cost of Ownership Switch Box (kCHF)	Cost of Ownership Solid State (kCHF)
Parts cost	~ 1.0	~ 3.0
Assembly work	~ x	0
Maintenance/ 4yrs	~ 0.5	~ 0.1

Table 5. Initial cost estimate for both technologies.

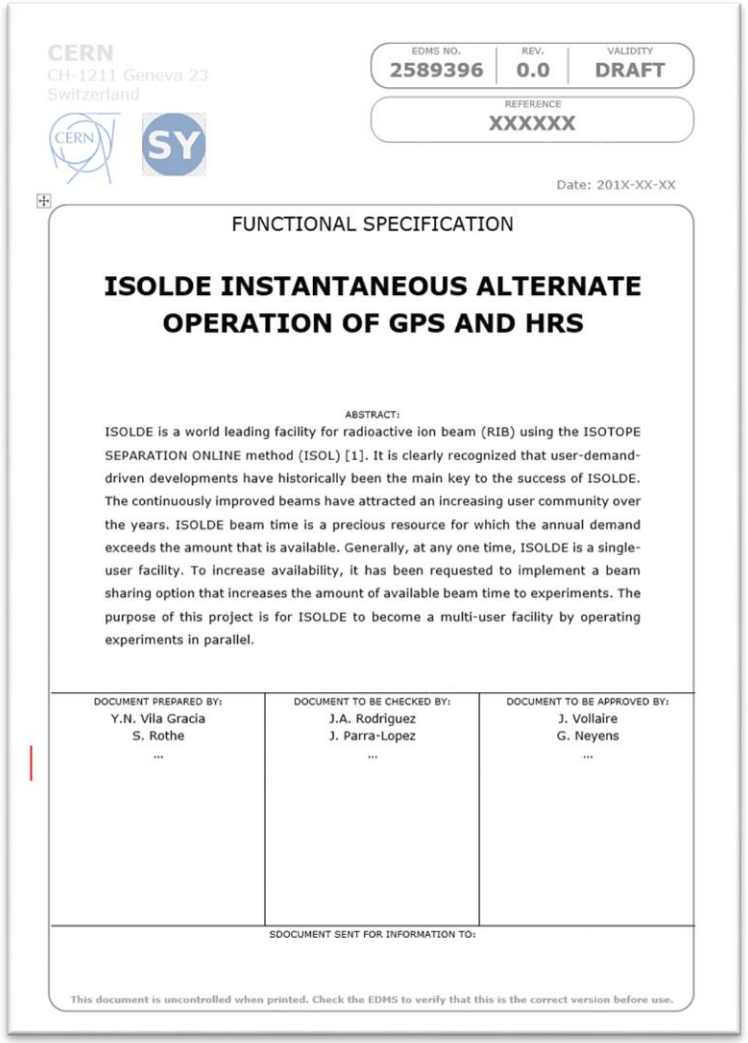
Circuit Name	Voltage (V)	Current (A)	New PSUs
YCA0.KIK10	-6000	1m	EHS 82 60n_S08-1CR-ID ch.1
YCA0. KIK10	+6000	1m	EHS 82 60p_S08-1CR-ID ch.1
YCA0. KIK10	-6000	1m	EHS 82 60n_S08-1CR-ID ch.2
YCA0. KIK10	+6000	1m	EHS 82 60p_S08-1CR-ID ch.2
YCA0.QS40-B	-6000	1m	EHS 82 60n_S08-1CR-ID ch.3
YCA0. QS40-L	+6000	1m	EHS 82 60p_S08-1CR-ID ch.3
YCA0. QS40-R	-6000	1m	EHS 82 60n_S08-1CR-ID ch.4
YCA0. QS40-T	+6000	1m	EHS 82 60p_S08-1CR-ID ch.4
YCA0. QS40-B	-6000	1m	EHS 82 60n_S08-1CR-ID ch.5
YCA0. QS40-L	+6000	1m	EHS 82 60p_S08-1CR-ID ch.5
YCA0. QS40-R	-6000	1m	EHS 82 60n_S08-1CR-ID ch.6
YCA0. QS40-T	+6000	1m	EHS 82 60p_S08-1CR-ID ch.6
YCA0. QS50-NEG	-6000	1m	EHS 82 60n_S08-1CR-ID ch.7
YCA0. QS50-POS	+6000	1m	EHS 82 60p_S08-1CR-ID ch.7
YCA0. QS50-POS	+6000	1m	EHS 82 60p_S08-1CR-ID ch.8
YCA0. QS50-NEG	-6000	1m	EHS 82 60n_S08-1CR-ID ch.8
YCA0. KIK-NEG	-6000	1m	EHS 82 60n_S08-1CR-ID ch.9
YCA0. KIK-POS	+6000	1m	EHS 82 60p_S08-1CR-ID ch.9
YCA0. KIK-NEG	-6000	1m	EHS 82 60n_S08-1CR-ID ch.10
YCA0. KIK-POS	+6000	1m	EHS 82 60p_S08-1CR-ID ch.10
YCA0. KIK70	-6000	1m	EHS 82 60n_S08-1CR-ID ch.11
YCA0. KIK70	+6000	1m	EHS 82 60p_S08-1CR-ID ch.11
YCA0. KIK70	-6000	1m	EHS 82 60n_S08-1CR-ID ch.12
YCA0. KIK70	+6000	1m	EHS 82 60p_S08-1CR-ID ch.12

Table 6. ISOLDE devices that would require a switch and a second pair of PSUs. EMDS: 2636481. ISOLDE – REEX-ISOLDE Power Converter Consolidation

Yago Nel VILA GRACIA

Next steps

- **Project board meeting**
  - Decide on switching technology
  - Decide # channels for demonstrator
- **Finalize functional specification**
- **Purchase (BEHLKE delay ~0.5y)**



CERN
CH-1211 Geneva 23
Switzerland

EDMS NO. 2589396 | REV. 0.0 | VALIDITY DRAFT

REFERENCE XXXXXX

Date: 201X-XX-XX

FUNCTIONAL SPECIFICATION

ISOLDE INSTANTANEOUS ALTERNATE OPERATION OF GPS AND HRS

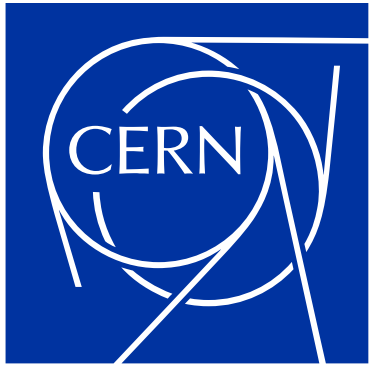
ABSTRACT:

ISOLDE is a world leading facility for radioactive ion beam (RIB) using the ISOTOPE SEPARATION ONLINE method (ISOL) [1]. It is clearly recognized that user-demand-driven developments have historically been the main key to the success of ISOLDE. The continuously improved beams have attracted an increasing user community over the years. ISOLDE beam time is a precious resource for which the annual demand exceeds the amount that is available. Generally, at any one time, ISOLDE is a single-user facility. To increase availability, it has been requested to implement a beam sharing option that increases the amount of available beam time to experiments. The purpose of this project is for ISOLDE to become a multi-user facility by operating experiments in parallel.

DOCUMENT PREPARED BY:	DOCUMENT TO BE CHECKED BY:	DOCUMENT TO BE APPROVED BY:
Y.N. Vila Gracia S. Rothe ...	J.A. Rodriguez J. Parra-Lopez ...	J. Vollaire G. Neyens ...

SDOCUMENT SENT FOR INFORMATION TO:

This document is uncontrolled when printed. Check the EDMS to verify that this is the correct version before use.



home.cern