Progress Report on the Commissioning of the ISOLDE Facility

Jose Alberto Rodriguez

on behalf of the operations section (BE-OP-ISO)

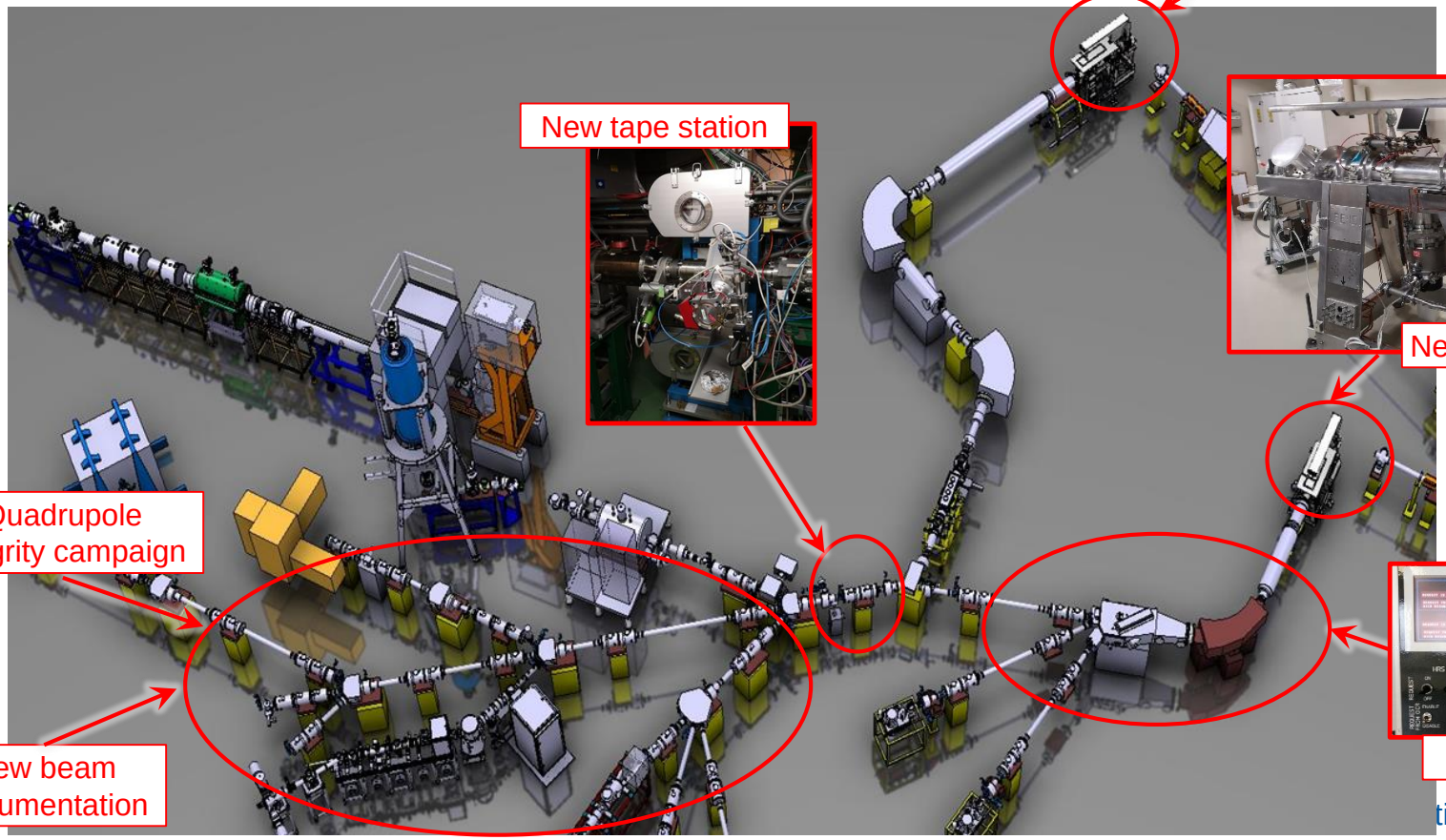
Outline:

- Introduction
- Low-energy beam lines
- Introduction
- REX/HIE-ISOLDE post-accelerator

Introduction:

Main tasks carried out during LS2 (low energy):

- Front-end (FE10) manufactured and installed in GPS, J. Vollaire (EN-STI)
- Front-end (FE11) manufactured and being tested off-line, J. Vollaire (EN-STI)
- New tape station, S. Rothe (EN-STI)
- New beam gates system, P. Fernier (BE-OP)
- New beam instrumentation, M. Duraffourg, P. Martins (BE-BI)
- Quadrupole integrity and polarity check campaign, M. Lozano (BE-OP)



Low-energy beam lines:

Front-end (FE10) manufactured and installed in GPS, J. Vollaire (EN-STI)

- Hardware pre-commissioning completed, S. Rothe (EN-STI)
- Handed over to BE-OP on Oct. 26th

Front-end (FE11) manufactured and being tested off-line, J. Vollaire (EN-STI)

New tape station, S. Rothe (EN-STI)

New beam gates system, P. Fernier (BE-OP):

- Control electronics, high-voltage power supplies and switches manufactured and installed
- Off-line hardware commissioning completed
- Beam commissioning for GPS, GLM and GHM on-going
- Beam commissioning for HRS planned for 2021

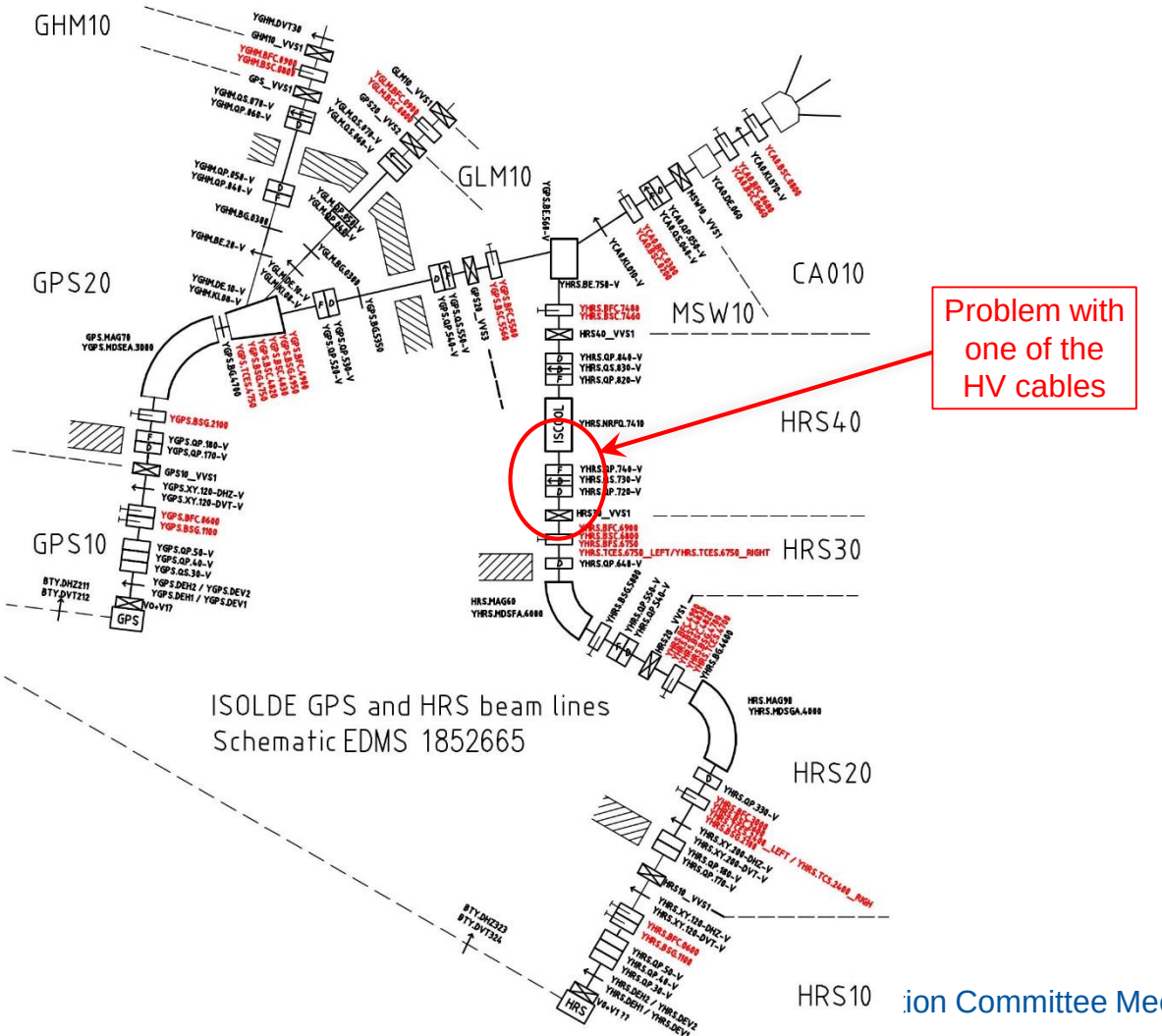
New beam instrumentation, M. Duraffourg, P. Martins (BE-BI):

- New standard FCs and scanning wires manufactured and installed (16 units)
- Hardware commissioning completed
- Beam commissioning on-going
- Issues found currently being addressed
- Installation of the special scanning wires after the separators postponed until the 20/21 technical stop

Low-energy beam lines:

Quadrupole integrity and polarity check campaign, M. Lozano (BE-OP): Multiple tests were performed on 76 quads, 184 power supplies and 304 cables and connectors

- Electrode of quad in the injection triplet of the cooler/buncher not biased (may explain the poor transmission observed during the last couple of years before LS2) ← Fixed



Low-energy beam lines:

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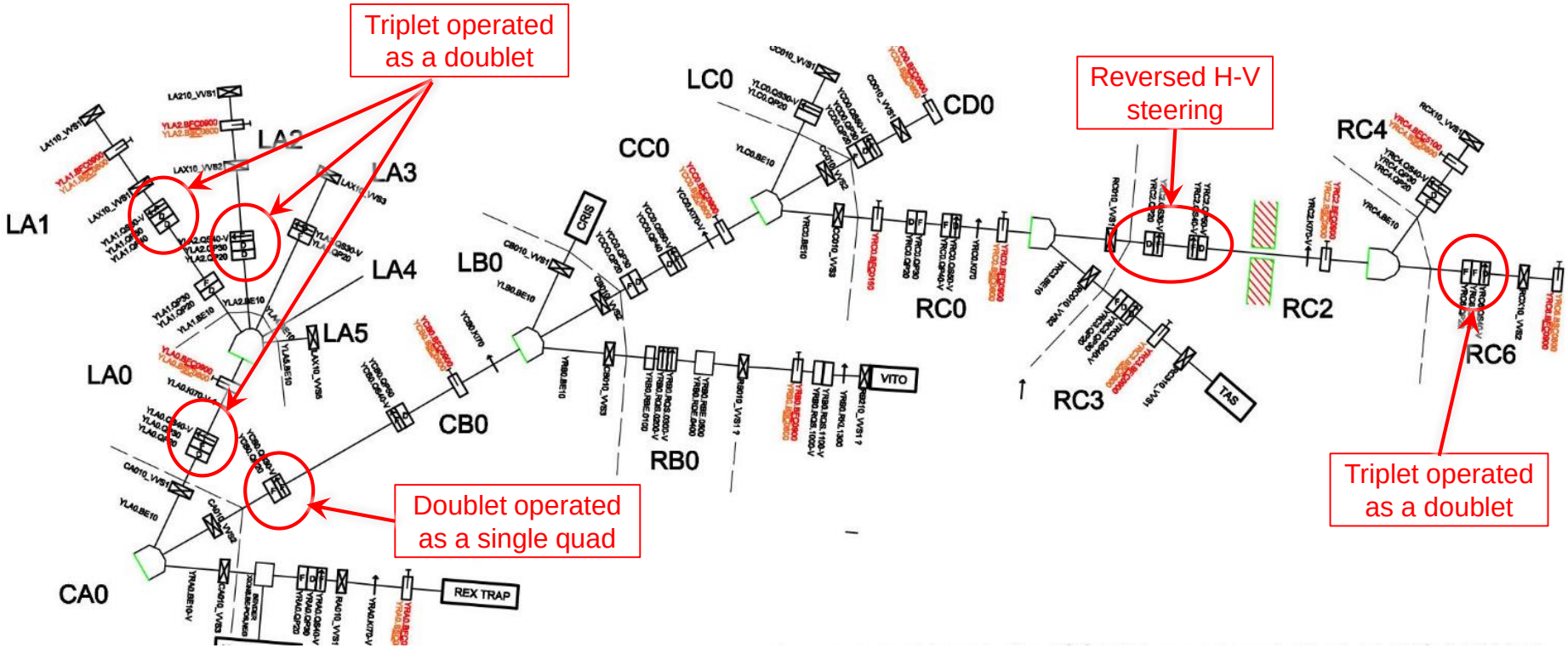
- Problem with the connector of a high-voltage cable in RC4 found
- Shorts to ground measurements: No issue found
- Capacity measurements: No issue found (i.e. no obvious problem inside the vacuum chamber)
- Polarity checks: Multiple issues found



Low-energy beam lines:

Beam commissioning (completed):

- Software used to control the front-end tested (FESA classes, high tension, heating…)
- GPS separator cycling application tested
- GPS mass scan application tested
- Initial set-up from GPS to most of the experimental station prepared
- Most of the old and new instrumentation tested

Beam commissioning (pending):

- HRS separator will be commissioned after FE11 is installed
- Cooler/buncher will be commissioned after FE11 is installed
- Operational set-ups to all experimental stations with current quad configuration need to be prepared
  - Remaining issues with beam instrumentation need to be solved beforehand
- Polarity of quads will be reversed
- New operational set-ups to all experimental stations need to be prepared
- Decision on quad polarity will be made based on the comparison of the two groups of set-ups

Outline:

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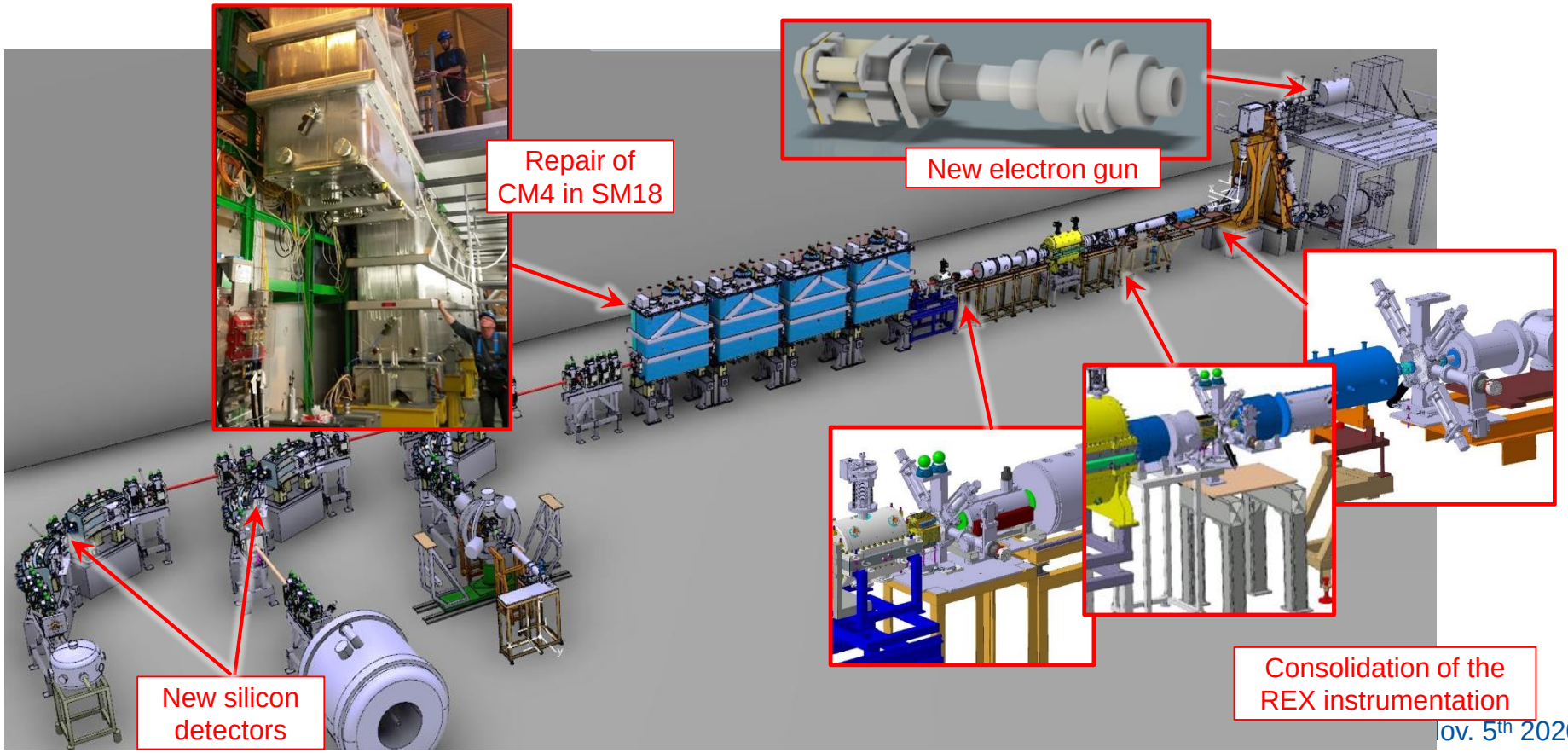
Introduction:

Main tasks carried out during LS2 (high energy):

- Repair of cryomodule (CM4) in SM18, E. Siesling (BE-OP), W. Venturini (BE-RF)
- New electron gun for REX-EBIS, F. Wenander (BE-ABP)
- Consolidation of the beam instrumentation in the REX linac, S. Mataguez (BE-OP), E. Bravin (BE-BI)
- Consolidation of the REX RF amplifiers, C. Gagliardi (BE-RF)
- New silicon detectors in XT02 and XT03, E. Bravin (BE-BI)
- New high-level control software, E. Piselli (BE-OP)



REX/HIE-ISOLDE post-accelerator:

Repair of cryomodule (CM4) in SM18, E. Siesling (BE-OP), W. Venturini (BE-RF)

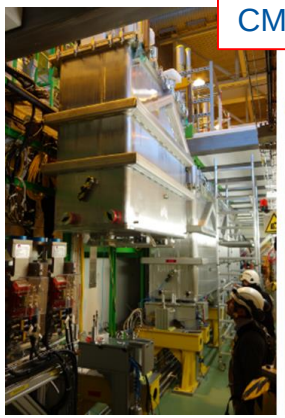
Consolidation of the REX RF amplifiers, C. Gagliardi (BE-RF)

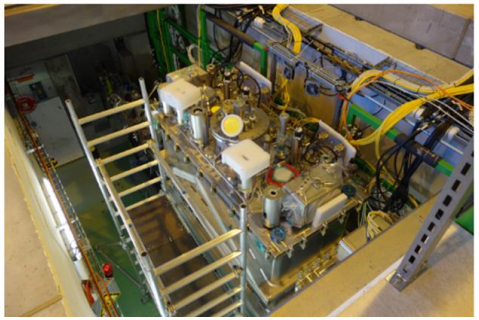
- Completed tasks:
  - CM4 uninstalled and transported to building SM18 at the beginning of LS2, E. Siesling (BE-OP)
  - The coupler of the 3rd cavity of CM4 repaired, W. Venturini (BE-RF)
  - The cryomodule was tested in the SM18 bunker, W. Venturini (BE-RF)
  - Transported back and reinstalled in the linac bunker at the beginning of 2020, E. Siesling (BE-OP)
  - Hardware commissioning of all the SRF systems completed in mid-October. Integrated gradients comparable to those in 2018 (i.e. comparable maximum beam energies)
  - REX amplifiers maintenance completed. Many subsystems fully refurbished, C. Gagliardi (BE-RF)
  - New low-level and high-level software to monitor REX amplifiers developed

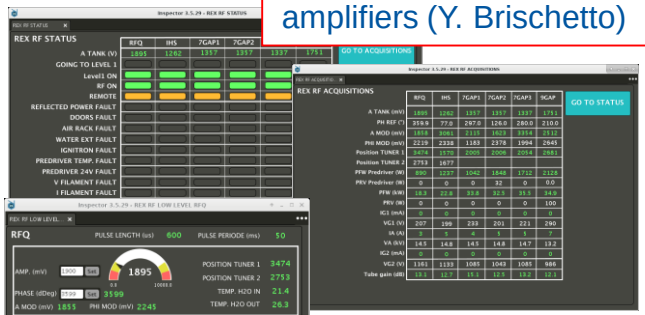
Refurbishment of REX amplifiers (C. Gagliardi)

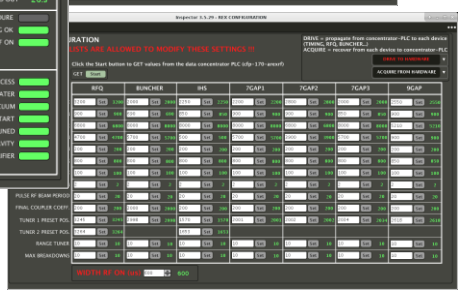
New software for REX amplifiers (Y. Brischetto)

Installation of CM4 (E. Siesling)







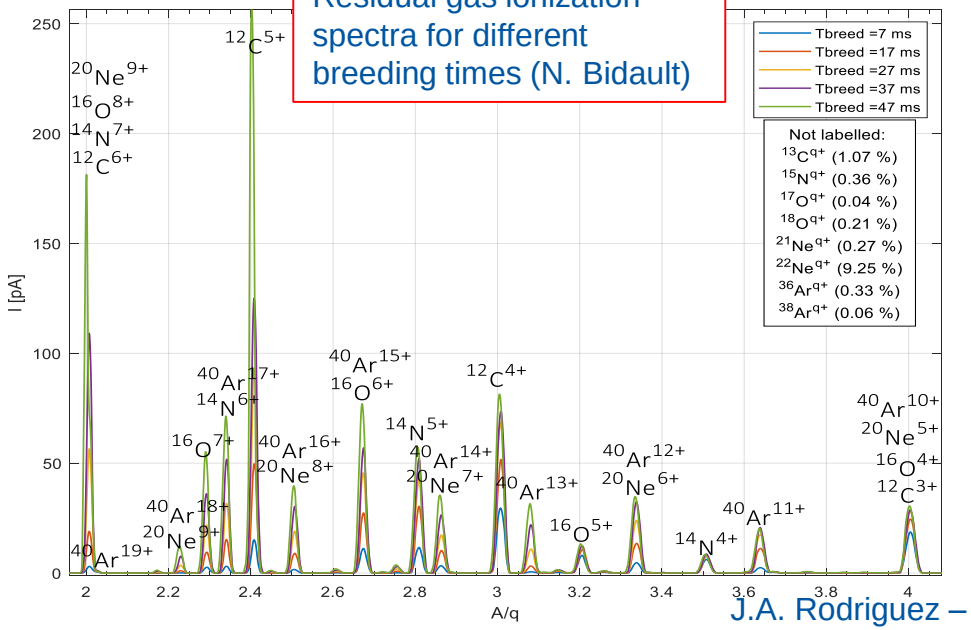


REX/HIE-ISOLDE post-accelerator:

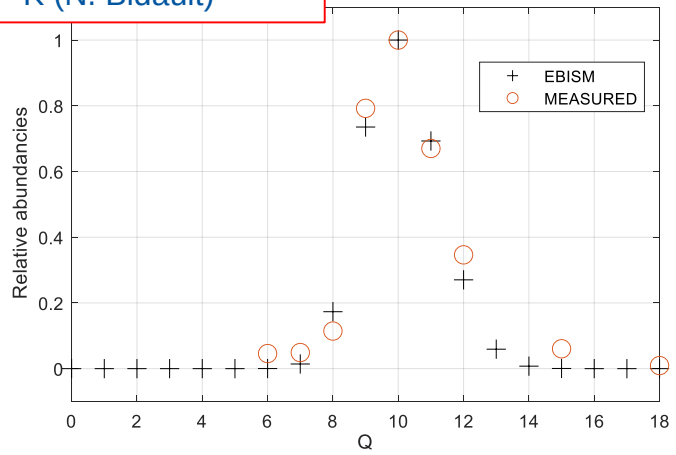
New electron gun for REX-EBIS, F. Wenander (BE-ABP):

- A new non-adiabatic with IrCe cathode electron gun designed, manufactured and installed during LS2
- Completed tasks:
  - Improved electron current density by a factor 2-2.7 (i.e. shorter breeding times)
  - Reached nominal charge breeding efficiencies for 39K10+
  - Residual gas ionization spectra characterized
  - Charge state distribution for 39K and 133Cs measured
- Pending tasks:
  - Better characterization of Ir and Ce contaminants
  - Injection of beams from the GPS target
  - F. Wenander requested 4 additional days to complete the performance characterization

Residual gas ionization spectra for different breeding times (N. Bidault)



Charge state distribution for ^{39}K (N. Bidault)



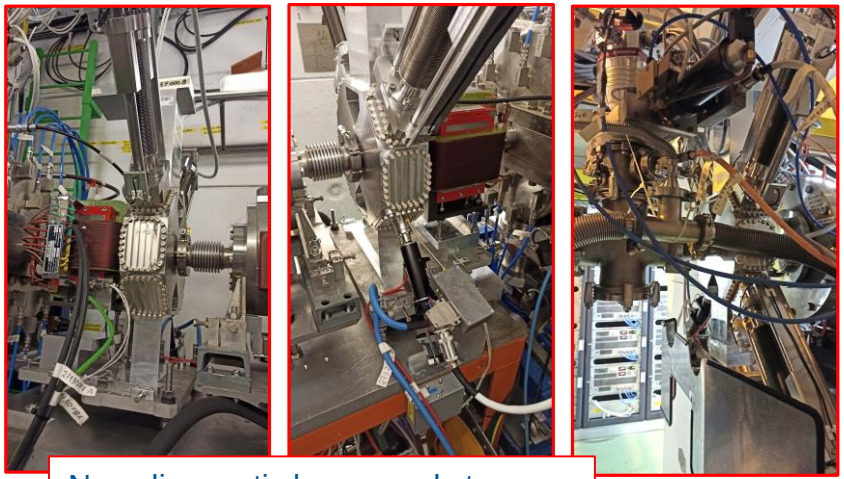
REX/HIE-ISOLDE post-accelerator:

Consolidation of the beam instrumentation in the REX linac, S. Mataguez (BE-OP), E. Bravin (BE-BI)

New silicon detectors in XT02 and XT03, E. Bravin (BE-BI)

New high-level control software, E. Piselli (BE-OP)

- Completed tasks:
  - New diagnostic boxes installed and commissioned
  - New XT02 and XT03 silicon detectors installed
  - Software for FCs, slits, collimators, attenuators and silicon detector count rate developed and tested
  - All older instrumentation has been recommissioned
- Pending tasks:
  - Beam commissioning of the new XT02 and XT03 silicon detectors
  - Several software applications related to the silicon detectors still under development
  - A few issues with existing instrumentation identified and currently being solved



New diagnostic boxes and steerers

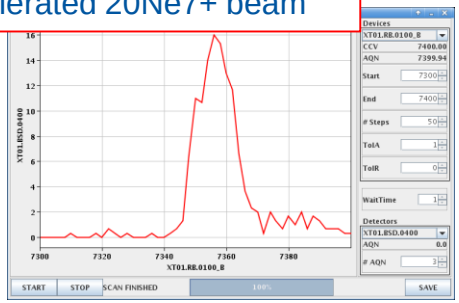
New software partially completed (E. Piselli)

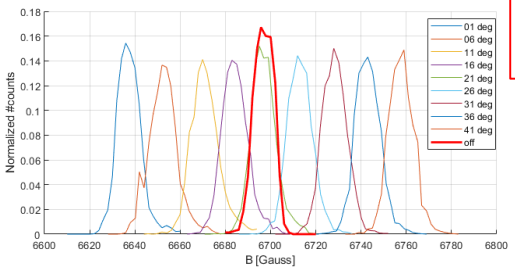
REX/HIE-ISOLDE post-accelerator:

Beam commissioning and machine studies (completed):

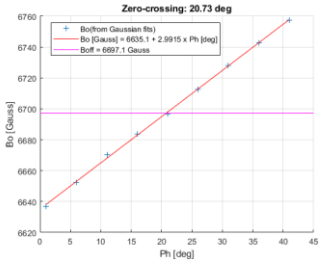
- Optical elements and beam instrumentation in the linac and HEBT lines fully commissioned
- External gas injection into the REX-EBIS system commissioning. Regulation problems need to be addressed
- Development of alternative optics in the REX A/q separator
- Beam (20Ne7+) accelerated to the maximum reachable energy (10.43 MeV/u)

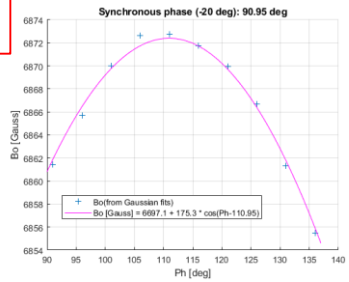
Energy distribution for a fully accelerated 20Ne7+ beam





Beam-based SRF field calibration validation





REX/HIE-ISOLDE post-accelerator:

Beam commissioning and machine studies (completed):

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- External gas injection into the REX-EBIS system commissioning. Regulation problems need to be addressed
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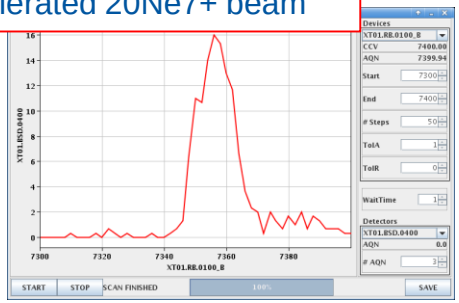

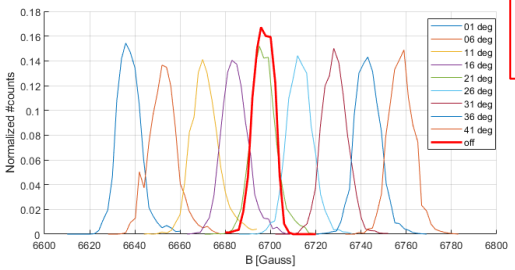

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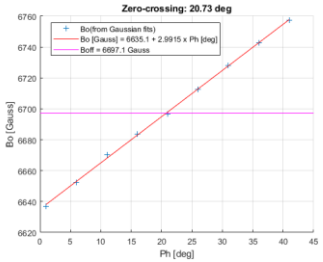
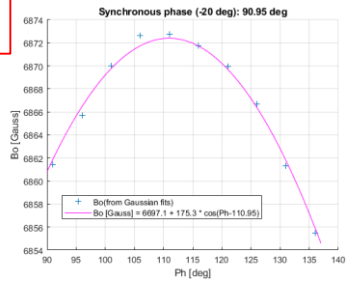
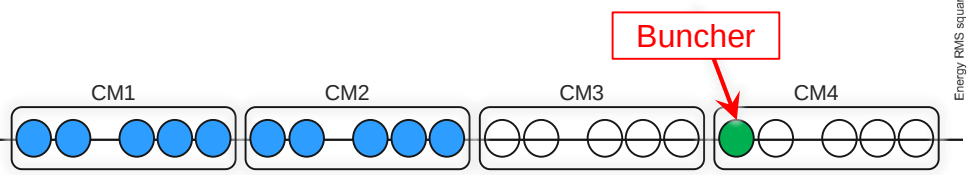
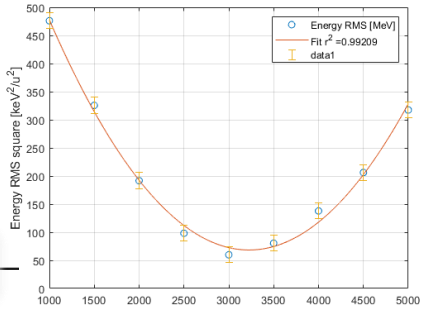


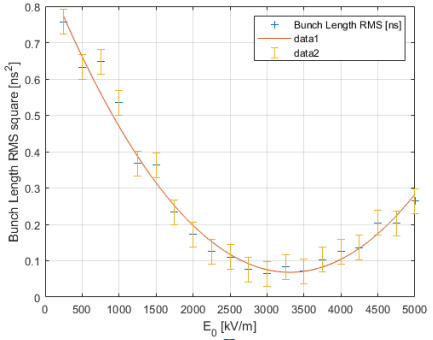


- Simplified cavity phasing procedure validated
- Beam-based field calibration procedure for the SRF cavities validated
- First order TTF model for beam energy calculations validated
- Longitudinal phase space characterization techniques developed, N. Bidault (BE-OP) (i.e. first step towards energy spread and bunch length beam optimization)

Energy spreads and bunch lengths for different buncher strengths (N. Bidault)







REX/HIE-ISOLDE post-accelerator:

Beam commissioning and machine studies (pending):

- Injection and acceleration of beam from the GPS front-end
- Longitudinal phase space characterization at different energies
- Characterization of the stability of the linac at A/q between 2.0 and 2.5
- Commissioning of the new XT02 and XT03 silicon detectors and comparison of the different beam energy measurements
- Development of techniques to manipulate the longitudinal phase space of the beam (i.e. energy spread or bunch length optimization for each of the experimental stations)