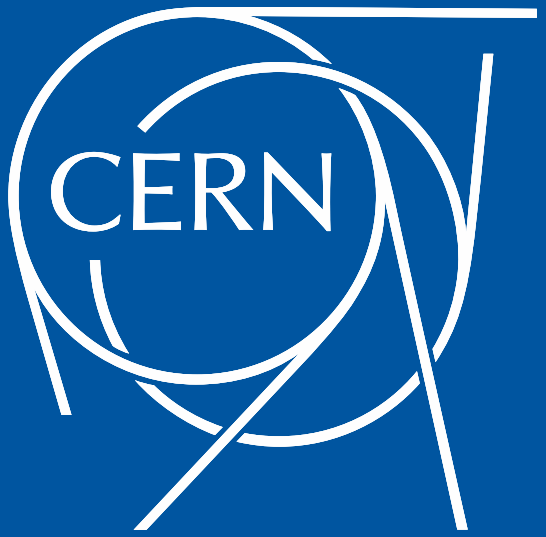

CERN

Operations of the REX/HIE-ISOLDE Linac during the 2017 Physics Campaign

Jose Alberto Rodriguez
on behalf of BE-OP-ISO and the
HIE-ISOLDE project team

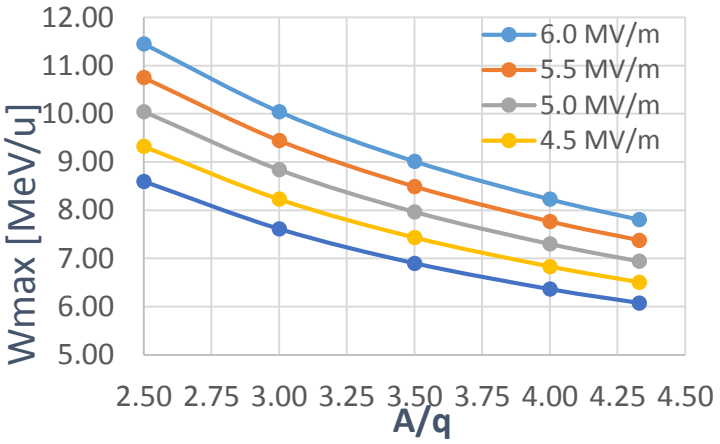
Outline:

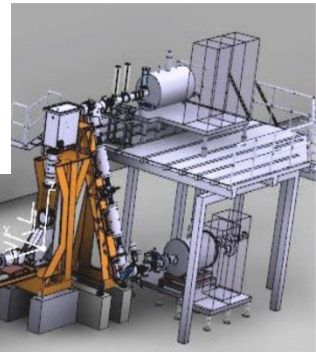
- Introduction
- Improvements introduced during the year
- Overview 2017 Operations
- High Energy Physics Campaign
- Summary

Introduction:

Phase 2A of HIE-ISOLDE fully operational:

- Additional cryomodule (CM3)
- Additional HEBT line (XT03)
- Modification of the XT02 HEBT line
- ISOLDE Solenoidal Spectrometer





CM3 and XT00 modification

REX-ISOLDE

High-beta cryomodules

XT03

SEC

XT02 extension and ISS

ISS

Miniball

Outline:

- Introduction
- Improvements introduced during the year
- Overview 2017 Operations
- High Energy Physics Campaign
- Summary

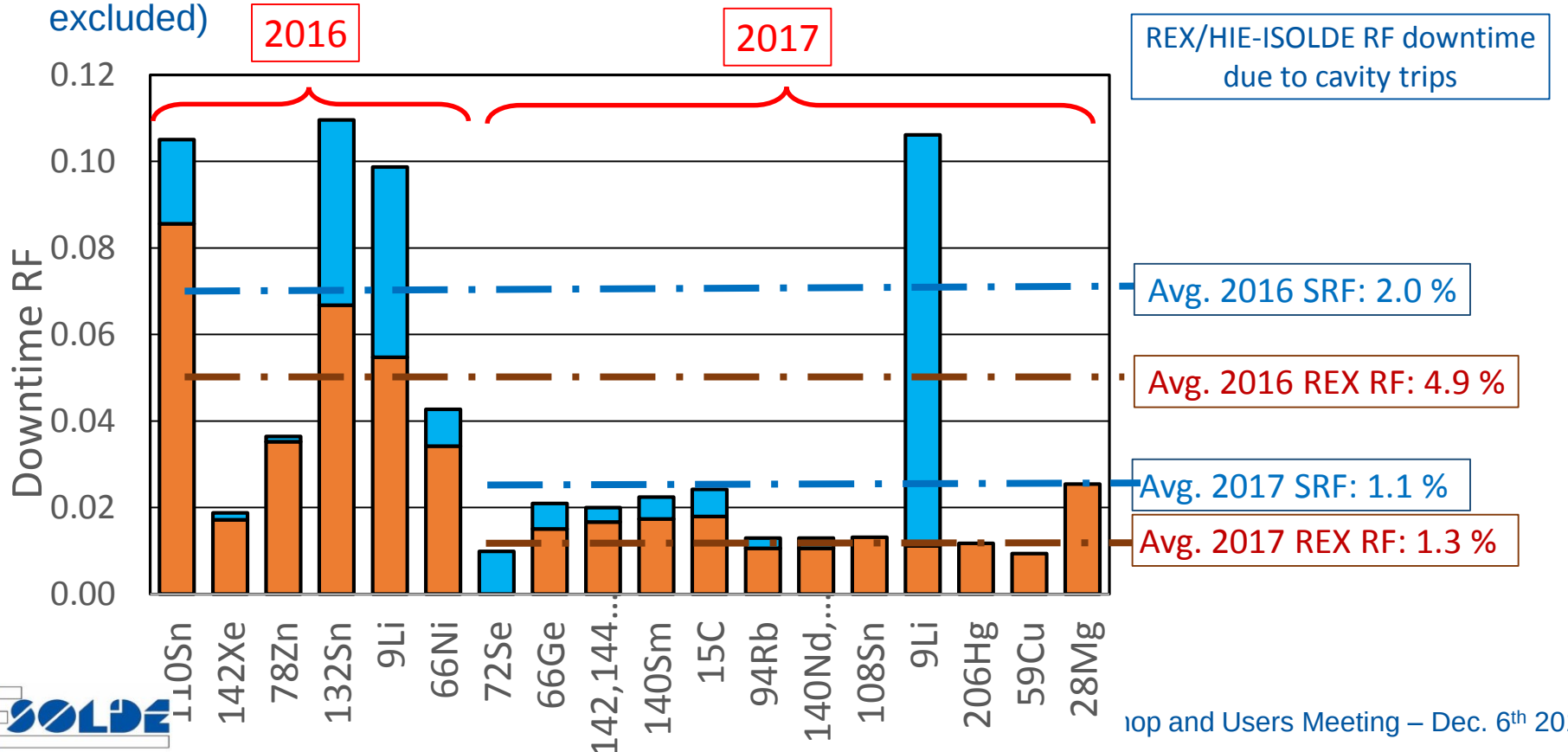
Improvements: Reliability of RF systems

Downtime due to normal conducting RF systems:

- 2016: 8 days down because of failure of the 9gap amplifier + 4.9 % cavity trips
- 2017: 6 hours intervention in 7gp2 + 1.3 % cavity trips
- **Scalability and reproducibility of the set-ups has improved significantly resulting in shorter time in between experiments**

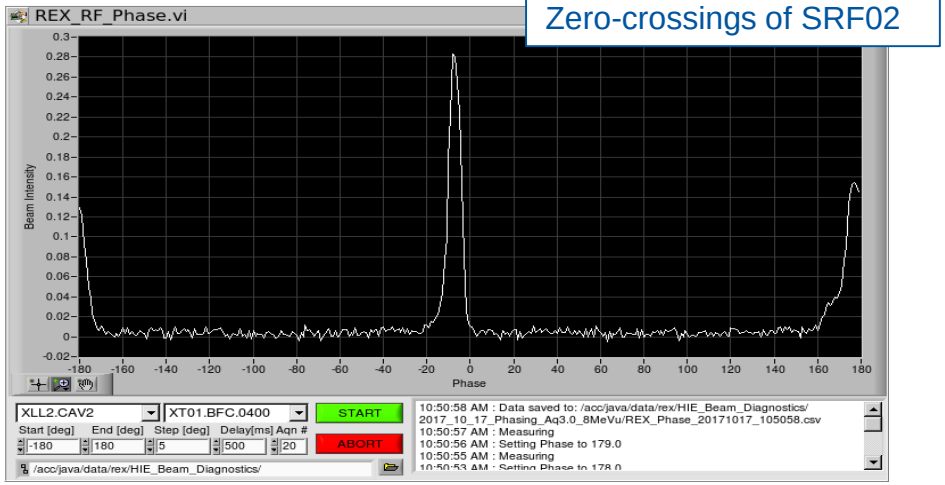
Downtime due to superconducting RF systems:

- 2016: 2.0 % cavity trips
- 2017: 16 hours because of LHe loss in CM1 + 1.1 % cavity trips (0.3 % if 9Li experiment is excluded)

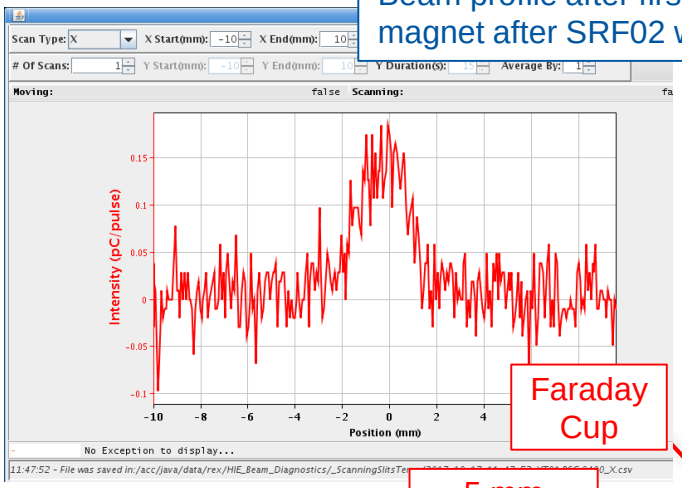


Improvements: Semiautomatic Phasing

- Procedure to phase the SRF cavities is well defined, robust and repeatable
  1. Phase scan to determine zero-crossings
  2. Set operational phase
  3. Scale HEBT line
  4. Adjust and document settings of the machine
- Software applications have been developed to automatize some of the steps
- Currently, phasing 15 cavities takes ~1.5 shifts
- Additional automation planned for 2018 (objective: phasing 20 cavities in 1 shift)



Zero-crossings of SRF02

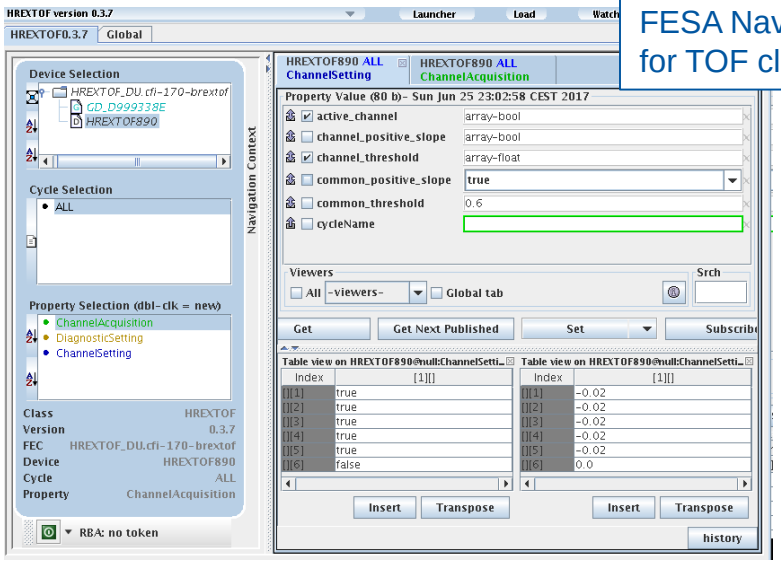


Beam profile after first dipole magnet after SRF02 was phased

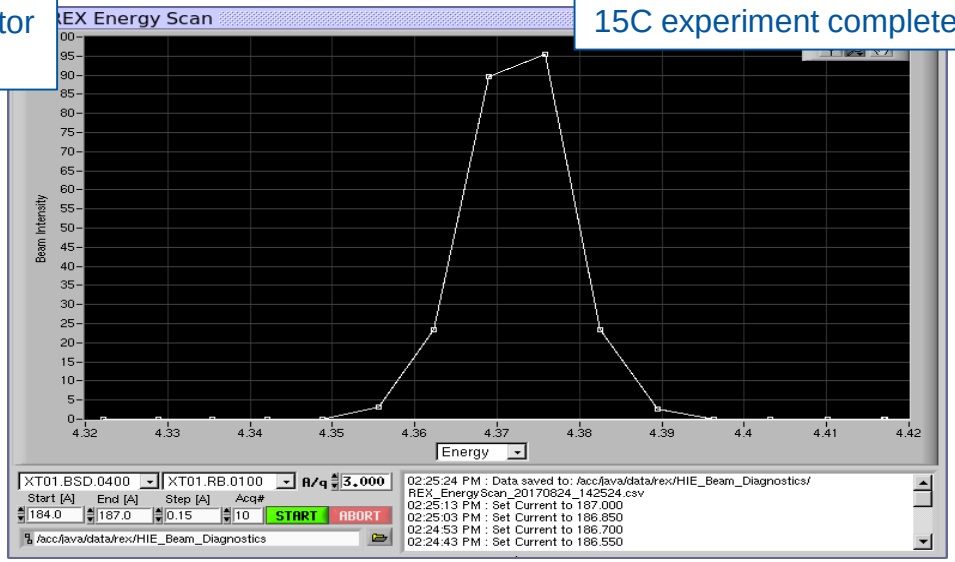
Improvements: Energy Scans

- Low-level controls (FESA class) Time Of Flight developed and partially commissioned (channel settings and particle count rate)

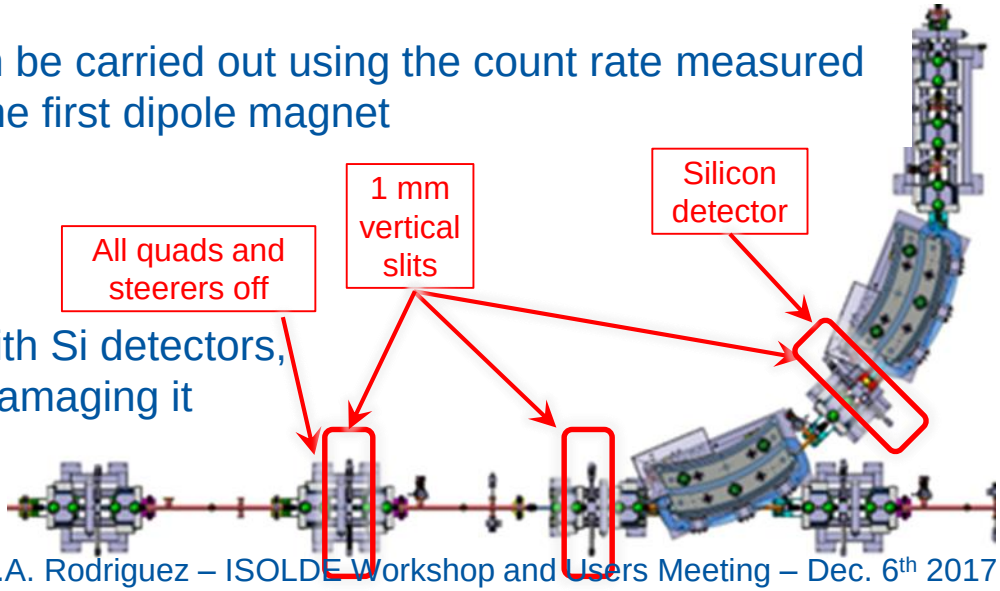
FESA Navigator for TOF class



Energy Scan after set-up for 15C experiment completed



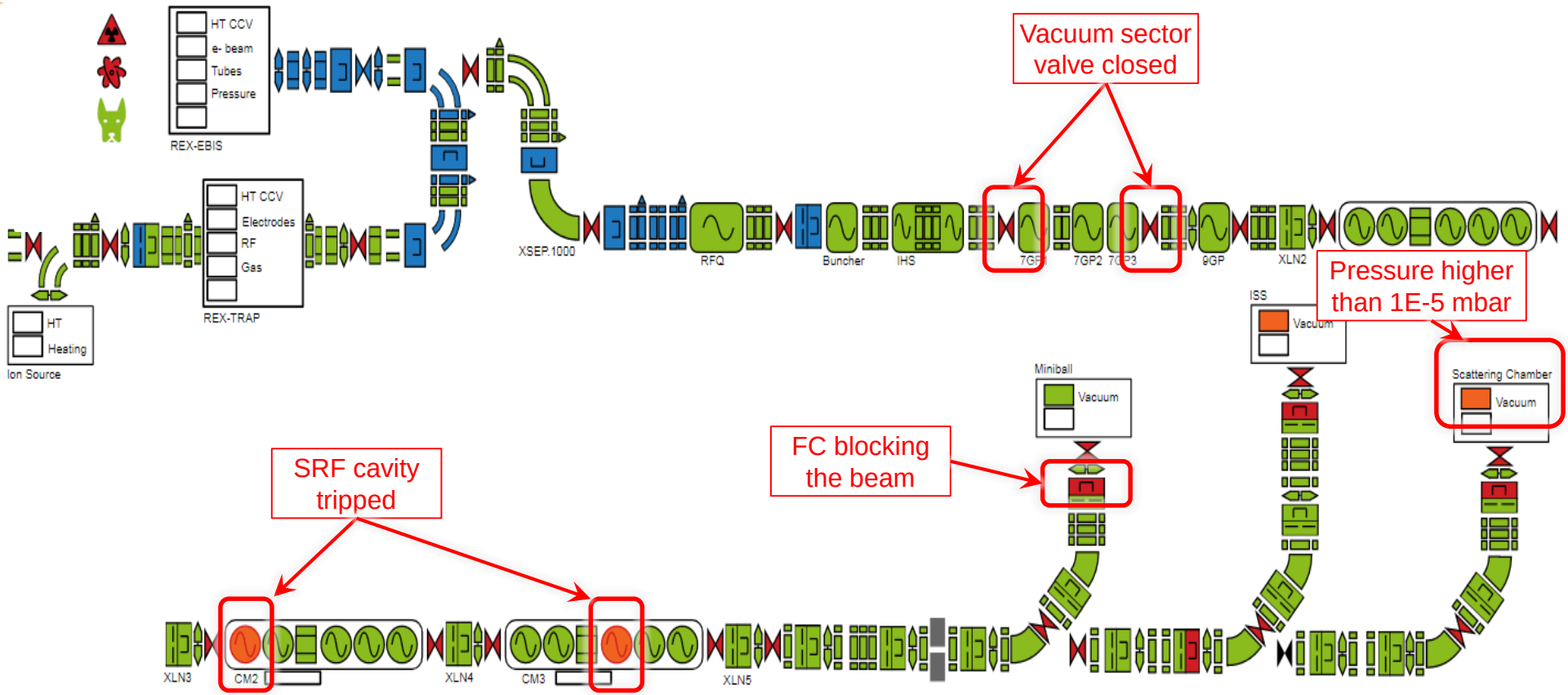
- Energy and energy spread of the beam can be carried out using the count rate measured at the Silicon detector at XT01.0400 after the first dipole magnet
- The method works very well:
  - Can be used for low-intensity beams
  - Can be completed in ~ 1 hour
  - However, as with all measurements with Si detectors, special attention is required to avoid damaging it



Improvements: Monitoring of the machine

Fast Beam Investigation (FBI) by E. Fadakis, E. Matli and K. Seintaridis (BE/OP):

- New tool to monitor the status of the facility
- Accessible on the general network, from any web browser
- REX/HIE-ISOLDE section partially commissioned during the last three weeks of the Physics campaign
- Will be completed and extended to the low-energy part of the facility next year



Outline:

- Introduction
- Improvements introduced during the year
- Overview 2017 Operations
- High Energy Physics Campaign
- Summary

Overview 2017 Operations:

- First radioactive ion beam (RIB) delivered (end wk. 27)
- Twelve experiments conducted despite of the relatively short Physics campaign (~1500 hours of RIBs)

Experiment number	Isotopes	Energy [MeV/u]	Experimental station	Time [hours]
IS628	^{28}Mg	5.5	Miniball Spect.	176
IS607	^{59}Cu	3.6 - 5.0	Edinburgh chamber	133.5
IS547	^{206}Hg	4.2	Miniball Spect.	84
IS561	^{9}Li	8.0	Scattering Chamber	80
IS562	^{108}Sn	4.5	Miniball Spect.	94
IS546	^{142}Sm, ^{140}Nd	4.6	Miniball Spect.	166
IS572	^{94}Rb	6.2	Miniball Spect.	140
IS619	^{15}C	4.35	Scattering Chamber	245
IS558	^{140}Sm	4.65	Miniball Spect.	113
IS553	^{142}Ba, ^{144}Ba	3.4, 4.2	Miniball Spect.	147
IS569	^{66}Ge, ^{70}Se	4.4	Miniball Spect.	97
IS597	^{72}Se	4.4	Miniball Spect.	33
			Total	**1508.5**

Overview 2017 Operations:

- In addition, different stable beams at a variety of energies were delivered to the three experimental station (15 times totalling ~500 hours)
- At this point, most standard ones can be delivered within hours of being requested for evenings or weekends

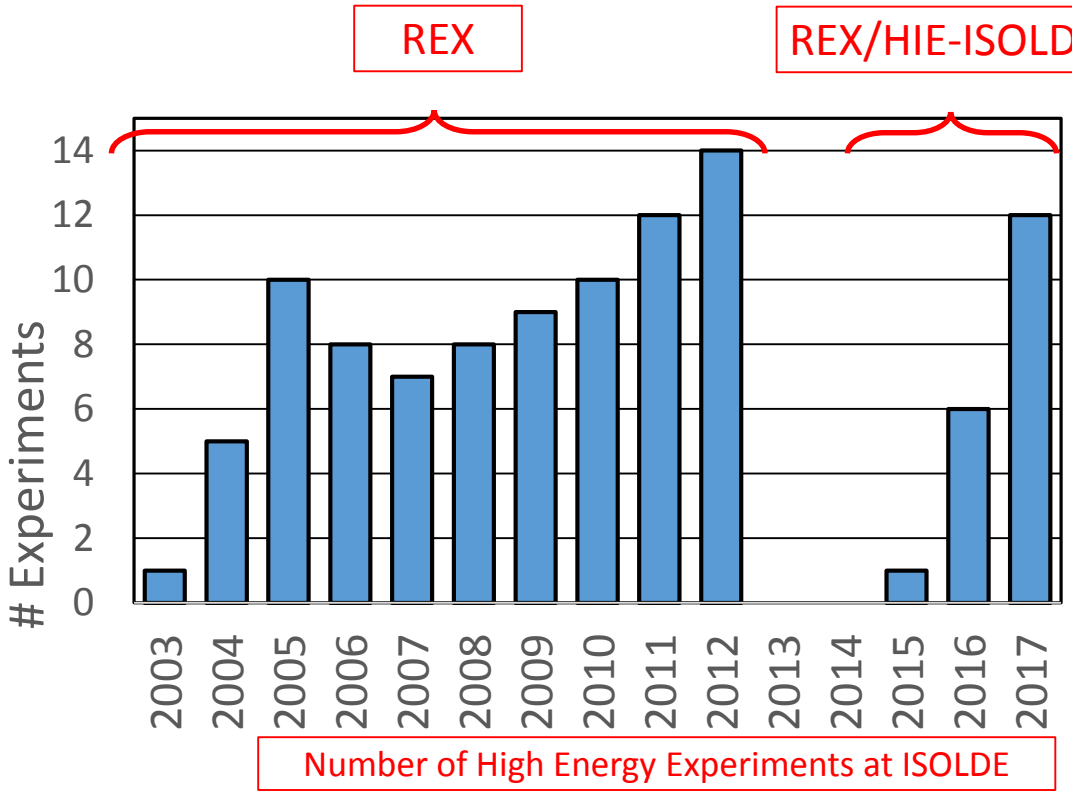
Isotopes	Energy [MeV/u]	Experimental station	Time [hours]
$^{14}N^{5+}$	5.5	ISS	16.0
$^{22}Ne^{6+}$	5.5	Miniball Spect.	121
A/q=4.0	4.10	Miniball Spect.	14.0
A/q=3.0	8.04, 5.87, 3.66	Scattering Chamber	67.5
A/q=4.0	4.5, 6.18	Miniball Spect.	25.5
A/q=3.0	4.37	Scattering Chamber	20.0
$^{15}N^{5+} \rightarrow {}^{15}N^{7+}$	4.35	Scattering Chamber	2.5
$^{22}Ne^{6+}$	4.0	Miniball Spect.	61.0
$^{22}Ne^{6+}$	4.4	Miniball Spect.	22.0
A/q=3.789	4.4	Miniball Spect.	11.0
A/q=4.0	5.5	Miniball Spect.	69.5
$^{22}Ne^{6+}$	4.0	Miniball Spect.	62.0
		Total	**492**

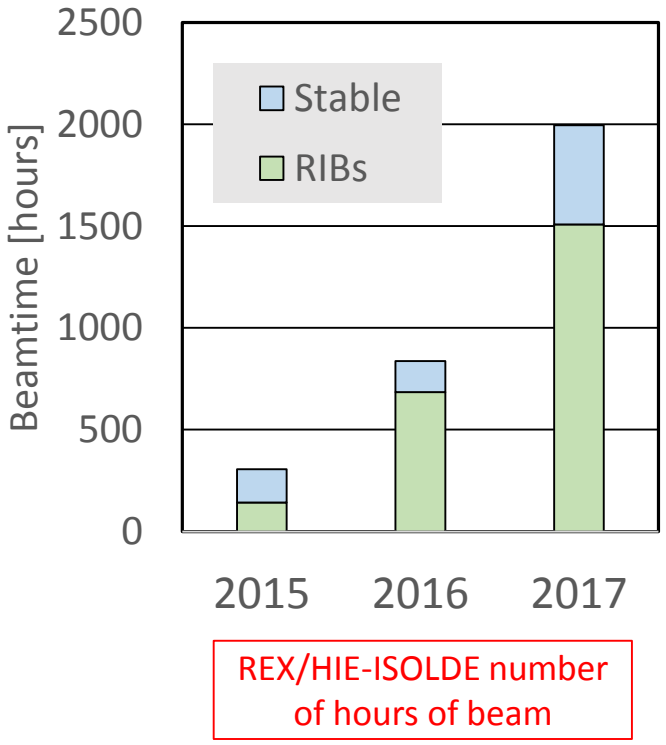
Overview 2017 Operations:

Evolution over time

Compared to 2016:

- Number of experiments: x2
- Number of hours of RIBs: x2.2
- Number of hours of stable beam: x3.2





Outline:

- Introduction
- Improvements introduced during the year
- Overview 2017 Operations
- High Energy Physics Campaign
- Summary

2017 REX/HIE-ISOLDE Physics Campaign:

IS597: Probing shape coexistence in neutron-deficient ^{72}Se via low energy Coulomb excitation

Set-up:

- Molecular beam: ^{72}SeCO
- First 7 SRF cavities used
- Beam energy: 4.425 MeV/u – Energy spread: 0.7%
- Slow extraction applied (1 ms RF pulse)
- Approximate beam intensities: 1.6E5 pps (combined $^{72}Se^{19+}$ and $^{68}Ge^{18+}$) at the beginning of the experiment

Main Issues:

- Target yields dropped by a factor 2 every ~12 hours
  - Target pre-baked to reduce contaminants
  - CO leak did not contribute to the formation of SeCO beam
- Dominant $^{68}Ge^{18+}$ contaminant from $^{32}S^{68}Ge$
- Problem with FC right after GPS separator
- Trip of electrostatic devices in central line

Consequences:

- Experiment stopped earlier than originally planned
- Only a small fraction (5-10%) of the requested ion were delivered

Experiment #	IS597
RIB (A/q)	$^{72}Se^{19+}$ (3.79)
Energy [MeV/u]	4.4
Target	GPS
Exp. Station	Miniball Spect.
Start date	Jul. 7th (23:00)
End date	Jul. 10th (10:00)
Length [hours]	33.5
Pilot beam (A/q)	$^{39}K^{10+}$ (3.9) $^{80}Se^{21+}$ (3.81)
Target type	ZrO_2
EBIS breeding time [ms]	58

RF structure	HIE	
	SRF03	SRF04
# Trips	1	3
Downtime [mins]	5	15
Downtime [%]	0.2 %	0.7 %

Beam transmission/efficiency (approx.)

Low energy	REX-TRAP + EBIS	REX/HIE linac
n.a.	2.1 %	70 %

2017 REX/HIE-ISOLDE Physics Campaign:

IS569: Solving the shape conundrum in ^{70}Se

Set-up:

- New target manufactured and installed (no prebaking). Originally, using the same target as for IS597 was planned
- Molecular beams: ^{70}SeCO / ^{66}GeS
- First 7 SRF cavities used
- Beam energy: 4.395 MeV/u – Energy spread: 0.7%
- Slow extraction applied (1 ms RF pulse)

Main Issues:

- Lower than anticipated ^{70}Se target yields
- Dominant $^{66}Ge^{16+}$ contaminant
- Problem with FC right after GPS separator

Consequences:

- Users decided to focus on ^{66}Ge instead of the originally requested ^{70}Se

Experiment #	IS569
RIB (A/q)	$^{70}Se^{17+}$ (4.118) / $^{66}Ge^{16+}$ (4.125)
Energy [MeV/u]	4.4
Target	GPS
Exp. Station	Miniball Spect.
Start date	Jul. 13th (19:45)
End date	Jul. 18th (9:00)
Length [hours]	13.15 / 89.25
Pilot beam (A/q)	$^{16}O^{4+}$… (4.0)
Target type	ZrO_2
EBIS breeding time [ms]	42

RF structure	REX			HIE		
	IH	7GP1	7GP3	SRF03	SRF04	SRF06
# Trips	1	1	4	2	2	3
Downtime [mins]	15	15	60	10	10	15
Downtime [%]	0.2 %	0.2 %	1.0 %	0.2 %	0.2 %	0.2 %

Beam transmission/efficiency (approx.)

Low energy	REX-TRAP + EBIS	REX/HIE linac
n.a.	2.0 %	74 %

2017 REX/HIE-ISOLDE Physics Campaign:

IS553: Determination of the B(E3,$0^+ \rightarrow 3^-$) strength in the octupole-correlated nuclei ^{142,144}Ba using Coulomb excitation

Set-up:

- Molecular ^{144}BaF and atomic ^{144}Ba beams
- First 7 SRF cavities used
- Beam energies:
  - 4.19 MeV/u – Energy spread: 0.7%
  - 3.39 MeV/u – Energy spread: 0.6%
- Slow extraction applied (1 ms RF pulse)
- Started several days ahead of time

Main Issues:

- CF_4 gas leak blocked early in the experiment (07/21). ^{144}BaF depleted a few days later (07/26)
- Target failed after 4.5E18 protons
- Some isobaric beam contaminants reported (Sm, Nd, Ce)
- Problem with FC right after GPS separator

Consequences:

- $^{142}Ba^{33+}$ at 4.2 MeV/u not measured (experiment ended earlier than originally scheduled)

Experiment #	IS553
RIB (A/q)	$^{142}Ba^{33+}$ (4.30) / $^{144}Ba^{33+}$ (4.36)
Energy [MeV/u]	3.4, 4.2
Target	GPS
Exp. Station	Miniball Spect.
Start date	Jul. 20th (18:40)
End date	Jul. 27th (19:50)
Length [hours]	147
Pilot beam (A/q)	$^{22}Ne^{5+}$ (4.4) $^{138}Ba^{32+}$ (4.31)
Target type	UC
EBIS breeding time [ms]	177 for $^{144}Ba^{33+}$

RF structure	REX			HIE		
	RFQ	IH	7GP3	SRF01	SRF02	SRF06
# Trips	1	6	3	3	2	1
Downtime [mins]	15	90	45	15	10	5
Downtime [%]	0.2 %	1.0 %	0.5 %	0.2 %	0.1 %	0.1 %

Beam transmission/efficiency (approx.)

Low energy	REX-TRAP + EBIS	REX/HIE linac
n.a.	5 % (molecular)	70 %

2017 REX/HIE-ISOLDE Physics Campaign:

IS558: Shape Transition and Coexistence in Neutron-Deficient Rare Earth Isotopes

Set-up:

- First 8 SRF cavities used
- Beam energy: 4.66 MeV/u – Energy spread: 0.9%
- Slow extraction applied (1 ms RF pulse)
- Started two days ahead of original schedule

Main Issues:

- Field emission in one of the SRF cavities and tight settings of one of the valves in the cryoline system resulted in higher than normal consumption of LHe
- Problem with FC right after GPS separator

Consequences:

- Lost 2.5 shifts of Physics until source of the problem with the LHe was understood
- Additional set-up time to re-phase some of the SRF cavities

Experiment #	IS558
RIB (A/q)	$^{140}Sm^{34+}$ (4.12)
Energy [MeV/u]	4.66
Target	GPS
Exp. Station	Miniball Spect.
Start date	Aug. 8th (18:00)
End date	Aug. 14th (9:00)
Length [hours]	112.5
Pilot beam (A/q)	$^{16}O^{4+}$… (4.0)
Target type	Ta - GdB6
Breeding time	166.5 ms

RF structure	REX			HIE			
	RFQ	IH	7GP3	SRF02	SRF04	SRF07	SRF08
# Trips	1	1	6	2	3	1	1
Downtime [mins]	15	15	90	10	15	5	5
Downtime [%]	0.2 %	0.2 %	1.3 %	0.2 %	0.2 %	0.1 %	0.1 %

Beam transmission/efficiency (approx.)

Low energy	REX-TRAP + EBIS	REX/HIE linac
n.a.	12 %	70 %

2017 REX/HIE-ISOLDE Physics Campaign:

IS619: Effects of the neutron halo in ^{15}C scattering at energies around the Coulomb barrier

Set-up:

- Molecular beam: $^{15}CO^{+}$
- One stripping foil used to eliminate or reduce stable contaminants from the REX-EBIS ($^{12}C^{4+}$, $^{15}N^{5+}$, $^{18}O^{6+}$)
- Second stripping stage ready but not used
- First 7 SRF cavities used
- Beam energy: 4.375 MeV/u (before foil) – Energy spread: 0.4%
- Slow extraction applied (1 ms RF pulse)

Main Issues:

- Difficult injection into the Scattering chamber (no FC available, problems interpreting the readings from different detectors in the experimental station)
- Problem with FC right after GPS separator

Consequences:

- Started delivering radioactive beam later than originally scheduled

RF structure	REX		HIE		
	IH	7GP3	SRF01	SRF02	SRF04
# Trips	17	1	6	2	11
Downtime [mins]	255	15	30	10	55
Downtime [%]	1.7 %	0.1 %	0.2 %	0.1 %	0.4 %

Experiment #	IS619
RIB (A/q)	$^{15}C^{5\rightarrow6+}$ (3.0→2.5)
Energy [MeV/u]	4.375
Target	GPS
Exp. Station	Scattering Chamber
Start date	Aug. 24th (14:30)
End date	Sep. 4th (8:00)
Length [hours]	245
Pilot beam (A/q)	$^{12}C^{4+}$ (3.0)
Target type	CaO
Breeding time	45 ms

Beam transmission/efficiency (approx.)

Low energy	REX-TRAP + EBIS	REX/HIE linac
n.a.	5.5 %	74 %

2017 REX/HIE-ISOLDE Physics Campaign:

IS572: Study of shell evolution around the doubly magic 208Pb via a multinucleon transfer reaction with an unstable beam

Set-up:

- All SRF cavities used (very stable operations)
- Beam energy: 6.21 MeV/u – Energy spread: 0.7%
- Slow extraction applied (1.5 ms RF pulse)

Main Issues:

- Radiation alarms in the hall (CA0 and REX separator)
- CERN safety did not approve the reclassification of the ISOLDE hall for the duration of the experiment to be able to run at higher than normal radiation levels
- Problem with FC right after GPS separator

Consequences:

- Local shielding added
- Additional set-up time to reduce (or shift) beam losses to less critical sections of the beam line
- Had to operate at a reduced proton current resulting in low statistics on the experiment

Experiment #	IS572
RIB (A/q)	$^{94}Rb^{23+}$ (4.09)
Energy [MeV/u]	6.2
Target	GPS
Exp. Station	Miniball Spect.
Start date	Sep. 13th (17:30)
End date	Sep. 21st (8:30)
Length [hours]	140
Pilot beam (A/q)	$^{16}O^{4+}$… (4.0)
Target type	UC
Breeding time	85 ms

RF structure	REX					HIE	
	RFQ	7GP1	7GP2	7GP3	9GP	SRF09	SRF13
# Trips	1	2	1	1	1	1	3
Downtime [mins]	15	30	15	15	15	5	15
Downtime [%]	0.2 %	0.3 %	0.2 %	0.2 %	0.2 %	0.1 %	0.2 %

Beam transmission/efficiency (approx.)

Low energy	REX-TRAP + EBIS	REX/HIE linac
90 % ?	9.5 %	71 %

2017 REX/HIE-ISOLDE Physics Campaign:

IS546: Study of the effect of shell stabilization of the collective isovector valence-shell excitations along the N=80 isotonic chain

Set-up:

- First 9 SRF cavities used
- Beam energies:
  - For $^{140}Nd^{33+}$: 4.625 MeV/u – Energy spread: 0.3%
  - For $^{142}Sm^{33+}$: 4.625 MeV/u – Energy spread: 0.4%
- Slow extraction applied (1.5 ms RF pulse)

Main Issues:

- Dominant ^{140}Sm beam contaminant during the initial $^{140}Nd^{33+}$ beam delivery
- Fairly frequent trips of the 9gp amplifier (insufficient water flow in the RF cavity)
- Problem with FC right after GPS separator

Consequences:

- Focus of the experiment shifted to the second isotope in the proposal (^{142}Sm)
- Experiment extended 2 shifts after target/RILIS optimization increased the ^{140}Nd yields by x20 and reduced the ^{140}Sm contamination to ~25% of the beam

Experiment #	IS546
RIB (A/q)	$^{142}Sm^{33+}$ (4.30) / $^{140}Nd^{33+}$ (4.24)
Energy [MeV/u]	4.62
Target	GPS
Exp. Station	Miniball Spect.
Start date	Sep. 27th (17:15)
End date	Oct. 5th (9:00)
Length [hours]	165.75
Pilot beam (A/q)	$^{16}O^{4+}$… (4.0)
Target type	Ta GdB
Breeding time	155 ms

RF structure	REX				
	IH	7GP1	7GP2	7GP3	9GP
# Trips	3	1	1	3	17
Downtime [mins]	45	15	15	45	255
Availability [%]	0.4 %	0.1 %	0.1 %	0.4 %	2.5 %

Beam transmission/efficiency (approx.)

Low energy	REX-TRAP + EBIS	REX/HIE linac
n.a.	9.5 % for $^{140}Nd^{33+}$ 8% for $^{142}Sm^{33+}$	70 %

2017 REX/HIE-ISOLDE Physics Campaign:

IS562: Transfer Reactions and Multiple Coulomb Excitation in the ^{100}Sn Region

Set-up:

- First 8 SRF cavities used
- Beam energy: 4.50 MeV/u – Energy spread: 0.3%
- Slow extraction applied (1.5 ms RF pulse)
- Beam intensity at XT01.0900: ~3.2E6 pps for 1.05 uA p current

Main Issues:

- Isobaric contaminant ^{108}In with the initial laser ionization scheme
- Intervention in 7gp2 amplifier (6 hours of downtime)
- DAQ limited

Consequences:

- Operated at a reduced proton current due to the high RIB beam intensity

Experiment #	IS562
RIB (A/q)	$^{108}Sn^{26+}$ (4.15)
Energy [MeV/u]	4.5
Target	HRS
Exp. Station	Miniball Spect.
Start date	Oct. 12th (20:00)
End date	Oct. 17th (8:00)
Length [hours]	94
Pilot beam (A/q)	$^{16}O^{4+}$… (4.0)
Target type	LaC
Breeding time	85 ms

RF structure	REX	
	IH	7GP2
# Trips	4	1
Downtime [mins]	60	360
Downtime [%]	1.1 %	6.0 %

Beam transmission/efficiency (approx.)

Low energy	REX-TRAP + EBIS	REX/HIE linac
85 %	9.4 %	70 %

2017 REX/HIE-ISOLDE Physics Campaign:

IS561: Transfer reactions at the neutron dripline with triton target

Set-up:

- One stripping foil used to reduce stable contaminants from the REX-EBIS ($^{12}C^{4+}$, $^{15}N^{5+}$, $^{18}O^{6+}$)
- All SRF cavities used (highest gradients so far)
- Beam energy (before foil): 8.04 MeV/u – Energy spread: 0.4%
- Slow extraction applied (1 ms RF pulse)

Main Issues:

- Lower than anticipated target yields (~10% of the proposal)
- Difficult injection into the Scattering chamber (some issues with the diagnostics and detectors inside the chamber)
- Problems with the movement of the target holder in the experimental station
- Frequent trips of several SRF cavities
- Proton stop of ~36 hours not planned in original schedule
- Problem with FC right after GPS separator

Consequences:

- A lot less data than originally planned

Experiment #	IS561
RIB (A/q)	$^{9}Li^{3\rightarrow 3+}$ (3.0)
Energy [MeV/u]	8.0
Target	GPS
Exp. Station	Scattering Chamber
Start date	Oct. 21st (00:45)
End date	Oct. 26th (9:00)
Length [hours]	80
Pilot beam (A/q)	$^{12}C^{4+}$ (3.0)
Target type	Ta Ta
Breeding time / Rep. rate	20 ms / 33 Hz

RF structure	REX		HIE				
	IH	7GP2	SRF04	SRF06	SRF09	SRF11	SRF13
# Trips	3	1	1	15	67	1	18
Downtime [mins]	45	15	5	75	335	5	90
Downtime [%]	0.9 %	0.3 %	0.1 %	1.6 %	6.9 %	0.1 %	1.8 %

Beam transmission/efficiency (approx.)

Low energy	REX-TRAP + EBIS	REX/HIE linac
97 %	3.1 %	72 %

2017 REX/HIE-ISOLDE Physics Campaign:

IS547: Coulomb excitation of the two proton-hole nucleus ^{206}Hg

Set-up:

- Both VADIS and RILIS ionization tried
- First 7 SRF cavities used
- Beam energy: 4.195 MeV/u – Energy spread: 0.35%
- Slow extraction applied (1 ms RF pulse)
- Beam intensities at XT01.0900:
  - VADIS mode: ~5E5(^{206}Hg+3x^{206}Pb) pps for 0.5 uA p current
  - RILIS mode: ~7.5E5 ^{206}Hg pps for 0.63 uA p current
- Collections in GLM in parallel (^{199}Hg)
- Target heating had to follow the proton current to keep the temperature stable

Main Issues:

- ^{206}Pb contamination when operated in VADIS mode
- Collections in GLM not compatible with RILIS ionization
- Stable contaminants from the REX-EBIS: ~ 0.9E5 ^{130}Xe^{29+} pps
- Problem with FC right after GPS separator

Consequences:

- Additional time to set-up RILIS and the injection into the REX-TRAP
- Several hours of high energy Physics traded for low-energy Physics

Experiment #	IS547
RIB (A/q)	^{206}Hg^{46+} (4.48)
Energy [MeV/u]	4.2
Target	GPS
Exp. Station	Miniball Spect.
Start date	Nov. 2nd (21:40)
End date	Nov. 6th (12:00)
Length [hours]	84 - time for GLM collections
Pilot beam (A/q)	^{40}Ar^{9+} (4.44)
Target type	Pb VD5
Breeding time	295 ms

RF structure	REX	
	7GP2	7GP3
# Trips	1	3
Downtime [mins]	15	45
Downtime [%]	0.3 %	0.9 %

Beam transmission/efficiency (approx.)

Low energy	REX-TRAP + EBIS	REX/HIE linac
n.a.	7 %	71 %

2017 REX/HIE-ISOLDE Physics Campaign:

IS607: The ^{59}Cu(p,α) cross section and its implications for nucleosynthesis in core collapse supernovae

Set-up:

- Experimental station behind Scattering chamber at XT03
- Between 4 and 12 SRF cavities used
- Five different beam energies:
  - 4.98 MeV/u – Energy spread: 0.6%
  - 4.71 MeV/u – Energy spread: 0.6%
  - 4.29 MeV/u – Energy spread: 0.5%
  - 3.99 MeV/u – Energy spread: 0.5%
  - 3.61 MeV/u – Energy spread: 0.6%
- Slow extraction applied (1 ms RF pulse)
- Started delivering beam a day ahead of time
- Beam intensity at XT03.USER2: ~6E5 pps for 1.86 uA p current

Main Issues:

- A few hours of downtime due to problems in the proton injector chain
- Direct energy scaling (probably) not working as well as expected (i.e. additional losses in the linac)

RF structure	REX
	IH
# Trips	5
Downtime [mins]	75
Downtime [%]	0.1 %

Experiment #	IS607
RIB (A/q)	$^{59}Cu^{20+}$ (2.95)
Energies [MeV/u]	3.6, 4.0, 4.3, 4.7 and 5.0
Target	GPS
Exp. Station	Edinburgh Chamber
Start date	Nov. 8th (18:45)
End date	Nov. 15th (8:30)
Length [hours]	133.5
Pilot beam (A/q)	$^{12}C^{4+}$ (3.0)
Target type	ZrO
Breeding time	140 ms

Beam transmission/efficiency (approx.)

Low energy	REX-TRAP + EBIS	REX/HIE linac
97 % ?	15 %	72 %

2017 REX/HIE-ISOLDE Physics Campaign:

IS628: Nuclear moment studies of short-lived excited states towards the Island of Inversion.
g factor of ^{28}Mg (2^+) using TDRIV on H-like ions

Experiment #	IS628
RIB (A/q)	$^{28}Mg^{9+}$ (3.11)
Energy [MeV/u]	5.5
Target	HRS
Exp. Station	Miniball Spect.
Start date	Nov. 21st (13:00)
End date	Nov. 29th (9:00)
Length [hours]	176 (+121 $^{22}Ne^{7+}$)
Pilot beam (A/q)	$^{22}Ne^{7+}$ (3.14)
Target type	SiC
Breeding time	46 ms

Set-up:

- First 12 SRF cavities used
- Beam energy: 5.505 MeV/u – Energy spread: 0.3%
- Stable beam before RIB: 121 hours of $^{22}Ne^{7+}$
- Slow extraction applied (1 ms RF pulse)
- Beam intensity at XT01.0900: ~2E6 pps for 1uA proton current
- No SRF trips (relatively low average gradient)

Main Issues:

- Activity built-up in the experimental station (high background)
- IH structure trips due to water flow interlock

Consequences:

- Proton current limited to ~ 0.5 uA

RF structure	REX				
	IH	7GP1	7GP2	7GP3	9GP
# Trips	23	1	2	4	1
Downtime [mins]	345	15	30	60	15
Downtime [%]	1.9 %	0.1 %	0.2 %	0.3 %	0.1 %

Beam transmission/efficiency (approx.)

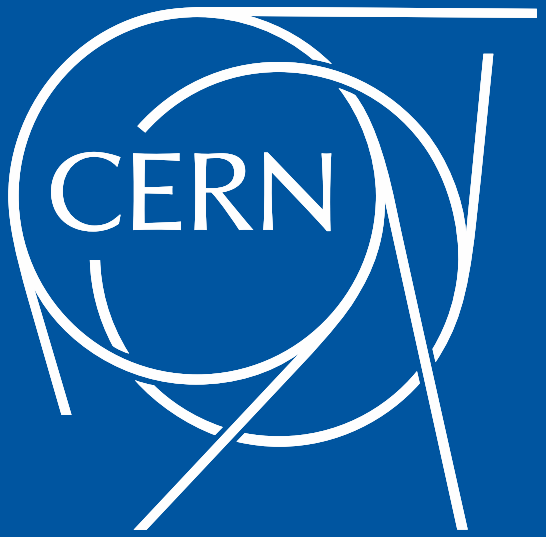
Low energy	REX-TRAP + EBIS	REX/HIE linac
83 %	13 %	70 %

Outline:

- Introduction
- Improvements introduced during the year
- Overview 2017 Operations
- High Energy Physics Campaign
- Summary

Summary:

- HIE-ISOLDE Phase 2A fully operational (3 cryomodules and 3 HEBTs lines)
- Improvements introduced over the last year:
  - Remarkable increase in the reliability of normal and superconducting RF
  - Better machine scalability and reproducibility of set-ups
  - Additional software tools, among others:
    - Energy and energy spread measurements
    - Phasing of the RF cavities
    - Monitoring of the status of the accelerator (FBI)
- Overall, quite successful Physics Campaign:
  - Number of experiments: 12
  - RIBs: 1508 hours
  - Stable beams: 492 hours
- The Operations team would like to thank:
  - Equipment owners for their support during the campaigns! (specially our colleagues in BE/BI, BE/RF, TE/VSC and BE/ABP)
  - L. Gaffney for his exceptional work throughout the whole campaign
  - The users of the facility for their patience and understanding


CERN