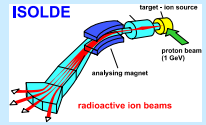
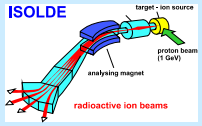


HIE-ISOLDE 2005-2011

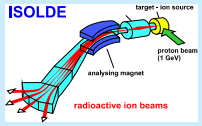
Mats Lindroos

HIE-ISOLDE: Outline



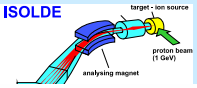
- In progress: Move into extension
  - Memo 1 March to all groups
- REX Linac energy upgrade
- REX low energy stage upgrade
- Target and target handling for 900 ms PSB cycling and linac 4
- Resonant Ionization Laser Ion Source, on-line and off-line
- Other activities
- REX staff
- Summary

Objective of HIE-ISOLDE



- Up-grade of ISOLDE facility – technical objectives
  - To benefit from injector upgrades as CERN
    - 900 ms cycling of PSB
    - Linac 4: fission fragments at 160 MeV/u?
  - To increase the energy and intensity of REX-ISOLDE
    - TRAP/EBIS upgrades and possible ECR source in parallel
    - First stage to 5.5 MeV/u
    - Second stage to 10 MeV/u
  - To improve the beam quality at ISOLDE
    - Controlled time structure, smaller transverse emittance and lower energy spread
    - High charge state beams for more Users

European Roadmap for RIB facilities



2009

SPIRAL II €100m

SPES €85m

MAFF €15m

HIE-ISOLDE €14m

EURISOL phase I

2012

€750m

Multi-MW driver

low energy intense RIB
precision measurements
Astro, "Fundamental",
Neutrino physics
Solid-State physics
Life-sciences

2015

EURISOL phase II

β-beam

national
international
EC frameworks
CERN

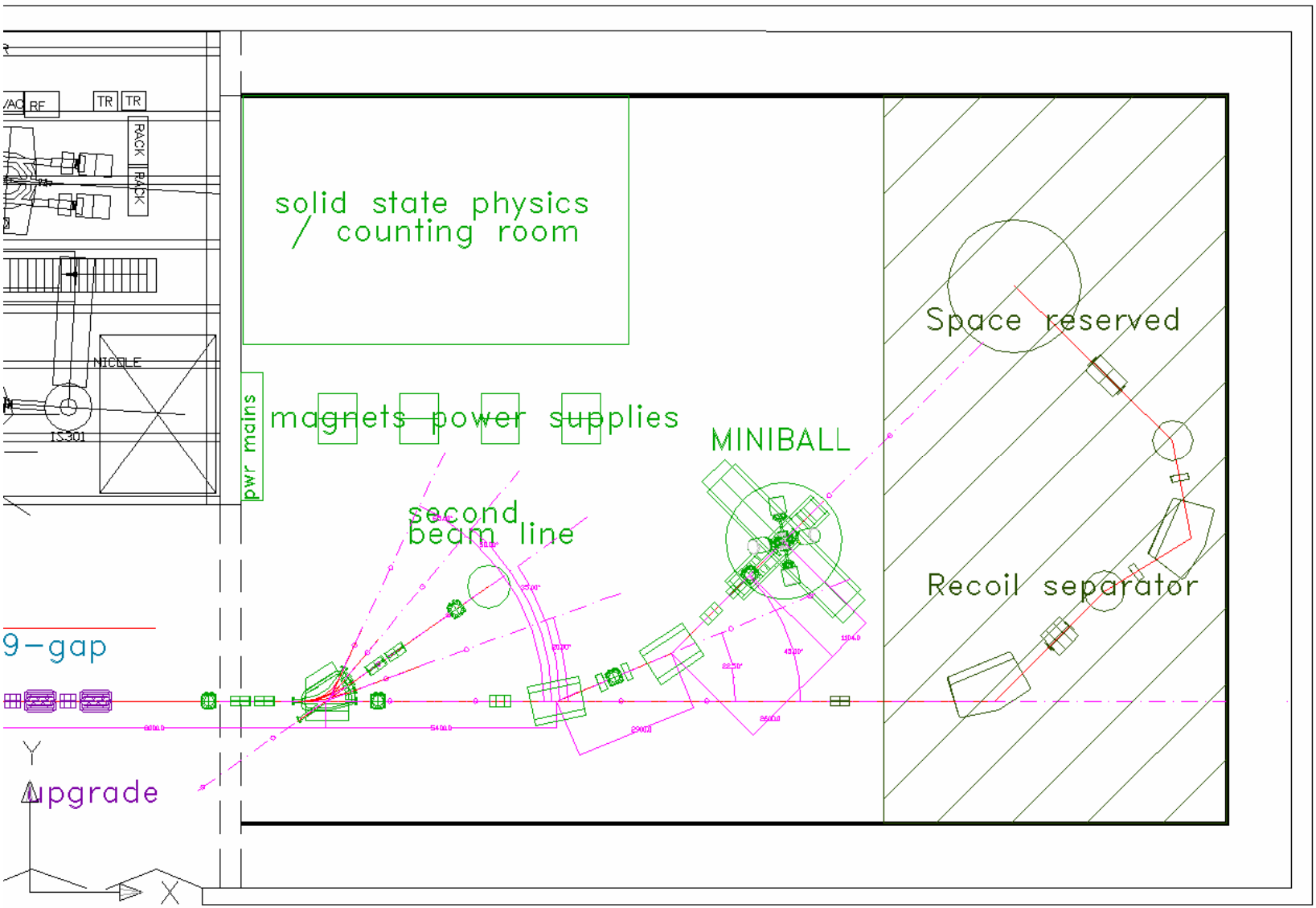
€1000m

GSI-FAIR

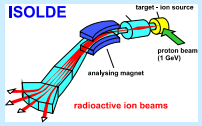
high energy RIB
v short lived nuclei
impulse reactions
Atomic, Plasma physics
Hadron, EoS physics

Peter Butler

In progress: Move into extension



In progress: Power and vacuum need

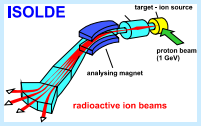


Present linac	# units	kW	total kW	l/min	total l/min
Vacuum					
turbo	13	0.500	6.5	0.0	0.0
roughing pump	2	0.950	1.9	0.0	0.0
cryo	4	1.800	7.2	5.0	20.0
			15.6		**20.0**
Electrostatic elements					
HV	32	0.007	0.2	0.0	0.0
Magnetic quads					
Danphysiks	22	6.000	132.0	5.0	110.0
MQ	26			1.6	41.6
Magnetic dipole					
MD1	1			0.9	0.9
MD3	1			13.0	13.0
Bouhnik	1	2.800	2.8	7.0	7.0
Bruker	1	28.000	28.0	15.0	15.0
			163.0		**187.5**
Ampli RF					
Bertronix 100MHz	5	35.000	175.0	0.0	0.0
Bertronix 200MHz	1	35.000	35.0	?	0.0
Buncher supply	1	5.000	5.0	0.0	0.0
			215.0		**0.0**
Cavites RF					
					l/min for dT=15K
RFQ	1				10.0
Buncher	1				0.0
IH	1				10.0
7G1	1				10.0
7G2	1				10.0
7G3	1				10.0
9G	1				10.0
			379.8		**252.5**

Mini-move	# units	kW	total kW	l/min	total l/min
Vacuum					
turbo	8	0.500	4.0	0.0	0.0
roughing pump	1	0.950	1.0	0.0	0.0
cryo	0	1.800	0.0	5.0	0.0
			5.0		**0.0**
Electrostatic elements					
HV	0	0.007	0.0	0.0	0.0
Magnetic quads					
MQ supplies	10	6.000	60.0	5.0	50.0
MQ	10			1.6	16.0
Magnetic dipole					
GSI bender	2			9.5	19.0
GSI bender supply	2	25.000	50.0	10.0	20.0
			110.0		**105.0**
			115.0		**105.0**

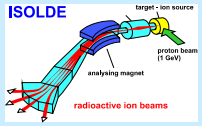
Present:	400kW	250l/min
Minimove:	+120kW	+100l/min
New hall total	+200kW	+220l/min

In progress: Power supplies



		number	aprox price CHF	aprox total price CHF		
Dipole 485A/60V GSI		2				
	Delta/Cern 30V/300A	A voir pour les performances demandés (stabilité, precision...)				
	Alimentation Delta 30/100	7	3500	24500		
	Control S7/300A C300008	1	4000	4000		
	Regul 300A C20942	2	4000	8000		
	Commande mise en // C20939	2	4000	8000		
	Distribution AC C20840A	2	3000	6000		
	rack 19"	2	1000	2000		
	cablage/installation rack	2	3000	6000		
	raccordement AC et DC	2	?	?		
	raccordement interlock	2	?	?		
					subtotal approx	**58500**
Quadruplet GSI + triplet		7				
	Danfysik 858 15V/200A	8	12400	99200		
	rack 19" equipé	3	5800	17400		
	cablage/installation alim	2	3000	6000		
	raccordement sur circuit eau demi	7	?	?		
	raccordement AC et DC	7	?	?		
	raccordement interlock	7	?	?		
					subtotal approx	**122600**
Singlet		2				
	Delta/Cern xxV/xxA					
	Alimentation Delta 30/100	2	?	?		
	Control S7/300A C300008	1	4000	4000		
	cablage/installation rack	1	1500	1500		
	raccordement AC et DC	2	?	?		
	raccordement interlock	2	?	?		
					subtotal approx	**5500**
					TOTAL	**186600**

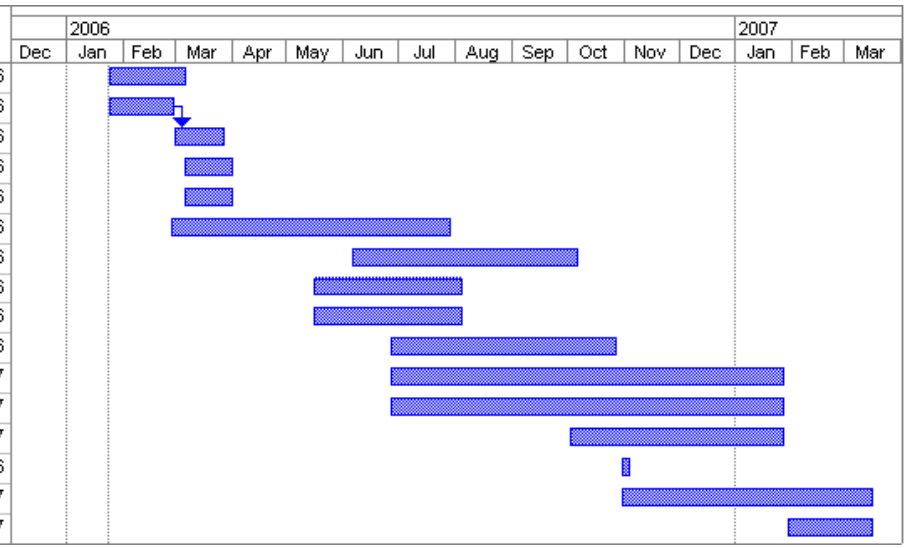
In progress: Estimated cost for move



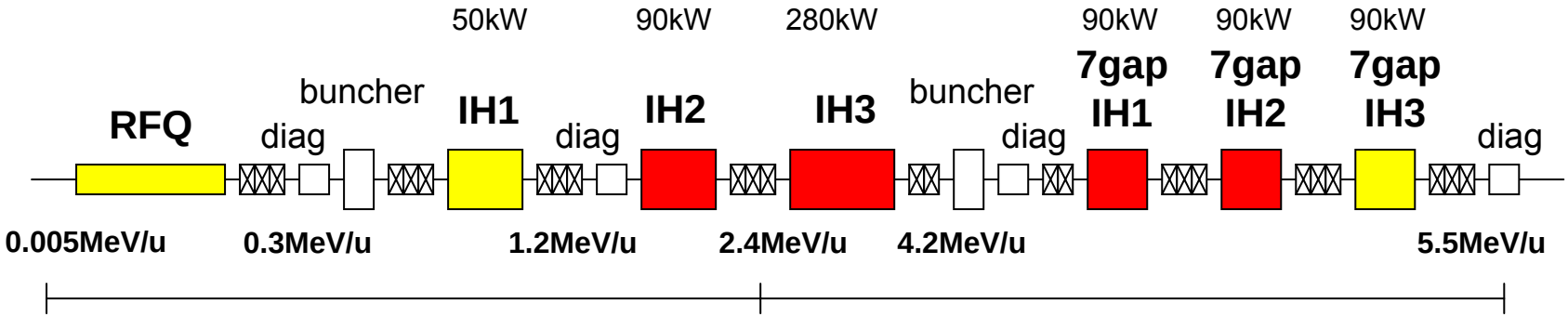
Item	Cost (kchf)	Comments
Cooling	10	Guess
Electricity	240	120 distribution rack, 120 cables
Vacuum	175	8 turbos in two sections with valves and control
Power supplies	186	
Alignment		
Beam observation	20	
Drawings+fabricatic	100	35 tubes, 30 supports, 10 follow-up, 25 drawings
Installation (MP)	75	2 FSU for six months (**all** installation)
Quads	25	3 missing quads
Total	831	

In progress: Planning

ID	Task Name	Duration	Start	Finish
1	Memo for MINI-MOVE	30 days	Tue 1/24/06	Mon 3/6/06
2	Alignment existing REX	25 days	Tue 1/24/06	Mon 2/27/06
3	Alignment new hall	20 days	Tue 2/28/06	Mon 3/27/06
4	Order power supplies	20 days	Mon 3/6/06	Fri 3/31/06
5	Order vacuum equipment	20 days	Mon 3/6/06	Fri 3/31/06
6	Design, drawings and follow-up	110 days	Mon 2/27/06	Fri 7/28/06
7	Manufacturing starts	90 days	Mon 6/5/06	Fri 10/6/06
8	Electrical services	60 days	Mon 5/15/06	Fri 8/4/06
9	Cooling water services	60 days	Mon 5/15/06	Fri 8/4/06
10	Installation new linac elements	90 days	Mon 6/26/06	Fri 10/27/06
11	Installation power supplies	155 days	Mon 6/26/06	Fri 1/26/07
12	Vacuum controls	155 days	Mon 6/26/06	Fri 1/26/07
13	Installation vacuum	85 days	Mon 10/2/06	Fri 1/26/07
14	Move existing bending magnet	5 days	Mon 10/30/06	Fri 11/3/06
15	Move miniball	100 days	Mon 10/30/06	Fri 3/16/07
16	Finalize installation	35 days	Mon 1/29/07	Fri 3/16/07

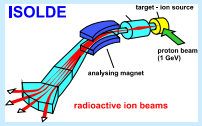


Linac: 5.5 MeV/u - IH option



	IH2	IH3	IH 7gap 1	IH-7gap2	IH-7gap3	price of components
rf-Amplifier	0	230	200	200	0	**630**
Low level rf-modules + SIMATIC, crates	0	20	20	20	0	**60**
electronics (vacuum, control, SIMATIC, PCs, ADCs, DACs, Profibus)	0	20	20	20	0	**60**
vacuumsystem (valves, gauges, pumps	40	40	20	20	10	**120**
tuning plungers, structure	10	15	10	10	5	**45**
resonator tank (material and production)	150	150	90	90	0	**480**
cooper plating (tank, structure)	15	20	15	15	0	**65**
support stands	5	5	5	5	5	**20**
magnetic lenses+power supply	50	50	50	50	0	**200**
price of the structures	**270**	**550**	**430**	**430**	**20**	**1680**

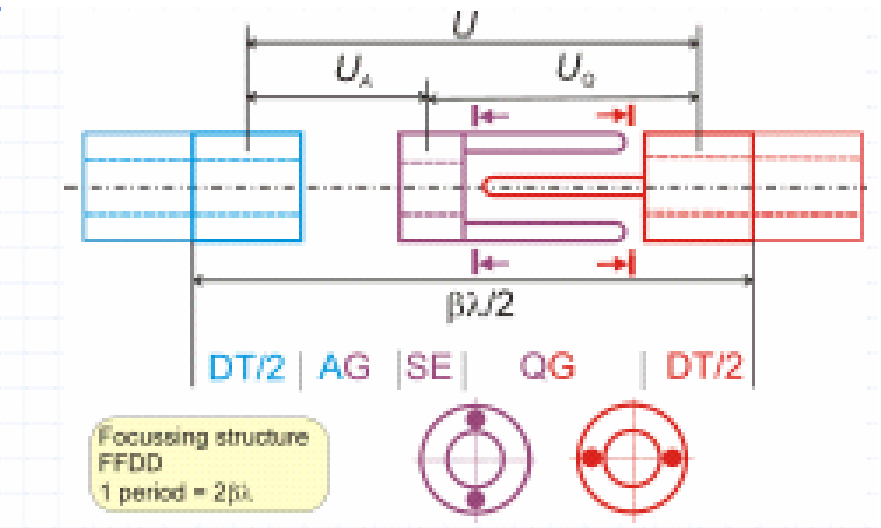
Linac: 10 MeV/u - ISTC option

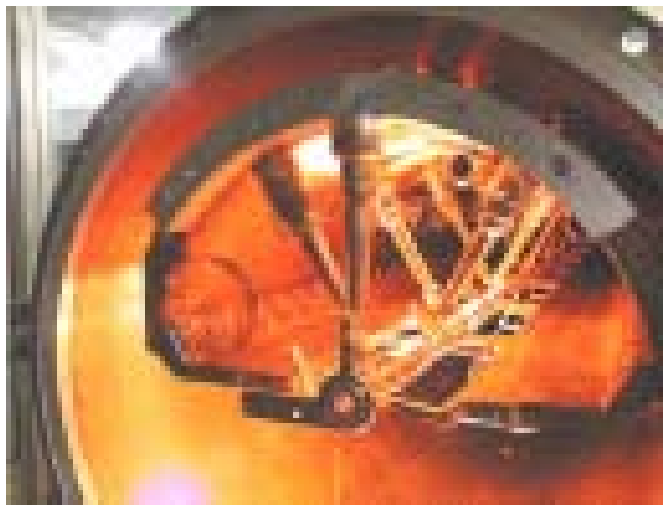


Proposed by IHEP:

„An RFQ DTL Section driven at H-mode of RF Oscillations. Transverse Focusing period 2βλ, Pattern FFDD. Effective acc. Voltage around 4 MV/m. Aperture Hole Diameter 10 mm. Normalized transverse Acceptance 3-4π mm mrad".

⇒ 5.5 – 10 MeV/u: Two 3.5 m Tanks, rf-Power: 500 kW/Tank



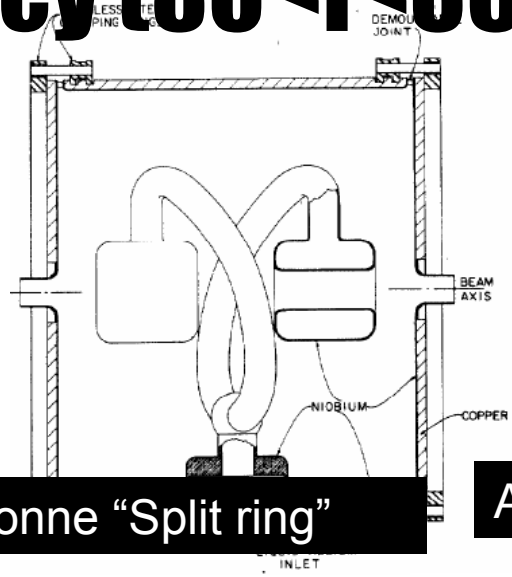


What is a superconducting linac?

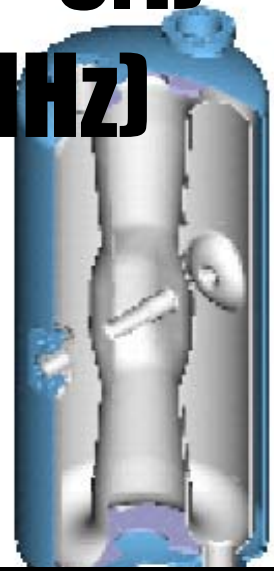
- Basically it's an array of small independent resonating cavities, equipped with their own small power amplifier.
- Since these small cavities have a wide velocity acceptance they can accelerate very efficiently a large variety of ions with different A/q ratio
- They provide very high field at c.w. operation with little power consumption.

Low energy SC cavities (0.01<β<0.1) at low frequency (80<f<350 MHz)

Legnaro "Reentrant"

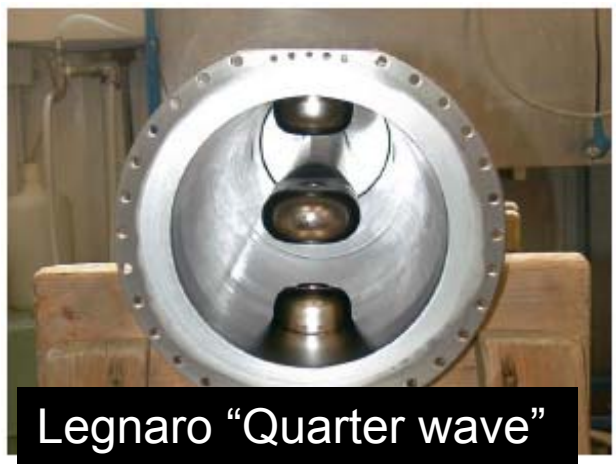


Argonne "Split ring"

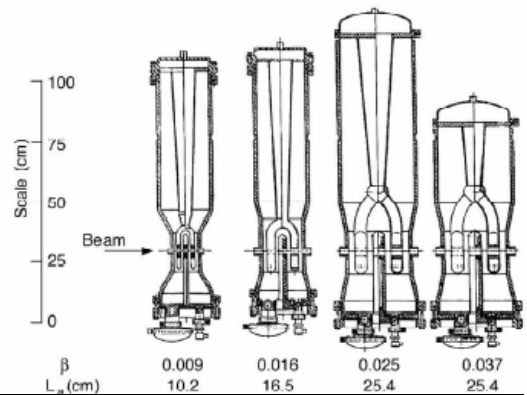


Argonne "Half wave"

Legnaro "SC RFQ"

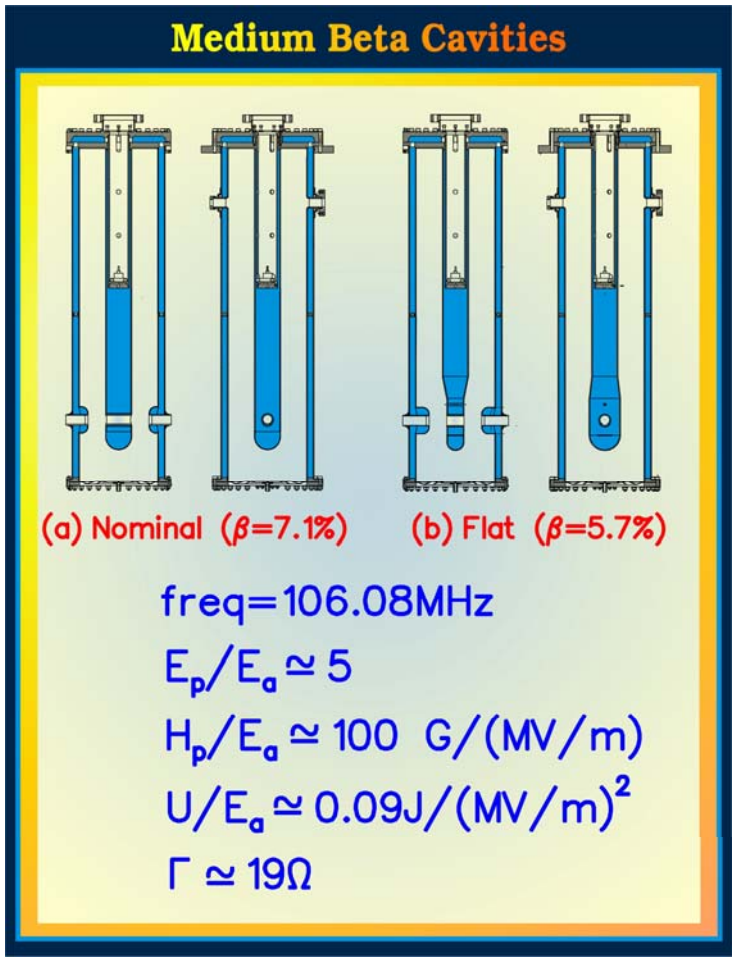


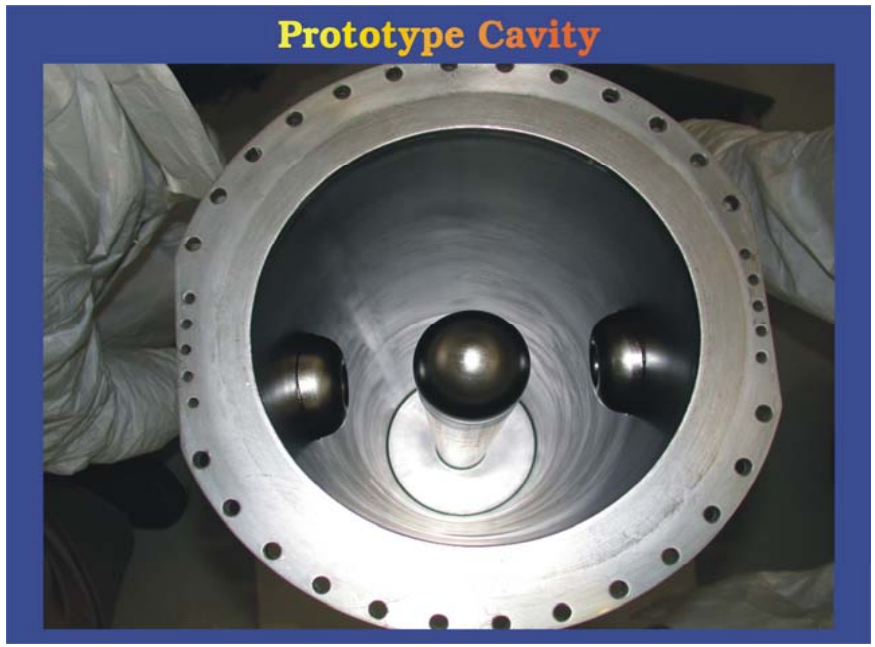
Legnaro "Quarter wave"



Argonne -Jaeri "Quarter wave"

State-of-the-art SC cavities used for radioactive heavy ions accelerators





$E_{acc}T$= 6MV/m over a length of 24 cm

= 1.44 MV @ 7W power dissipation on LHe.

Courtesy of B. Laxdal,
TRIUMF

Some reason to go SC… 1/2

- Higher flexibility and higher beam quality achievable with respect to NC.
- Conventional beam dynamics (assures constant longitudinal emittance).
- Possibility of having large aperture → very high transmission.
- Effective voltage always available, so lighter ions can be accelerated to higher energy.

Some reason to go SC... 2/2

- The CW operation open the door to future upgrade of the charge breeder to high duty cycle → more beam for the experiments.
- Really modular scheme and adapted for series production → hence cheaper in view of the big up-grade.
- Possibility of several integration with CERN infrastructure such as chemical polishing, clean room, cryogenic plant.
- In the last years, SC linac demonstrated a reliability higher then 90% and all the new planned facilities foresee SC post-accelerator (EURISOL).

Back of the envelopes calculation

- Energy upgrade from 1.2 to 5.5 MeV/u for a A/q=4.5 means an effective voltage of 19.4 MV
- Assuming 1 MV per cavity (conservative value) 20 cavities are needed.
- Cryostats 2 meters long can contain 4-5 cavities, (it depends from the focusing scheme) so the 5.5 MeV/u can be reached in 10m.

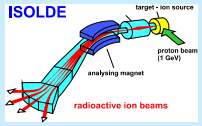
An attempt of cost estimate - to be verified

SC LINAC MEDIUM β	*CAVITIES*	1160000
	CRYOSTATS	1025000
	PROTOTYPE	100000
	QUADRUPOLES	340000
	VACUUM	200000
	AMPLIFIERS	200000
	CONTROLS	150000
	RF CONTROLS	100000
	DIAGNOSTICS	100000
	SERVICES	125000
	SAFETY	100000
		3600000 CDN

This was a cost estimation for 20 cavities, 5 cryostat and a prototype for the ISAC-II linac. Recent result show that the cost of the cavity can be reduced by using sputtered Nb on copper cavity.

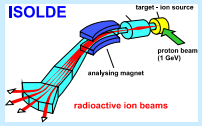
M. Pasini

Linac technology review

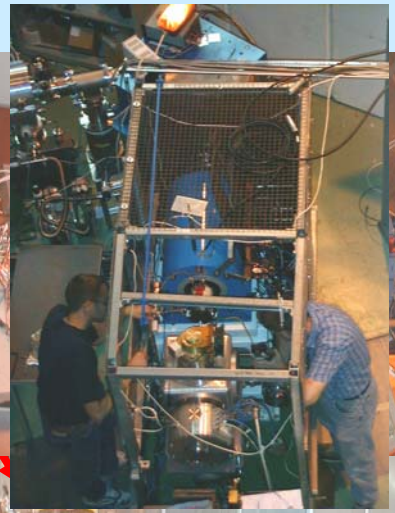


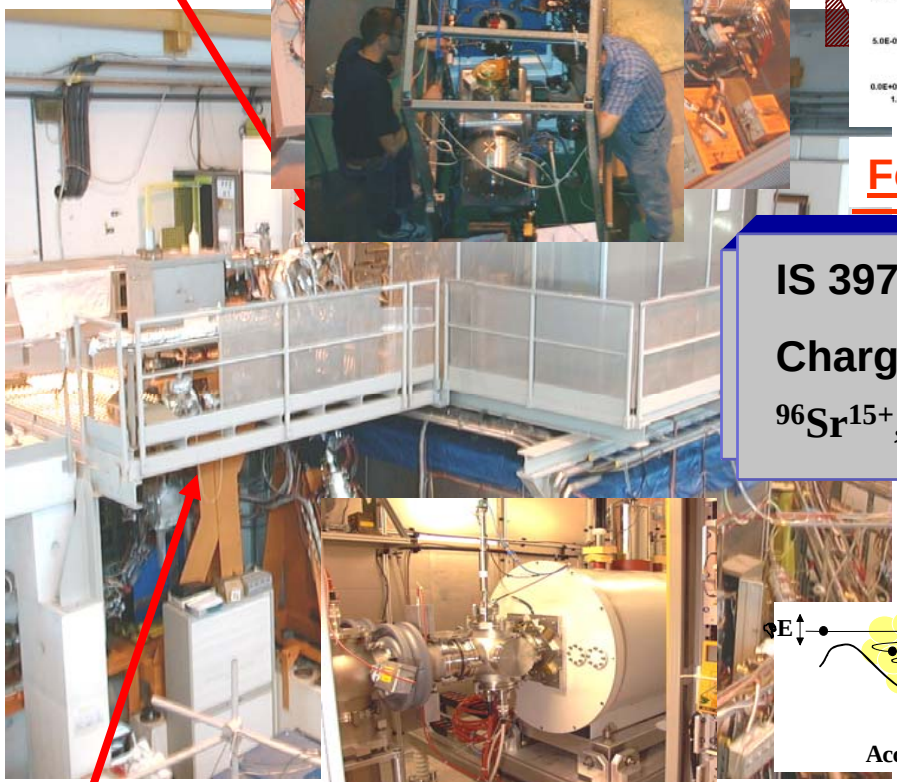
- Internal review of beam-line layout for the move of mini-ball into the extension in March 2006
- Proposal to be prepared for IH and superconducting technology for 15 April
  - Budget for staff that will work on this?
  - Time limit?
- External review of linac technology proposals in last week of May
  - TRIUMF, GSI, Orsay specialists

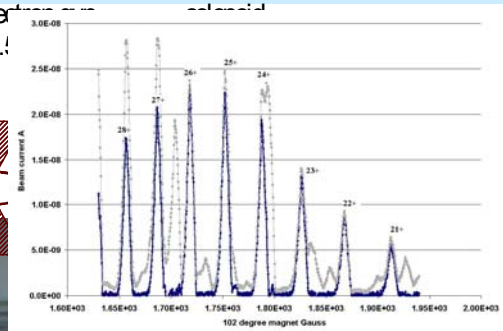
REX Trap – EBIS - ECR

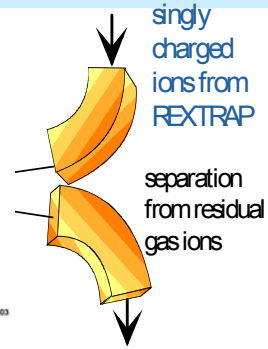


REX EBIS







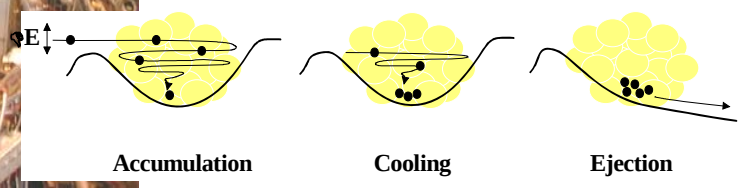


For A > ?:

IS 397 team

Charge breeding of Uranium and

$^{96}Sr^{15+}$, $^{94}Rb^{15+}$

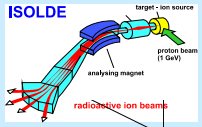


q/A-selector

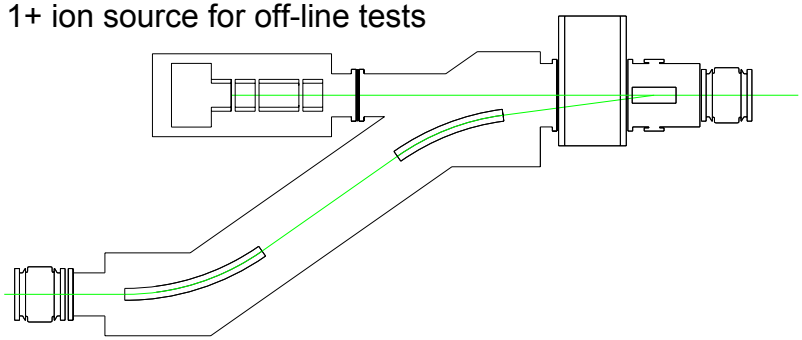
REXTRAP

Mats Lindroos

Charge breeding



1+ ion source for off-line tests



Electrostatic benders to elevate the beam from 125 cm level to 175 cm level (50cm elevation)

Double einzel lens

PHOENIX-ECRIS 14 GHz charge breeder

102° bending magnet

Existing QP triplet

Beam scanner + Faraday cup

Emittance scanner

QP triplet

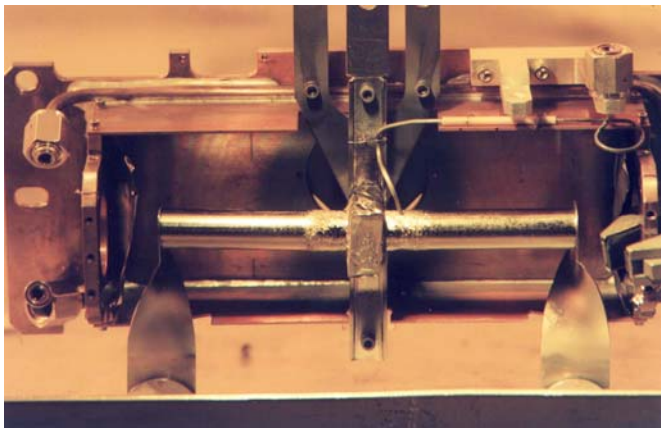
(optional) HV platform for implantation

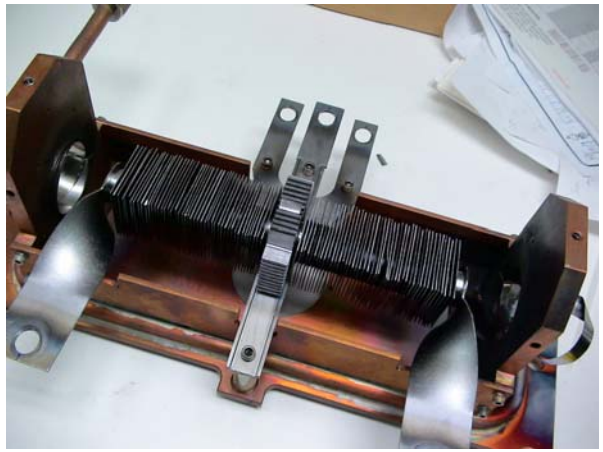
Electrostatic bender

QP doublet

RFQ + LINAC

Targets: Higher power and fission fragments





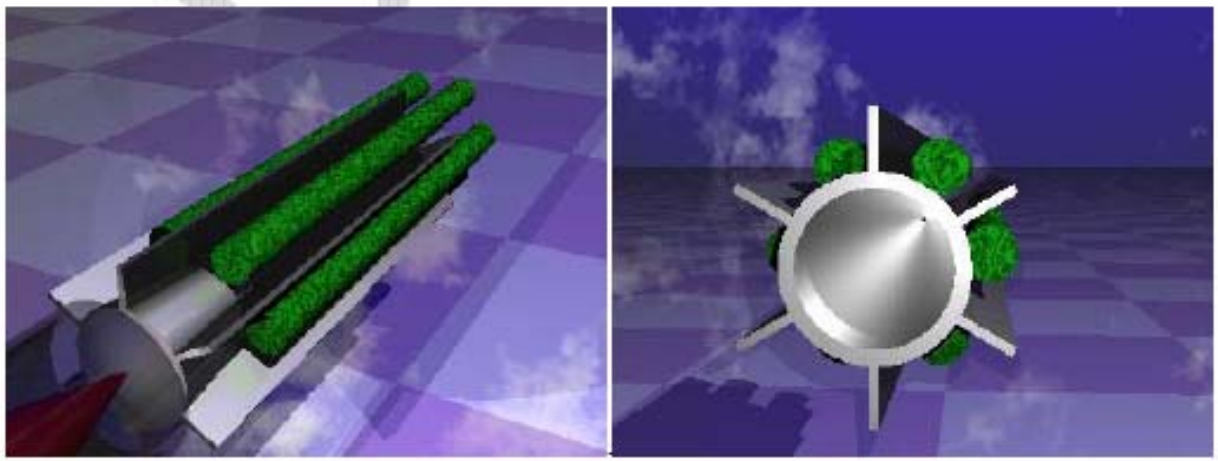
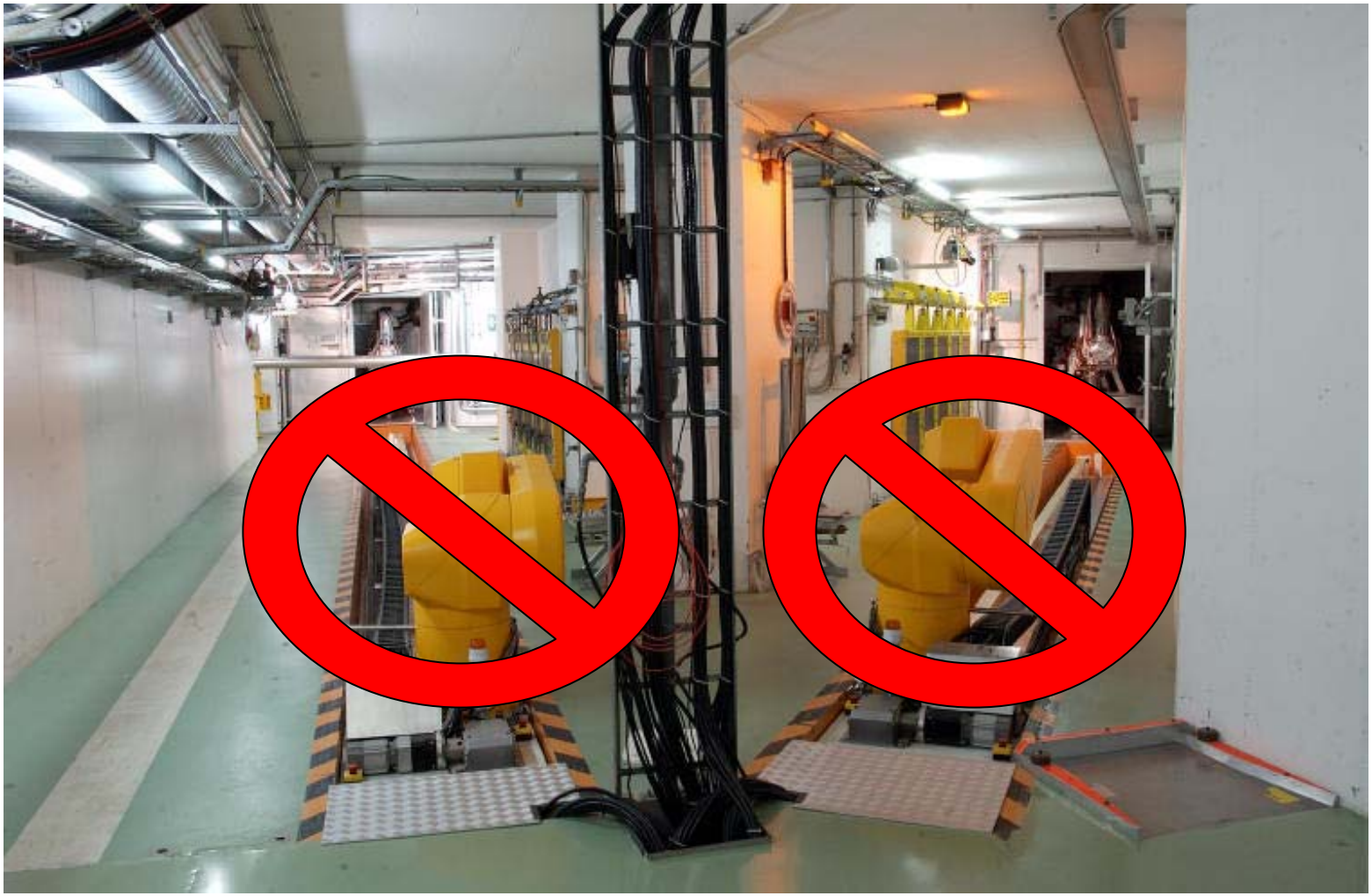


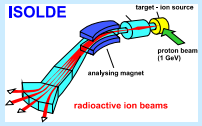
Fig.1 Schematic layout of the n-converter/target configuration

Mats Lindroos

Target handling and safety (10 microAmps)

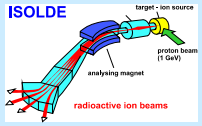


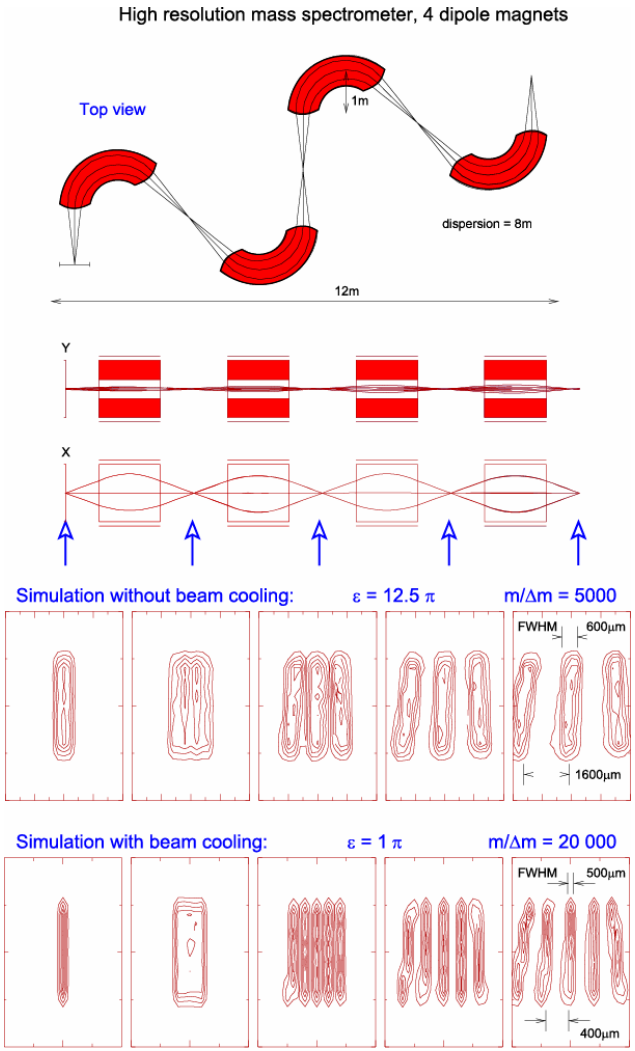
RILIS improvements



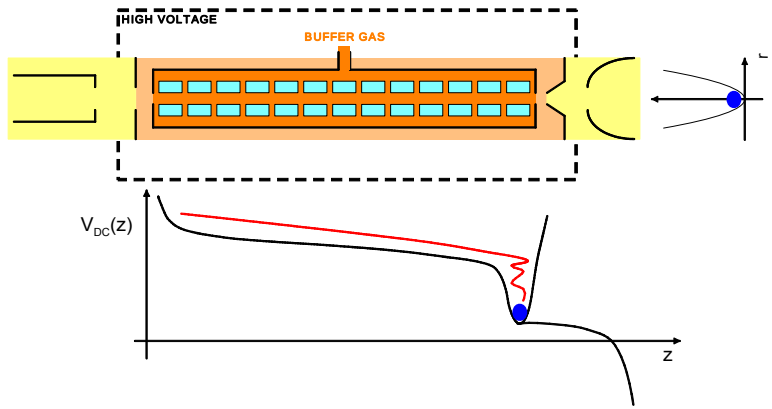
- New RILIS pump lasers
  - Solid state laser to replace CV lasers without degrading performance
  - Installation in shutdown 2006-2008
  - Replacing dye lasers with Ti:saphire lasers or other solid-state lasers
  - LIST for ISOLDE
- Off-line lab for new developments and atomic spectroscopy research
  - Under installation
- External grants
  - 2.4 MCHF from Wallenberg in Sweden
  - BMBF application submitted for LIST

Beam quality: New HRS and RFQ cooler

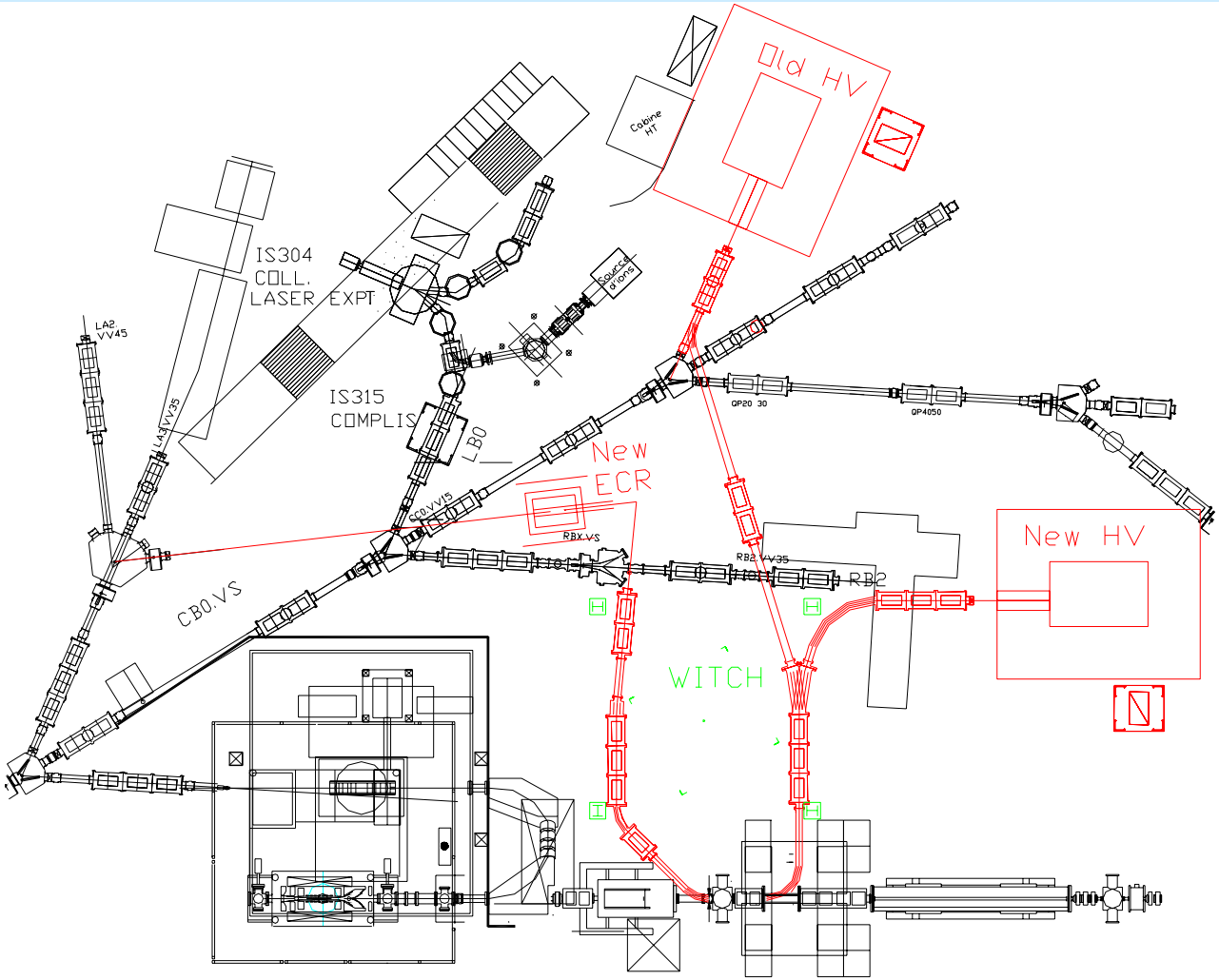




- "Isobaric" separation
- Separation limited by the beams transverse size
- Cooling at low energy with RFQ cooler

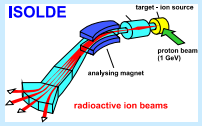


High charge state beam-line



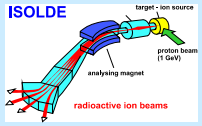
Mats Lindroos

Infrastructure



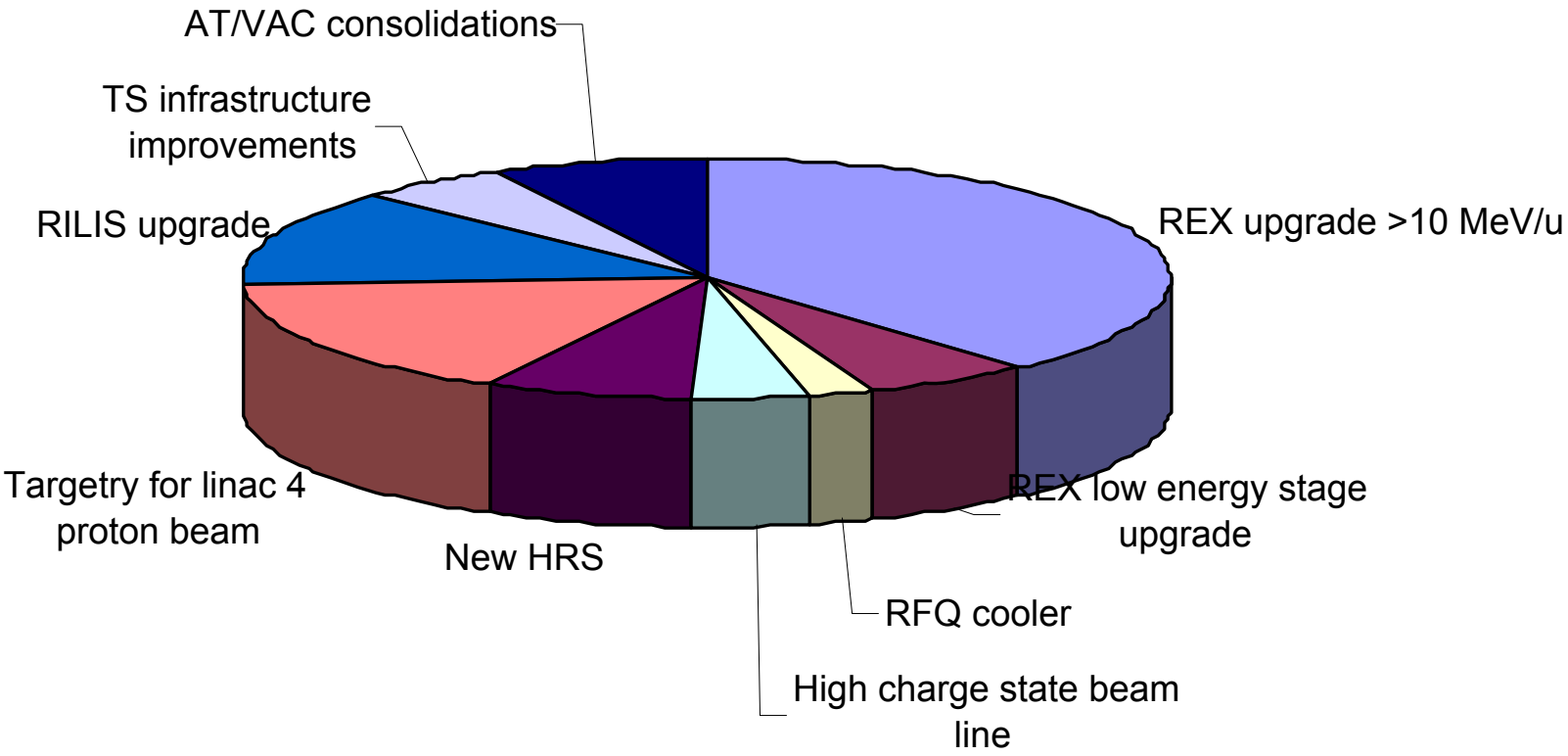
- Technical Services
  - Second transformer for ISOLDE to assure non-interrupted operation during maintenance of transformers
  - Ventilation for extension
  - Cooling for REX upgrades and new experiments
- Vacuum group
  - Replacement of vacuum controls with new standard control units
  - Increase recovery tank capacity and connect RFQ cooler, REX trap and EBIS (ECR?)

Budget: overview

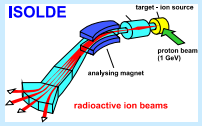


WP No	Task name	*Cost*	
		Material (kCHF)	*Staff (FTE)*
1	REX upgrade >10 MeV/u	7750	17.1
2	REX low energy stage upgrade	1175	2.4
3	RFQ cooler	495	1.8
4	High charge state beam line	800	1.2
5	New HRS	1500	1.9
6	Targetry for linac 4 proton beam	3300	10.5
7	RILIS upgrade	2630	2.6
8	TS infrastructure improvements	1100	1.8
9	AT/VAC consolidations	1500	1.8
10	ISOLDE physics group	1000	6
	Total:	21250	47.1

Budget: overview



HIE-ISOLDE budget



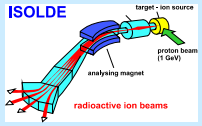
Total material cost (kCHF):	**21250**								
Total external (kCHF):	7055								
Total CERN (kCHF):	14195								
Year:		2004	2005	2006	2007	2008	2009	2010	2011
Annual external:		255	580	2000	1200	1600	820	300	300
Annual CERN:		0	20	525	2300	3100	3350	2750	2150
Annual totals:		255	600	2525	3500	4700	4170	3050	2450

Total personyear:	**47.1**								
Year:		2004	2005	2006	2007	2008	2009	2010	2011
Annual staff in personyear:		0.9	2.1	3.8	8	9.3	8.8	7.1	7.1

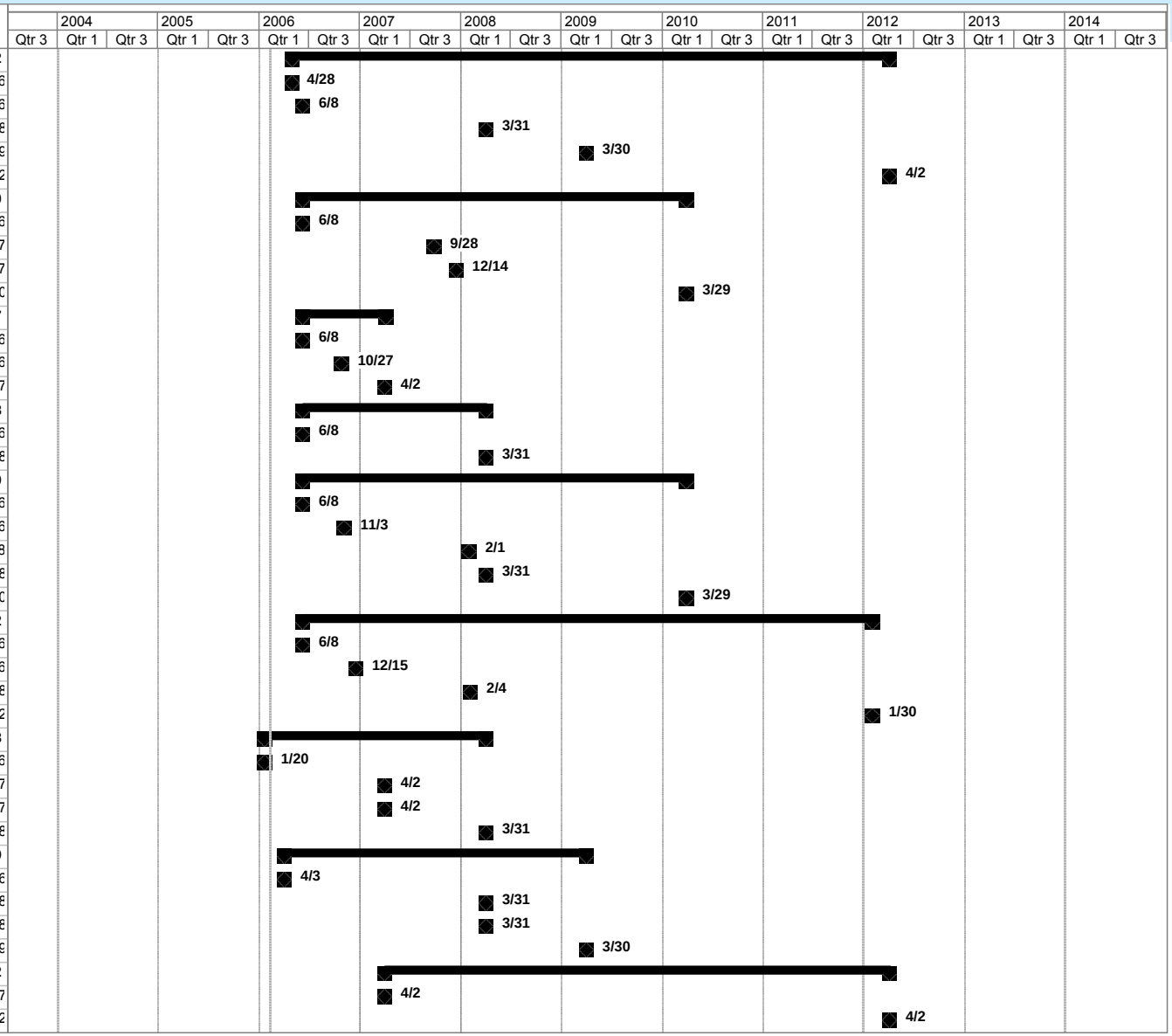
External contributors	***Material (kCHF)***	***Comment***
ISOLDE collaboration	2000	
IKS Leuven, BE	850	Approved
IKS Leuven, BE	1000	Application being prepared
EPSCR, UK	255	Approved
VR, SE	2400	Approved
BMBF, D	350	Design study already approved
Total	6855	

Associated approved pro	***Material (kCHF)***	***Staff (FTE)***
EURISOL DS Targets	100	7
EURISOL DS Safety		2
EURISOL DS Beampreparation		3
EURONS chargebreeding		1
EURONS mass separators		1
Total	**100**	14

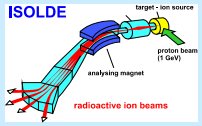
Time plan



ID	Task Name	Finish
1	**LINAC upgrade**	**Mon 4/2/12**
2	Review of linac technology	Fri 4/28/06
3	Decision RB	Thu 6/8/06
4	REX-linac 4.2 MeV/u	Mon 3/31/08
5	REX-linac 5.5 MeV/u	Mon 3/30/09
6	REX-linac 10 MeV/u	Mon 4/2/12
7	**REX low energy stage upgrade**	**Mon 3/29/10**
8	Decision RB	Thu 6/8/06
9	Tests of Phoenix set-up completed	Fri 9/28/07
10	Review of chargebreeding technology	Fri 12/14/07
11	REX low energy stage upgraded	Mon 3/29/10
12	**RFQ cooler**	**Mon 4/2/07**
13	Decision by RB	Thu 6/8/06
14	Commisioning completed	Fri 10/27/06
15	First beam into central beam-line	Mon 4/2/07
16	**High charge beamline**	**Mon 3/31/08**
17	Decision by RB	Thu 6/8/06
18	First beam to central beam-line	Mon 3/31/08
19	**New HRS**	**Mon 3/29/10**
20	Decision by RB	Thu 6/8/06
21	Prototype magnet delivered	Fri 11/3/06
22	Prototype verified	Fri 2/1/08
23	Decision by ABM on final design	Mon 3/31/08
24	New HRS operational	Mon 3/29/10
25	**Targetry for linac 4**	**Mon 1/30/12**
26	Decision by RB	Thu 6/8/06
27	FLUKA simulations completed	Fri 12/15/06
28	Decision by ABMB on lay-out	Mon 2/4/08
29	New target area operational	Mon 1/30/12
30	**RILIS upgrade**	**Mon 3/31/08**
31	Grant received from KWF	Fri 1/20/06
32	Replacement for CV lasers operational	Mon 4/2/07
33	LARIS operational	Mon 4/2/07
34	Replacement of Dye-lasers operational	Mon 3/31/08
35	**TS infrastructure**	**Mon 3/30/09**
36	New eletricity distribution system operati	Mon 4/3/06
37	New transformer operational	Mon 3/31/08
38	New cooling water stage operational	Mon 3/31/08
39	New ventilation system operational	Mon 3/30/09
40	**AT/VAC consolidation**	**Mon 4/2/12**
41	All roughing pumps moved from hall	Mon 4/2/07
42	Vaccum consolidation	Mon 4/2/12

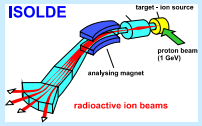


Work plan

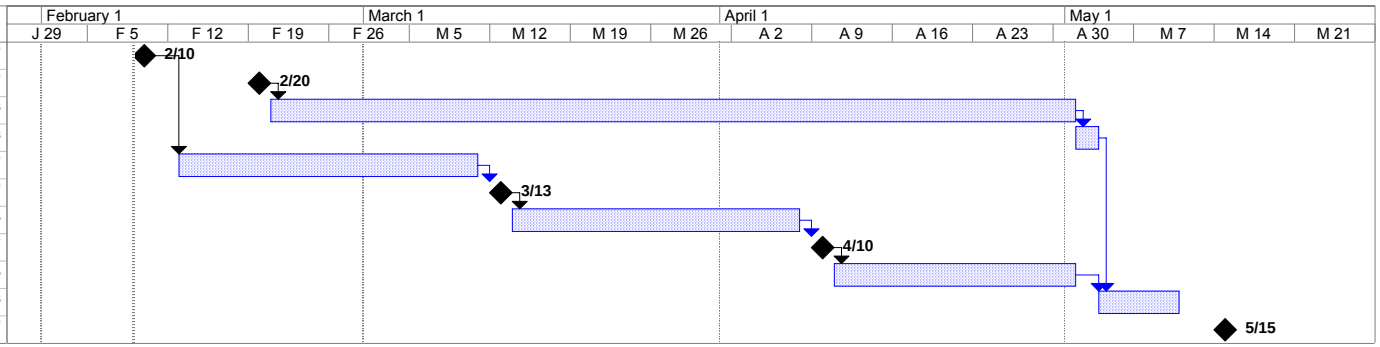


- Presentation for group leaders of HIE-ISOLDE project, 10/2
- Individual discussions with group representatives, >28/2
- Approval by ABMB of staff allocation for REX upgrade technology study, 20/2
- REX upgrade technology study (2 months)
- 1st General Project preparation meeting in March, 13/3
- Consultation with groups
- 2nd General project preparation meeting in April, 10/4
- Consultation with groups
- REX external review panel meeting, 1st week of May
- Finalize proposal
- Presentation of project proposal to ABMB

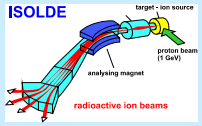
Proposal preparation



ID	Task Name	Duration
1	Presentation of HIE-ISOLDe for	1 day?
2	Decision on staff allocation REX	1 day?
3	Study of REX upgrade technolo	50 days
4	REX external review panel mee	2 days
5	Consultation with group	20 days?
6	1st general HIE-ISOLDE projec	1 day?
7	Consultation with groups	19 days
8	2nd general HIE-ISOLDE projec	1 day?
9	Consultation with groups	15 days
10	Draft proposal	5 days
11	Presentation of project proposa	1 day?



REX staff



1) Fredrik Wenander - 01.12.2003-30.11.2006, E
2) Lee Neville - 01.02.2004-31.01.2007, C
3) Nicolas David - 01.03.2004-28.02.2007, C
4) Nikolai Trofimov - 01.10.2004-30.09.2006, E
5) Didier Voulot - 01.08.2005-31.08.2006, Fellow

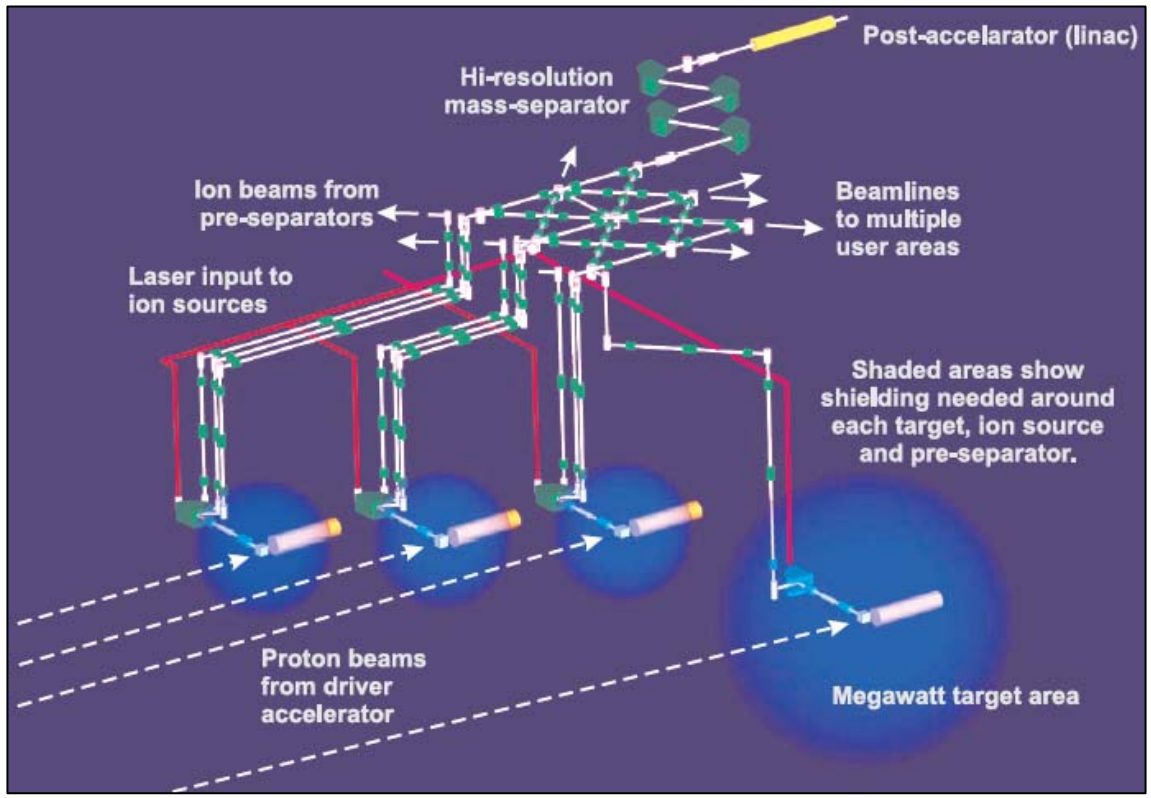
#) Thomas Sieber - 16.11.2003- 31.08.2005, E

Is it early enough to know about these posts in June?

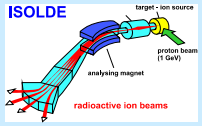
100kW direct production

5 MW spallation n target

→ 100 MeV/u RIB



Summary



- The HIE-ISOLDE project proposal will be presented for Research Board 8 June 2005
  - External review of linac technology in first week of May 2006
  - Presentation for ABMB 15 May
  - Need of staff to work on the two proposals for the external review
- Questions for you:
  - Who is my partner in each group to check and refine the figures for each WP?
  - When do we need a decision on the REX staff?