THE LINAC RESEARCH FACILITY (LRF) AT THE UNIVERSITY OF HUELVA

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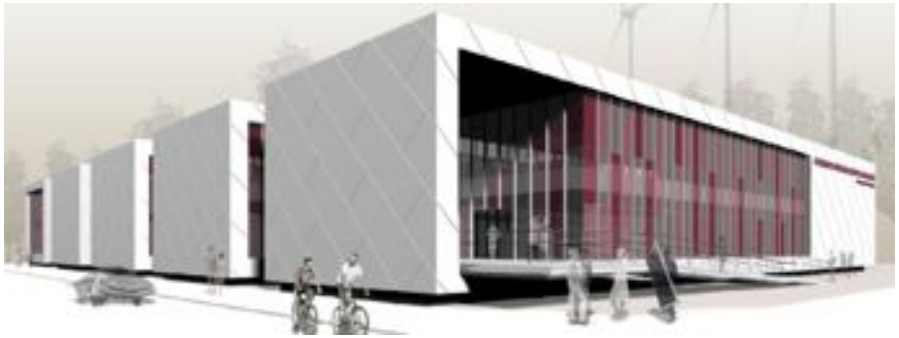
LINAC RESEARCH FACILITY (LRF-Huelva)

– New University Campus at the Science & Technology Park (PCTH, Huelva -Spain)



The **Linac Research Facility** is foreseen to be a leading facility for producing intense HEAVY ION BEAMS for basic research on nuclear physics and applications.

Basic nuclear physics research with heavy ions

- Nuclear reactions and spectroscopy with stable heavy ions using high intensity beams: coulomb barrier, astrophysics, super-heavies, clustering,…
- European ECOS initiative: run experiments where high intensity beams/long run periods are needed
- Wide range of ions and energies, from keV/u ~15 MeV/u
- Possibility to install IGISOL type ion source for stopped beams.

Applications

-Possibility to accelerate protons & deuterons at moderate intensities
-Modern radio-isotope production
-Material research for energy and aerospace
-Medicine (branchiotherapy; proton therapy; dosimetry, etc)

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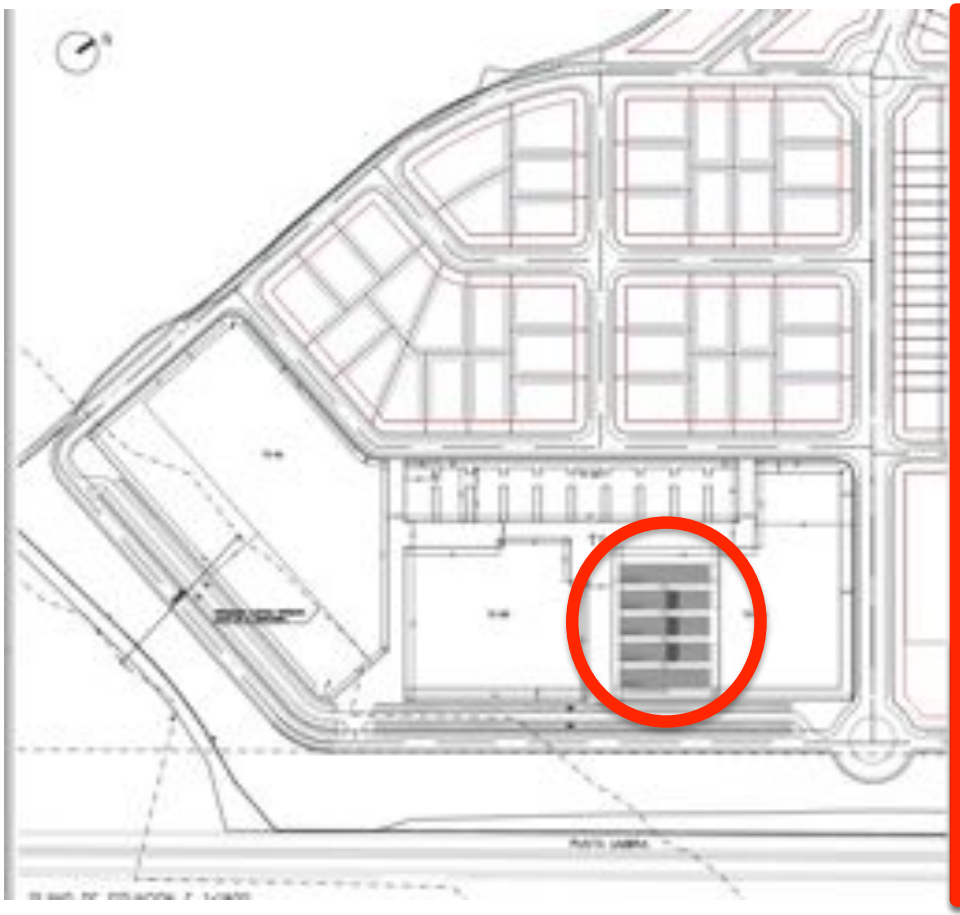
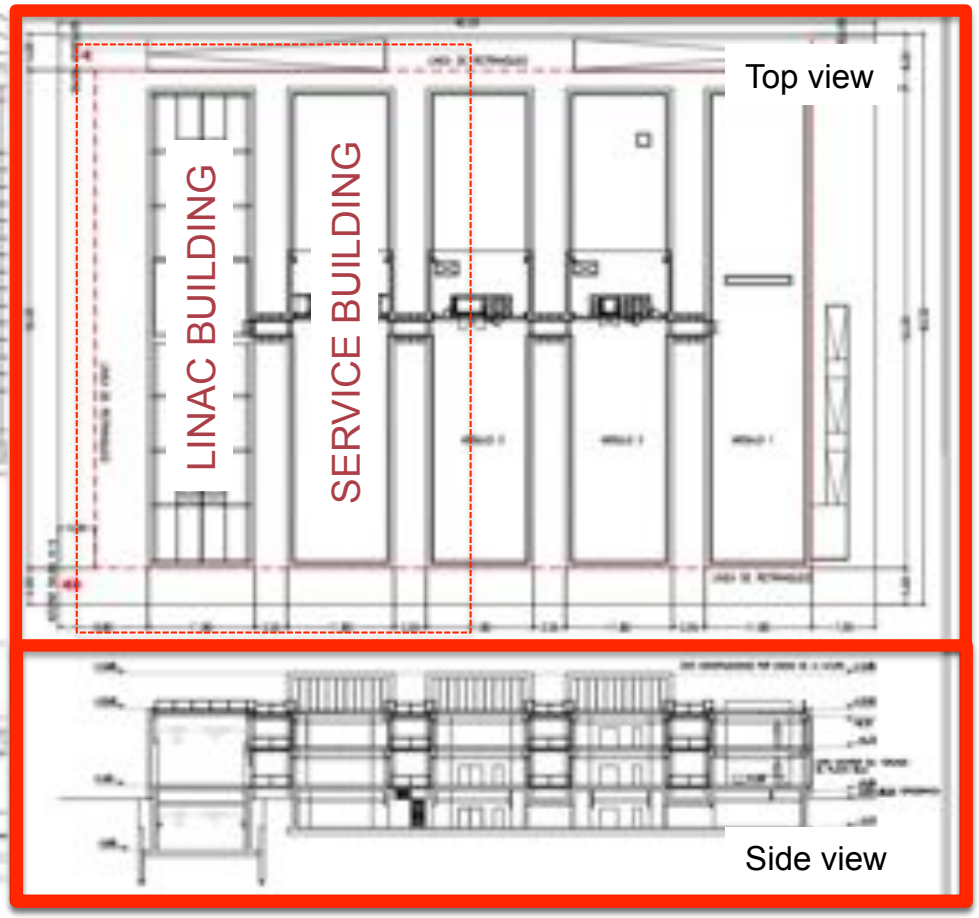
Science & Technology Park (PCTH, Huelva)



Science & Technology Campus



LINAC building: Machine at basement (-6m level)
Auxiliary equipment at surface (0m level)
Experiment control room

SERVICE building: Workshops, cryogenic lab, clean room, etc…

LINAC RESEARCH FACILITY (LRF-Huelva)

LINAC building follows SARAF (Israel) design concept

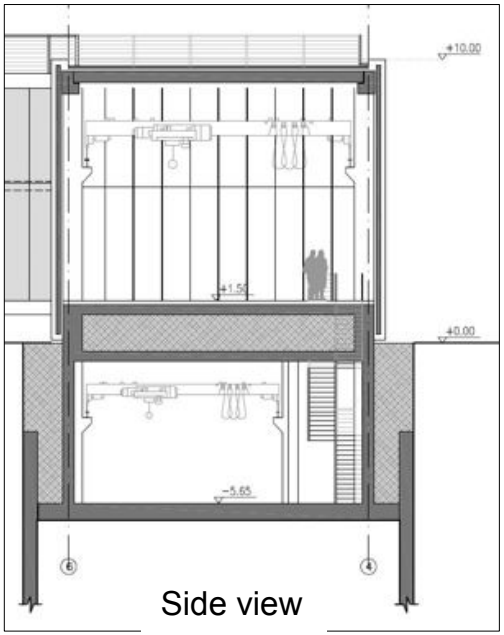
PHASE -1

PLANT
Lenght: 60 m
Width: 12 m

Level: 0 m
Height: 10 m

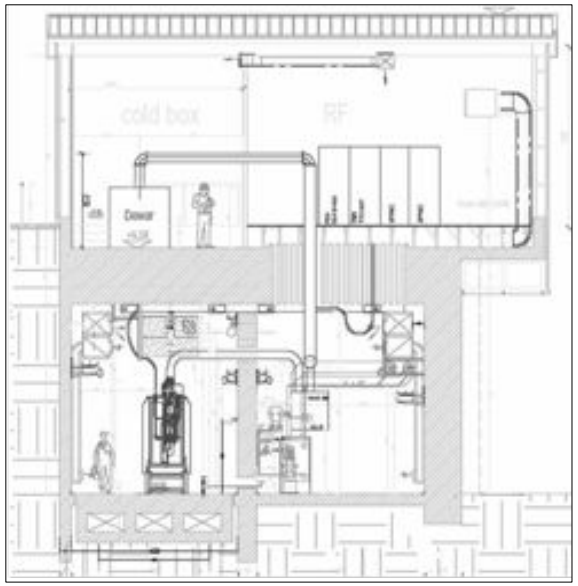
Level: -5.6 m
Height: 6 m

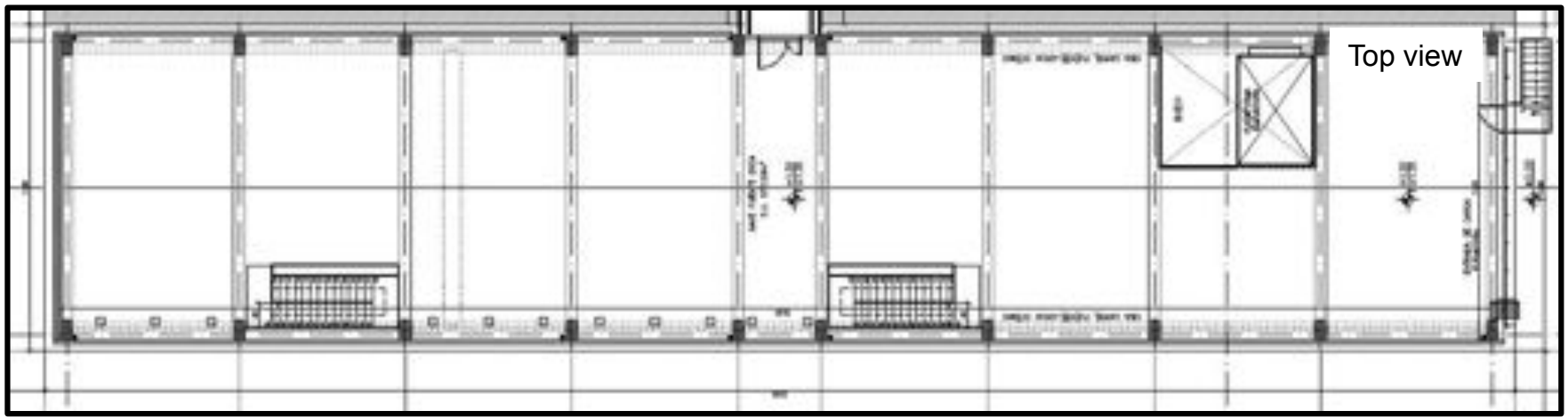
LRF-Huelva



Side view

SARAF-Israel




Top view

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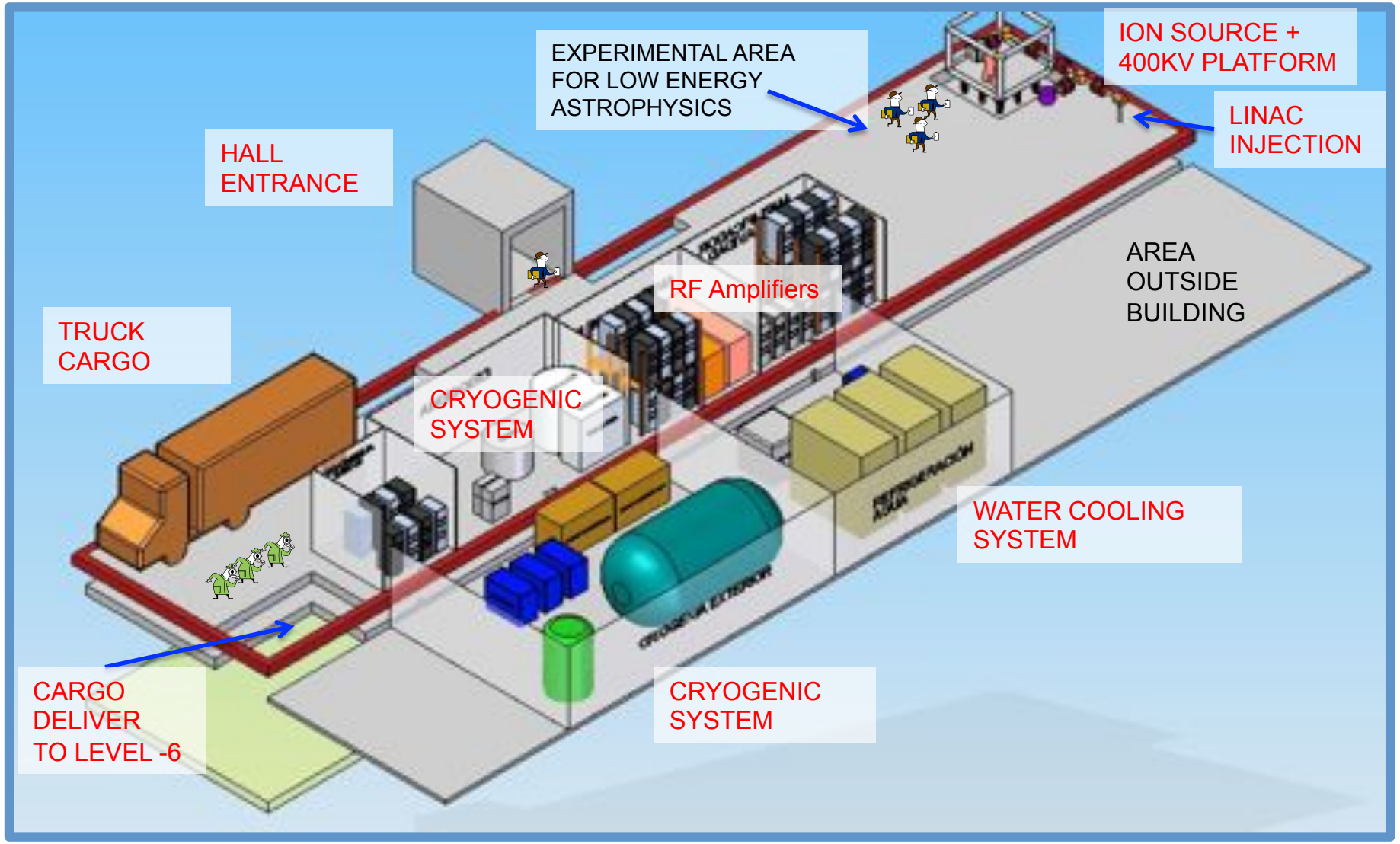
LEVEL 0m



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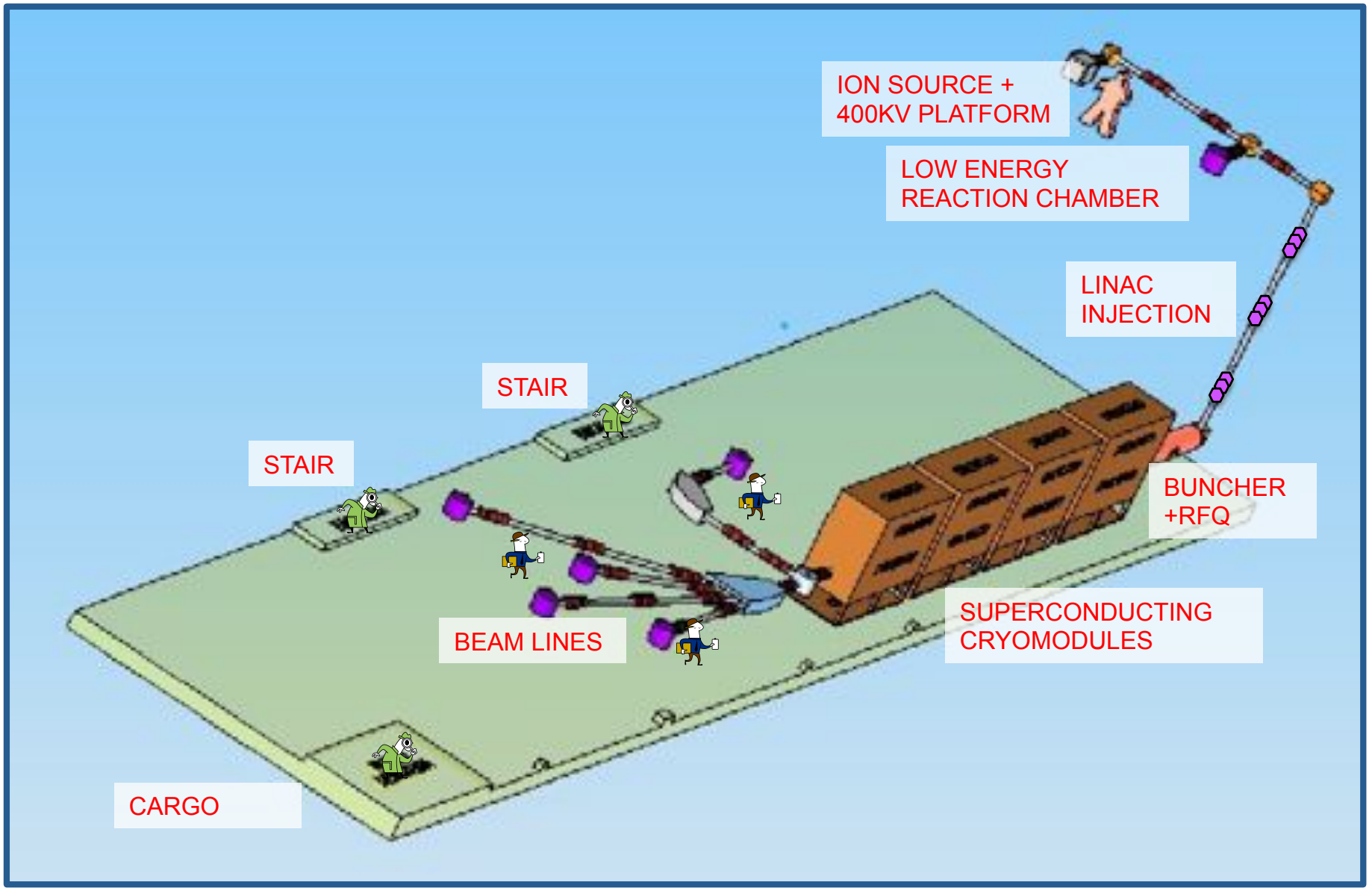
LEVEL -6m



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Parameter	Value	COST /Time	Comments
Ion Species	Heavy ions, protons		SCR ion source
Current Range	~1-2 mA (protons) ~ 500uA – 10 uA HI		HI intensities depends strongly on Q/A
PHASE 1	> 20 MeV protons > 5 MeV/u HI	16 Meur 2 years	Auxilliary, Cryogenics, Ion source, LEBT, RFQ, 2 x cryomodules (7 x SC), 2 beam lines
PHASE 2	> 20 – 50 MeV protons > 16 MeV/u HI	5 Meur 2 years	2 x Cryomodule, Ext. Cryogenics, full experimental hall
PHASE 3	> 70 MeV protons	3 Meur 1 year	1 x Cryomodule, proton therapy line, IGISOL line

RESEARCH & APPLICATION PROGRAM		
Basic nuclear physics	Materials for Fusion and Fission energy	Proton therapy
Astrophysics	Solar cells	Exotic isotopes
Super-heavies	Radioisotopes	
Coulomb barrier		

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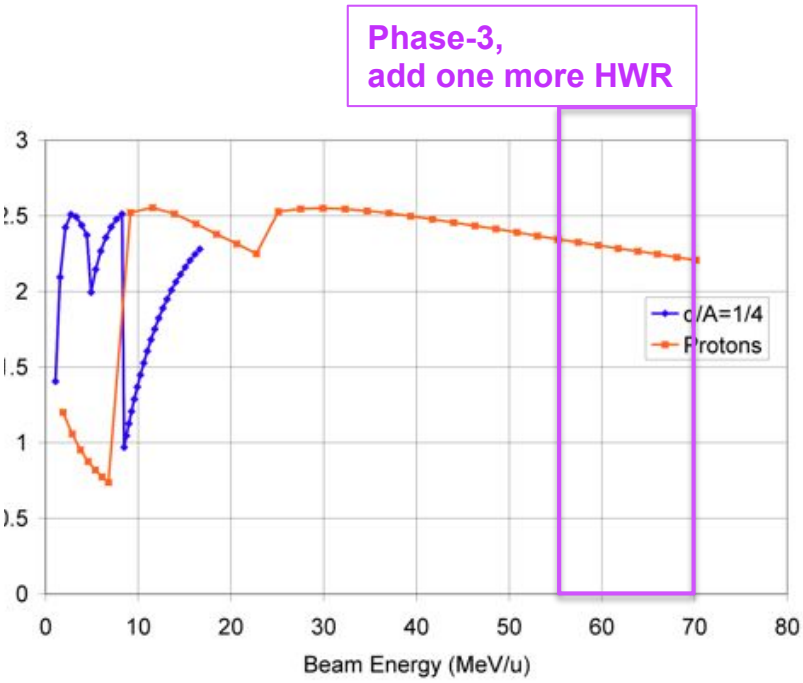
Table 5. Main parameters of the Linac

	Frequency, MHz	β_{OPT}	Number of cavities	Comments
MHB*	36.375 (the 1st harmonic)	N/A	1	
RFQ	72.75	N/A	1	Based on ANL 60.625 MHz RFQ
QWR1	72.75	0.077	7	Design is available as ANL/ATLAS upgrade cryomodule
QWR2	109.125	0.15	7	Design is available as ANL/ATLAS upgrade cryomodule
HWR	181.875	0.25	14	Prototype cavity (f=170 MHz) was demonstrated at ANL



LRF-Huelva calculation
(P. Ostroumov, ANL)

"Safe" innovation:
- concept: chained 5 x CRYOMODULES (7 SC each) reaching > 80 MV field → largest field/m → proton & HI drivers for energy and isotope production (MYRRHA, EURISOL).
- Works for sure… but must be proved!

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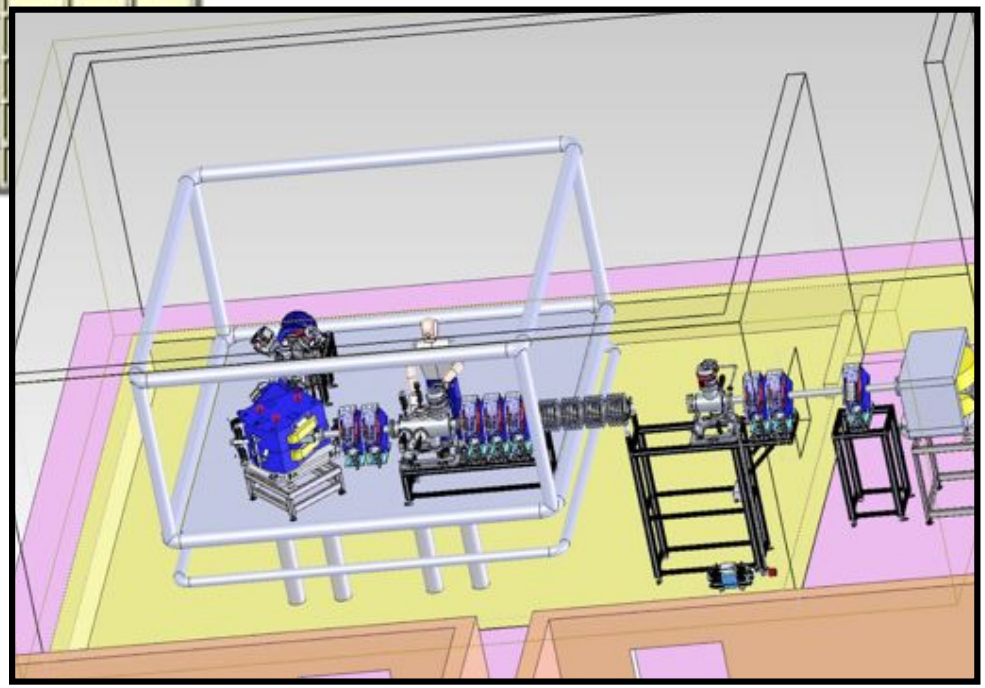
ION SOURCE AND 400 KV PLATFORM

Ions/Q	1+	2+	4+	6+	8+	9+	11+	14+	20+	23+	25+	26+	27+	30+	31+	32+
H	2000															
H_2	1000															
H_3	700															
He	2000	1000														
C	500	350	200	3												
N	1000	300	100	10												
O	1000	400	300	200												
Ne	1000	300	200	160	25											
Ar	1000	350	250	200	200	90	30	1								
Kr	1000						25	15								
Ag			250	250	200	90	30		4							
Xe	500				220				15	14	10	5				
Ta									4	0.8						
Au												10	6			
Pb									10		5	3	1			

Caracterisitcs of Supernanogam ECR ion source (Pantechnik, France). Intensisty (uA) depends on charge state.



Preliminary arrangement of 400KV-HV platform and optics at LRF-Huelva.

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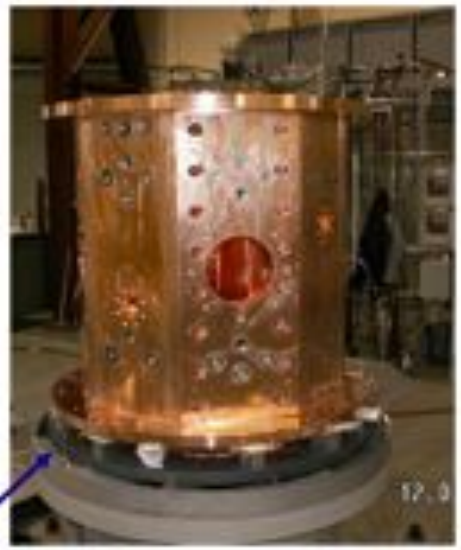
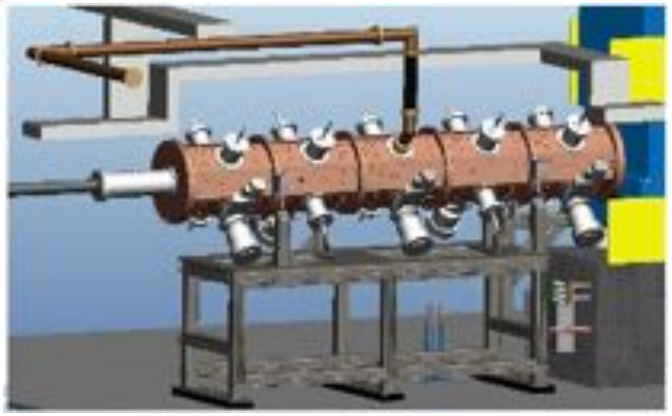
RFQ

	Parameter	Value
1	Duty cycle	100%
2	q/A	1/5 to 1
3	Input Energy	30 keV/u
4	Output Energy	750 keV/u
5	Average radius	7.2 mm
6	Vane Length	5.5 m
7	Inter-Vane Voltage	70 kV
8	RF power consumption	60 kW





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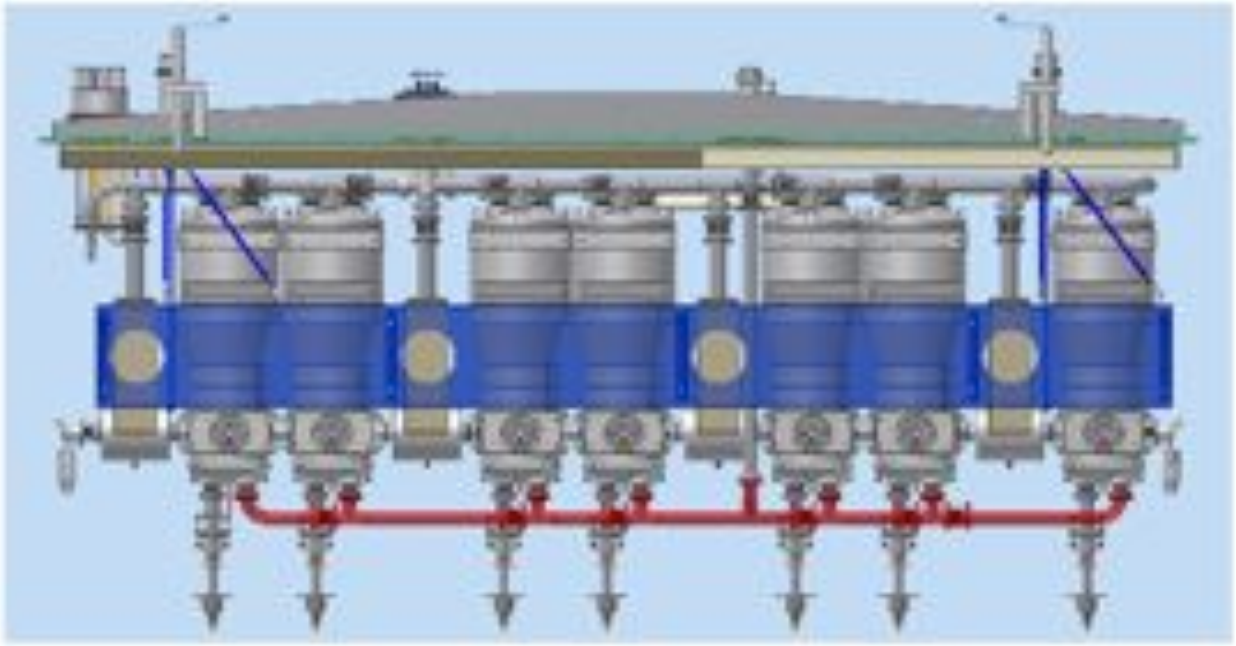
New Cryomodule

- Seven 72. 75 MHz cavities and 4 SC solenoids with 30 mm aperture
- Length – 5 meters, design voltage 17.5 MV



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Companies

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