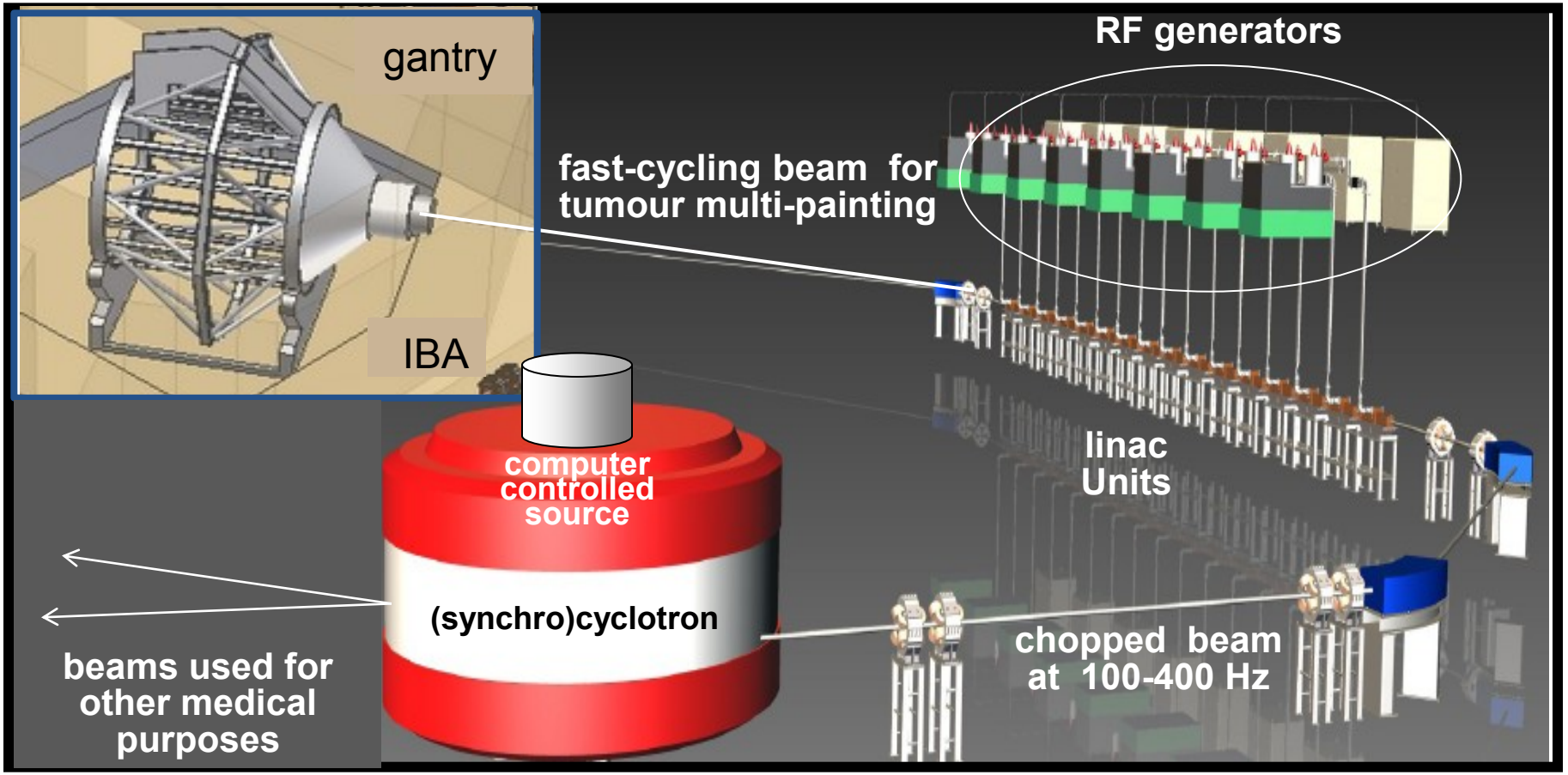
TEST OF A 3 GHz HIGH-GRADIENT ACCELERATING CAVITY

U. Amaldi, R. Bonomi, A Degiovanni, M. Garlasché, A. Garonna, I. Mondino, P. Pearce, P.L. Riboni, V. Rizzoglio and S. Verdù Andrès

General Concept of a Cyclinac



The energy can be varied in 2-3 ms in the full range by changing the power pulses sent to the 16-22 accelerating modules (forming 8-11 RF Units)

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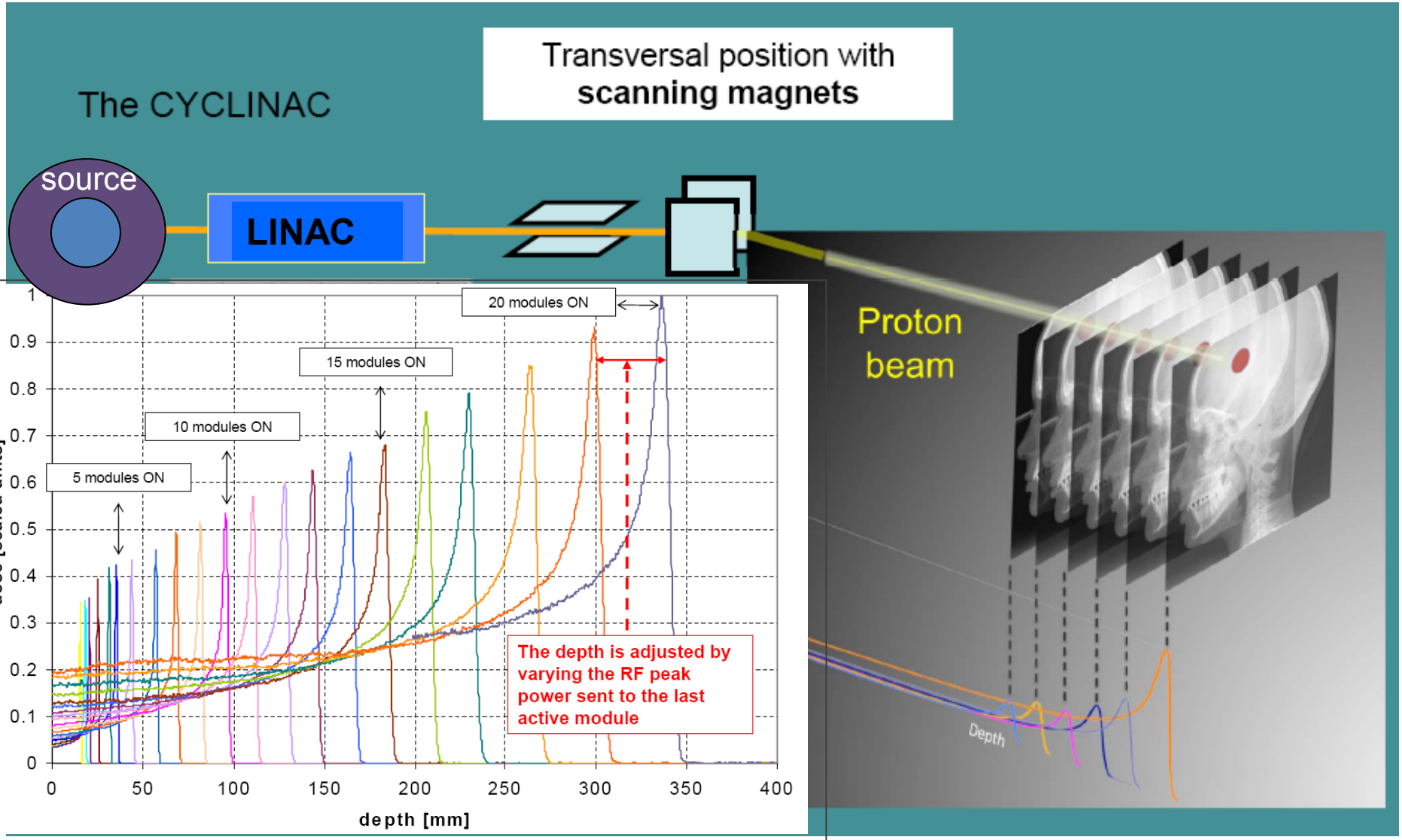

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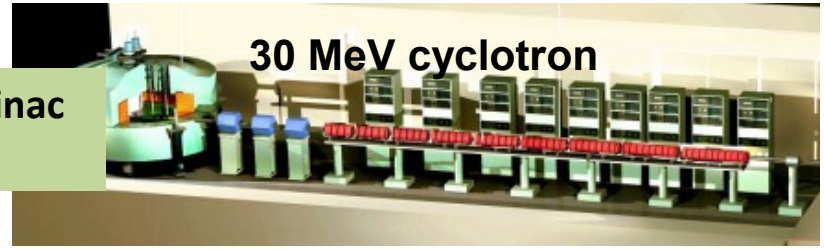

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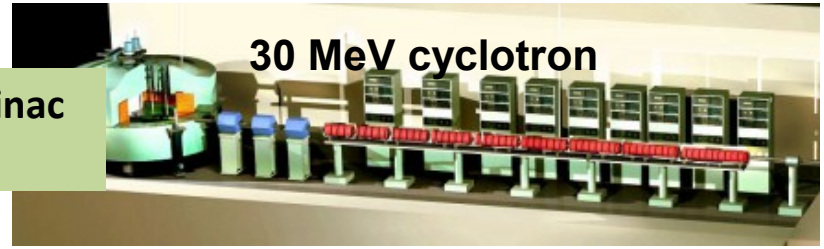

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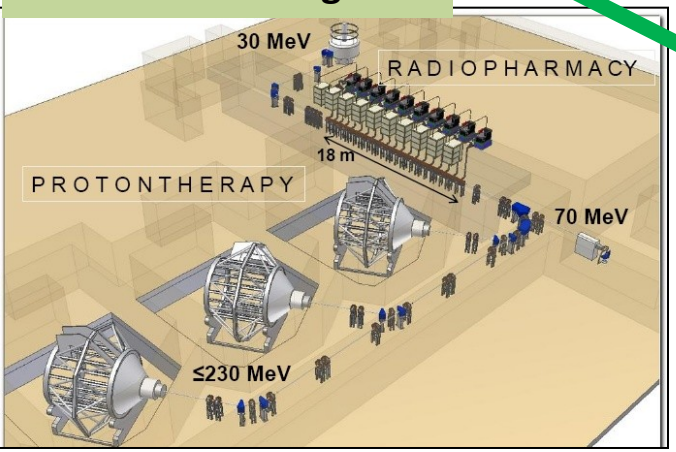

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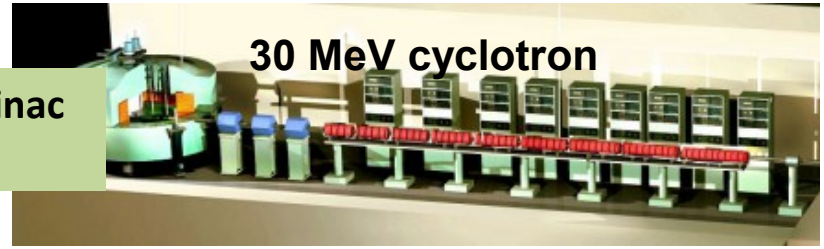

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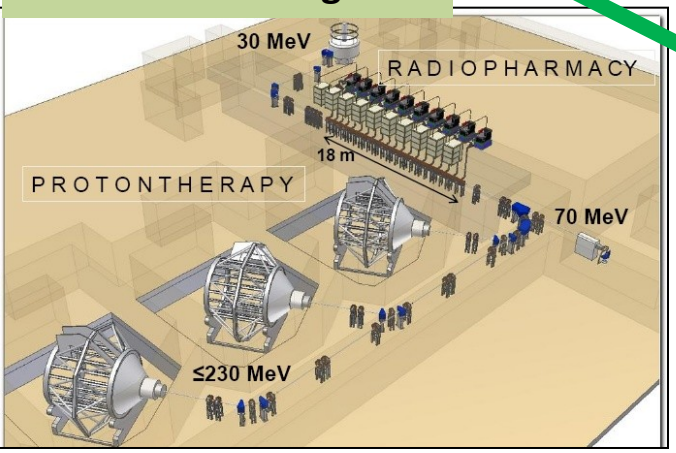

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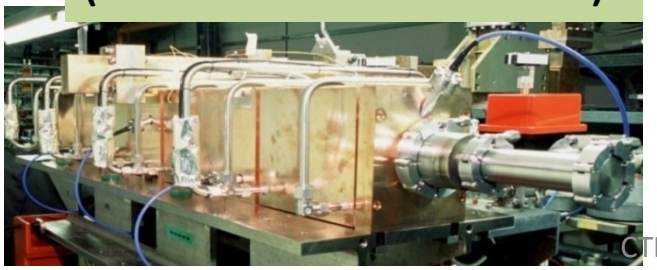

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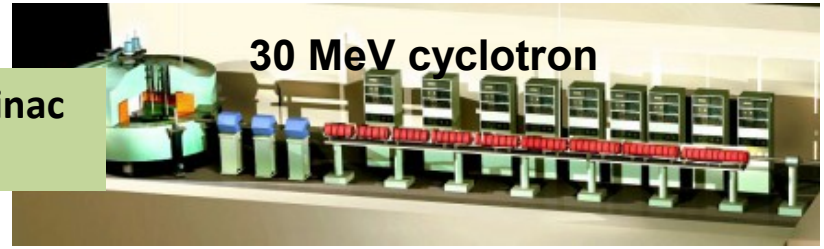

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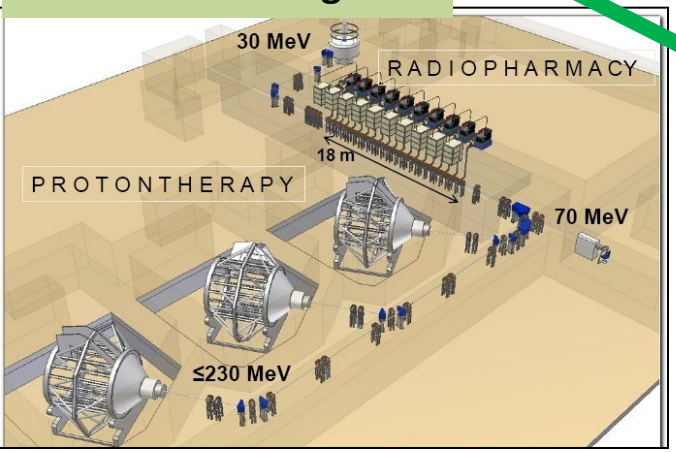

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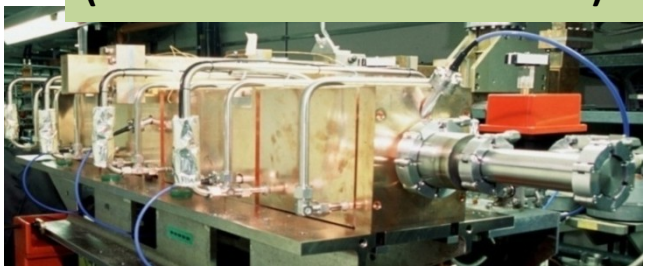

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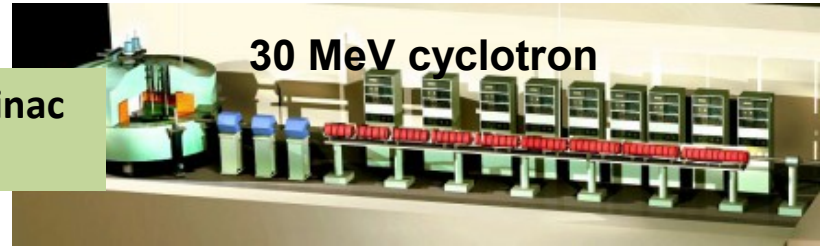

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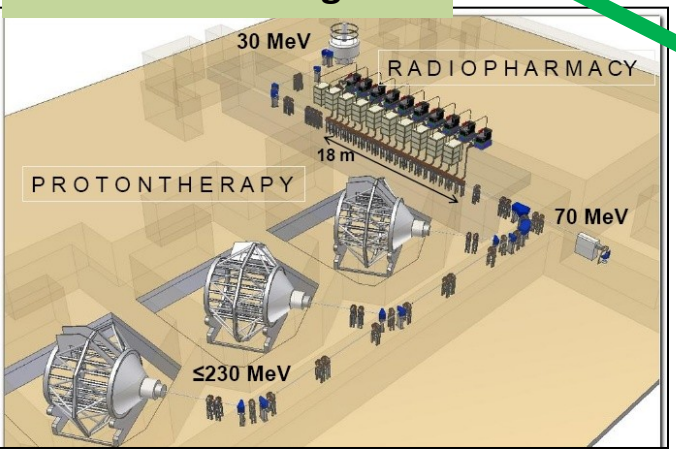

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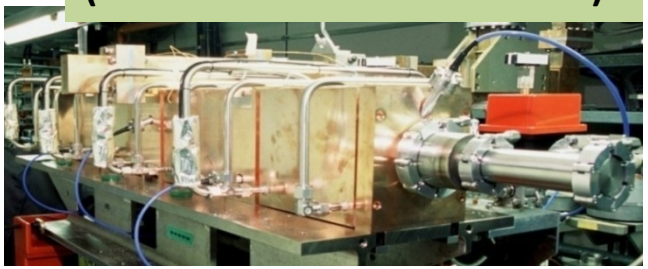
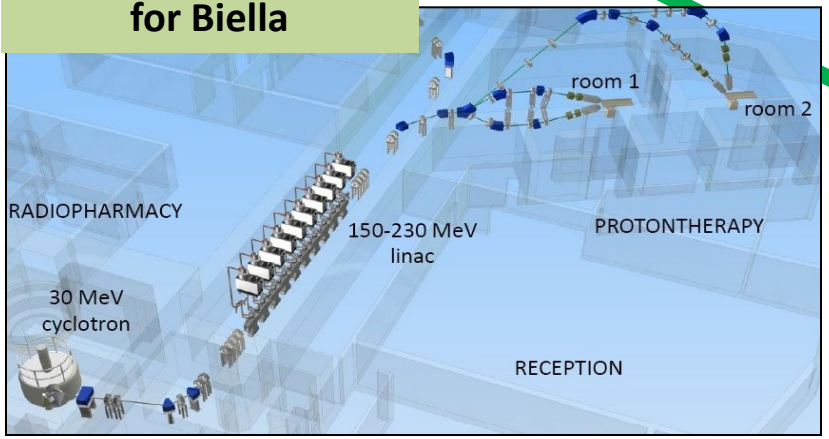


2008: Pediatric IDRA for Biella



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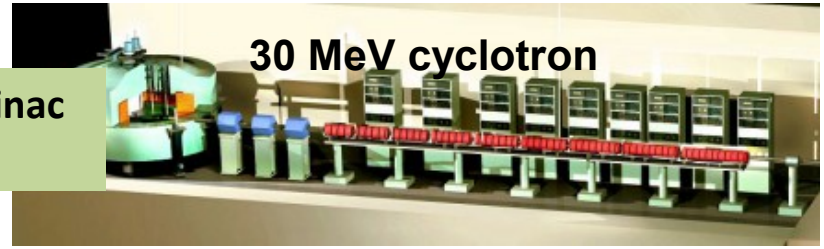

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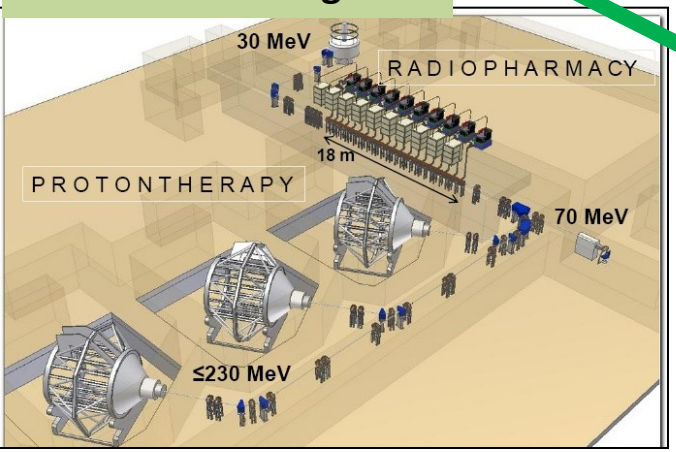

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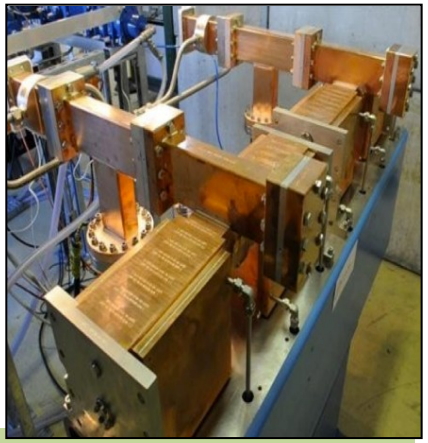

2010: First Unit of LIGHT
ADAM=Application of Detectors and Accelerators to Medicine

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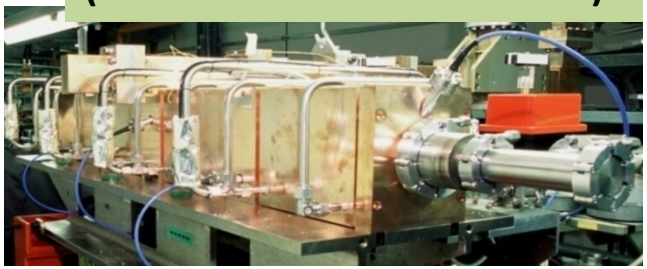

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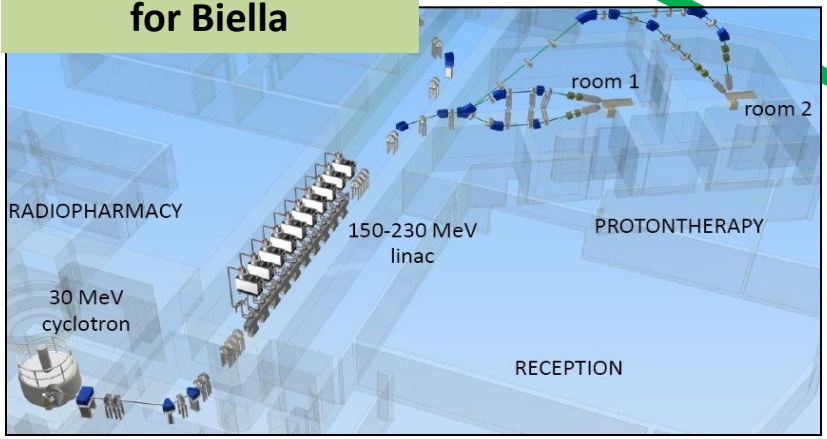

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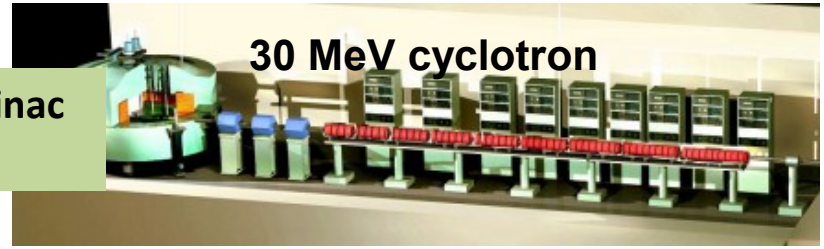

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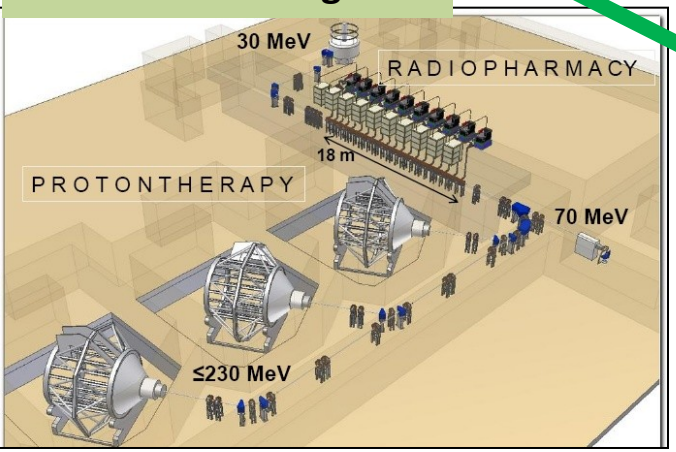

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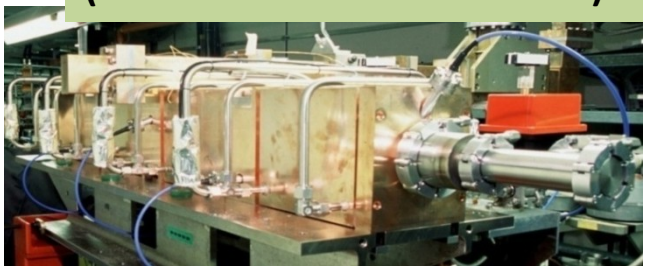

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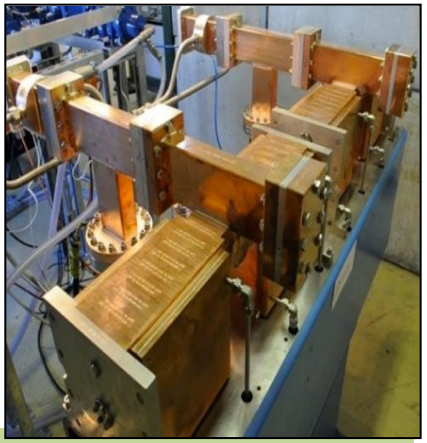

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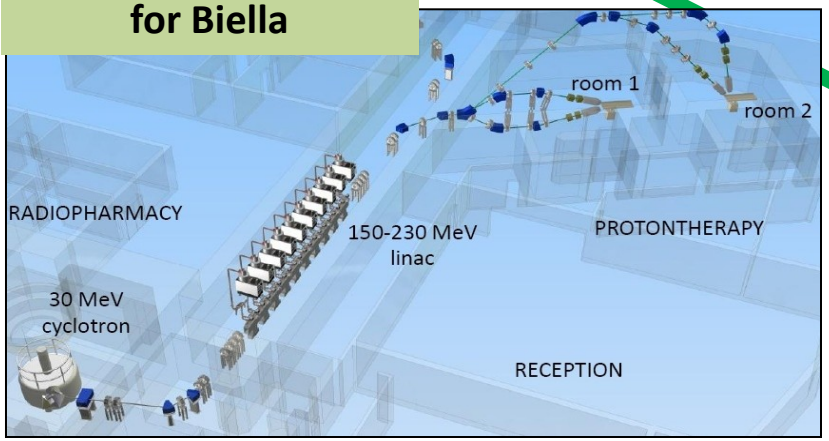
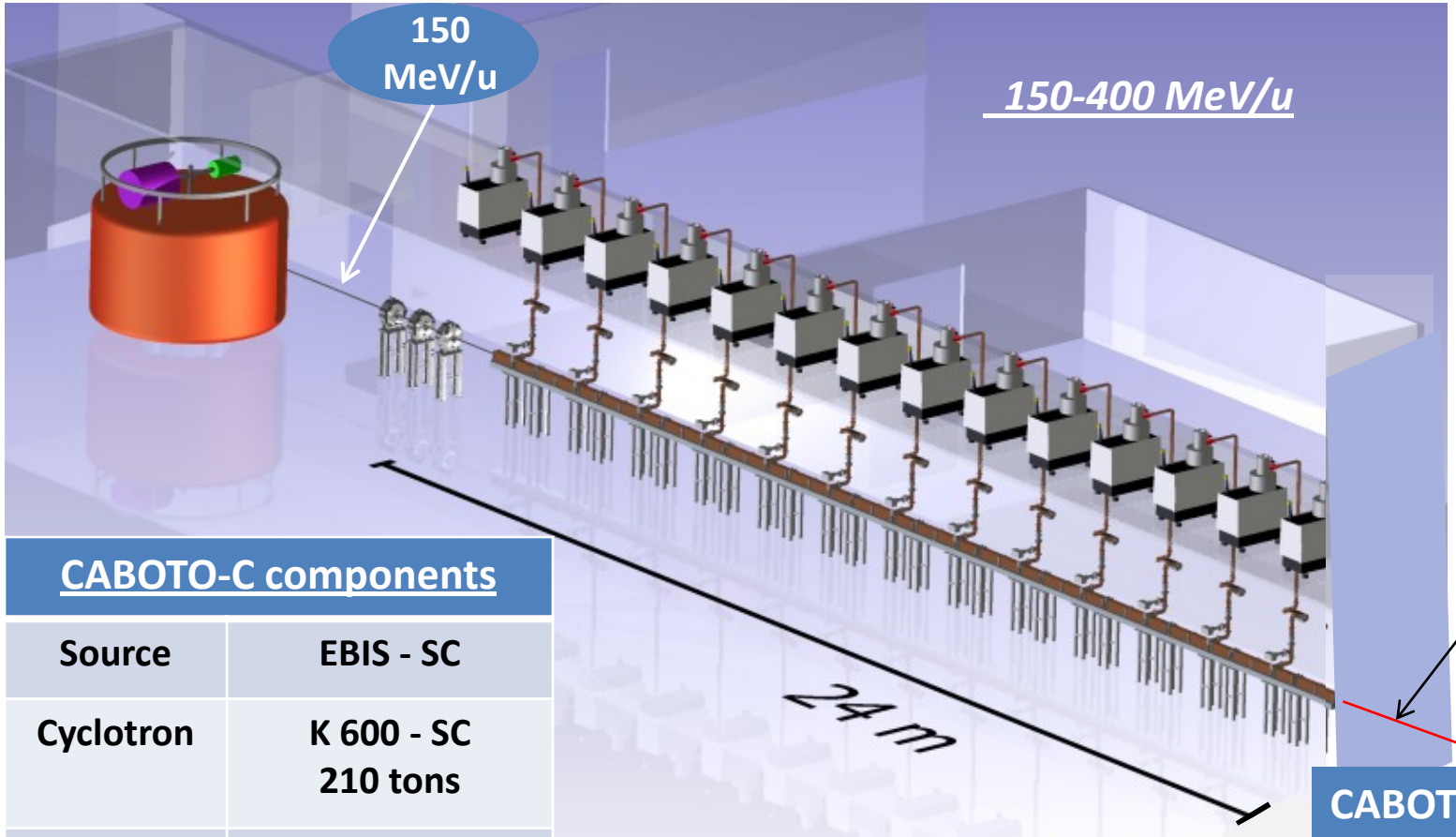


2010
TULIP +
CABOTO

The last design of a cyclinac for carbon ions: CABOTO-C

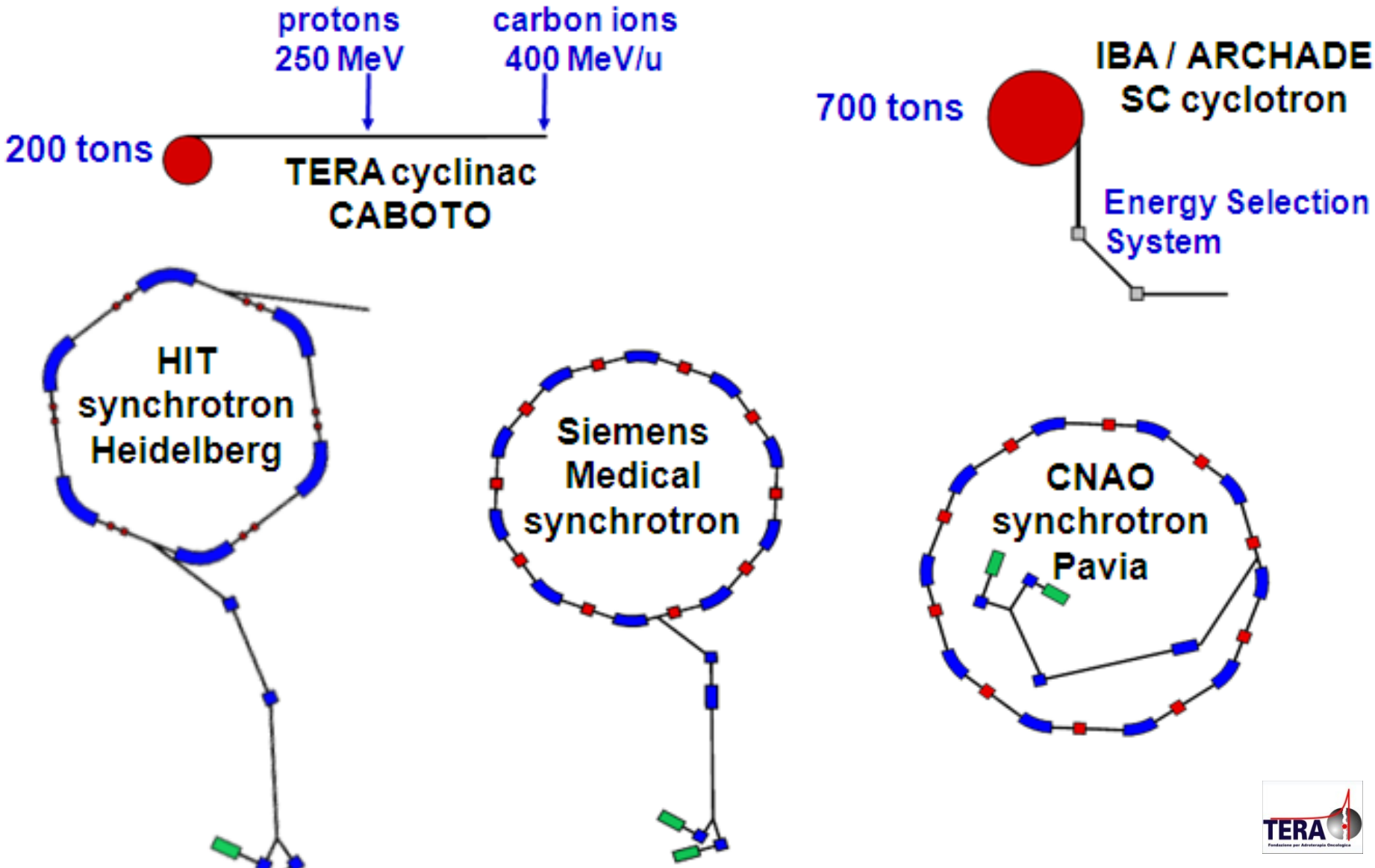


CABOTO-C components	
Source	EBIS - SC
Cyclotron	K 600 - SC 210 tons
Linac	CCL @ 5.7 GHz 14 modules
RF power system	14 Klystrons (P_{peak} = 12 MW)

CABOTO – C =

CArbon BOoster for Therapy in Oncology

Dimensional comparison among carbon ion accelerators

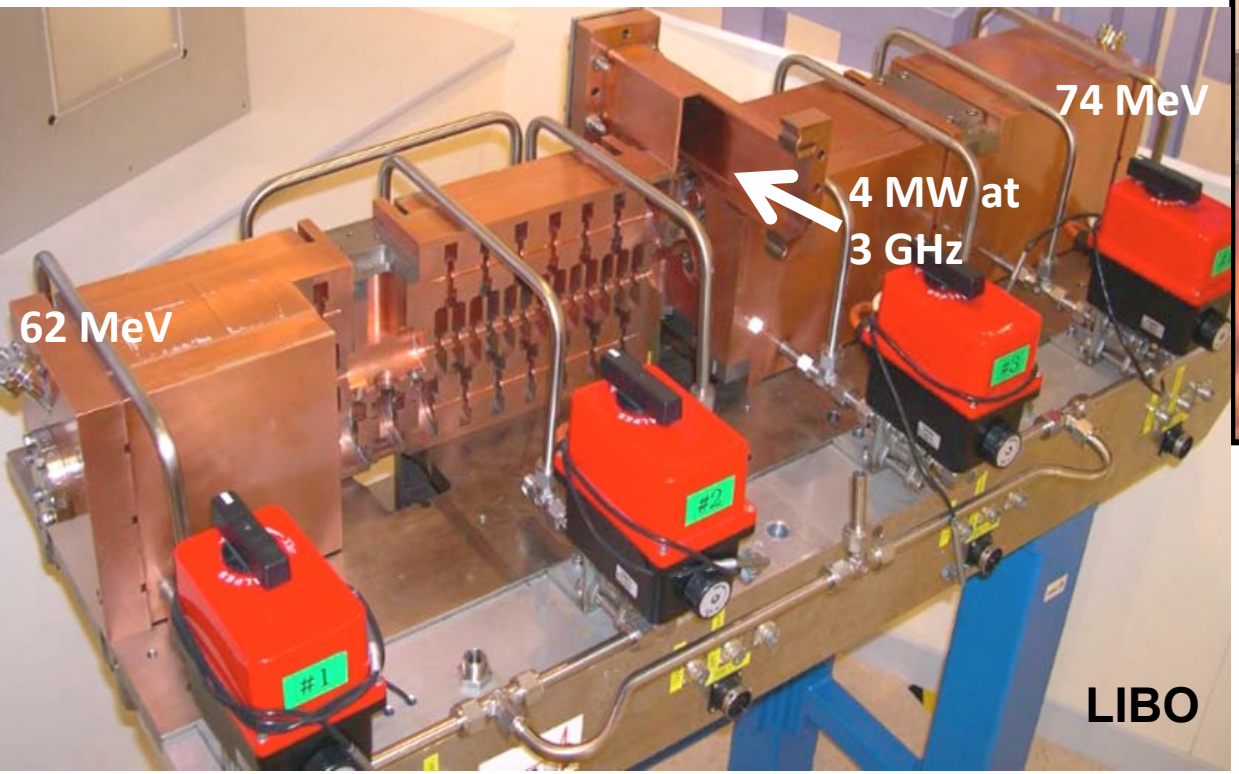


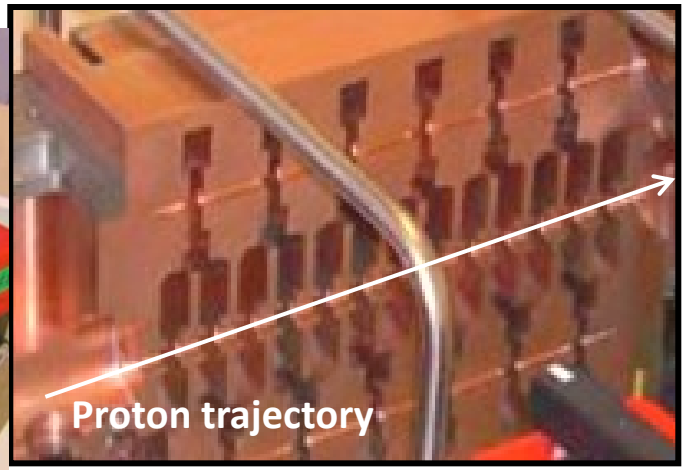
TULIP = TUrning LInac for Proton therapy

35 MeV cyclotron

3 or 5.7 GHz linac

SW Cell Coupled Linac for β = 0.25-0.60





LIBO and LIGHT at 3 GHz:
gradient E ≤ 20 MV/m

Surface field
E_s ≤ 90 MV/m
(Kilpatrick ≤ 2)

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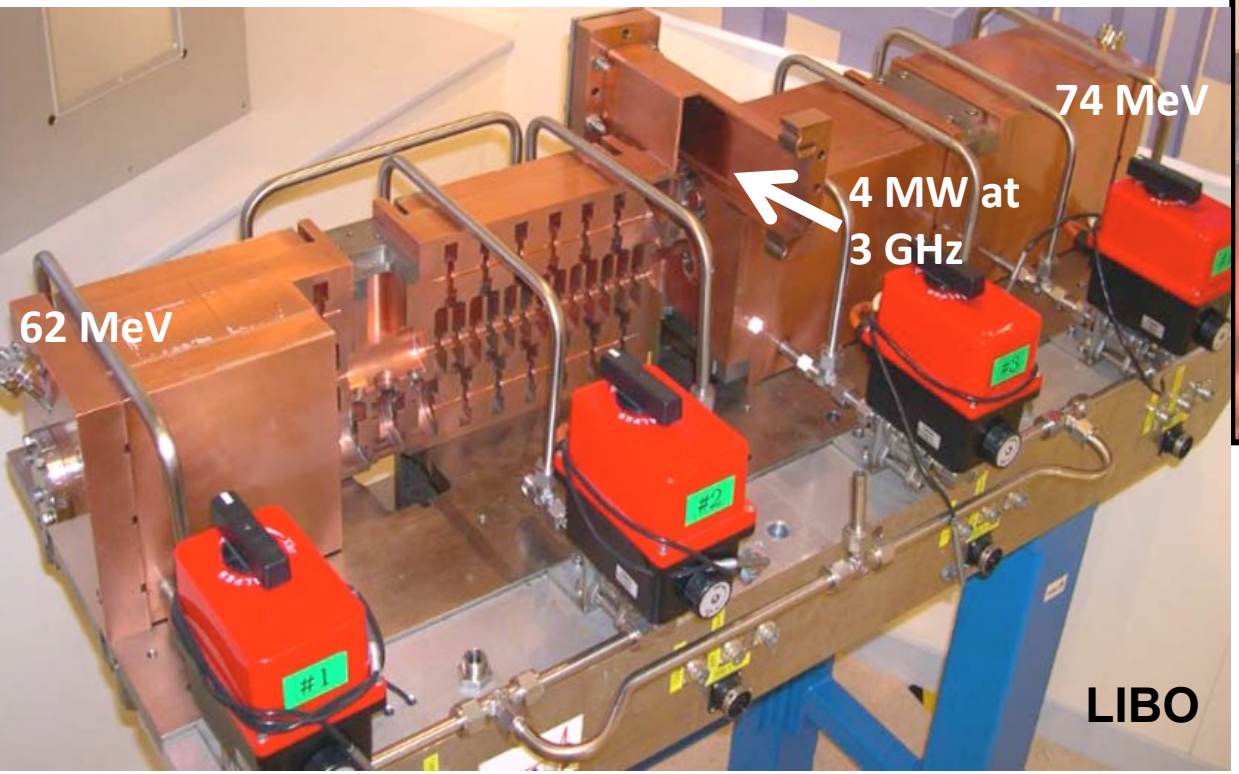

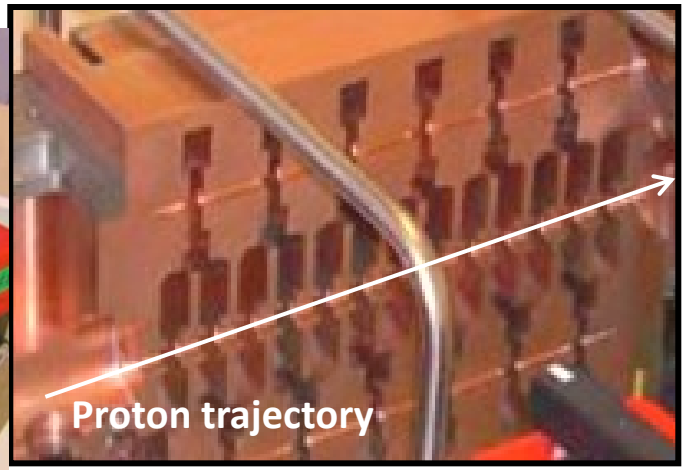

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For CABOTO and TULIP:
E ≤ 35-40 MV/m
At 3 GHz or higher

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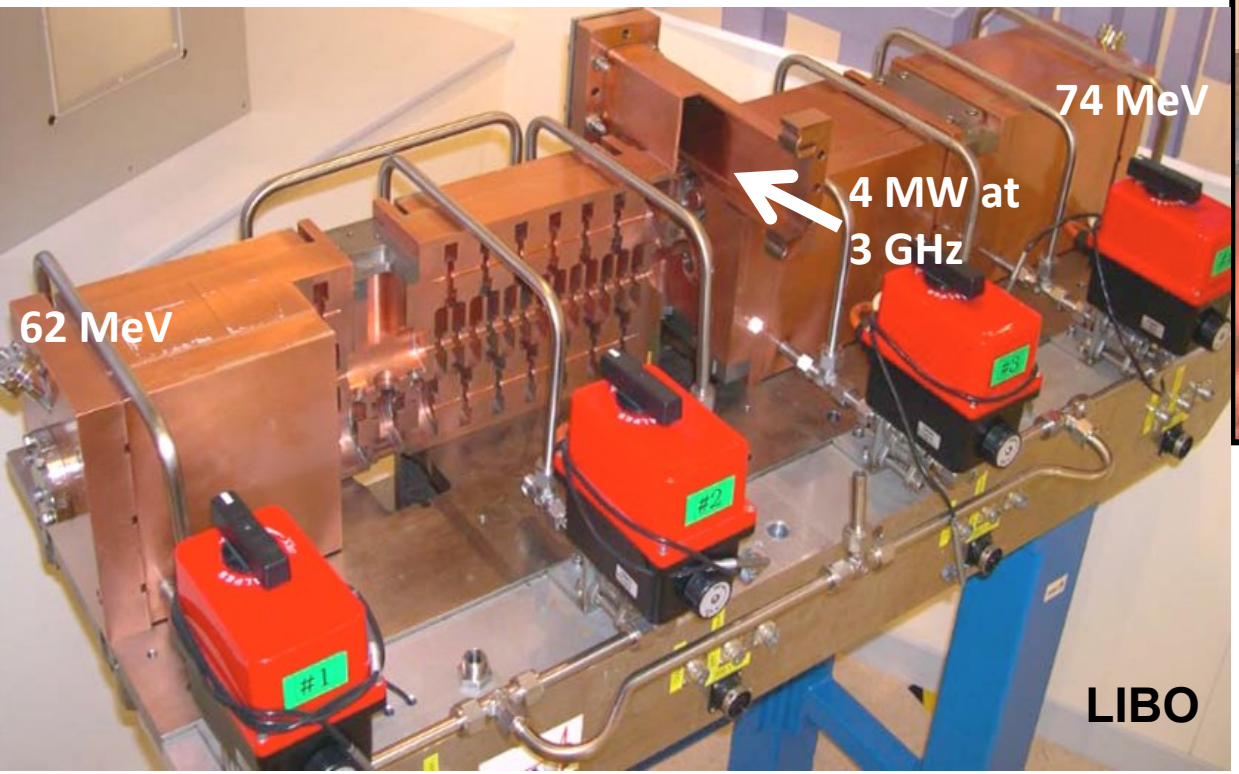

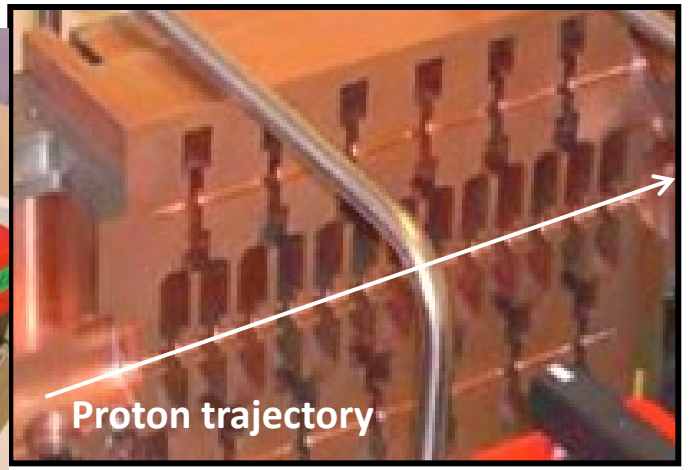

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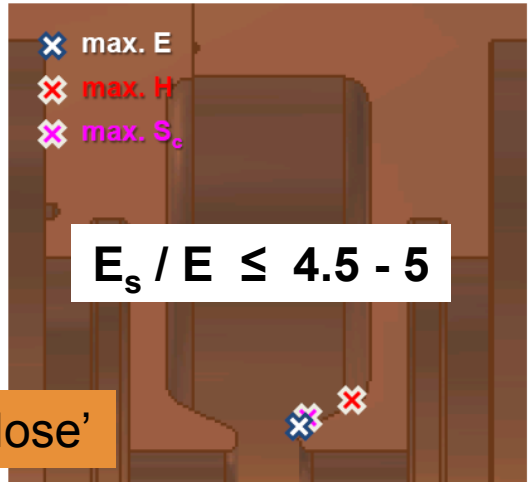

Problem: 'the Nose'

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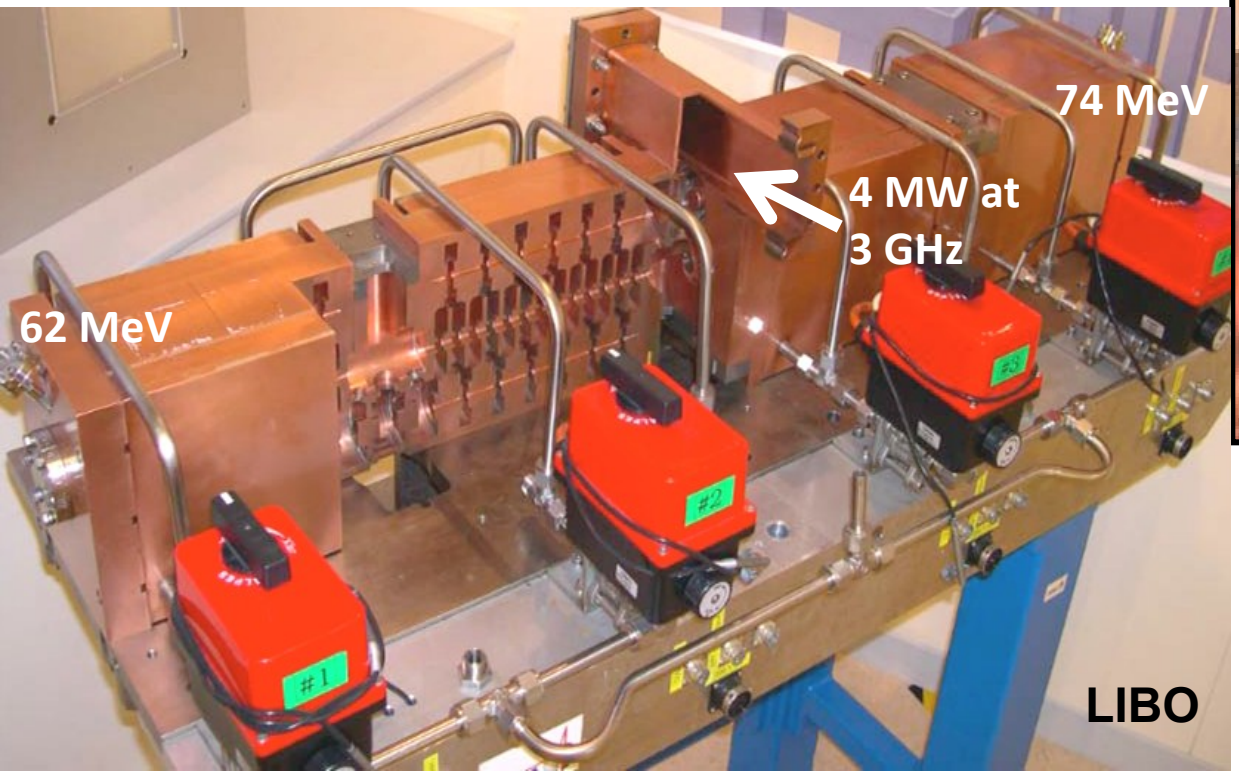

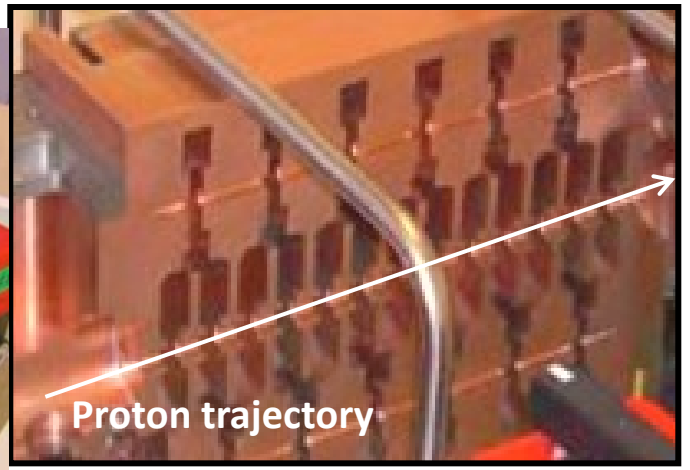

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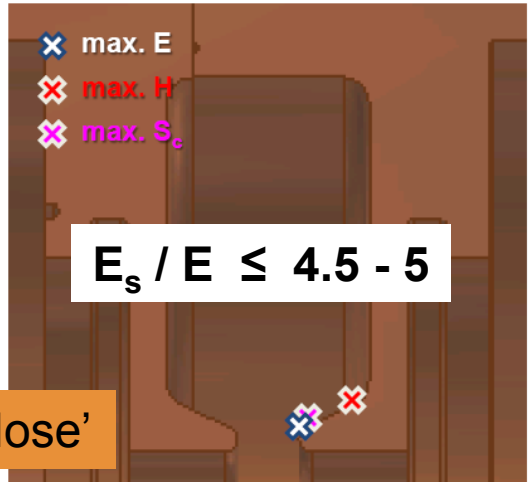

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As far as E_s is concerned:

TERA's 40 MV/m are equivalent to CLIC's 100 MV/m

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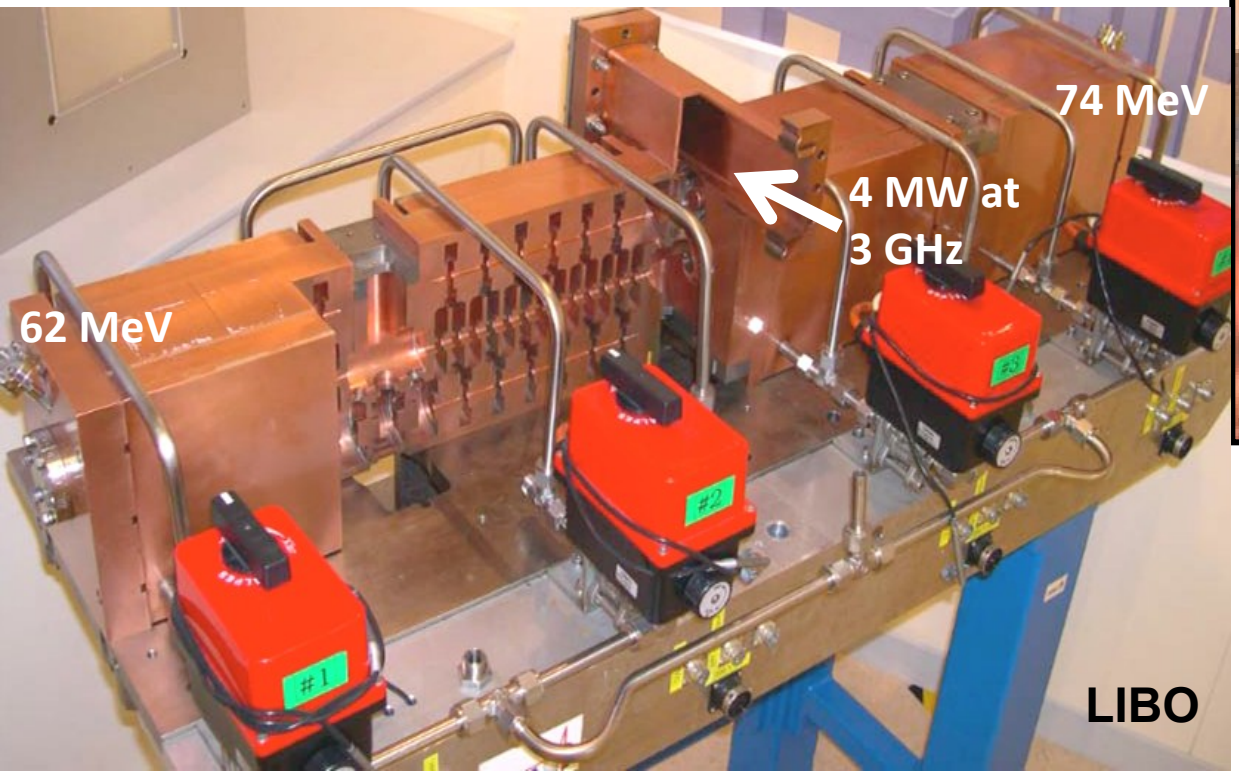

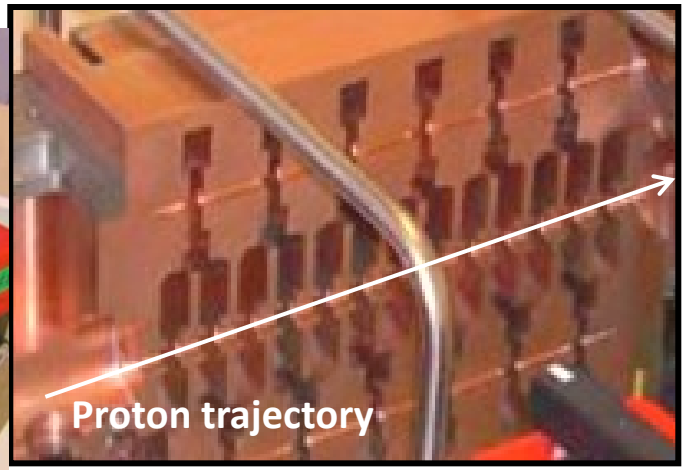

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E ≤ 35-40 MV/m
At 3 GHz or higher

Problem: 'the Nose'

BDR for TERA:
Linac is 15 m long and a treatment is (20x100 Hz x120s) pulses

BDR ≤ 3 10^{-7}

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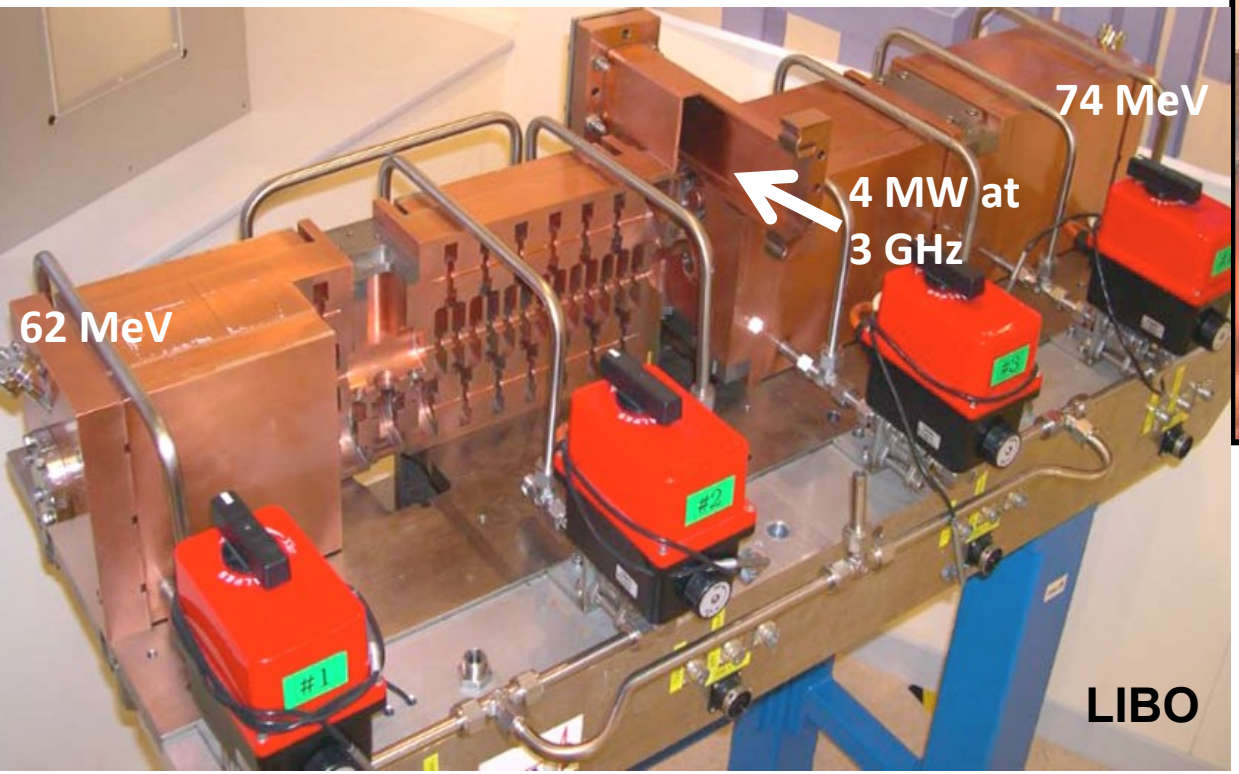

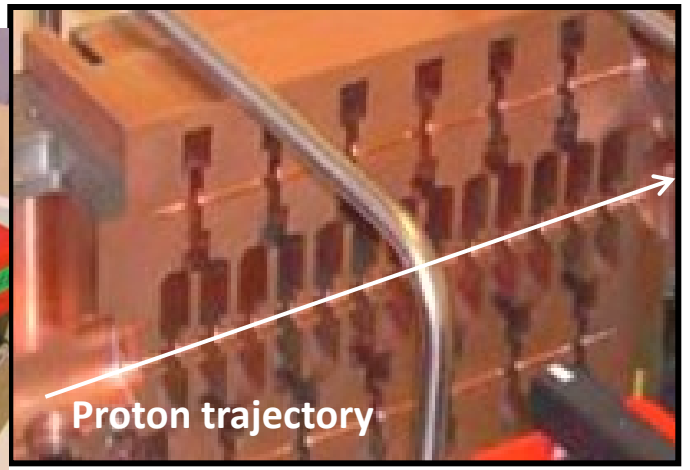

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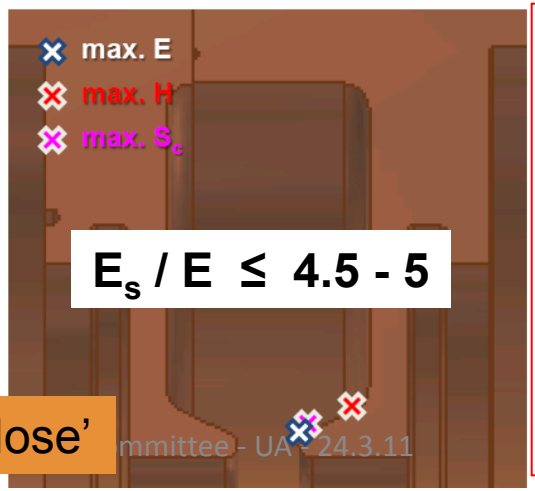


Problem: 'the Nose'

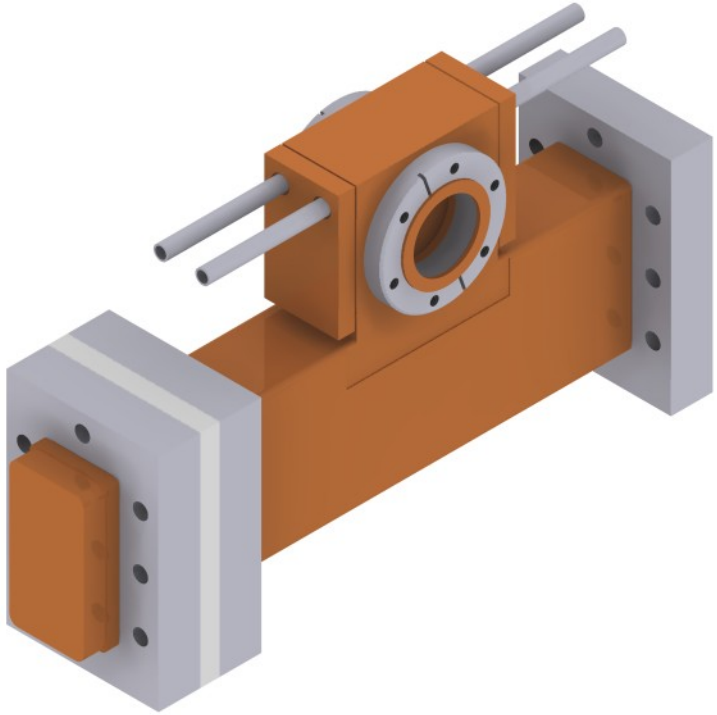
TERA is facing the same challenges as CLIC
BUT
cannot go to freguencies larger than 6 GHz: tranverse acceptance, distributed sources

Since 2009 TERA has started an high gradient test Program

Prototype test structures:

- **3 GHz single-cell cavity**
- **5.7 GHz single-cell cavity**
- **multi-cell structure**

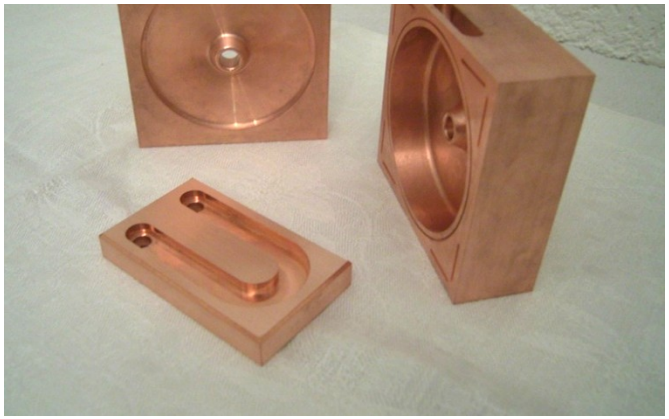
3 GHz Test Cavity general layout

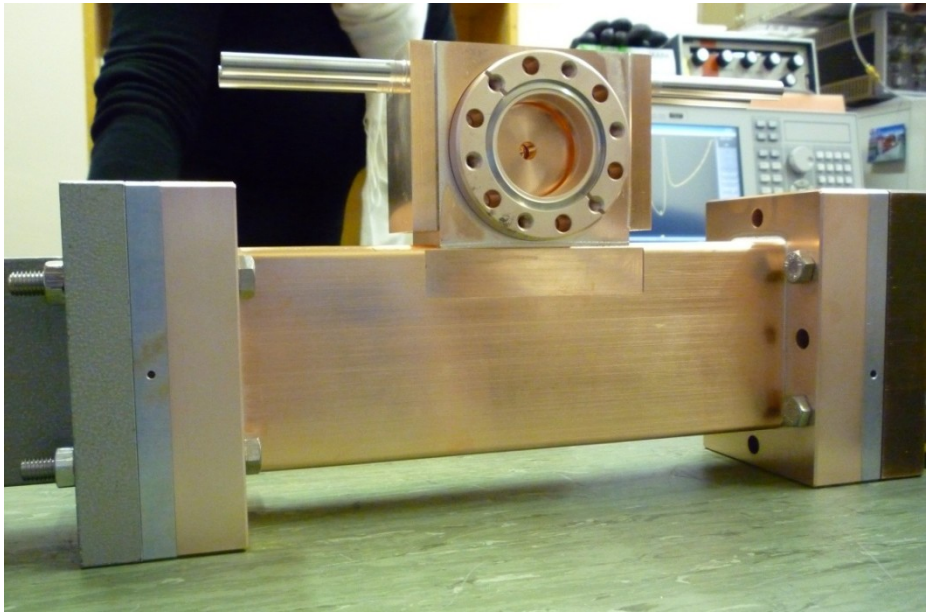


ngle accelerating cell

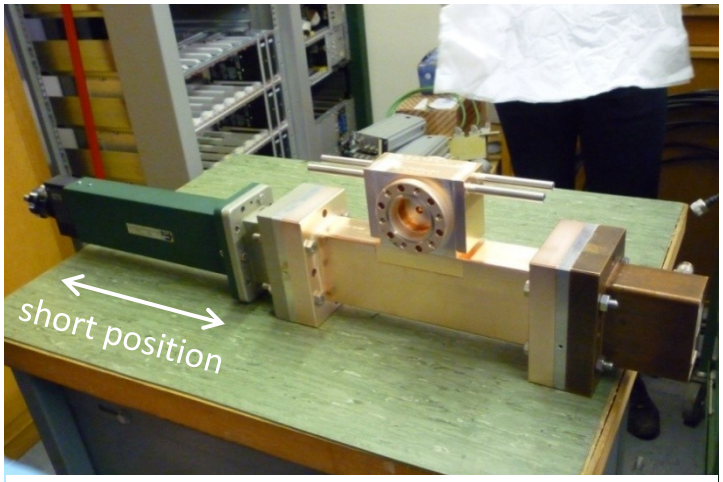
-coupled to WR284 waveguide

ɔoling system (two plates, in-out pipes)

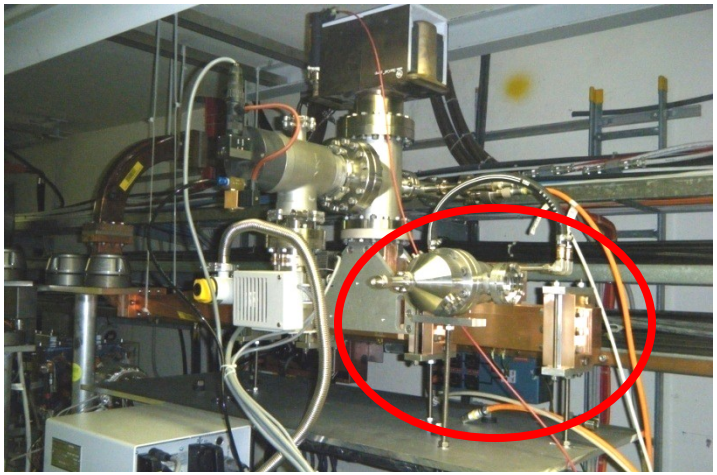




Preliminary high power test



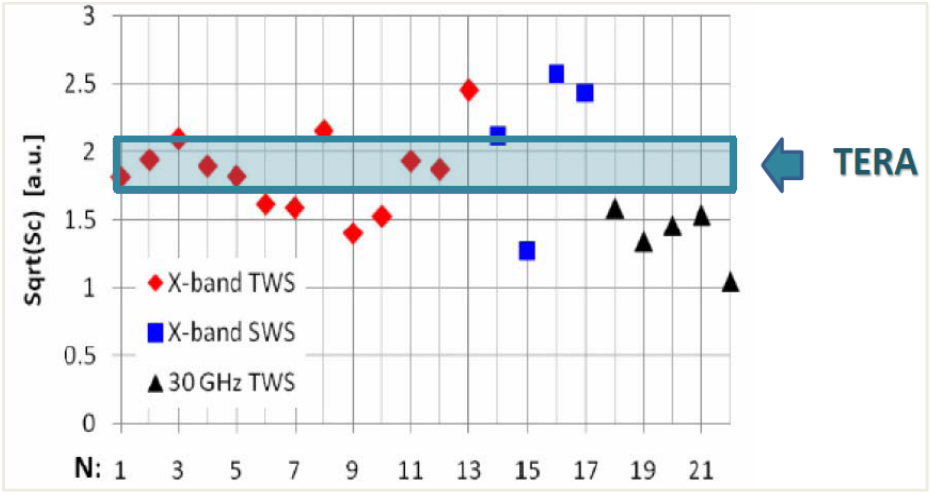
Low Power Measurments (Jan 2010)



High Power Test (@CTF3 – Feb 2010)

Indirect measurments of field through Faraday Cup

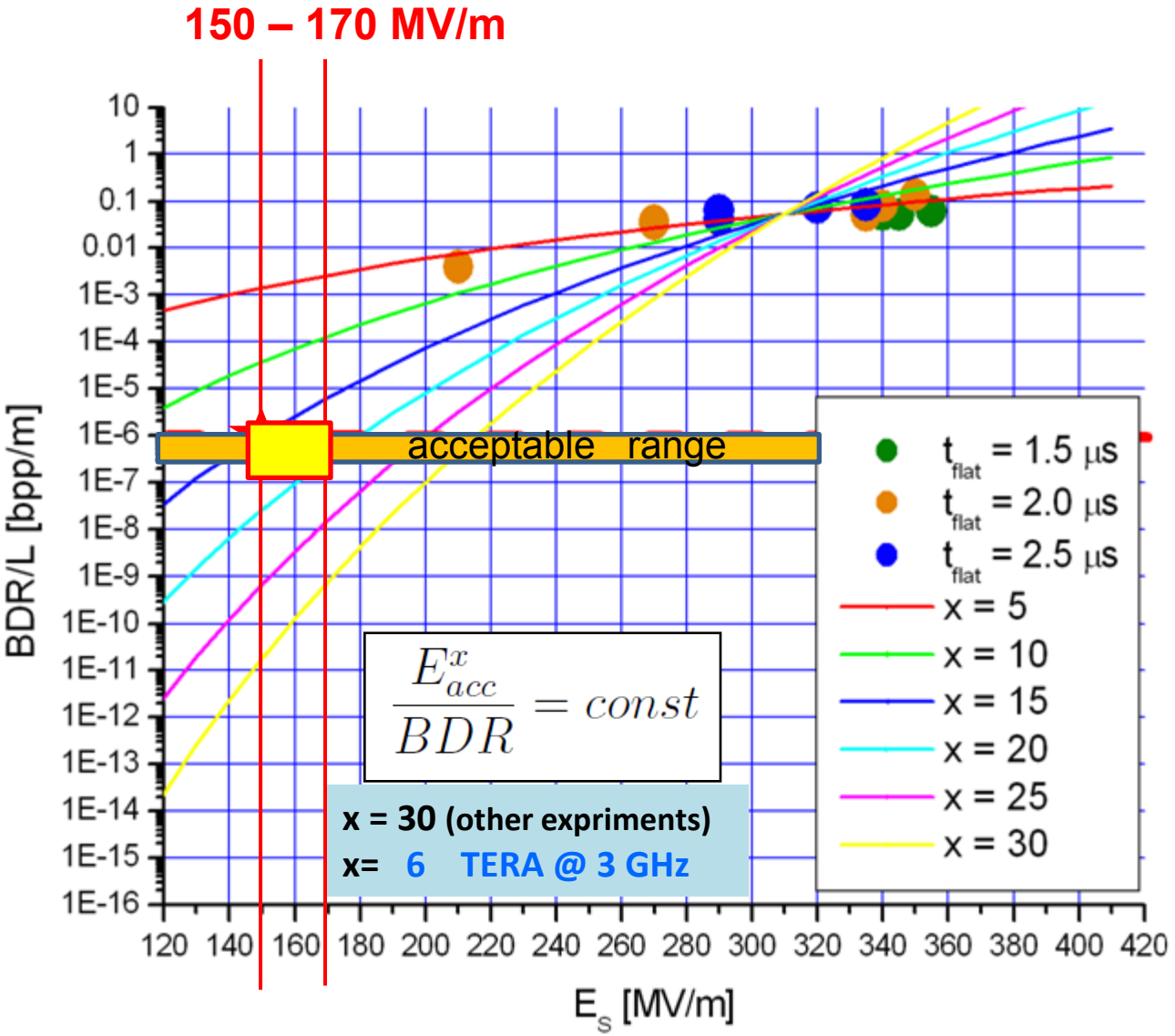
S. Verdú Andrés et al. (2010) *LINAC10 Proceedings*



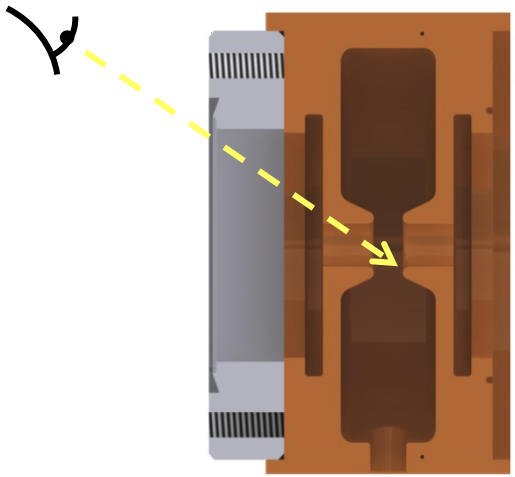
Preliminary results compared with literature data

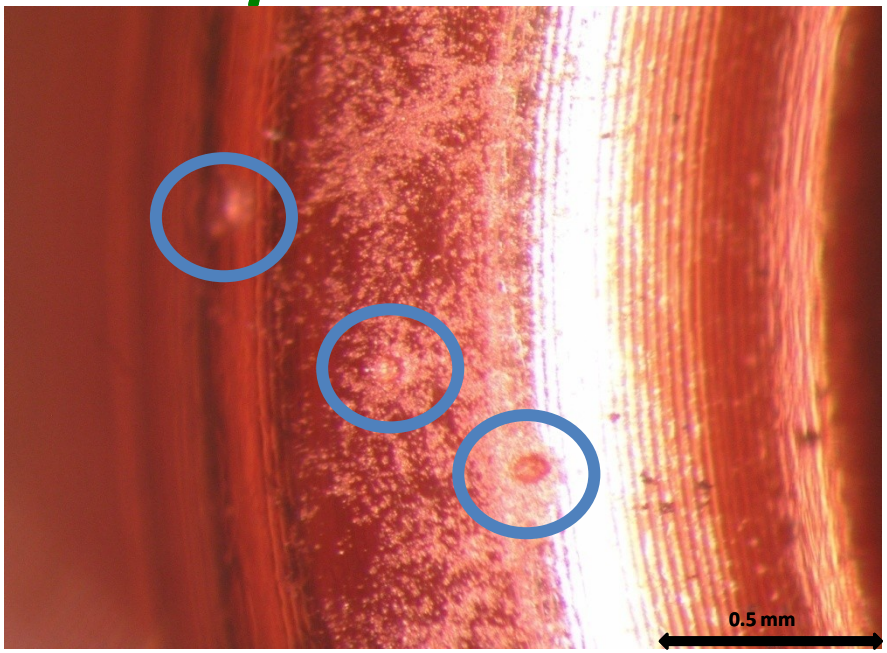
[A. Grudiev et al, Phys. Rev. ST Accel. Beam 12 (2009)]

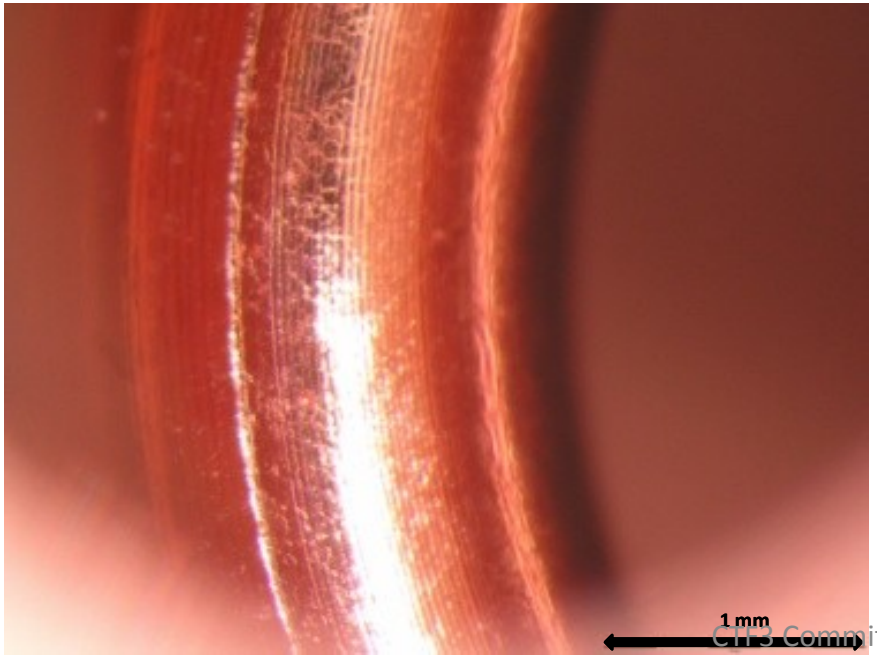
High power test: first results after few nights and no conditioning



Microscopy surface Inspection







Microscope's inside view on nose region: several craters and sparse activity can be observed.

Difficulties in reconstructing the actual position of the craters.

Final conclusion will come after cutting and opening the cavity.

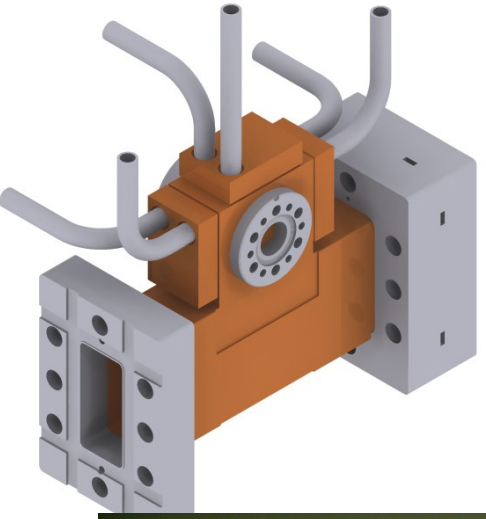
To complete the measurement

we request 4 weeks

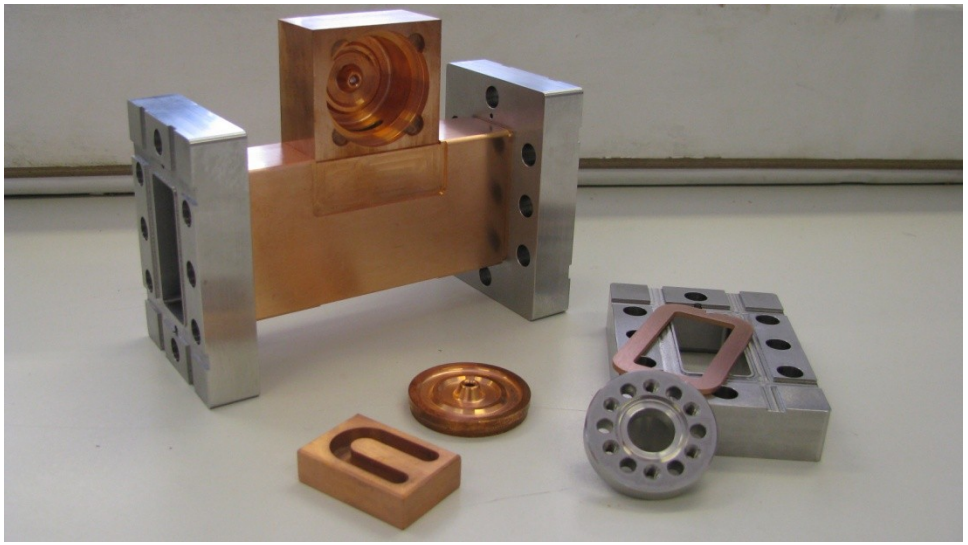
for mounting, conditioning and testing

this cavity

The pieces of the 5.7 GHz test cavity are inhouse



Prototype	1 & 2	3 tendering
Material	C10100 Copper	
Dimensional tolerance band	10 µm	5 µm
Surface roughness (Ra)	0.4 µm	0.025 µm



Low power tuning in 10 days
To be tested after the 3 Ghz cavity in Frascati (L. Picardi)
(with ADAM's magnetron)