BEAM PARTICLE SOURCES RESEARCH AT UNIVERSIDAD AUTÓNOMA DE SINALOA

XXXI Reunión Anual de la División de Partículas y Campos de la SMF

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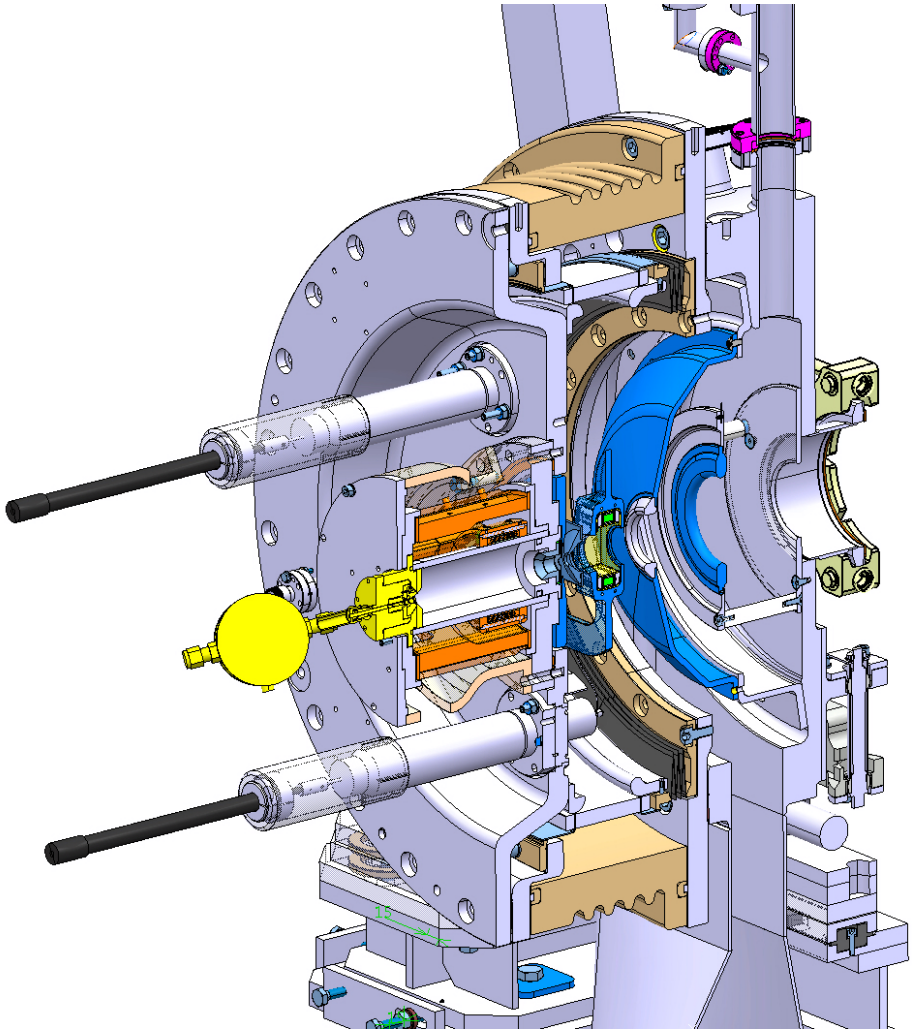
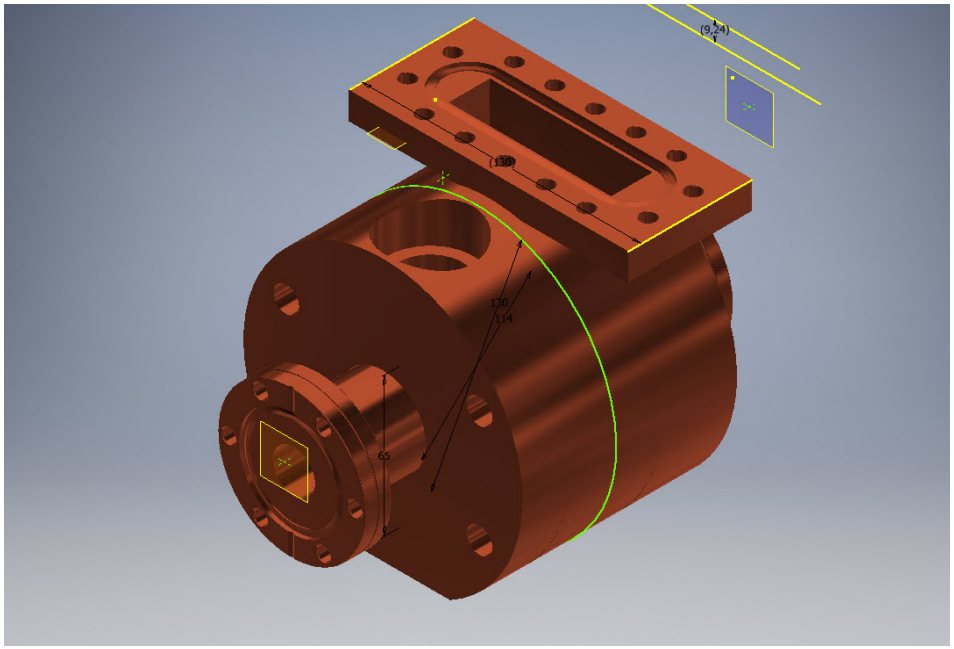
Particle Sources

- Several charged particle source related research and projects ar in progress at the University of Sinaloa(UAS).
- The work can be divided into development of ion sources towards increase the beam intensity, Electron guns suitable for research an industrial applications.

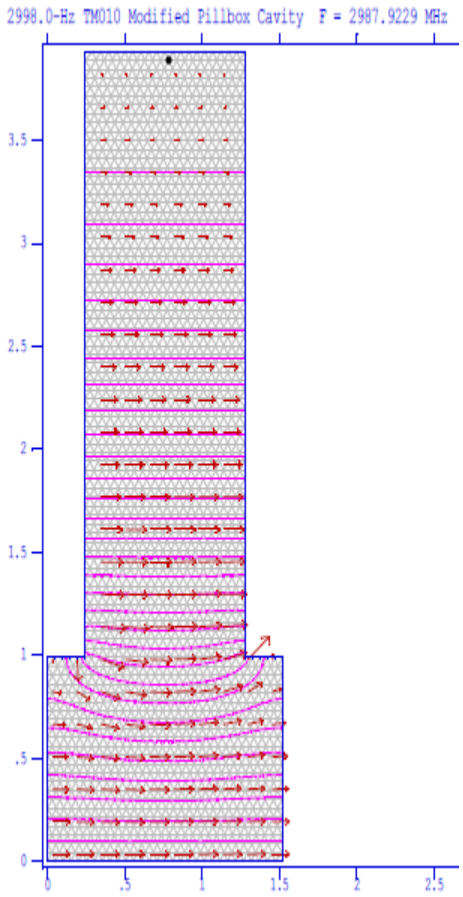


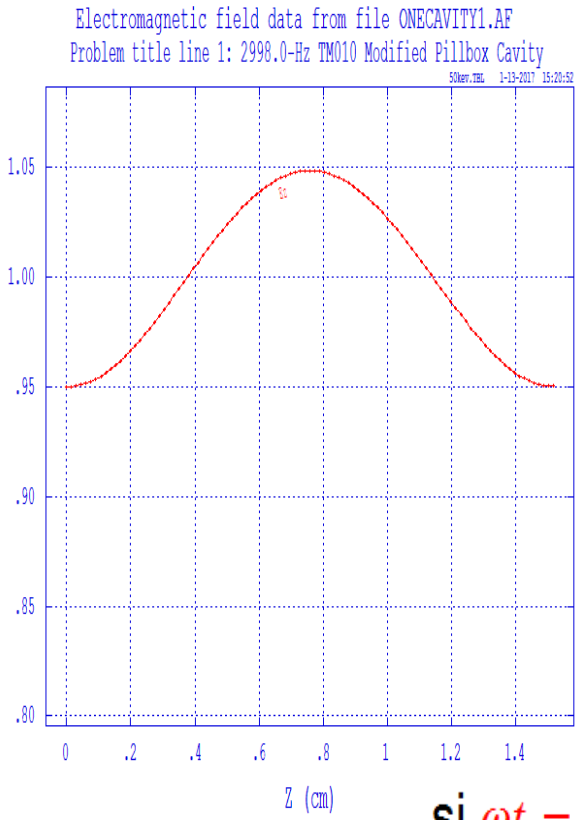
Electron Linac RF Cavity

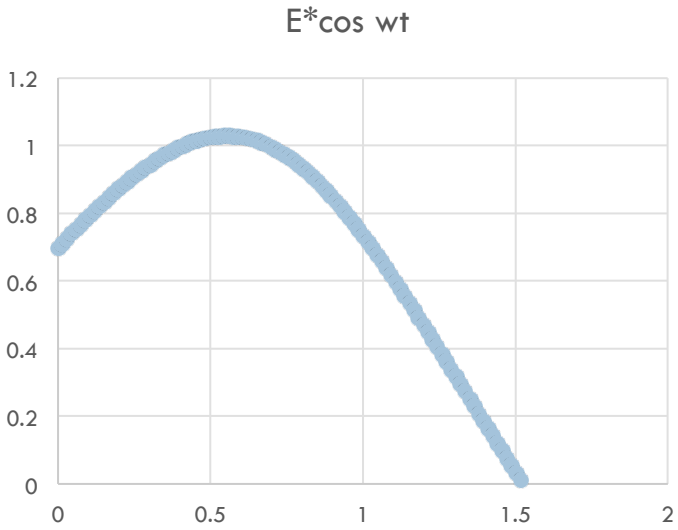
- An electron Linac is under design within the university
- Taking in to account the electromagnetic fields and mechanical constrains.
- Several CNC machines are ready to be used and milling the cavity parts



Simulations – 50Kev, 1 cavity







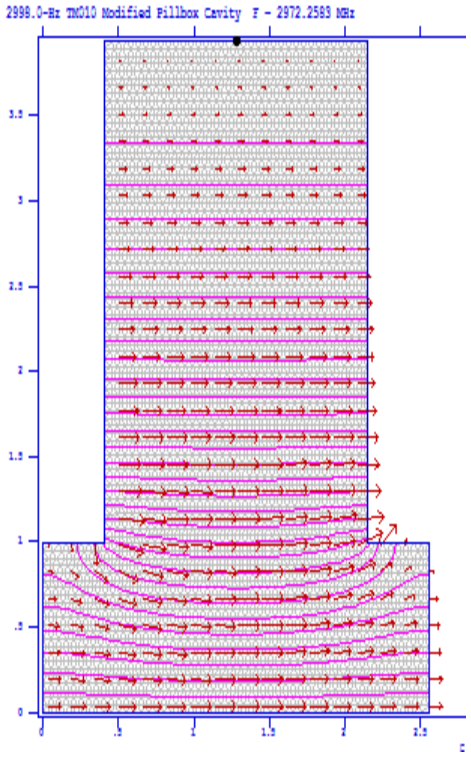
$$\omega t \approx w\frac{z}{v} = \frac{2\pi z}{\beta}\frac{f}{c}$$

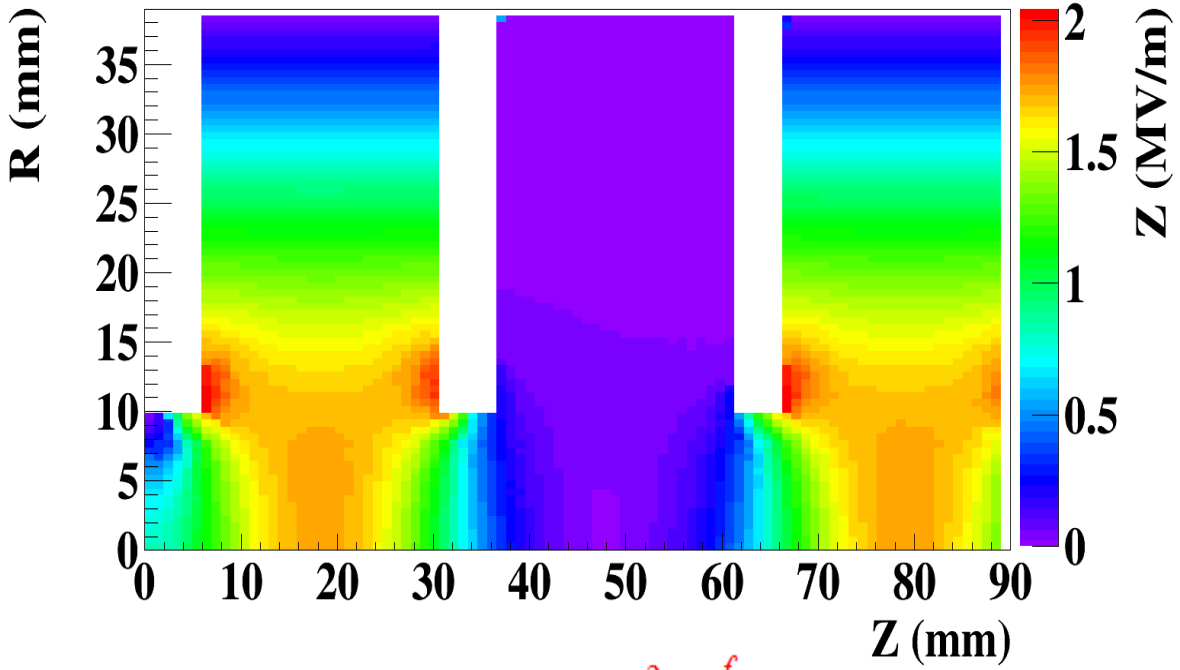
si $\omega t = \frac{\pi}{2} \Rightarrow z = \frac{\beta c}{4f}$ $\beta = 0.4126$

Simulations Super Fish and IBsimu

$$E_r(r,z,t) = j\sum_{n=-\infty}^{\infty} E_n \frac{k_n}{K_n} J_1(K_n r) e^{j(\omega t - k_n z)}$$

200Kev, 1 cavity





$$\omega t \approx w\frac{z}{v} = \frac{2\pi z}{\beta}\frac{f}{c}$$

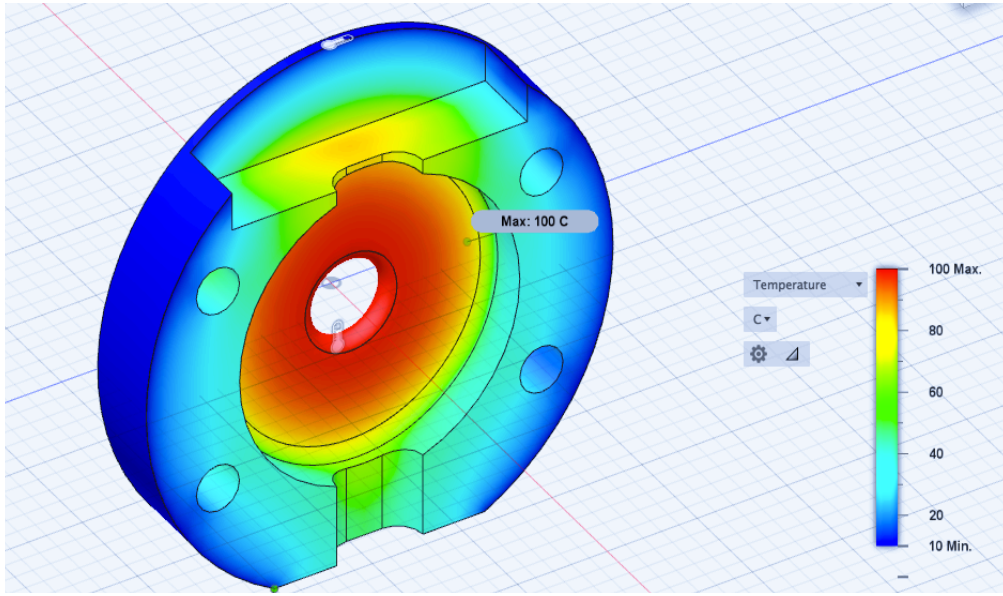
$$\beta = 0.6953$$

Simulations Super Fish and IBsimu

$$\Psi(w + f_w\,\Delta t, p_w + g_w\,\Delta t, t + \Delta t)\,\Delta A_Q = \Psi(w, p_w, t)\,\Delta A_P$$

Mechanical Design

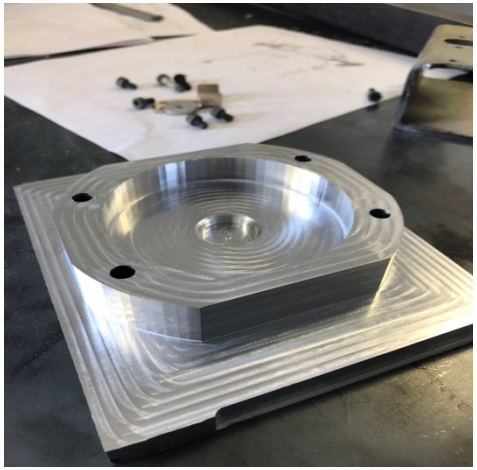
- After design the cavities to resonate in the proper frequency a mechanical design is needed to put together the system
- Vacuum Tests in CINVESTAV



100 C Thermal Load in the cavity Iris

Workshop

- Thanks to CONACYT projects and the collaboration of Ildefonso Leon with Parque de innovacion tecnologica we have to our disposal a workshop to fabricate the parts



CERN COLLABORATION

- The collaboration with CERN is concerning two of the LHC Linacs

- Linac4 in the Source department
- Linac3 in beam dynamics and realistic simulations of Heavy ion beam transport

CERN donates RF ion source to UA Sinaloa

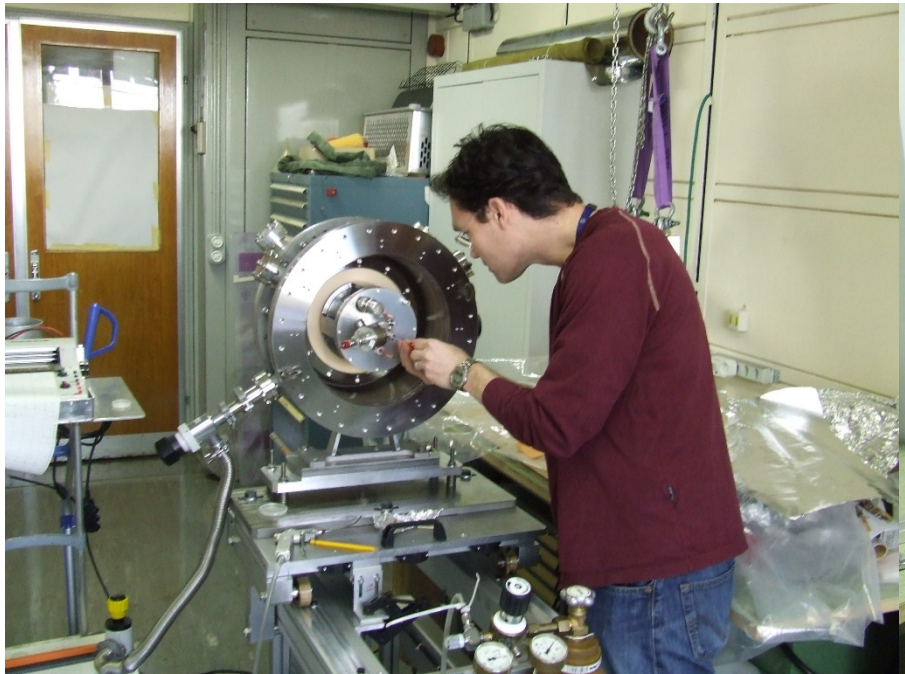
Linac4 H^- source prototype built by CERN-DESY collaboration, put into service in 2008; no longer used at CERN now

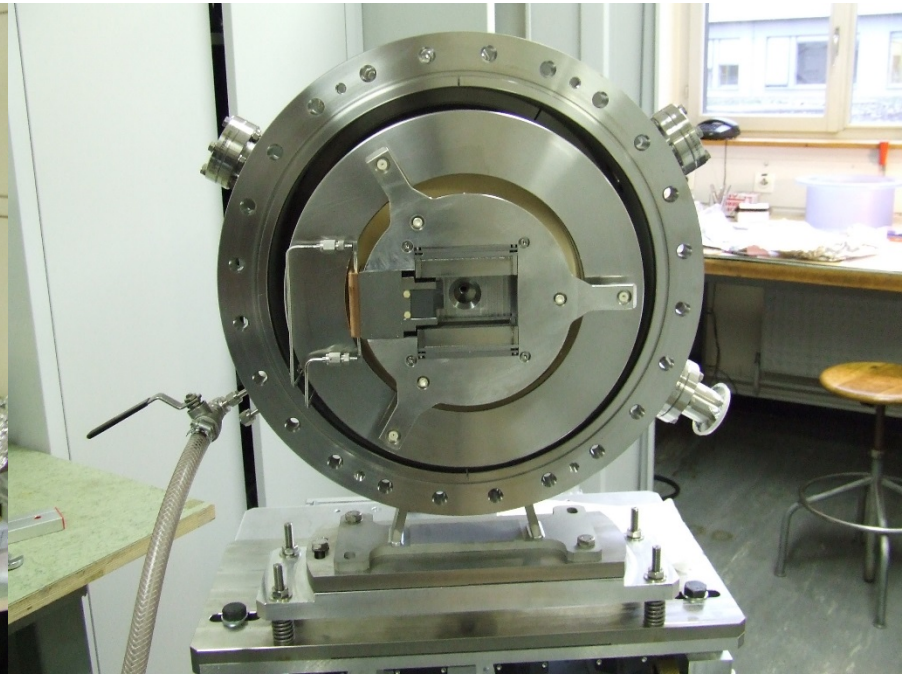
ion components shipped to Mexico (estimated value 250 kCHF)

(1) ceramic plasma chamber, (2) magnetic circuits, (3) RF antenna, (4) injection flanges with ignition gap, (5) ceramic isolation disks, and (6) front-end chamber

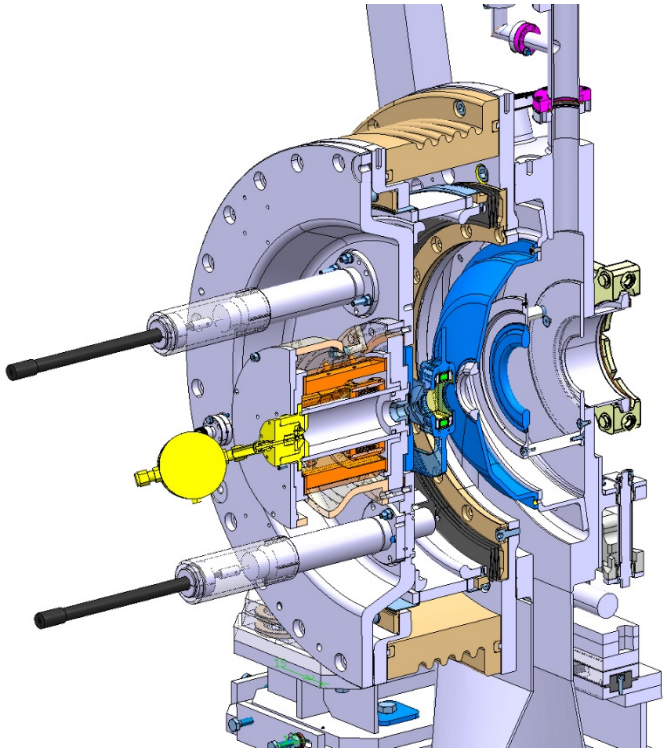
Ion Source applications at the Universidad Autonoma de Sinaloa:

boosting the training of students in producing charged particle beams, electronics for beam instrumentation and detector construction



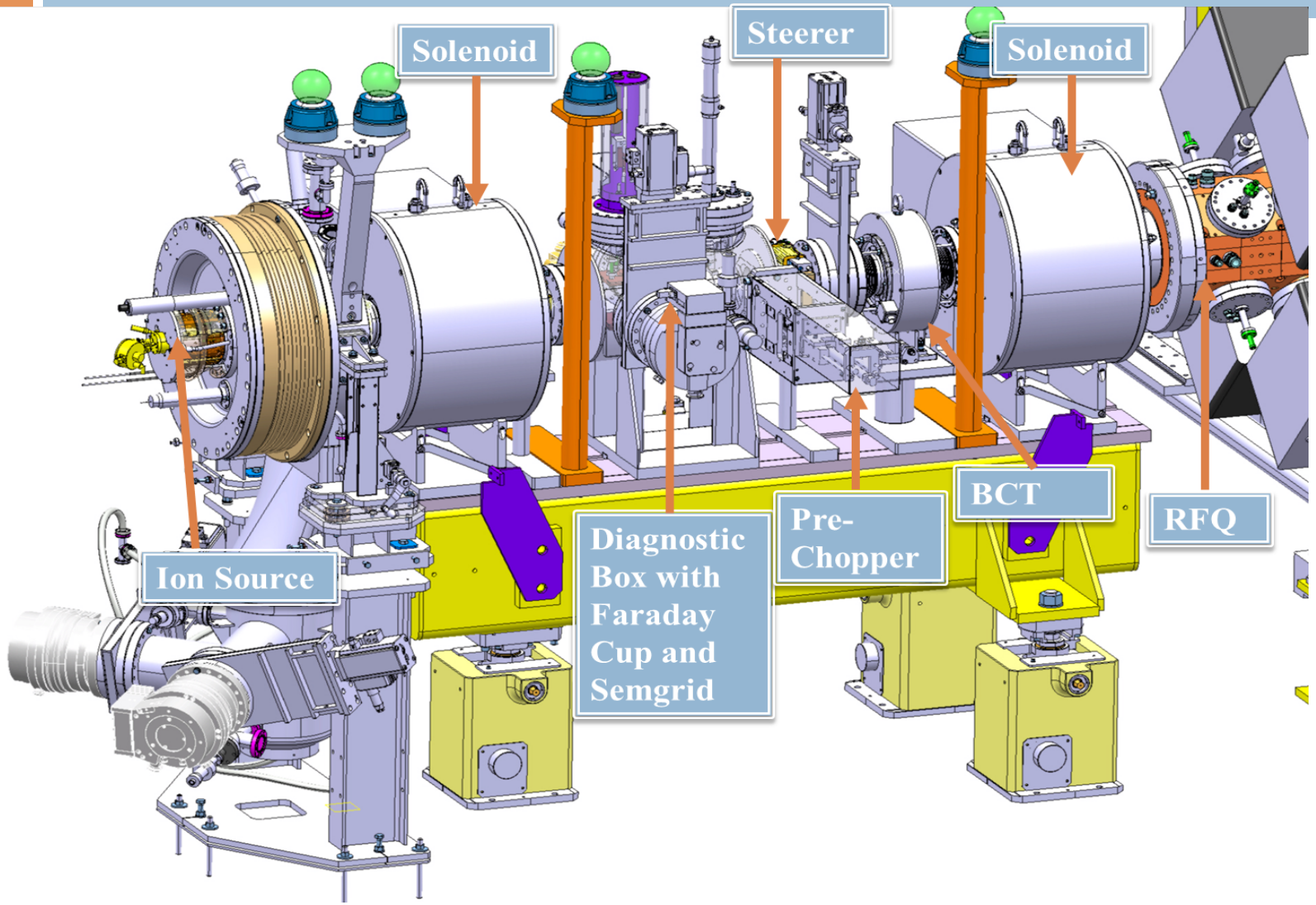


Linac4 Source IOS-01



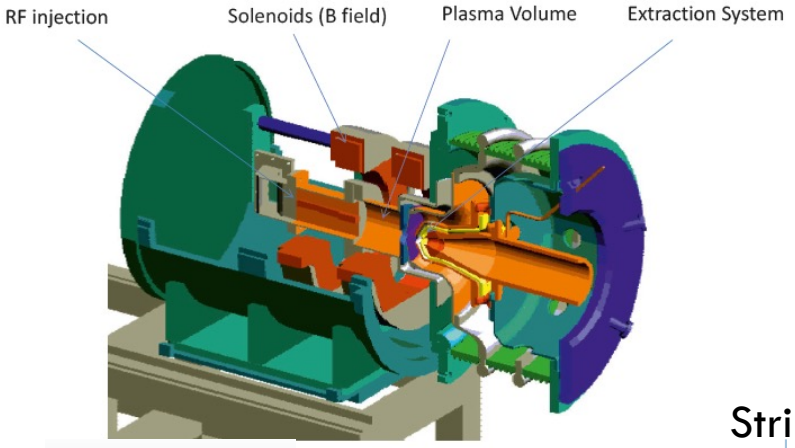
- It deliver up to 20 mA of H- and 100 mA of protons. (máximum ion beam current in mexico 100 nA)
- The collaboration includes the the design of the missing equipment.
- In proton mode can achieve up to 50 KeV and 35 KeV in negative ions.

Beam Line


Solenoid
Steerer
Solenoid
Ion Source
Diagnostic Box with Faraday Cup and Semgrid
Pre-Chopper
BCT
RFQ

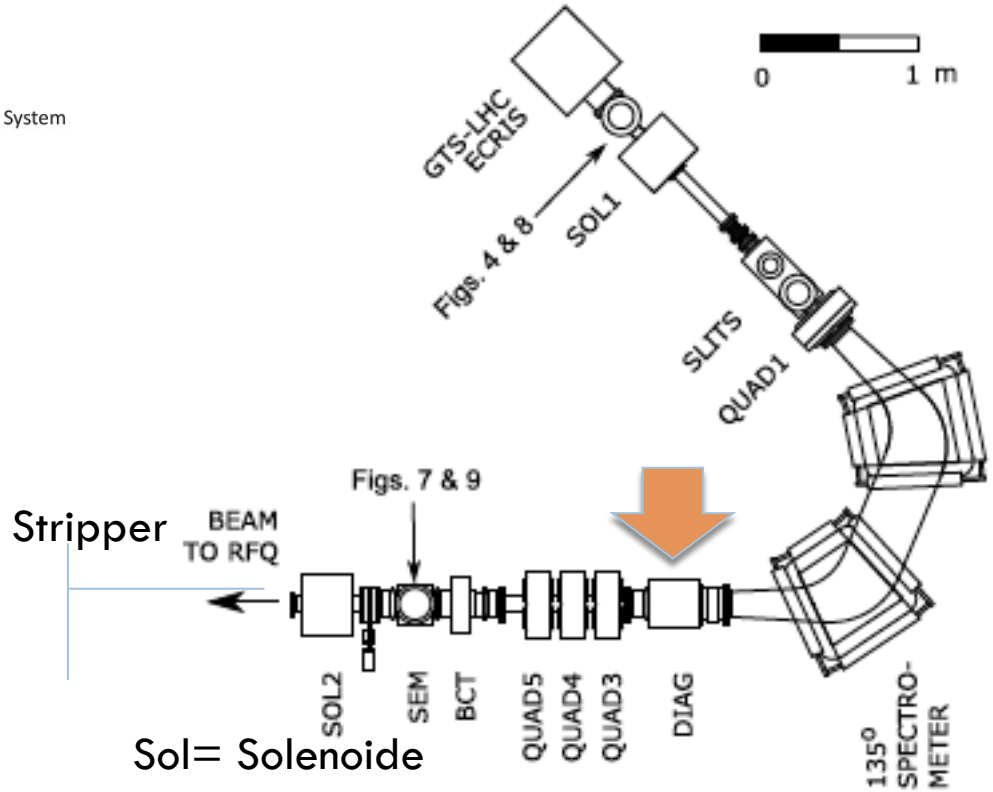
Linear Acelerator 3 (Linac3)

- The heavy ions are created in a ECR source



LIU - LHC Injectors Upgrade Project

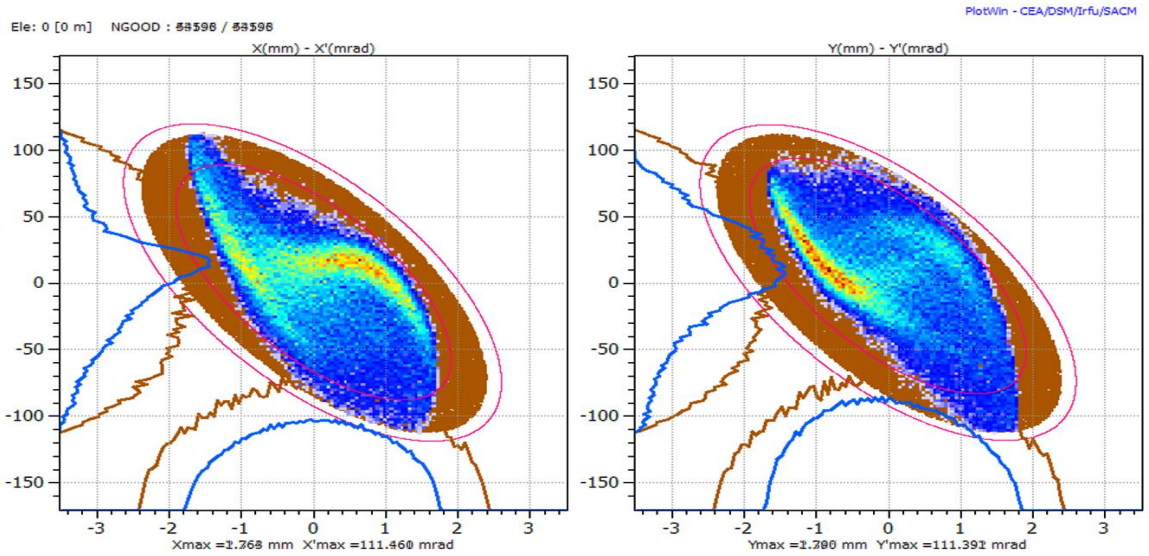
R. Scrivens DetlefKuchler



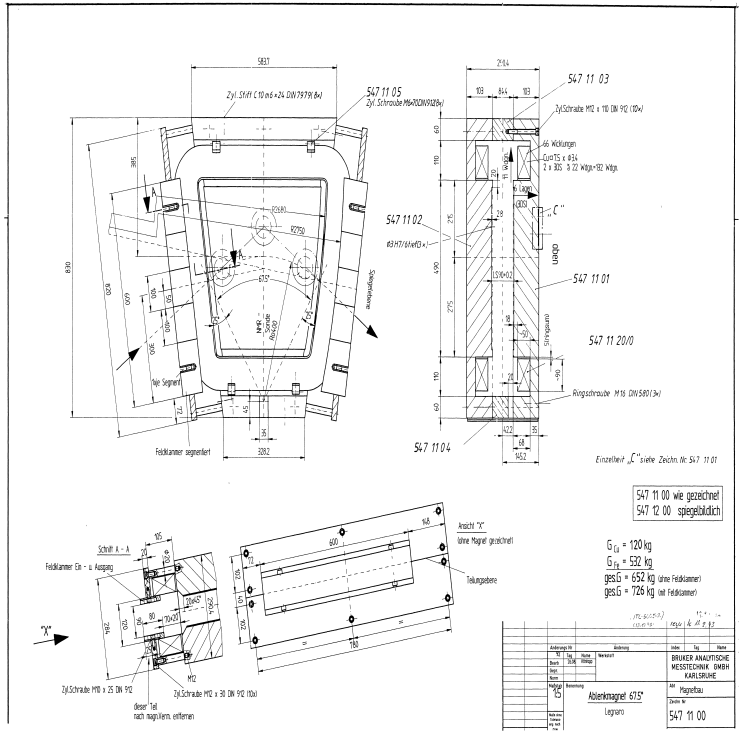
Sol= Solenoide
Diag=Diagnostic Chamber
Quad=Quadrupole
BCT=Beam Current Transformer

Lead 29

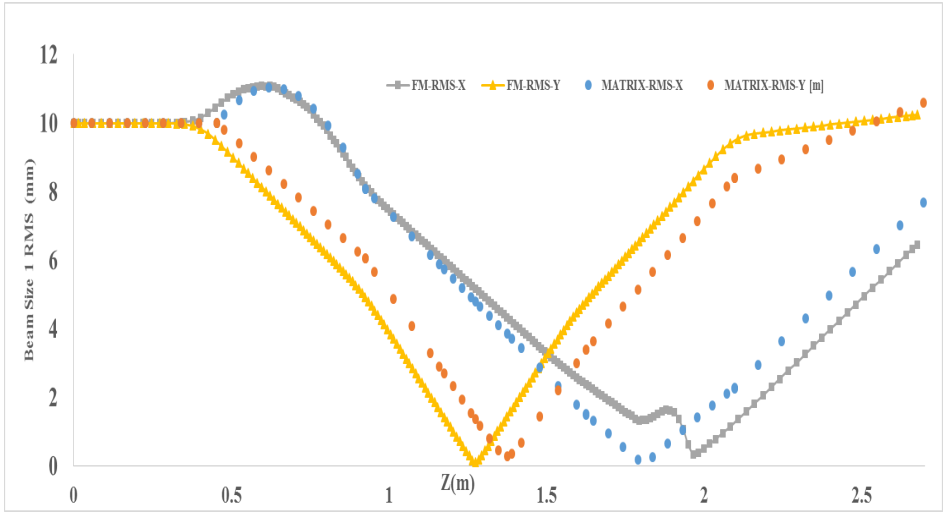
- The ion source deliver a beam that contains many species of particles O, C ,H,Pb
- To match the beam to the acceleration cavities the Pb^{29} is the particle that we need to take from the source
- How?

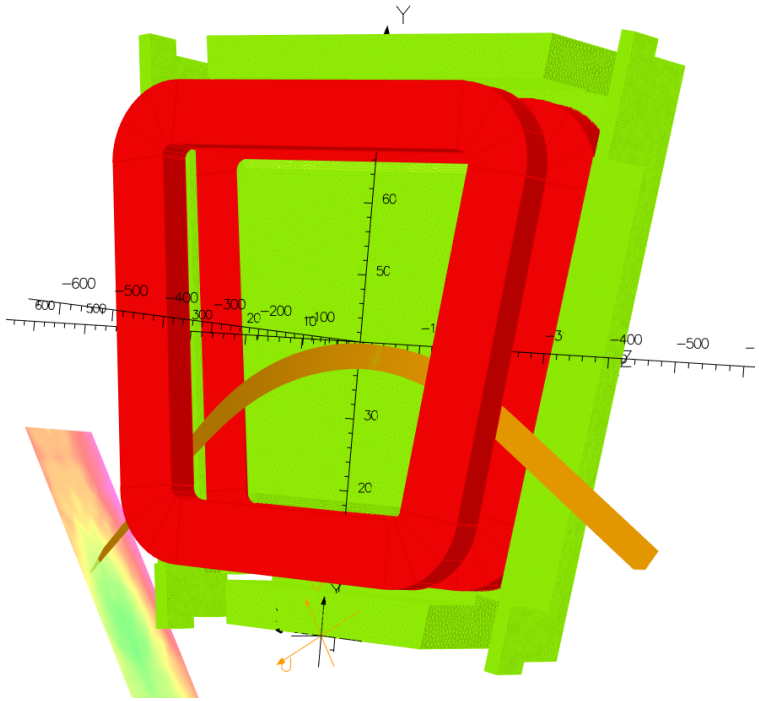


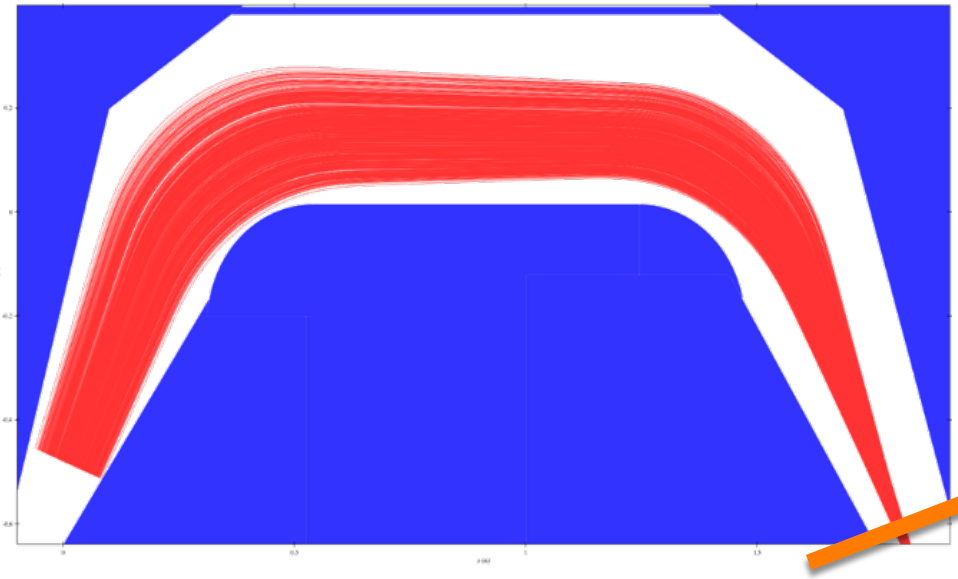
Linac3 Spectrometer



Matrix and new simulation comparison





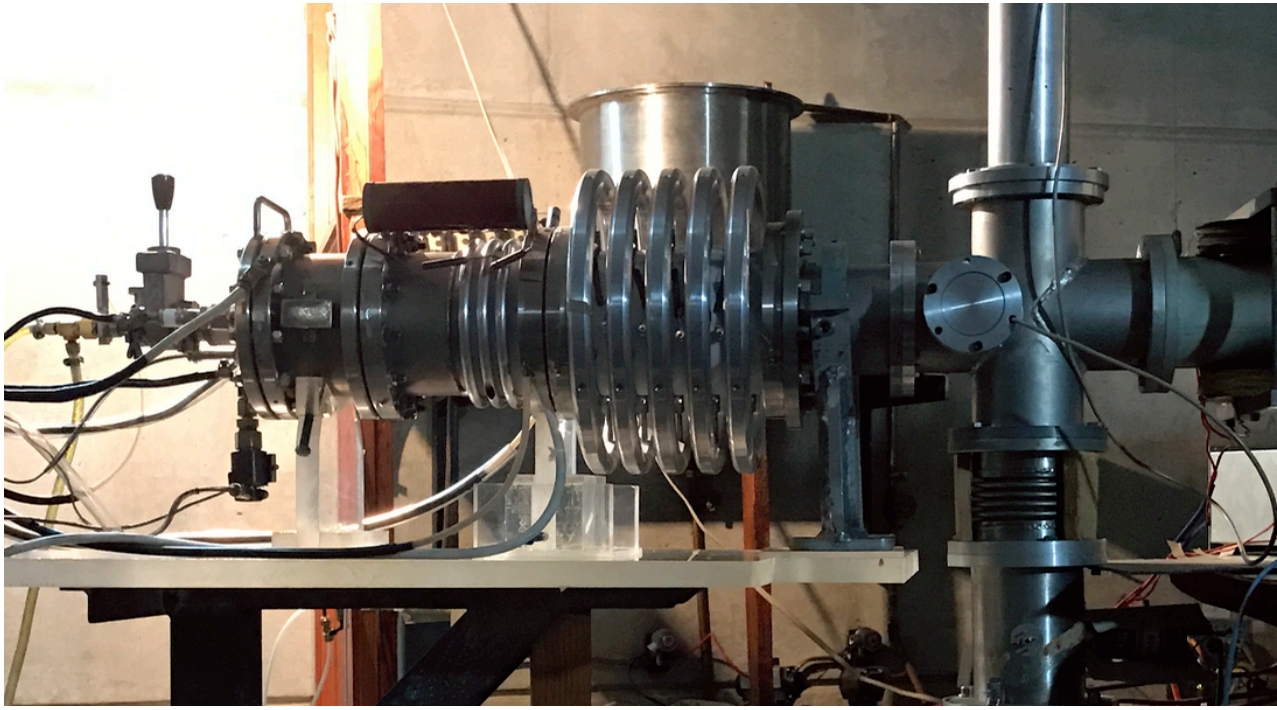


Plane to compare the beam profiles

Instituto nacional de investigaciones Nucleares Ion Source

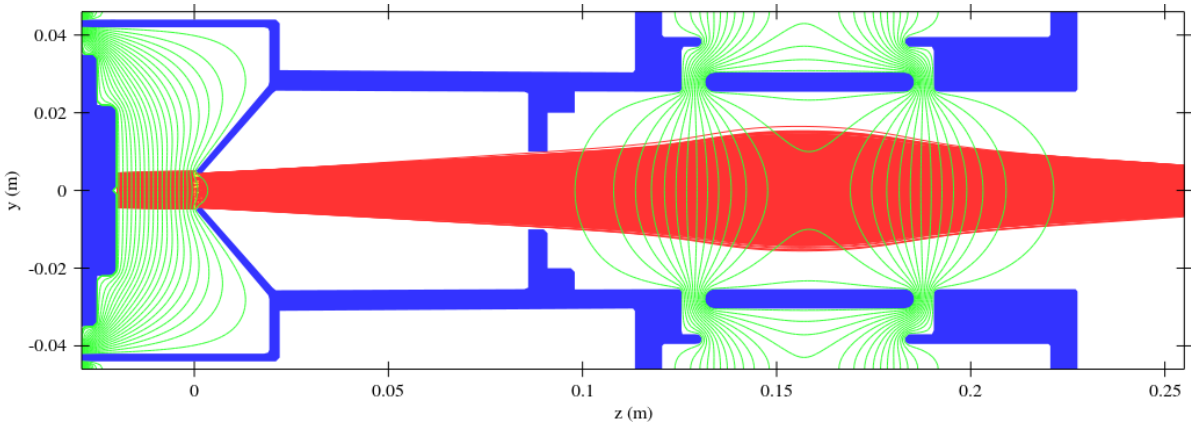
- Snic Type Ion Source

- Max Current 30 nA
- Emittance ?



ININ Ion Source

- There are two ion Linacs at Instituto Nacional de Investigaciones Nucleares
- A profound research need to be done to increase the beam intensity in the source and improve the extend of its research.



Ion source 3-D Simulation with beam intensity at 50 nA

Vlasov equation used to solve the system

$$\frac{\partial \Psi}{\partial t} + \boldsymbol{f}\,\nabla_r \Psi + \boldsymbol{g}\,\nabla_p \Psi = -\left(\nabla_r \boldsymbol{f} + \nabla_p \boldsymbol{g}\right)\Psi$$

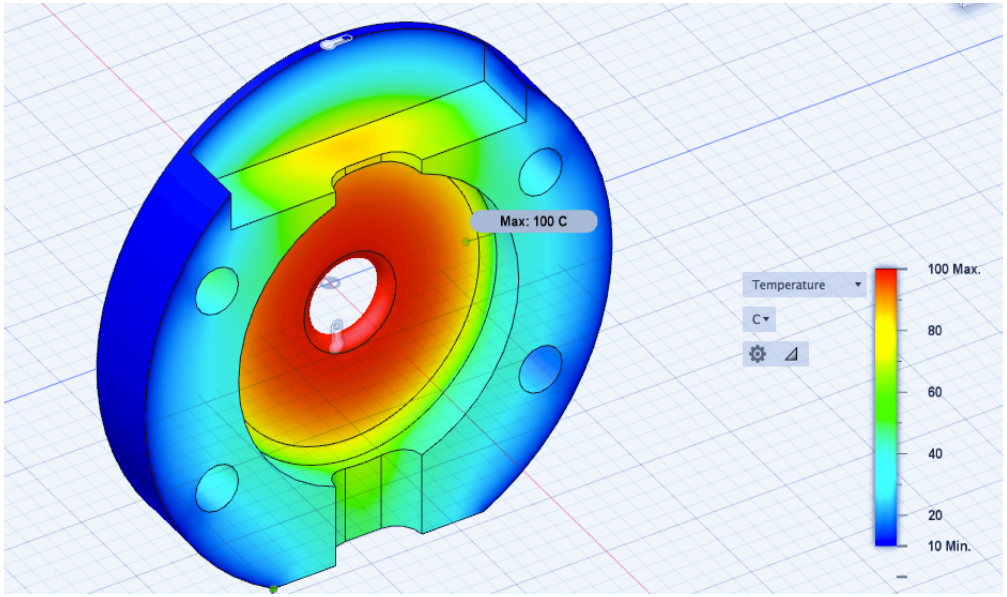
Conclusions

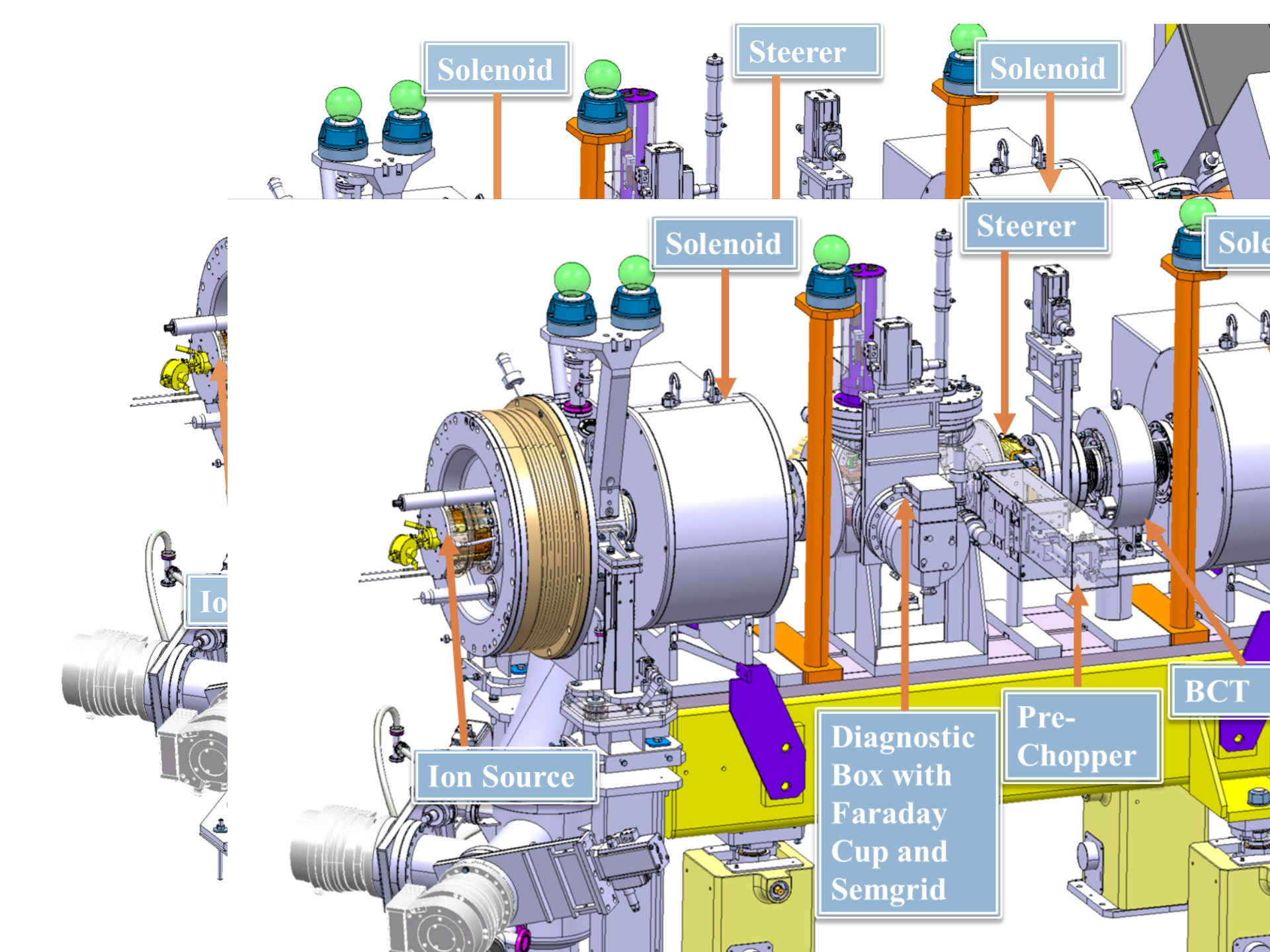
- With the acquired knowledge so far, it is possible to start small projects.
- There are outgoings collaborations related to accelerator physics between international institutes and Mexican universities
- SINALOA-CERN,LINAC4-LINAC3
- SINALOA-CINVESTAV
- SINALOA-ININ
- • A closer collaboration with the industry is necessary to develop all the technology.

Thank you for your attention !!

General Description

- Electron Gun UAS
- Ion Source CERN-UAS
- Source UAS-ININ
- Summary




Solenoid
Steerer
Solenoid
Solenoid
Steerer
Ion Source
Diagnostic Box with Faraday Cup and Semgrid
Pre-Chopper
BCT