BEAM PARTICLE SOURCES RESEARCH AT UNIVERSIDAD AUTÓNOMA DE SINALOA

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

- Several charged particle source related research and projects are 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 and industrial applications.
An electron Linac is under design within the university.
Taking into account the electromagnetic fields and mechanical constraints.
Several CNC machines are ready to be used and milling the cavity parts.
Simulations – 50Kev, 1 cavity

Electromagnetic field data from file ONECAVITY1.AF
Problem title line 1: 2990.0-Hz TM010 Modified Fillbox Cavity

\[ E \cos \omega t \]

\[ \omega t \approx \frac{\pi z}{\nu} = \frac{2\pi z}{\beta} \frac{f}{c} \]

\[ \omega t = \frac{\pi}{2} \Rightarrow z = \frac{\beta c}{4f} \]

\[ \beta = 0.4126 \]

\[ E_r(r, z, t) = j \sum_{n=-\infty}^{\infty} E_n \frac{k_n}{K_n} J_1(K_n r) e^{j(\omega t - k_n z)} \]
200Kev, 1 cavity

Simulations Super Fish and IBsimu

\[ \omega t \approx \omega \frac{r}{v} = \frac{2\pi z}{\beta} \frac{f}{c} \]

\[ \beta = 0.6953 \]

\[ \Psi(w + f_w \Delta t, p_w + g_w \Delta t, t + \Delta t) \Delta A_Q = \Psi(w, p_w, t) \Delta A_P \]
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. (máximo 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
The heavy ions are created in an ECR source.
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:

\[
\frac{\partial \Psi}{\partial t} + f \nabla_r \Psi + g \nabla_p \Psi = - (\nabla_r f + \nabla_p g) \Psi
\]
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