ID: MOPLR060

CIADS NORMAL TEMPERATURE FRONT-END DESIGN

W.L.Chen, Y.He, Z.J.Wang, W.P.Dou, Y.S.Qin, H.Jia S.H. Liu

Institute of Moden Physcis, Chinese Academy of Sciences, Lanzhou, Gansu 730000, China

Abstract

CIADS project is a strategic plan to solve the nuclear waste problem and the resource problem for nuclear power plants in China. The linac will accelerate 10mA proton beam from 35keV out of ECR ion source to 600MeV. For CIADS driven linac, which is a 6 MW machine, the most critical issue is the beam loss control. The RT section producing good beam performance for SC section is beneficial for beam loss control. LEBT and RFQ will respectively be used to provide good quality beam in transverse and longitudinal.

1 Introduction

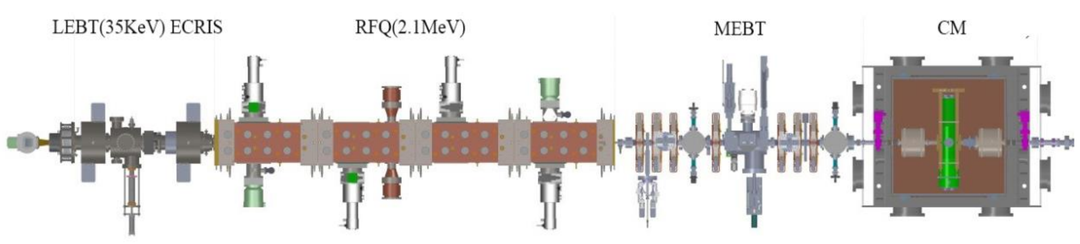

Figure 1. The layout of the ADS LEBT and parts of RFQ.

1. Unwanted particles: H_2^+ and H_3^+
2. H_2 removal from the ion source to the downstream
3. Good beam quality to SC section
4. More online beam diagnostics tools

2 LEBT System

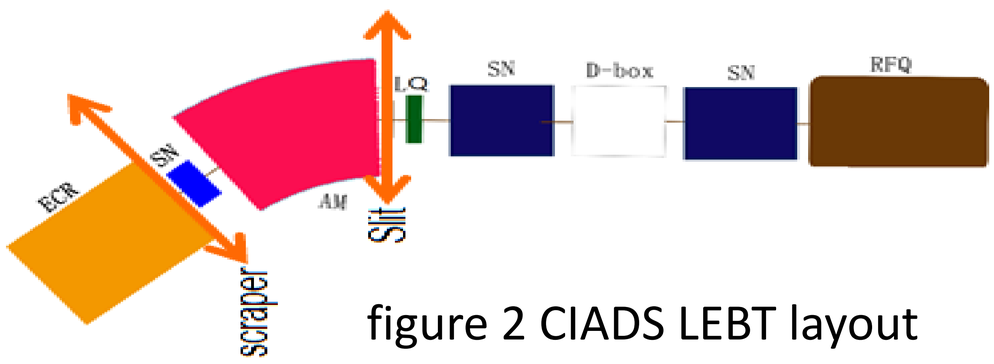

figure 2 CIADS LEBT layout

1. To scrap the unwanted partilcles, the bending magnet rotation angle and edge angle is chosen with 20° and 6° .
2. A “point source” concept is proposed in CIADS LEBT design to improve the solenoid spherical aberration.
3. With aperture achieve the beam current adjusting, and improve the beam quality.

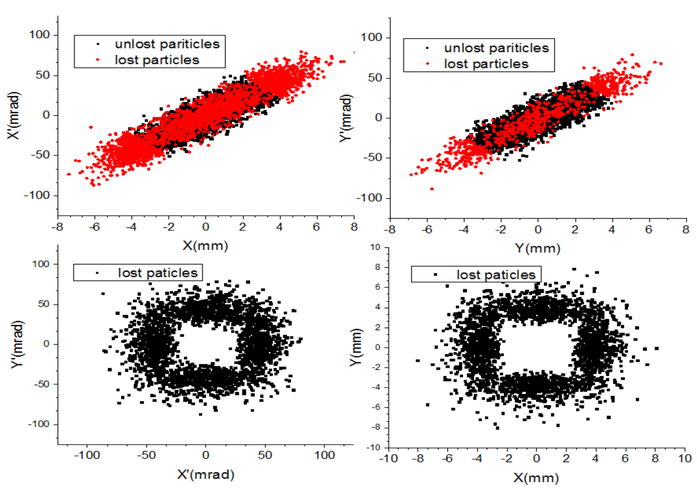

figure 3 Point source simulation

the outer particles is stroked off from the initial beam just by one aperture, which are the parts of the beam with relatively large beta and Aleph.

3 RFQ System

The RFQ for C-ADS injector II was designed by collaboration between LBNL and IMP. The ratio between maximum emittance and RMS emittance is about 45, And it still meets C-ADS injector II requirements. But for the CIADS which is a high power machine, a good longitudinal beam quality is critical for the downstream SC section. The beam loss may occur because of the large longitudinal emittance. The maximum longitudinal emittance is the main issue which need to be considered. Basd on the above consideration, the new beam dynamics scheme has preliminary achieved a smaller total longitudinal emittance.

Table 4.compare between the injector II and CIADS RFQ

Parameters	RFQ for Injector II	RFQ for CIADS
Inter-vane Voltage(kV)	65	70
KP factor	1.2	1.32
Min.aperture (mm)	3.2	3.33
Modulation	1-2.38	1-2.19
Syn.Phase (deg)	-90 ~ -22.7	-90 ~ -25
Long.Emittance _rms (keV ns)	0.0534	0.0506
Long.Emittance _max (keV ns)	2.4267	1.9156
Proton fraction	>95	%
Lcavity/Lelectrode (cm)	420.8/419.2	450
Transmission	99.6	99.4
Cell number	192	247

4 MEBT System

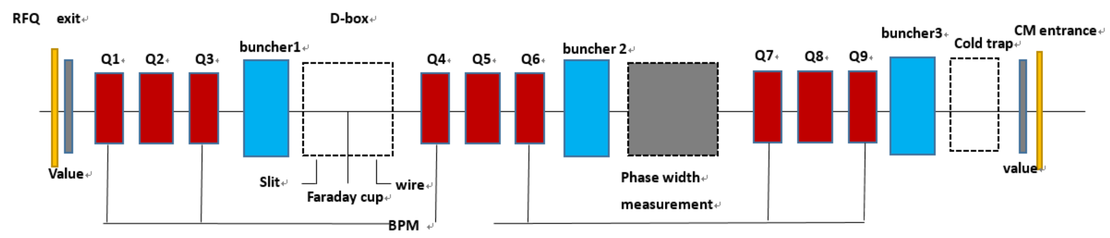

Figure 5 CIADS MEBT layout

Table 2. TWISS parameters before and after MEBT

Twiss Parameters	RFQ exit	SC entrance
α_x	0.3	-0.58
$\beta x(mm/pi.mrad)$	0.25	0.57
α_y	-0.11	-0.58
$\beta y(mm/pi.mrad)$	0.11	0.57

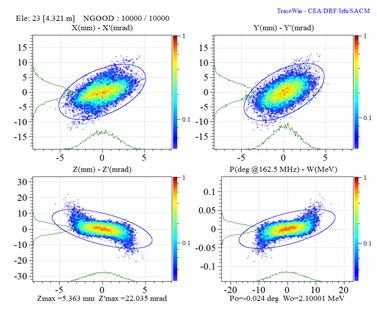

Figure 6 phase space out of MEBT

5 SUMMARY AND CONCLUSIONS

The beam dynamics design of RT section and SC section for CIADS linac are presented, and a new RFQ with small longitudinal emittance is proposed to improve beam transport and accelerating efficiency