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A standalone radio frequency quadrupole accelerator for swift heavy ions

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The radio frequency quadrupole (RFQ) is known for bunching, focusing and acceleration of ion beam and more importantly, it does not require transverse focusing element like quadrupole magnets between accelerating cells compared to drift tube linacs. By pushing the limits of handling surface electric field between RFQ vanes, it is possible to make a standalone 352 MHz RFQ reaching 1.8 MeV/u energy gain for swift heavy ions upto mass to charge ratio (A/q) ≤ 4. Special RFQ vane material of cryo Cu*is considered by which surface electric fields can be pushed around 50 MV/m** and the whole RFQ is designed within a length of 5m which is substantially less than any RFQ + DTL combination of equivalent energy gain accelerator for heavy ions. Such systems are highly promising for compact medical LINACS and as well as standalone facilities for nuclear physics experiments. The adiabatic bunching and focusing inherently stabilize the beam dynamics at proper RFQ power and cavity tuning. We present the beam optics design using PARMTEQ code and RFQ cavity design along with thermal analysis using CST MWS. The error analysis is provided to support the design in terms of practical feasibility.

Footnotes

*Dimov et. al, Beam Commissioning of the 750 MHz Proton RFQ for the LIGHT Prototype, 9th IPAC, Vancouver, Canada, 29 Apr - 4 May 2018, pp.TUPAF002.**Lombardi et. al, Beam dynamics in a high frequency RFQ, 6th IPAC2015, Richmond, VA, USA, PP. WEYB2.

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