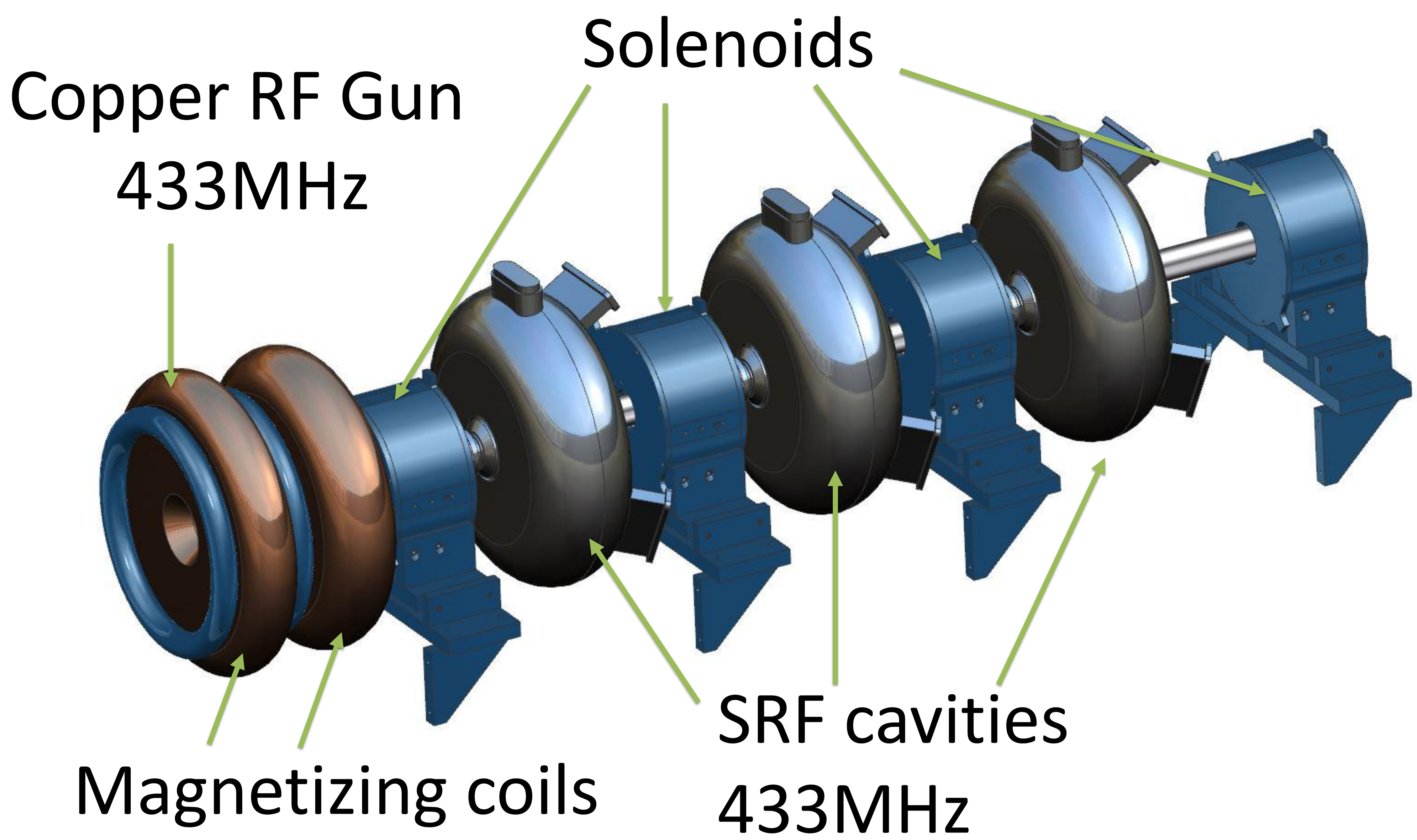
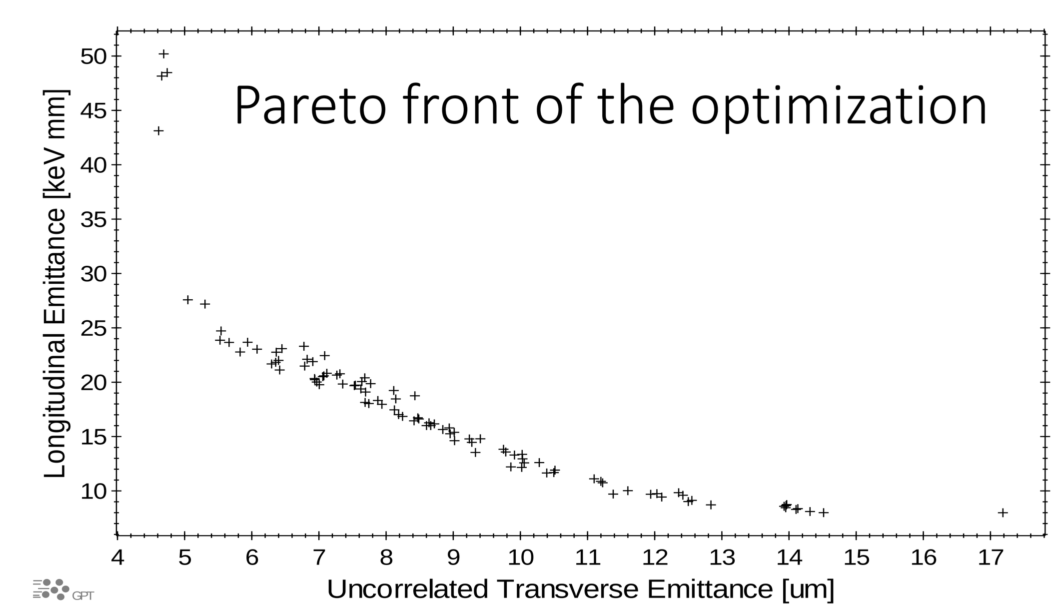
A NORMAL CONDUCTING RF GUN AS AN ELECTRON SOURCE FOR JLEIC COOLING

Parameter	
Energy at the cooler	20-55 MeV
Bunch charge	3.2 nC
CCR bunch frequency	476 MHz
Bunch length at cooler (full)	2 cm
Injector bunch frequency	43.3 MHz
Drift emittance	36 mm mrad

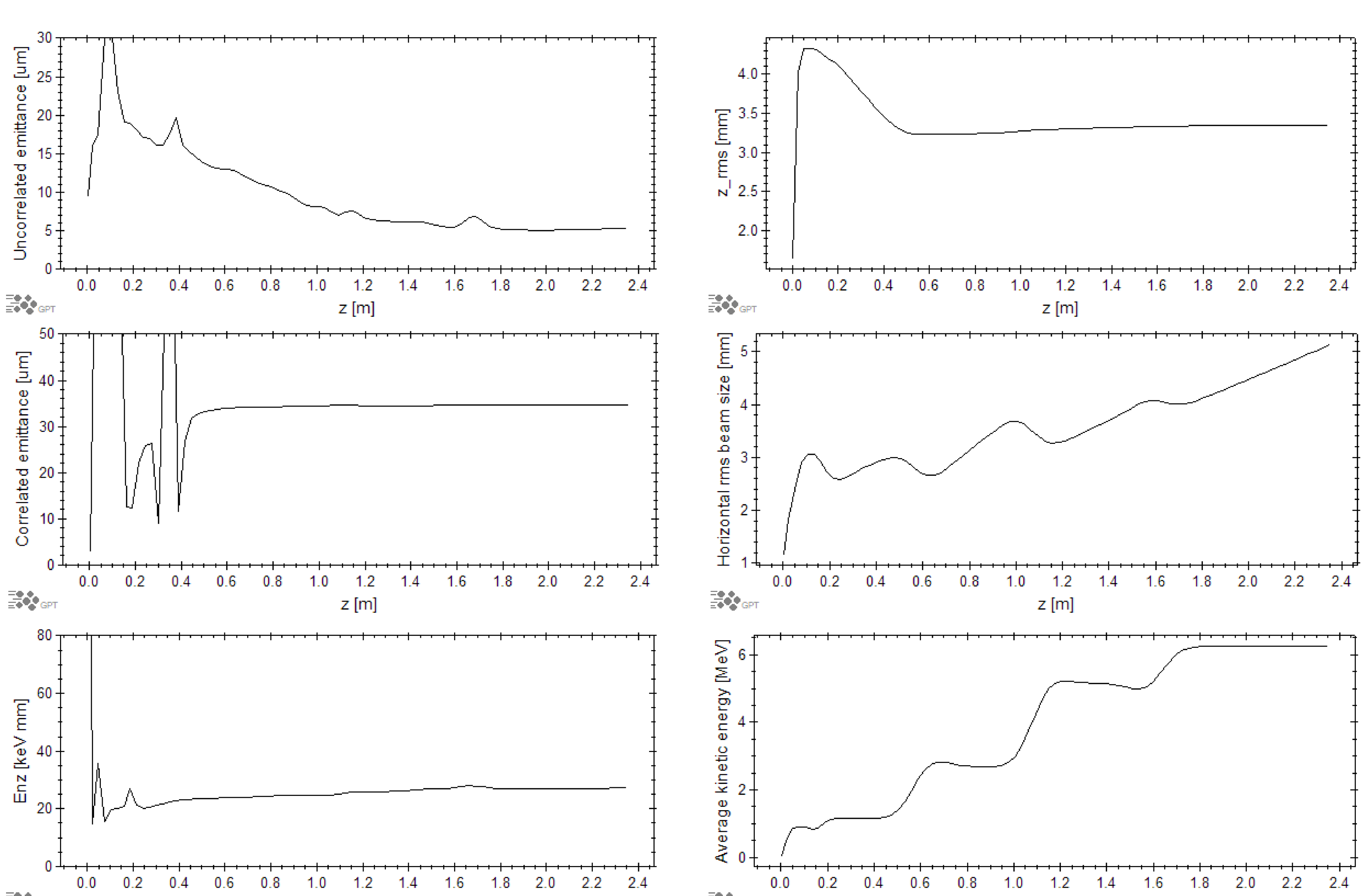
The baseline design assumes that beam current is delivered from a multi-alkali photocathode inside a 400kV DC electron gun. The typical gradient on the cathode is ~4.3MV/m in this gun. The complete beam parameters for the injector are listed above. Previously reported results from this design indicate that in order to deliver 3.2nC, the transverse emitting area should be large and the bunch length long, 1cm diameter and 143ps rms respectively. It was also noted that while the bunch is at low energy, below ~2 MeV, space charge forces dominate both transversally and longitudinally, whereas after this soft limit, angular momentum dominates transverse properties. **The supposition with substituting the DC gun for an RF gun is that the higher cathode gradient and exit energy will both allow for greater flexibility and performance of the injector.**





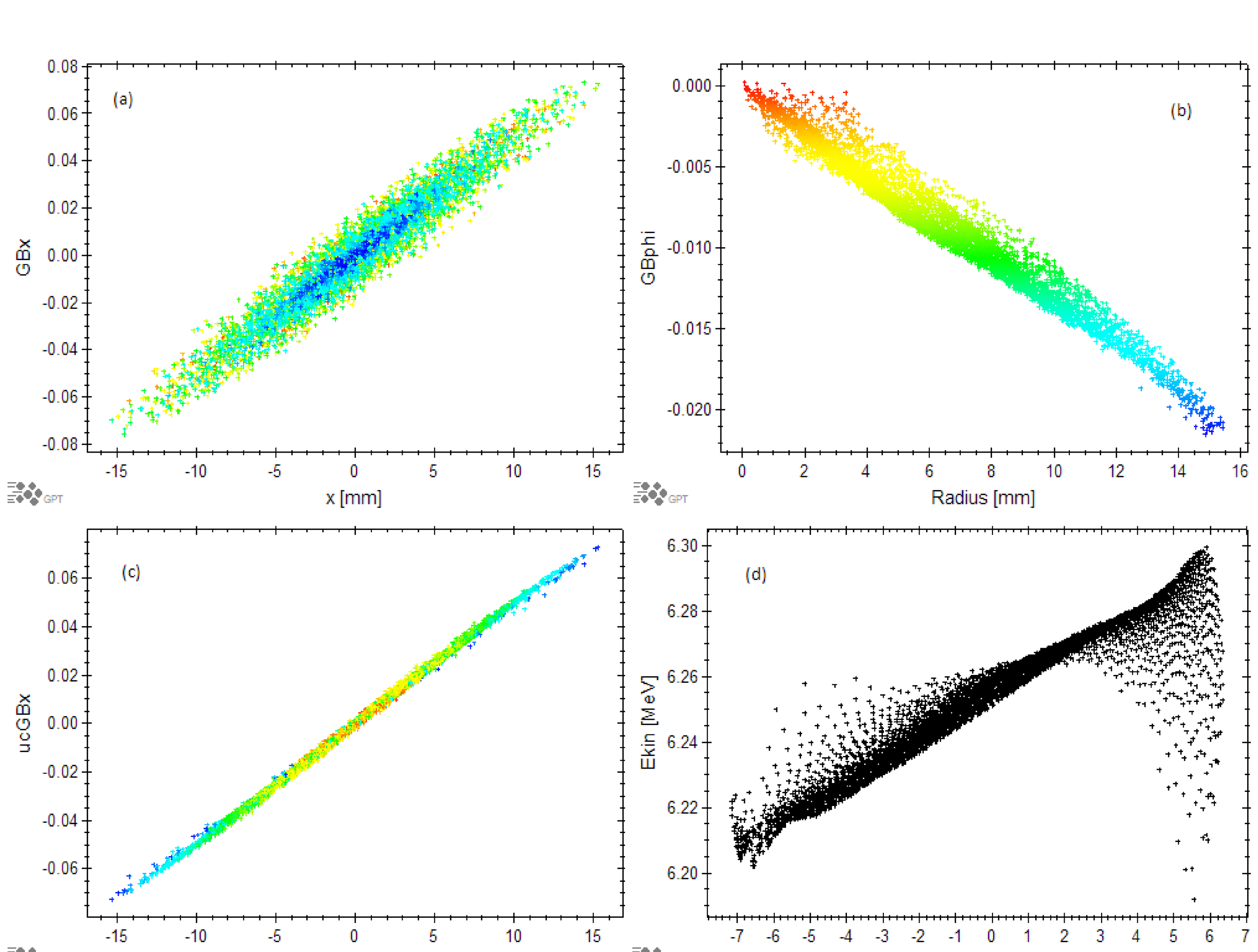
OPTIMIZATION RESULTS

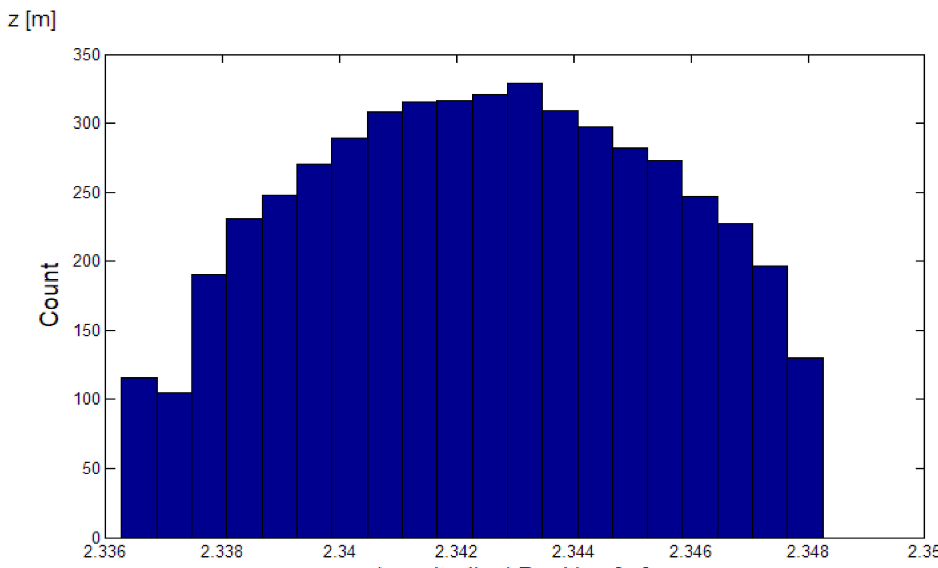
The objectives of the optimization were to minimize both longitudinal and transverse emittance. Specifically the aim was to minimize the uncorrelated portion of transverse emittance whilst maintaining the correlated drift emittance of 36μm. The Pareto front is shown above, depicting a minimum achievable transverse uncorrelated emittance of ~5μm and a low longitudinal emittance in the range of 10-50keV mm. The transverse phase space is shown in the bottom left (a), which indicates that emittance compensation has been achieved. Furthermore, with simulation is it possible to view the uncorrelated transverse emittance, (c). This is the emittance that would be evident in the cooling solenoid. (b) depicts the radius versus angular momentum, which shows that the magnetization is well preserved through the beamline as this is both narrow and linear. The l ongitudinal bunch profile is shown in blue, which follows the truncated Gaussian temporal shape of the assumed laser on the cathode. This suggests that with a temporal uniform distribution that there is the potential to maintain this desirable shape, which improves cooling and CSR degradation in the CCR.



RF – DC GUN COMPARISON

	RF Gun	DC Gun
Injector energy	5.84 MeV	6.8 MeV
Bunch charge	3.2 nC	3.2 nC
Uncorrelated transverse emittance	6.8mm mrad	7mm mrad
Bunch length rms	4.4 mm	4.03 mm
Longitudinal emittance	27 keV mm	26keV mm
Injector length	2 m	5 m





DISCUSSION & CONCLUSION

The results of this preliminary investigation do not show a clear-cut advantage to using an RF photoinjector source over DC guns. There is benefit to fewer components required and a shorter injector length. The acceleration to MeV range energy in the RF gun offers improvements to the longitudinal profile and magnetization, but these must be quantified and propagated through the CCR to see possible gains globally. Further research will include the effects of uniform laser distributions and higher gun voltage

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