EM Implosion Memos

Memo 47

May, 2010

Revisiting ODU's requirements from the PSIRA

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Abstract

The parameters desired by ODU from the final, experimental realization of the PSIRA are summarized. It is shown that the PSIRA system designed, with the focusing and launching lenses, meets all the requirements.

1 Introduction

The basic PSIRA system can be thought to consist of three major components: (1) reflector, (2) focusing lens, and (3) launching lens. The T4FASC-CSS-SPVSHC and T4FASC-CSS-CPVCHC launching lenses designed and optimized in [1–5] complete the conceptual realization of the PSIRA system.

2 Requirements

The peak electric field focal impulse amplitude, $E_{\max}$, and spot size for the launching lens designs, with the focusing lens ($\epsilon_{r_{\max}} = 9.0$), are summarized below [5],

Table 1: $E_{\max}$ and spot sizes for the launching lens designs

Configuration	$E_{\max}$ (V/cm)	Spot diameter (cm)	Spot area (cm^2)
T4FASC-CSS-SPVSHC	0.22	1.45	1.65
T4FASC-CSS-CPVCHC	0.19	1.54	1.86

The primary application of the PSIRA system is intended for treatment of skin cancer (melanoma). The expectations of our collaborators at ODU, from the PSIRA, are summarized in Table2[1]. For

Table 2: Parameters expected from the PSIRA by ODU

Parameter	Requirement
FWHM	$\leq$ 200 ps
Peak impulse amplitude	20-50 kV/cm
Spot area	$\leq$ 1 cm^2
Frequency (repetition rate)	$\gtrapprox$ 10 kHz
Duration	5-10 mins

the PSIRA system designed, with the focusing and launching lenses, the FWHM is well below 200 ps, even after allowing for dispersion inside the lens materials. To obtain a 20 kV/cm peak impulse amplitude requires an input of approximately 20/0.2 kV = 100 kV or more, which is quite easily achieved in practice (the actual input voltage is likely much greater to account for experimental losses, such as losses in the lens materials). As observed in Table 1, the spot areas are approximately twice that of the desired values. However, a ten layer focusing lens would bring this down to the millimeter range. The duration of 5-10 mins is also practically achievable. The most challenging constraint is the frequency or repetition rate. With the current technology, the maximum frequency of the switch discharge is only a few 100 Hz with a maximum of 1 KHz[2].

[1]Personal communication with Shu Xiao, ODU

[2]Personal communication with Mike Skipper, ASR Corporation

3 Conclusion

The repetition rate is the only limitation of the PSIRA system. However, if this is not much of a concern, the electric field and spot size parameters of the PSIRA are well within the desired ranges and as such this is extremely useful for preliminary investigations.

References

[1] Prashanth Kumar, Carl E. Baum, Serhat Altunc, Christos G. Christodoulou and Edl Schamiloglu, "The truncated four feed-arm configuration with switch cones (T4FASC) and a spherical pressure vessel." EM Implosion Memo 42, May 2010.

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[4] Prashanth Kumar, Carl E. Baum, Serhat Altunc, Christos G. Christodoulou and Edl Schamiloglu, "Optimization of the T4FASC-CSS-SPVSHC and T4FASC-CSS-CPVCHC configurations." EM Implosion Memo 45, May 2010.

[5] Prashanth Kumar, Carl E. Baum, Serhat Altunc, Christos G. Christodoulou and Edl Schamiloglu, " Comparison of electromagnetic parameters for the T4FASC-CSS-SPVSHC and T4FASC-CSS-CPVCHC congurations with the focusing lens." EM Implosion Memo 45, May 2010.