Anti-interference design in Cable SGEMP experiment

Maoxing Zhang, Cui Meng, Meiqing Zhong, Bolun Feng,
Key Laboratory of Particle & Radiation Imaging, Ministry of Education,
The Department of Engineering Physics, Tsinghua University,
Beijing, China.

Abstract—Cable System Generated Electromagnetic Pulse (SGEMP) refers to the phenomenon that X-ray interacts with cable to produce electron, which then excites current and voltage response. The ideal irradiation environment for cable SGEMP experiment is pure X-ray, usually produced by accelerators. But in practice, the accelerator will also produce strong electromagnetic pulse (EMP) radiation when producing X-ray. It will bring difficulties to experimental measurement. This paper presents an anti-interference design in the cable SGEMP experiment, which can effectively reduce the external EMP interference, and reduce the coupling of the electrons emitted by the shield itself to the experimental cable; the real SGEMP response can be deduced through the measured signal.

Keywords- Cable SGEMP, electromagnetic shielding, anti-interference design.

I. INTRODUCTION

The ideal X-ray source for the cable SGEMP experiment is the high current and low-energy pulse accelerator. But in practice, the accelerator will also produce strong electromagnetic pulse (EMP) radiation when producing X-ray [1]. Sometimes the noise caused by EMP is even greater than cable SGEMP response, resulting in the SGEMP response signal being submerged by the noise.

II. ANTI-INTERFERENCE DESIGN

From the above analysis, additional electromagnetic shielding is required for the test cable. However, the addition of shielding will attenuate the X-ray and act with the X-ray to emit electrons, causing new interference to the measured signal. Therefore, this paper proposes an anti-interference design for the cable SGEMP experiment of coaxial cable, considering the negative effects of shielding.

The schematic diagram of anti-interference design is shown in Fig. 1. A layer of metal shield is sleeved on the outside of the test cable and grounded at both ends to shield external EMP interference. And a liner with low atomic number (low-Z) can be attached to the inner side of the outer shield as far as possible to absorb the electrons emitted from the outer shield [2].

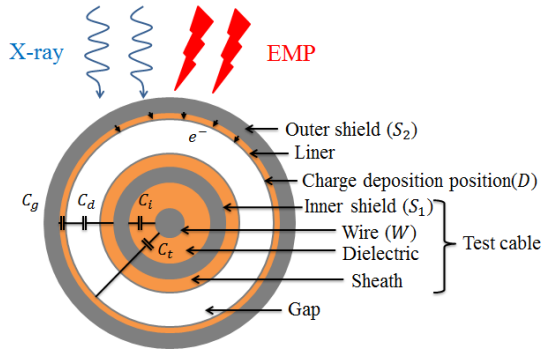

Figure 1. Cross section diagram of test cable and anti-interference design.

III. EXPERIMENTAL VERIFICATION

We conducted cable SGEMP experiments under the accelerator, and treated the same coaxial cable with shielding and without shielding respectively. The measured voltage response of the cable core is shown in Fig. 2. It can be seen that the test cables without anti-interference design will be interfered by strong electromagnetic radiation, and the noise even drowns the SGEMP signal. However, the cables with anti-interference design have good signal-to-noise ratio and achieve the expected effect.

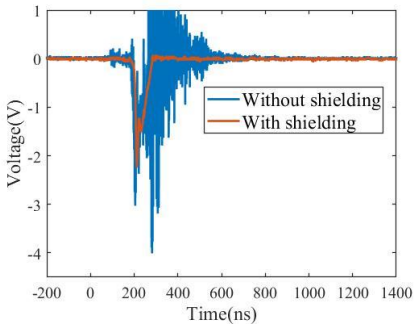

Figure.2. Test cable terminal voltage response with or without anti-interference design

REFERENCES

[1] X.-L. Fan. “Preliminary Research on Electromagnetic Radiation during Operation of Intense Electron-Beam Accelerator,” M.S. thesis. Dept. Optoelectronic Sci. Eng., National University of Defense Technology, Changsha, China, 2011.p. 63.

[2] B.-X. Chen, Z. Zhang, “Interaction between radiation and matter,” in Nuclear Radiation Physics and Detection Science, 1st ed., China: Harbin Engineering University Press, 2011, pp. 171–184.