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High-efficiency traveling-wave accelerating structure with ceramic insertion

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In a radiofrequency accelerating structure with ceramic insertion, high shunt impedance (162 megaohm/m) and high group velocity (3.1% of the speed of light) are achieved simultaneously. The ceramic insertion is in the form of a cylinder, sandwiched between copper endplates with the beam aperture opened at the center. We report our theoretical study on this novel type of traveling wave accelerating structure that operates with a 2pi/3-mode at 5.7 GHz. The high shunt impedance is realized by the low-loss, highly reflective ceramic insertion confining the accelerating mode at the center. The high group velocity, or fast filling time of the radiofrequency wave, is made possible by the side coupling slots designed with large dimensions. As a result, this novel traveling wave accelerating structure enhances the power efficiency significantly, by two means. The high shunt impedance allows providing a greater accelerating gradient with a given amount of radiofrequency power. The fast filling time allows an earlier start of the beam acceleration within each radiofrequency power pulse, thus leading to a higher duty factor of the accelerator beam production. This type of the structure design allows using metallic iris features, which minimizes the electric field magnitude witnessed by the ceramic component. We also discuss the scheme of using periodic permanent magnets to focus an electron beam in the accelerating structure. The unique radiofrequency coupler design is also addressed.

Footnotes

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