Traveling Waves along the Metasolenoid

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A new magnetic particle called "metasolenoid" was introduced in [1, 2], see Figure 1. It consists of a stack of closely packed metallic single split-ring resonators. In the lowest-order resonant mode the metasolenoid can be used as a magnetic inclusion [1], but in its higher order modes it can be used as a high-quality resonator [2]. At higher modes, the magnetic field is mostly concentrated inside the solenoid, where are no metallic parts. The field distribution is quite similar to that inside volume resonators. Therefore, the quality factor of a metasolenoid can be much higher than the quality factor of an ordinary microstrip resonator.

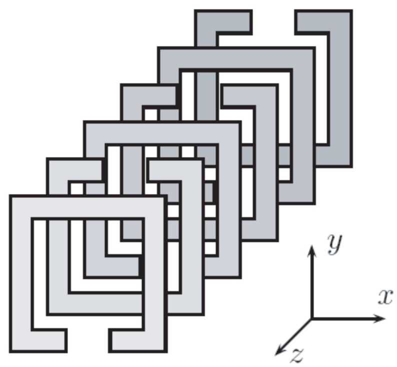

Figure 1: Geometry of the metasolenoid.

In this study, we focus on the use of the metasolenoid as a wavequiding structure. Eigenmodes in a wavequide made of coupled capacitively loaded wire loops were studied also in [3, 4], but there only the interaction between the neighboring loops was taken into account. Such approach is valid only if the separation between the loops is of order of the loop radius or larger, i.e., when the interaction between the loops is weak. In this study, the interaction between the rings that are not neighbors is also taken into account. Therefore, structures with small separations between the rings can be studied. When the separation between the rings is small, the coupling between them is strong and the waveguide is capable to support slow waves with very short wavelength.

Metasolenoids can find applications in the design of delay lines, filters, and resonant magnetic sensors.

REFERENCES

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