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## Frontier Applications of Metamaterials to Magnetic Confinement Fusion

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The heating, current drive and diagnosis of magnetized plasmas relies heavily on the injection and emission of electromagnetic waves. The requirements for beam steering and focusing are stringent and, often, unique. As an example, perfect focusing of Electron Cyclotron Emission requires that higher frequencies be focused at larger distances from the receiver. This implies the need for a dramatic, “reverse” chromatic aberration, opposite to the behavior exhibited by conventional focusing elements. Starting from this example, I will show that the optical properties of metamaterials can be tailored to the focusing and steering needs of plasma heating, current drive and diagnostics. In addition, metamaterials for passive diagnostics in the microwave range can be easily and cost-effectively manufactured by ink-jet printing on plastic substrates. The ink in question is a liquid suspension of silver nanoparticles. With different designs and materials, this approach is easily generalized to high-power heating, current drive and active diagnostics.

### Summary

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