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**Metamaterial lens of frequency-dependent focus optimized for highest ECE spatial resolution** KENNETH HAMMOND, SCOTT MASSIDDA, Columbia University, WILLIAM CAPECCHI, University of Wisconsin-Madison, FRANCESCO VOLPE, Columbia University — Electron cyclotron emission (ECE) is typically collected from the low-field side of toroidal plasmas by quasi-optical systems optimized for a single frequency. As a result, ECE suffers from losses in transverse resolution in regions with different cyclotron frequencies. For best spatial resolution, it would be desirable for the ECE optics to focus different frequencies to the respective locations in the plasma from which they are emitted. This requires a dramatic increase of focal length with frequency ("reverse chromatic aberration"), not encountered in conventional convergent lenses. Recent simulation work [1,2], however, suggests that metamaterial lenses consisting of arrays of sub-wavelength phase shifters can be engineered to simultaneously focus all frequencies of interest at their respective EC-emitting locations. Here we present the design and initial experimental results for a prototype metamaterial lens for the 8-12 GHz band, and the design of a metamaterial lens for ECE at 80-130 GHz in a DIII-D-like plasma. We also discuss extensions to other millimeter wave diagnostics, as well as to high-power heating.

[1] W.J. Capecchi et al., *Optics Express* **20**, 8761 (2012);
[2] K.C. Hammond et al., *J. Inf. Milli. THz Waves* **34**, 437 (2013).

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