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Measurement of sub-micron density gradient plasma scale length and collisionality evolution: Toward plasma optic performance optimization[1] GRAEME SCOTT, Lawrence Livermore National Laboratory — A renewed interest in the plasma mirror (PM) is evident from the wealth of recent investigations published in the literature and as the PM's repertoire of applications evolves, the matter of their efficiency becomes increasingly important, and in our recent work we demonstrated how the traditionally lossy optical component can be optimized to be 96 % reflective by introducing a finite density scale length to its surface. A recently developed technique will be presented where we simultaneously measure the sub-micron density scale length evolution as well as the collisionality and temperature of the plasma, and correlate this with the PM optical performance. This is a generally useful experimental technique in itself, since these parameters are challenging to experimentally measure in the vicinity of the critical surface. Tracking the evolution of the parameters over tens of picoseconds leads us to novel conclusions on the plasma composition and gives insight into the kinematic plasma expansion physics. This provides avenues for investigation of further plasma optic optimization techniques relevant to multipicosecond lasers, which is of particular interest in the context of multi-kiloJoule relativistic laser plasma interactions, as many such systems come online across the world.

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