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Relativistic transparency and non-axisymmetry of laser-accelerated ion beams from the Break-Out Afterburner[1] B.J. ALBRIGHT, L. YIN, KEVIN J. BOWERS[2], CHENGKUN HUANG, D. JUNG, J.C. FERNÁNDEZ, B.M. HEGELICH, Los Alamos National Laboratory — In the Break-Out Afterburner (BOA) ion acceleration mechanism [1], an ultraintense, ultrahigh contrast laser interacts with a nano-scale, solid-density target, which expands as the electrons under the laser spot heat to relativistic temperatures. When the electron density drops below the relativistic critical density, the target turns transparent and a period of enhanced ion acceleration, called the Break Out Afterburner, ensues. A large (tens of TeV), longitudinal electric field forms that co-moves with the target ions. A defining features of the BOA, as seen in VPIC kinetic plasma simulations and observed in experiments at the LANL Trident laser facility, is that the ion beams form as a pair of lobes with density and energy possessing maxima in the direction orthogonal to the laser polarization. This paper will focus on analytic theory explaining how these lobes form as a consequence of subtle effects of the laser ponderomotive force. [1] Yin et al. *Laser and Part. Beams* **24**, 2, 291 (2006).

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