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Rarefaction shock waves as a diagnostic of critical points¹ EDWARD STARTSEV, IGOR KAGANOVICH, RONALD DAVIDSON, PPPL — Critical points of liquid-vapor transition in the warm dense matter regime are difficult to measure due to the high pressure and density of the medium. In this paper, it is proposed to make use of rarefaction shock wave phenomena for identifying the region of the critical point. Rarefaction shock waves only exist near the critical point, and thus they can be used for identification of the critical point. Under normal conditions, only compression shock waves exist due to the requirement that entropy should increase in the shock wave. However, near the critical point the entropy can increase in the rarefaction wave; therefore, the compression shock wave is unstable and the rarefaction shock wave is stable in this region [1]. Moreover, the region of existence of the rarefaction shock wave is rather narrow near the critical point, making it an excellent indicator of the critical point. In this paper the rarefaction shock formation during the expansion of the heated material as it goes through critical point as it expands is studied analytically and numerically. We give examples of calculations of rarefaction shock wave formation during expansion of foils irradiated by an ion beam pulse for the NDCX-II facility.

[1] Ya. Zeldovich, Zh. Eksp. Teor. Fiz. 16 , 363 (1946).

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