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Femtosecond dynamics of cluster expansion XIAOHUI GAO, XIAOMING WANG, BONGGU SHIM, ALEXEY AREFIEV, MIKHAIL TUSHENTSOV, BORIS BREIZMAN, MIKE DOWNER, University of Texas at Austin — Noble gas clusters irradiated by intense ultrafast laser expand quickly and become typical plasma in picosecond time scale. During the expansion, the clustered plasma demonstrates unique optical properties such as strong absorption and positive contribution to the refractive index. Here we studied cluster expansion dynamics by fs-time-resolved refractive index and absorption measurements in cluster gas jets after ionization and heating by an intense pump pulse. The refractive index measured by frequency domain interferometry (FDI) shows the transient positive peak of refractive index due to clustered plasma. By separating it from the negative contribution of the monomer plasma, we are able to determine the cluster fraction. The absorption measured by a delayed probe shows the contribution from clusters of various sizes. The plasma resonances in the cluster explain the enhancement of the absorption in our isothermal expanding cluster model. The cluster size distribution can be determined. A complete understanding of the femtosecond dynamics of cluster expansion is essential in the accurate interpretation and control of laser-cluster experiments such as phase-matched harmonic generation in cluster medium.

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