Kawasaki, Araki and Tanaka Reply: In the preceding Comment [1] Sausset and Tarjus (ST) proposed an alternative scenario for the slow dynamics in our two-dimensional (2D) polydisperse colloidal liquids [2], based on the frustration-limited domain theory [3] which focuses on self-generated frustration in the order parameter itself as in [4]. ST claimed that sufficiently polydisperse hexatic order is not space-filling, so it is a 2D analog of the icosahedron. We agree with the former, but the latter seems to be subtle due to the lack of the uniformity of frustration. An exact 2D analog may be hexatic ordering on a surface of incommensurate constant curvature in the sense that in both cases frustration is ‘uniform’ [2, 4]. We regard the same phenomenon as random-field effects in our model predicts the divergence of \( \xi \sim \rho C \) for \( \Delta = 0 \% \) [Fig. 1(b)]. The fitting yields \( x \sim 3 \), consistent with the suggestion of ST [1]. \( x \) is suggested to be related to the correlation length exponent of the unfrustrated system [3]: For the present case (2D hexatic ordering), \( \xi \sim \rho \theta \sim 40 \% \) [8]. This fits reasonably well to our data. Here \( \phi \) is the fraction volume of colloids and \( \phi_I \) is the icosahedron. We described our thoughts on the differences between the two approaches in detail in [1], we do not repeat it here.

First we show the analysis proposed by ST in Fig. 1(a). Their function \( \xi^{*} \sim B(\phi - \phi_{I})/\phi_I + C \) fits reasonably well to our data. Here \( \phi \) is the volume fraction of colloids and \( \phi_I \) is the icosahedron. An exact 2D analog may be hexatic ordering on a surface of incommensurate constant curvature in the sense that in both cases frustration is ‘uniform’ [2, 4]. We regard the same phenomenon as random-field effects in our model predicts the divergence of \( \xi \sim \rho C \) for \( \Delta = 0 \% \) [Fig. 1(b)]. The fitting yields \( x \sim 3 \), consistent with the suggestion of ST [1]. \( x \) is suggested to be related to the correlation length exponent of the unfrustrated system [3]: For the present case (2D hexatic ordering), \( \xi \sim \rho \theta \sim 40 \% \) [8]. This fits reasonably well to our data. Here \( \phi \) is the volume fraction of colloids and \( \phi_I \) is the icosahedron. We described our thoughts on the differences between the two approaches in detail in [1], we do not repeat it here.

Next we mention our previous simulation study of a system with competing orderings [7]. In this case, the underlying crystalline order is anti-ferromagnetic and the crystallization is of first order. Nevertheless, we observe behavior very similar to the present case. The basic features of the phase diagram are also very similar between the two [compare Fig. 1(b) with Fig. 2 of [1]]. These facts seem to support our scenario.

Finally, we note that our preliminary study on 3D polydisperse colloidal liquids indicates that there exists medium-range crystalline ordering (fcc or hcp), which is not icosahedral, and \( \xi \sim (\phi_0/\phi - 1)^{-1/3} \) consistent with our prediction [3]. This also supports our scenario. At the same time, however, a recent study by Coslovich and Pastore favors the scenario of frustration-limited domain theory [3] rather than ours. Thus, further careful studies are required to settle the issue of the role of frustration in the glass transition. Such efforts will ultimately lead to a clear physical understanding of the glass transition.

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1. F. Sausset and G. Tarjus, Preceding comment.
2. T. Kawasaki, T. Araki, and H. Tanaka, Phys. Rev. Lett. 99, 215701 (2007).
3. G. Tarjus, S.A. Kivelson, Z. Nussinov, and P. Viot, J. Phys.: Condens. Matter 17, R1143 (2005).
4. D. R. Nelson, *Defects and Geometry in Condensed Matter Physics* (Cambridge Univer. Press, Cambridge, 2002).
5. H. Tanaka, J. Phys.: Condens. Matter 10, L207 (1998); J. Chem. Phys. 111, 3163, 3175 (1999).
6. H. Tanaka, J. Non-Cryst. Solids 351, 3371 (2005).
7. H. Shintani and H. Tanaka, Nature Phys. 2, 200 (2006).
8. L. Santen and W. Krauth, Nature 405, 550 (2000).
9. K. Watanabe and H. Tanaka, submitted.
10. D. Coslovich and G. Pastore, J. Chem. Phys. 127, 124504 (2007).