Supplementary Information

I The Percus-Yevick structure factor

In case of monodisperse and spherical particles the scattering contributions arising from interparticle correlations are decoupled from the scattering properties of one single particle. Hence, the structure factor $S(q)$ depends only on the interparticle interaction potential and can be related to the *Fourier* transform of the direct correlation function $c(q)$ of the particles:

$$S_{\mathrm{PY}}(q) = \frac{1}{1 - nc(q)} \qquad \text{Eq. S-1}$$

For microemulsion systems containing droplets with a non-ionic surfactant shell the droplet interactions can be described by a repulsive hard sphere potential. Assuming a complete monodisperse droplet distribution, $c(q)$ can be calculated within the *Percus-Yevick* approximation. This leads to the analytical expression:

$$nc(q) = \frac{36\left(1 + 2\phi_{\mathrm{disp}}\right)^2}{x^3\left(1 - \phi_{\mathrm{disp}}\right)^4}\phi_{\mathrm{disp}}^2\left[h_1 + h_2 + h_3\right] \qquad \text{Eq. S-2}$$

With

$$h_1 = -2\left[\frac{\sin(x) - x\cos(x)}{3\phi_{\mathrm{disp}}} - \frac{4}{x^3}\right]$$
$$h_2 = \frac{1}{3}\left[\left(1 - \frac{6}{x^2}\right)4\sin(x) - \left(1 - \frac{12}{x^2} + \frac{24}{x^4}\right)x\cos(x)\right] \qquad \text{Eq. S-3}$$
$$h_3 = 2\left[\left(\frac{2}{x^2} - 1\right)\frac{x\cos(x)}{2} + \sin(x) - \frac{1}{x}\right].$$

Here, the abbreviation $x = 2R_{\mathrm{HS}}q$ was used, in which R_{HS} is the hard sphere radius of the particles. As the assumption of a complete monodisperse system leads to an overestimation of the oscillations arising from the interparticle interactions a *Gaussian* distribution function $W(R_{\mathrm{HS}}, R_{\mathrm{HS},0}, \sigma_{\mathrm{HS}})$ (see Eq. 9)) has to be applied again to account for a size distribution of the hard sphere radius. An integration over all radii leads to the averaged *Percus-Yevick* structure factor $\overline{S_{\mathrm{PY}}(q)}$:

$$\overline{S_{\mathrm{PY}}(q)} = \int_0^\infty dR_{\mathrm{HS}}\, S_{\mathrm{PY}}(q) W\left(R_{\mathrm{HS}}, R_{\mathrm{HS},0}, \sigma_{\mathrm{HS}}\right). \qquad \text{Eq. S-4}$$

Since Eq. S-4has no analytical solution the integral has to be solved numerically.

II. Evaluation of the GIFT fitting procedure

In order to evaluate the quality of the GIFT procedure the first step is to compare the fitting functions calculated by GIFT to the actual scattering curves. The second step, the deconvolution of the PDDF to the scattering length density distribution, is also combined to a fitting procedure, namely the description of the PDDF calculated in the first step. Thus, if both fitting procedures generate a good description of the data or function, respectively, it can be concluded that the results are reasonable. The scattering curves with the GIFT fitting functions and the PDDFs as well as the fitting curves to these PDDFs are shown in Fig. S-1.

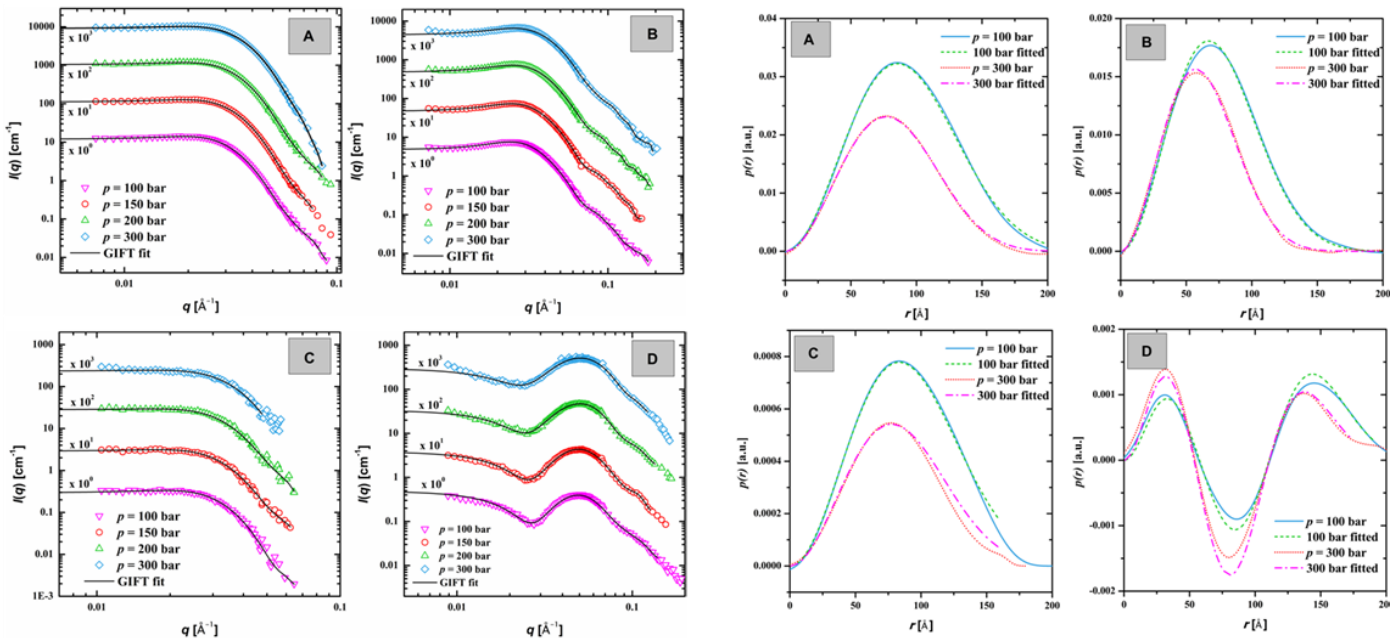

Figure S-1: GIFT fitting functions to the scattering data shown in Fig. 7 (left) and selected PDDF functions without absolute normalization and the according fitting functions generated by means of the DECON program package. Obviously, all fitting functions describe the data completely.