in state-of-the-art oscilloscopes will result in averaging of actual intensity dynamics, Fig. 4(a) (black). Surprisingly the radiation statistics is not completely Gaussian in random DFB fiber laser. The lower the dispersion, the more non-exponential is intensity probability density function (pdf), Fig. 4(c), revealing probable correlations in radiation. The background level of intensity autocorrelation function (ACF) is higher than 0.5, Fig. 4(b), confirming that the radiation is not completely stochastic. The intriguing question of non-gaussian intensity statistics in the radiation of the random DFB fiber laser has to be further investigated. Note that in conventional mirror based laser cavities non-gaussian intensity statistics is previously reported [33–35] arising from partial correlations between different longitudinal modes, which are well-defined (but still strongly fluctuating and broad) in those systems [43]. Intensity dynamics and statistical properties of random DFB fiber laser are not studied experimentally up to date.

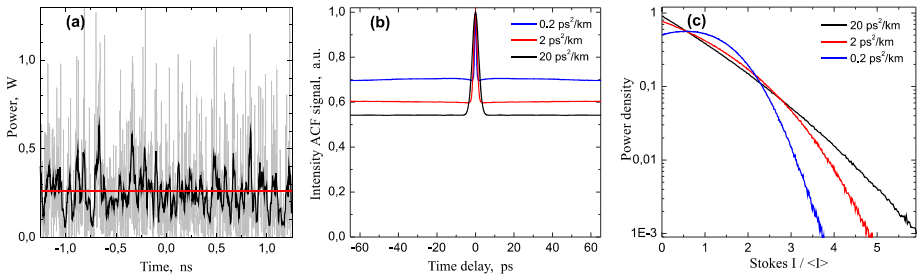

Fig. 4. (a) Typical intensity dynamics (grey shows original simulated data, black – smoothed with a bandwidth of 40 GHz, red – average lasing power level), (b) Intensity ACF and (c) intensity pdfs for different fiber dispersions. Pump power is 2 W on all graphs.

4. Conclusion

For the first time a full numerical modeling of random DFB fiber laser based on Rayleigh scattering are performed with the use of generalized NLSE. It is shown that to describe in general the random DFB fiber laser generation properties, random distributed feedback can be taken into account via average energy income only without taking into consideration the random strength of the scattering on micron scales and its coherence properties. Calculated generation power and its longitudinal distribution as well as optical spectrum are in good qualitative agreement with previous experimental results. It is shown that increasing the dispersion or decreasing the nonlinear coefficient leads to the narrower generation spectrum providing a possibility to spectral management of random DFB fiber laser generation. Temporal and statistical properties of radiation are also studied. The intensity statistics and intensity auto-correlation function reveal non-gaussian statistics of the random DFB fiber laser radiation.

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