ESRF	**Experiment title:** **Probing dynamical heterogeneities in glasses by small-angle nuclear resonant scattering**	**Experiment number**: SC-5219
Beamline: ID18	**Date of experiment**: from: 08/12/2021 to: 14/12/2021	**Date of report**:
Shifts: 18	**Local contact(s)**: Dimitrios Bessas	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Alessandro Martinelli* (University of Padova)

Federico Caporaletti* (University of Amsterdam)

Giulio Monaco* (University of Padova)

Simone Capaccioli* (University of Pisa)

Report:

Driven by scientific reasons, the experiment SC-5219 (Main proposer Martinelli), was exchanged with the experiment SC-5288 (Main proposer Caporaletti) accepted for 2022/I, in agreeement with the User Office and the ESRF Safety.
For this reason, the measurements envisaged for experiment SC-5288 were performed during this beamtime and the following report thus describe the corresponding experimental results.

In detail, we investigate the mosaic structure of the prototypical van der Walls glass-former cumene using time-domain interferometry and the Johari-Goldstein relaxation as a probe [1,2]. The aim was to characterize the evolution of the "mosaic structure" of glasses on approaching the glass transition temperature.

The dynamics of cumene was investigate in the temperature range going from 0.80 Tg to 0.93 Tg (with Tg=126K) and for exchanged wavevectors up to 40 nm^{-1}, i.e. ranging from inter- to intra-molecular distances.

The measurements were perfomed employing a multi-lines scheme that was recently developed by some of the proposers [3,4] and which allows to directly extract the intermidiate scattering function of the system ($f(q,t)$).
Some example of the measured intermidiate scattering functions are shown in Fig. 1. The good quality of the data allowed us to fylly characterize the microscopic dynamics of the sample, especially at large scattering vectors, where the Johari-Goldstein relaxation dominates the microscopic dynamics [1].

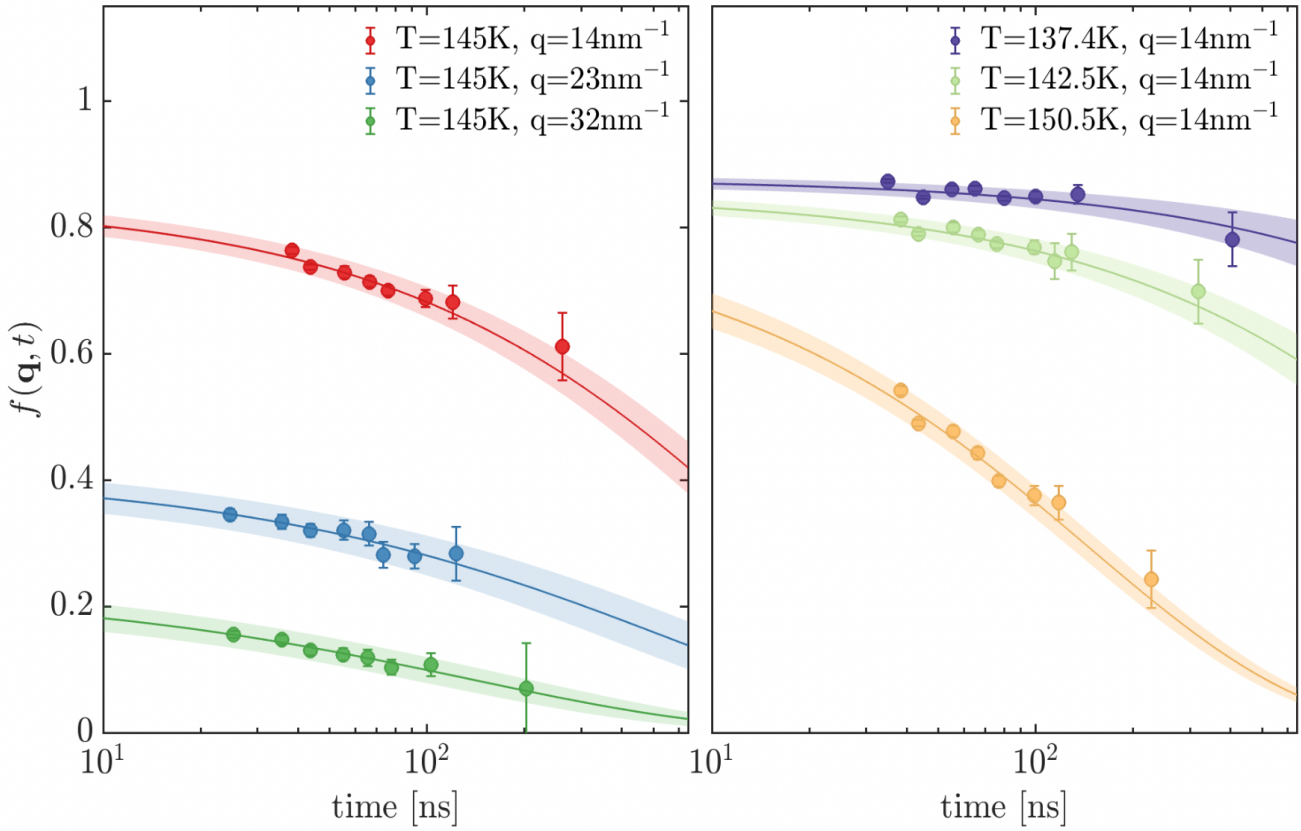

Figure 1: Left panel: intermediate scattering functions (ISFs) obtained from the time-domain interferograms at different scattering-vector (q) at a fixed temperature. Right panel: ISFs extracted from the time-domain interferograms measured at fixed (q) and different temperatures.

By measuring the relaxation strength of the Johari-Goldstein relaxation, we could hence extract the fraction of highly mobile molecules participating in the mosaic structure (i.e. the relaxation strenght) and thus follow the temperature evolution of the percolating cluster. Th analysis of the experimental data, complemented by dielectric spectroscopy measurements, is now completed and a manuscript reporting these results is in preparation.

References

[1] **F. Caporaletti** et al., Nature communications 12, 1 (2021).
[2] **F. Caporaletti** et al., Scientific reports 9, 1 (2019).
[3] **F. Caporaletti** et al., Review of Scientific Instruments 88, 105114 (2017).
[4] **F. Caporaletti** et al., Philosophical Magazine 100, 2646 (2020).