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Amyloid fibrils under extreme conditions

We performed *in situ* high pressure XRD experiments on amyloid fibrils of insulin and the peptides TTR105-115 and GNNQQNY in their supernatant solution. These experiments were performed at the Swiss-Norwegian beamline (SNBL) via the CRG exchange mechanism.
We were able to demonstrate a new method to investigate structural features and mechanical properties of amyloid fibrils. By directly probing the distance between the β-strands in a β-sheet as a function of pressure, we were able to determine the Young's modulus of these biological fibres along the fibre axis. This modulus is generally measured via the more commonly used AFM technique, which is a methodology that is not unambiguous due to numerous assumptions as well as the fact that the stress is applied perpendicular to the fibre axis. Another major new result is a comparison between silicone oil and water as compression media, showing that the Young's modulus in silicone oil almost half the one in water. This can be explained by a penetration mechanism whereby water penetrates the fibre under pressure. Our result stresses that water plays a major role in determining the mechanical properties of the amyloid fibrils. The Young's modulus value obtained in silicone oil is more likely to be relevant for (non-aqueous) nanotechnological applications. Finally, the remarkably high stability of the fibrils (up to 10 GPa or 100 kbar!) also indicates the role of peptide packing, in addition to the previously emphasized hydrogen bonds, and provide independent evidence for recent structural models by Eisenberg and co-workers. A manuscript describing the details of this work has now been submitted (Meersman *et al.*)

Meersman, F., Quesada Cabrera, R., McMillan, P.F. and V. Dmitriev. 2008. Influence of water on the mechanical properties of amyloid fibrils. *Phys. Rev. Lett., submitted*