Supplementary Information (SI) for Physical Chemistry Chemical Physics.

Supplementary Information

Origin of the ρ^{γ}/T scaling of conductivity relaxation and water relaxation times in a mixture of water with protic ionic liquid

K. L. Ngai

CNR-IPCF, Institute for Chemical and Physical Processes,

Largo B. Pontecorvo 3, I-56127 Pisa, Italy

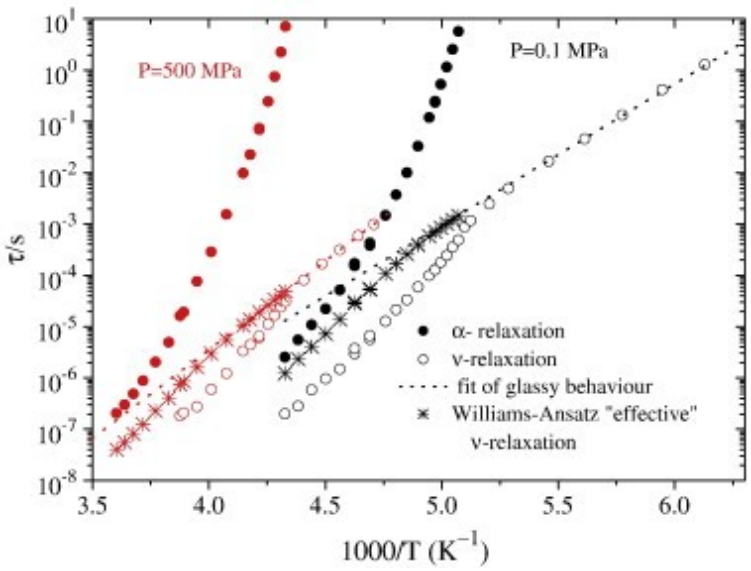

Fig. S1. Semilog Plot of relaxation times vs. reciprocal T of 26 wt.% fraction of water in PPG400. Close and open circles indicate α- and ν-processes, respectively. Asterisks are the relaxation times of the "effective" relaxation obtained from the convolution procedure indicated by the Williams ansatz. Black and red symbols indicate isobaric scan done at P=0.1 and 500 MPa, respectively. Dotted lines are Arrhenius fits to the data in the glassy state. Figure reproduced from Ref.[S1] by permission from Elsevier.

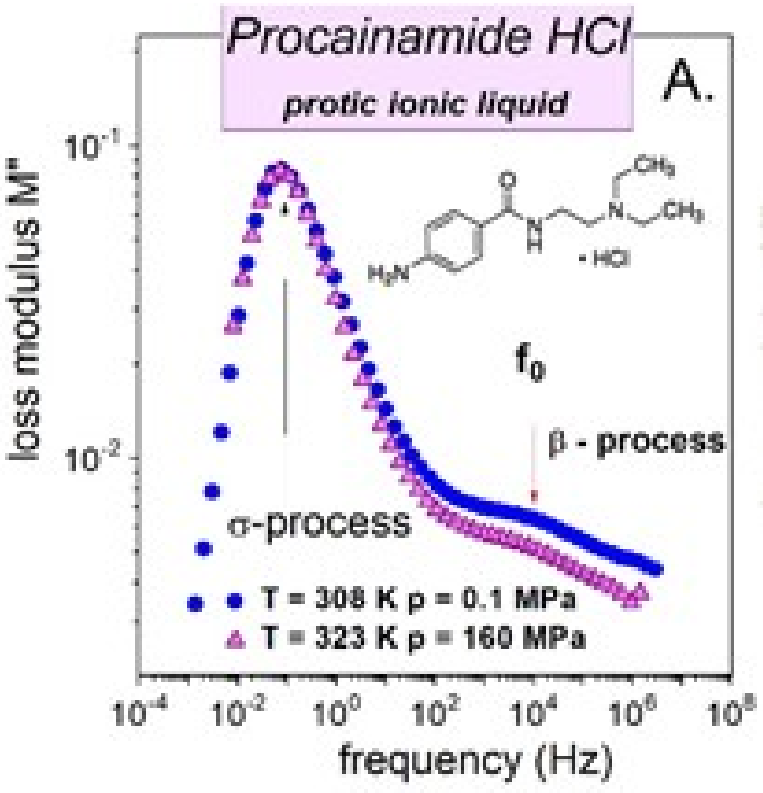

Fig. S2. Comparison of electric loss modulus spectra recorded at different temperature and pressure combinations and constant loss peak frequency for procainamide HCl with data from Ref.[S2] replotted.

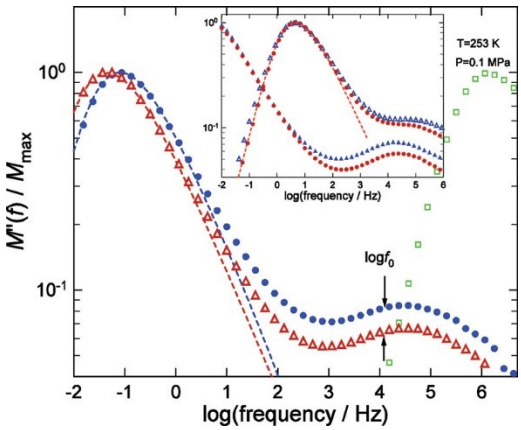

Fig. S3. Normalized $M''(f)$ spectra of [Si-MIm][BF4] at different combinations of P and T to show co-invariance of τ_α, τ_β, and n at constant τ_α. Red open triangles (P=600 MPa, T=253 K). Blue circles (P=0.1 MPa, T=213 K). Green open squares (P=0.1 MPa, T=253 K). Blue and red lines are fits by Fourier transform of stretched exponential correlation function with n=0.43. The inset show

co-invariance at two more constant values of τ_α. Blue triangles are data at ambient pressure and T=218 and 208 K from right to left. Red filled circles are data at constant T=253 K and P=300 MPa and 500 MPa from right to left. The arrows indicate the locations of the logarithm of the primitive conductivity relaxation frequencies, logf_0, which agree with the most probable β-conductivity relaxation frequencies within a factor of about 2. Figure reproduced from Ref.[S3] by permission from ACS.

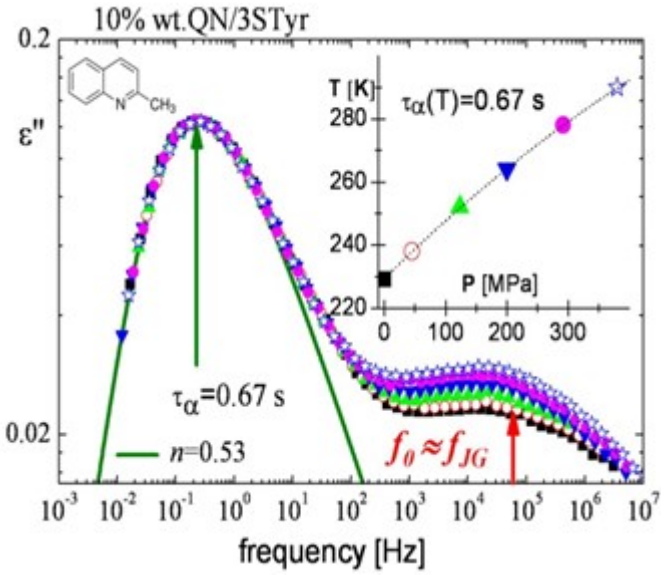

Fig. S4. *T*-*P* superposition of loss spectra for 10% QN in tristyrene measured for different T and P combinations but the same τ_α= 0.67 s. The line is a Fourier transformed of the Kohlrausch function with $\beta_{KWW} \equiv (1\text{-}n) = 0.53$. The results demonstrate the co-invariance of three quantities, τ_α, n, and τ_{JG}, to widely different combinations of T and P. Data of Kessaire et al. [S4] replotted.

References

S1. S. Capaccioli, K.L. Ngai, S. Ancherbak, P.A. Rolla, and N. Shinyashiki, The role of primitive relaxation in the dynamics of aqueous mixtures, nano-confined water and hydrated proteins, *J. Non-Cryst. Solids* 2011, **357**, 641–654.

S2. Z. Wojnarowska, A. Swiety-Pospiech, K. Grzybowska, L. Hawelek, M. Paluch, and K. L. Ngai Fundamentals of ionic conductivity relaxation gained from study of procaine hydrochloride and procainamide hydrochloride at ambient and elevated pressure. *J. Chem. Phys*. 2012, **136**, 164507.

S3. G. Jarosz, M .Mierzwa, J. Ziolo, M. Paluch, H. Shirota, and K. L. Ngai, Glass transition dynamics of room-temperature ionic liquid 1-methyl-3-trimethylsilylmethylimidazolium tetrafluoroborate. J. Phys. Chem. B 201, **115**,12709–16.

S4. K. Kessairi, S. Capaccioli, D. Prevosto, M. Lucchesi, S. Sharifi, and P. A. Rolla. Interdependence of primary and Johari-Goldstein secondary relaxations in glass-forming systems. *J. Phys. Chem. B* 2008,**112**, 4470.