Rheological hysteresis in soft glassy materials THIBAUT DIVOUX,
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de Lyon — The nonlinear rheology of a soft glassy material is captured by its con-
stitutive relation, shear stress vs shear rate, which is most generally obtained by
sweeping up or down the shear rate over a finite temporal window. For a huge
amount of complex fluids, the up and down sweeps do not superimpose and define
a rheological hysteresis loop. By means of extensive rheometry coupled to time-
resolved velocimetry, we unravel the local scenario involved in rheological hysteresis
for various types of well-studied soft materials. Building upon a systematic ex-
perimental protocol, we introduce two observables that quantify the hysteresis in
macroscopic rheology and local velocimetry respectively, as a function of the sweep
rate δt^{-1}. Strikingly, both observables present a robust maximum with δt, which de-
fines a single material-dependent timescale that grows continuously from vanishingly
small values in simple yield stress fluids to large values for strongly time-dependent
materials. In line with recent theoretical arguments, these experimental results hint
at a universal timescale-based framework for soft glassy materials, where inhomoge-
neous flows characterized by shear bands and/or wall slip play a central role.

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