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Intermittent burst dynamics in porous media: experiments on slow drainage flows

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The intermittent burst dynamics during the slow drainage of an artificial quasi-2D porous medium is studied experimentally. We have verified a theoretically predicted scaling for the burst size distribution which was previously accessible only via numerical simulations. We show that this system satisfies a set of conditions known to be true for critical systems, such as intermittent activity with bursts extending over several time and length scales, self-similar macroscopic fractal structure and a scaling behavior for the power spectrum associated with pressure fluctuations during the flow. The observation of a $1/f$ scaling region in the power spectra is new for porous media flows and, for specific boundary conditions, we notice the occurrence of a transition from $1/f$ to $1/f^2$ scaling. An analytically integrable mathematical framework was employed to explain this behavior.

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