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Direct experimental measurement of the pair correlation function during the slow drainage of a porous medium

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We have given experimental grounding for the remarkable observation made 30 years ago by Furuberg et al. [1] of an unusual dynamic scaling for the pair correlation function $N(r,t)$ during the slow drainage of a porous medium. The authors of that paper have used an invasion percolation algorithm to show numerically that the probability of invasion of a pore at a distance r away and after a time t from the invasion of another pore, scales as $N(r,t) \propto r^{-1} f\left(r^D/t\right)$, where D is the fractal dimension of the invading cluster and the function $f(u) \propto u^{1.4}$, for $u \ll 1$ and $f(u) \propto u^{-0.6}$, for $u \gg 1$. Our experimental setup allows us to have full access to the spatiotemporal evolution of the invasion, which was used to directly verify this scaling [2]. Additionally, we have connected two important theoretical contributions from the literature [3,4] to explain the functional dependency of $N(r,t)$ and the scaling exponent for the short-time regime ($t \ll r^D$). A new theoretical argument was developed to explain the long-time regime exponent ($t \gg r^D$).

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