The Atlas model, in and out of equilibrium

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Consider a one-dimensional semi-infinite system of Brownian particles, starting at Poisson(L) point process on the positive half-line, with the left-most (Atlas) particle endowed a unit drift to the right. We show that for the equilibrium density (L=2), the asymptotic Gaussian space-time particle fluctuations are governed by the stochastic heat equation with Neumann boundary condition at zero. As a by product we resolve a conjecture of Pal and Pitman (2008) about the asymptotic (random) fBM trajectory of the Atlas particle.

In a complementary work, we derive and explicitly solve the Stefan (free-boundary) equations for the limiting particle-profile when starting at out of equilibrium density (L other than 2). We thus determine the corresponding (non-random) asymptotic trajectory of the Atlas particle.

This talk is based on joint works with Li-Cheng Tsai, Manuel Cabezas, Andrey Sarantsev and Vladas Sidoravicius.