

# Endogenous instabilities in financial market

Laboratory: Ladhyx, UMR CNRS 7647, Ecole Polytechnique  
Supervision: Michael Benzaquen (CNRS)  
Contact: michael.benzaquen@polytechnique.edu

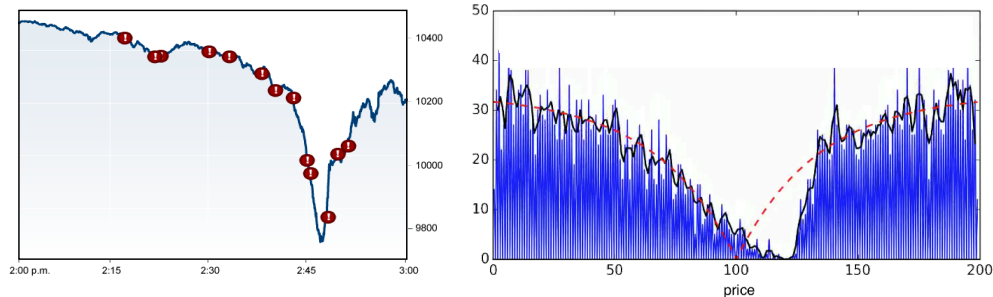


Figure 1: Left: "Flash Crash" May 6, 2010. Right: numerical simulation of the limit order book.

## Subject

Ever since Bachelier's PhD thesis in 1900 – a theory of Brownian motion 5 years before Einstein – our understanding of financial markets has reasonably progressed. Over the past decades financial engineering has grown tremendously and has regrettably outgrown our understanding. The inadequacy of the models used to describe financial markets is often responsible for the worst financial crises, with significant impact on everyday economy. From a physicist's perspective, understanding price formation in financial markets namely how markets absorb and process information of thousands of individual agents to come up to a "fair" price is a truly fascinating and challenging problem. Statistical physics has taught us that systems made of a large number of individual entities may display robust (often unanticipated) regularities that rise above individual behaviours. Or as P. W. Anderson puts it "More is different", see [1]. We work on building self-consistent agent-based models able to reproduce stylised facts revealed by real market data. The success of zero-intelligence models comforted us in the idea that market dynamics can, to some extent, be understood from a purely mechanical endogenous perspective, in conflict with most economical models. In particular models need no exogenous ingredients (such as news reports) to be able to reproduce a number of well-established empirical findings.

One remarkable observation is that a substantial fraction of the large price jumps (or "micro-crashes") that take place in financial markets cannot be correlated to economic or financial news feeds [2, 3]. This indicates that small-scale market crashes seem to be induced by the dynamics of the market itself, or in other words that sudden price movements are predominantly endogenous.

The internship – consisting in studying the dynamics and instabilities of the limit order book – will have both an analytical and numerical components. It should be noted that this study constitutes a challenging intellectual issue, and above all a fundamental practical issue from the point of view of regulation of financial markets.

## References

- [1] P. W. Anderson, *Science* **177**, 393 (1972).
- [2] D. M. Cutler, J. M. Poterba, and L. H. Summers, *Journal of Portfolio Management* **15**, 4 (1989).
- [3] A. Joulin, A. Lefevre, D. Grunberg, and J.-P. Bouchaud, *Wilmott Magazine* **Sep**, 1 (2008).