Nonconcentration of Return Times
Ori Gurel-Gurevich
Microsoft Research

Let T be the return time to the origin of a simple random walk on an infinite recurrent graph. We show that T is heavy tailed and non-concentrated. More precisely, we have

$$
\begin{align}
P(T > t) &> c/\sqrt{t} \tag{1} \\
P(T = t | T \ge t) &< C \log(t)/t. \tag{2}
\end{align}
$$

Inequality (1) is attained on Z, and we construct an example demonstrating the sharpness of (2). We use this example to answer negatively a question of Peres and Krishnapur about recurrent graphs with the finite collision property (that is, two independent SRW on them collide only finitely many times, almost surely).

Joint work with Asaf Nachmias.