A periodic branching random walk with immigration on $\mathbb{Z}^d$

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We consider a branching random walk with immigration and branching sources located periodically on $\mathbb{Z}^d$. We assume that time is continuous and the intensity matrix of random walk is denoted by $\{a(v,u)\}_{v,u\in\mathbb{Z}^d}$. The intensity of branching and immigration at a point v are denoted by $\beta(v)$ and $\alpha(v)$ respectively.

Let A_0 and Q be the operators $l_2(\mathbb{Z}^d) \to l_2(\mathbb{Z}^d)$ such that

$$(A_0 f(\cdot))(v) = \sum_{u\in\mathbb{Z}^d} a(v,u) f(u),$$

$$Qf(v) = \beta(v) f(v).$$

During the talk, the equation for the mathematical expectation of the number of particles at the moment t at the point u with starting point v will be presented and the following theorem will be formulated:

Theorem 1. *Let $\lambda_1(0) > 0$ be the upper bound of the spectrum of the operator $A_0 + Q$. Then for every $u, v \in \mathbb{Z}^d$ there exists $C = C(u,v,d,\alpha)$ such that*

$$M(v,u,t) = C(v,u,d,\alpha) \cdot \frac{e^{\lambda_1(0)t}}{t^{d/2}} \left(1 + O\left(\frac{1}{t}\right)\right), \quad t \to \infty.$$