生物物理学报(2002) 18(4), 418-428

PDF文档

应用主方程方法研究分子马达的定向运动

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利用主方程的方法，研究了在一维三态周期跳跃模型下分子马达的定向运动。首先假定马达在任意两个相邻状态之间的跃迁距离(substeps)相等，对于给定的任意初始分布，得出了与时间有关的几率分布的解析表达式，包括到达稳态之前的所有的瞬态过程，由此可获得马达在各个时刻的漂移速度v、扩散系数D以及描述马达随机性质的随机参数r(randomness parameter)。同时还计算了马达到达稳态所需要的特征时间。根据马达的运动特点，我们又把以上结果推广到了不等间隔的情况，并引入了外力分配系数θ_j^+ 和θ_j^- 来表征外力对跃迁率的影响程度，以便于研究马达在拖动负载运动时的动力学行为，使之更符合生物化学的实际。并把计算结果(漂移速度v和随机参数r分别随[ATP]和外力f的变化关系)同实验进行了比较，与实验值符合较好。

MASTER EQUATION APPROACH TO MOLECULAR MOTOR'S DIRECTED MOTION

The master equation approach to molecular motor's directed motion based on periodic one-dimensional three-state hopping model is studied. First, It was assumed that the step distance between arbitrary successive states (dj) is equal. An explicit solution is obtained for the probability distribution as a function of the time for any initial distribution with all the transients included, and the drift velocity v, the diffusion constant D and the randomness parameter r can also be obtained at any time from the probability distribution. Meanwhile, the characteristic time for the motor to reach steady state was calculated. But, the real molecular motor's motion is not the simple equal-distance transition, the substep lengths is always unequal and the effect of an external load f on individual chemical states is not equal. Thus, in the case of inequality of substep lengths the load distribution factors θ_j^+ and θ_j^- which reflect how the external load f affects the transition rates were introduced. In this way the dynamical behaviors of molecular motor under external load f can be conveniently studied. By comparison with experimental result (drift velocity v and randomness parameter r versus [ATP] and external load f), it is shown that the model presented here can explain the available data rather satisfactorily.

关键词

分子马达(Molecular motor); 跳跃模型(Hopping model); 几率分布(Probability distribution); 转换速率(Transition rate)