Anomalous Diffusion with Heterogeneity

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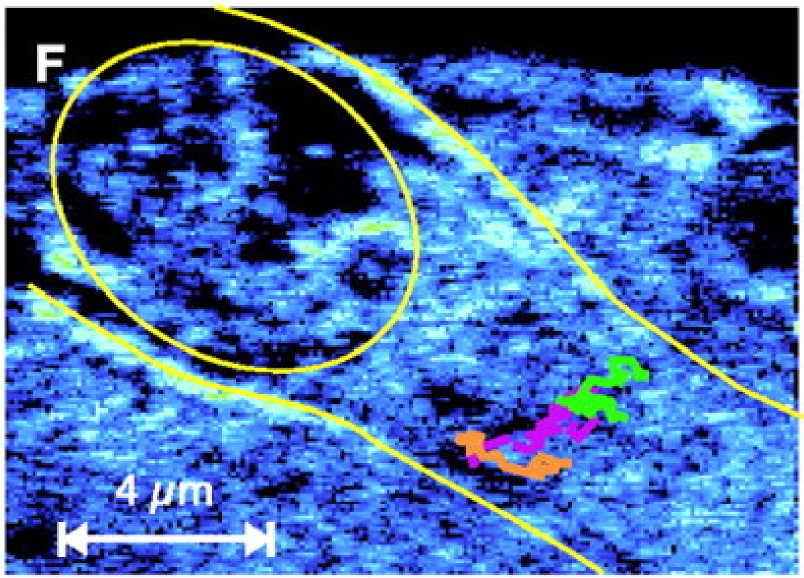
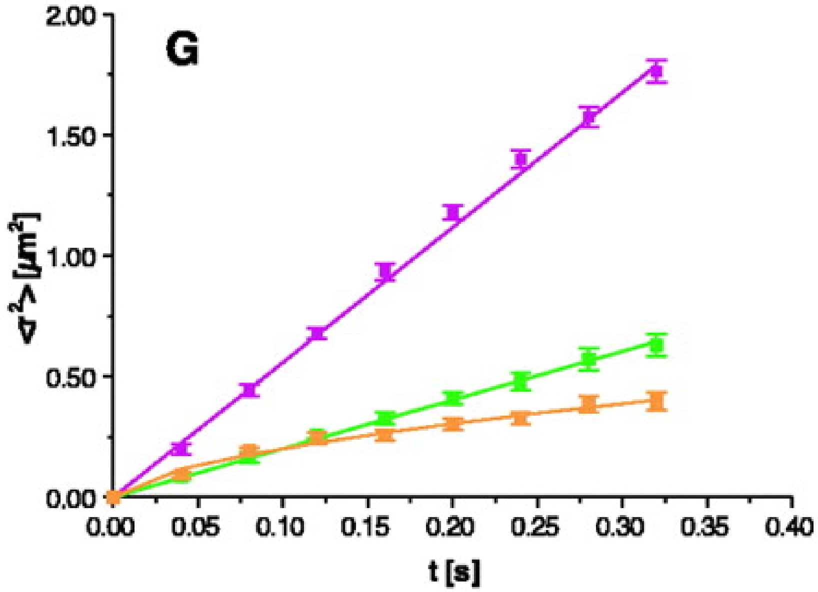
Contents

1.The infection pathway of viruses in living cells

G. Seisenberger, *et al*. Science **294**,1929 (2001).



The dynamics of viruses in cytoplasm



The mean square displacements

The mean square displacement $\propto t^{\alpha}$

$$\boxed{0.5 < \alpha \leq 1}$$

2. Anomalous diffusion

In Einstein's view,

$$f(x,t+\tau)dx = dx\int_{-\infty}^{\infty} d\Delta f(x+\Delta,t)\phi_\tau(\Delta),$$

where

$f(x,t)dx$: The probability for finding a particle in $[x,x+dx]$

$\phi_\tau(\Delta)$: The normalized distribution for a displacement Δ in a time step τ $(\phi_\tau(\Delta) = \phi_\tau(-\Delta))$

$$\downarrow$$

$$\frac{\partial f}{\partial t} = D\frac{\partial^2 f}{\partial x^2} \quad \left(D \equiv \frac{1}{\tau}\int_{-\infty}^{\infty} d\Delta \frac{\Delta^2}{2}\phi_\tau(\Delta)\right)$$

The mean square displacement $= 2Dt$

τ is random variable,

A power-law decay

$$\psi_\alpha(\tau) \propto \frac{s^\alpha}{\tau^{1+\alpha}} \qquad (0 < \alpha < 1, \quad s << \tau)$$

(s is a characteristic time)

The mean square displacement $\propto t^\alpha$

(with the assumption: $\phi_\tau(\Delta) = \phi(\Delta)$)

3. Anomalous diffusion with heterogeneity

α_1	α_2		
		α_i	

The local fluctuations of α in the spatial cells

$$\int_0^1 d\alpha P(\alpha)\psi_\alpha(\tau)$$

$P(\alpha)$: The distribution to observe α in a spatial cell

4. Summary

- The virus infection in living cells

- Anomalous diffusion with *local fluctuations* of the diffusion exponent

♣ The determination of the distribution of the exponents

to be submitted