衝突カスケード

$$\bar{m}_{\rm e} \propto m \quad n(m) \propto m^{-\alpha}$$

$$\int m_{\rm e} \boxed{n(m)\Delta m\, \sigma v\; n(m')dm'} \propto m^{11/3-2\alpha}\,(\bar{m}'/m)^{1-\alpha}$$

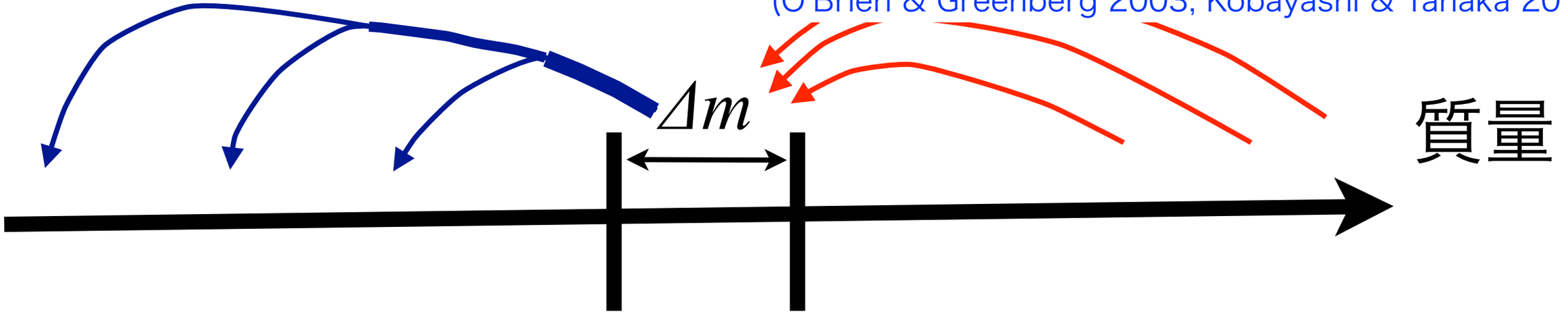
単位時間当りの衝突回数

α=11/6　　($r^{-3.5}$)

(Dohnanyi 1969; Tanaka et al. 1996)

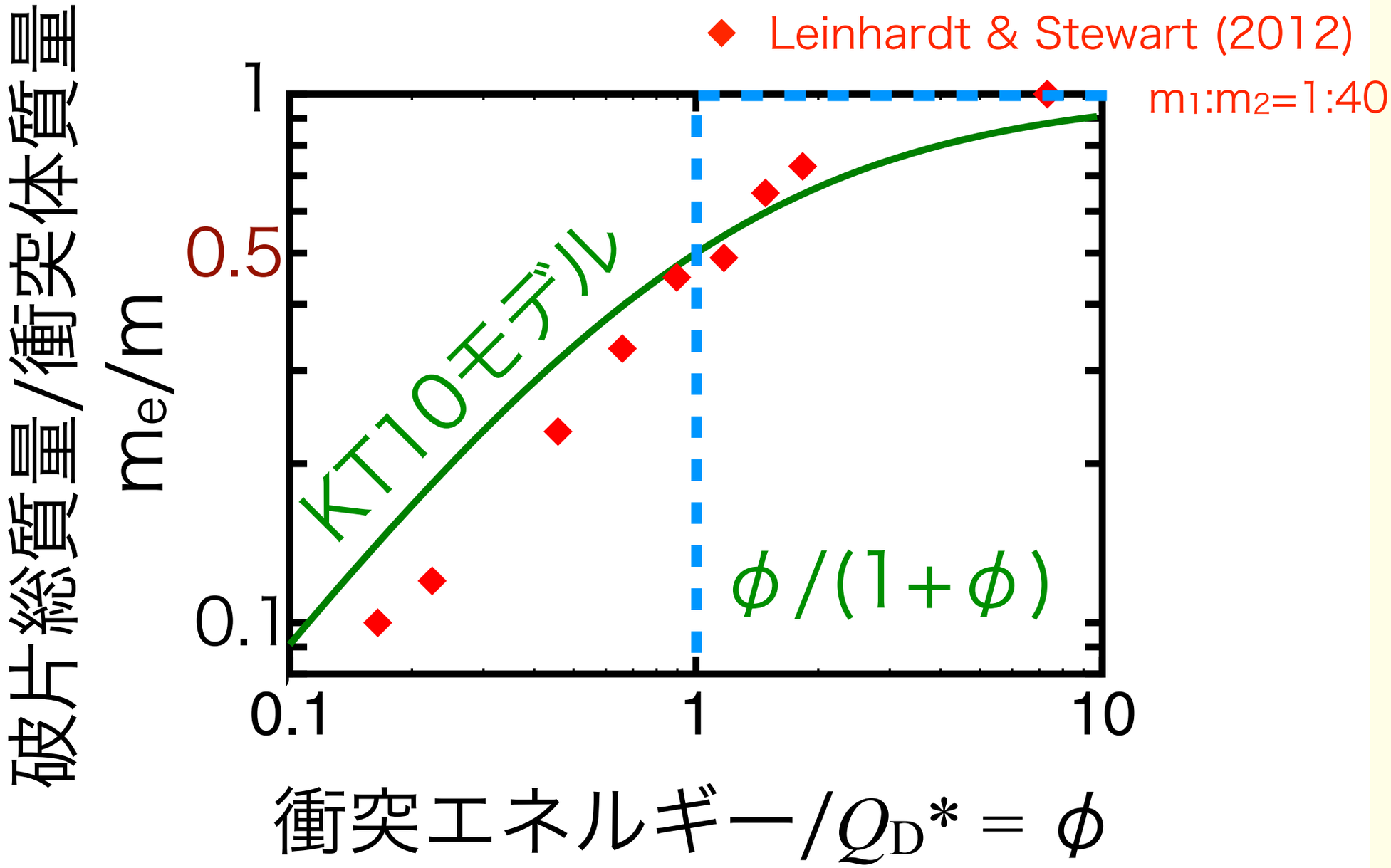
$$\bar{m}'/m \propto m^p \quad \alpha = (11+3p)/(6+3p)$$

(O'Brien & Greenberg 2003; Kobayashi & Tanaka 2010)



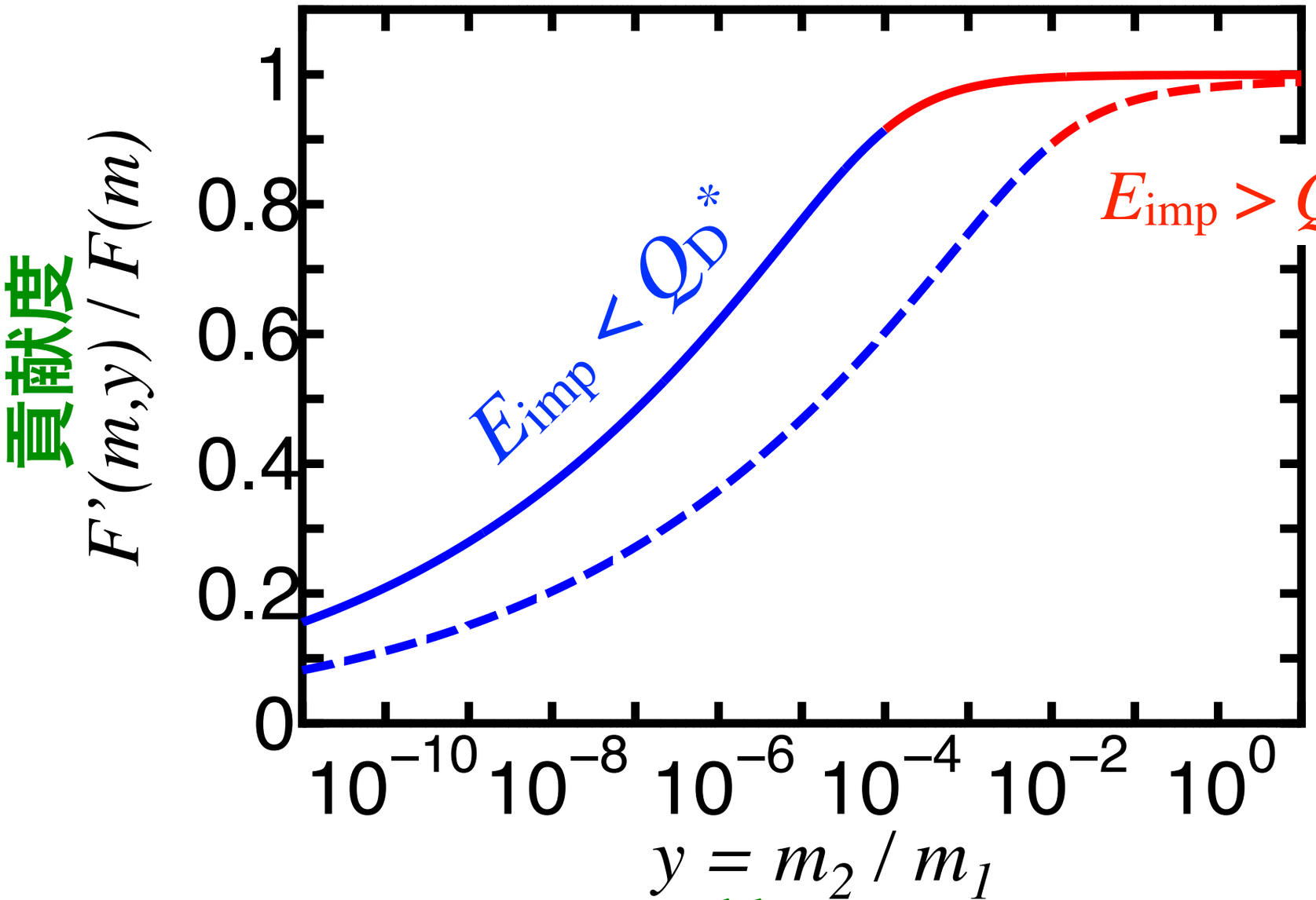
- **質量分布はベキになる(大きい物が質量を持つ)。**
- **m_eとm'/mの関係が輸送を決める。**

破壊のモデル


Leinhardt & Stewart (2012)
m1:m2=1:40
KT10モデル
φ/(1+φ)
破片総質量/衝突体質量
me/m
1
0.5
0.1
0.1
1
10
衝突エネルギー/Q_D^* = φ

どういう衝突が重要か？

$$\frac{v^2}{Q_{\rm D}^*} = 200, 2000$$



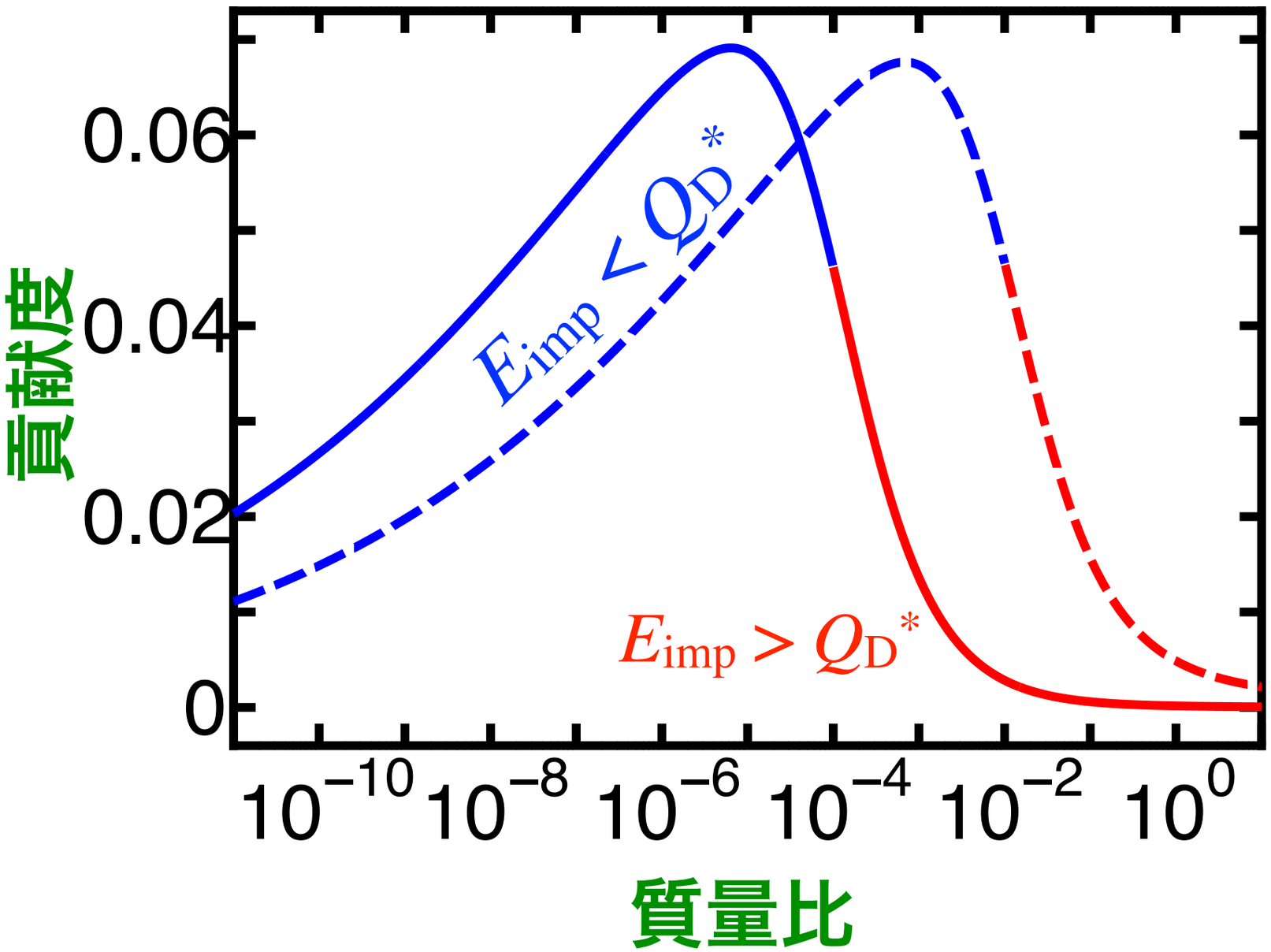
- 弱い衝突が重要
- 大きい質量比の衝突が重要

$$\bar{y} = 10^{-6}\text{–}0.1 \left(\frac{2Q_{\rm D}^*}{v^2} \right)$$

$$\bar{m}_{\rm e} = 10^{-6}\text{–}0.1m$$

どういう衝突が重要か？

$$\frac{v^2}{Q_{\rm D}^*} = 200, 2000$$



- 弱い衝突が重要
- 大きい質量比の衝突が重要

$$\frac{\bar{m}'}{m} = 10^{-2}\text{–}10^{-1}\ \frac{Q_{\rm D}^*}{v^2}$$

$$\bar{m}_{\rm e} = 10^{-2}\text{–}10^{-1}\ m$$

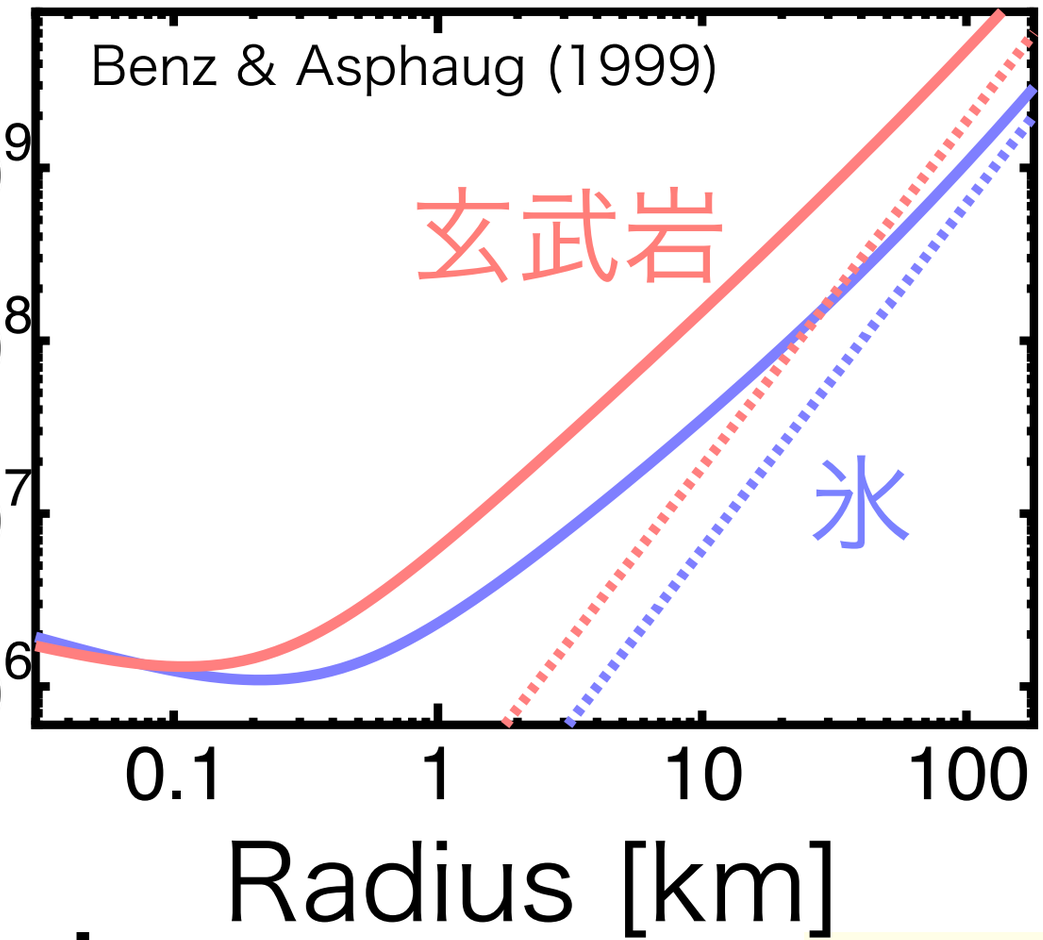
衝突カスケードの時間

惑星形成でカスケードを起こすとき、

初期微惑星より小さい

$$t_{\rm c}^{-1} \approx \frac{\Sigma_{\rm s}}{m_{\rm p}} \pi r_{\rm p}^2 \Omega_{\rm K} \times \left(\frac{\bar{m}'}{m_{\rm p}} \right)^{*}$$

$$\propto \left(\frac{e_{\rm p}^2 v_{\rm K}^2}{2 Q_{\rm D}^*(m_{\rm p}, \quad ,} \right.$$



微惑星の質量、離心率、$Q_{\rm D}^*$が重要！

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