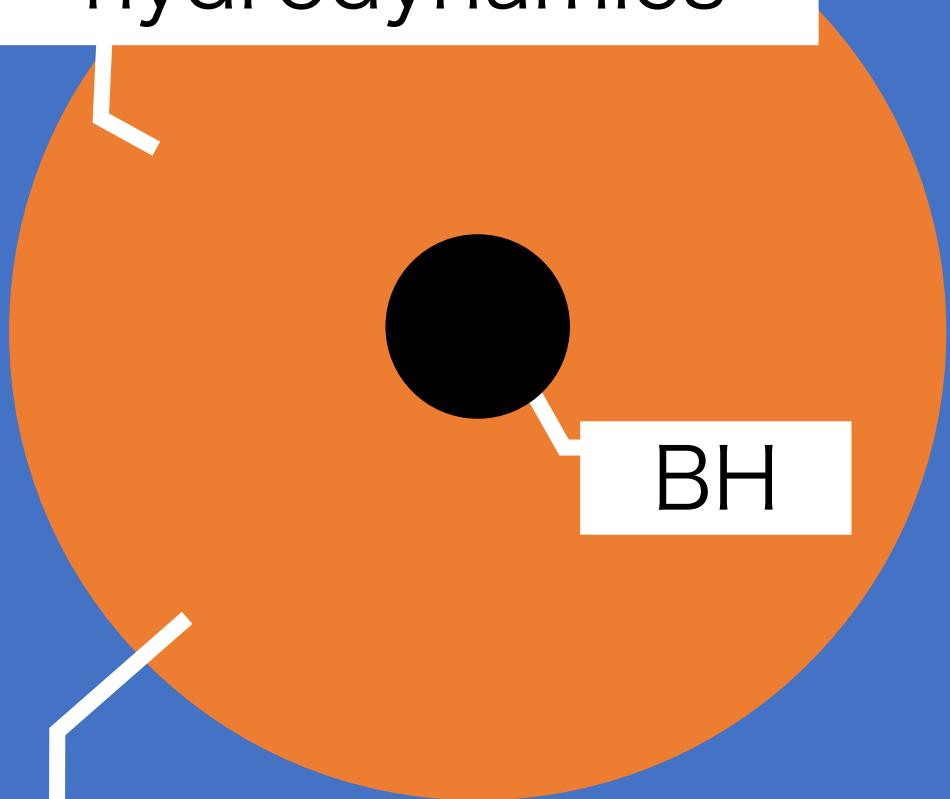


ダストガス間の速度差を考慮した 巨大ブラックホールへの質量降着と ダスト熱輻射

Shohei Ishiki (Hokkaido University),
Takashi Okamoto (Hokkaido University),
Hidemobu Yajima (Tukuba University)

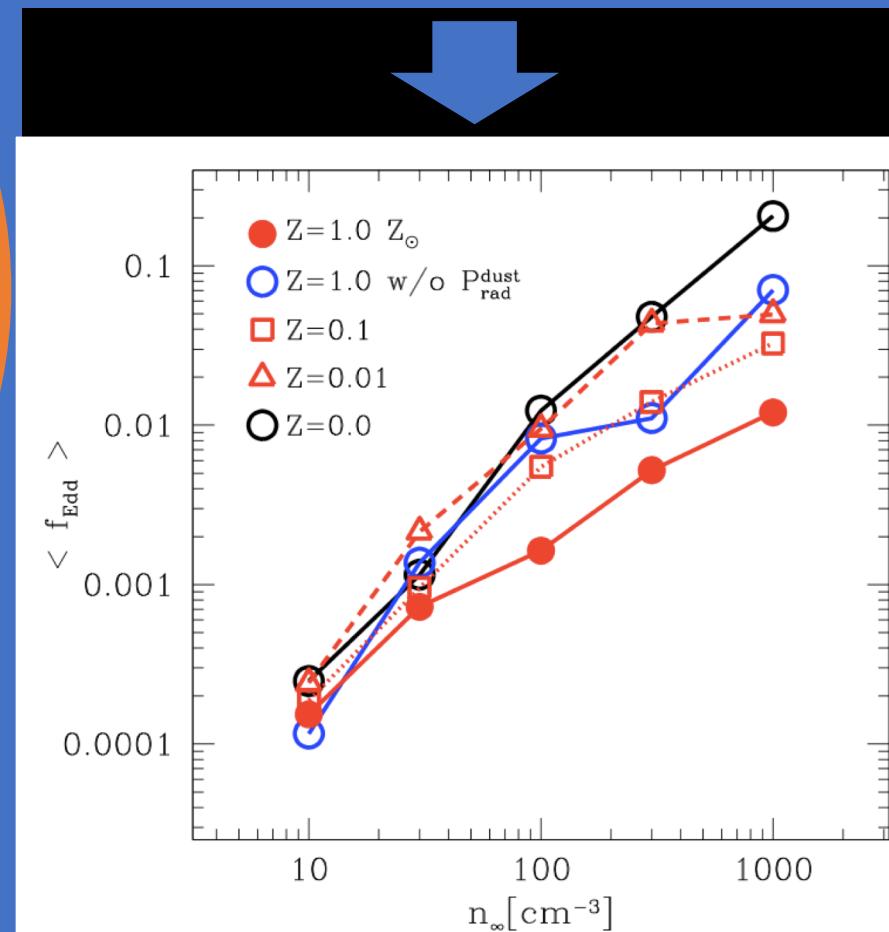
1. Introduction

1D radiation hydrodynamics



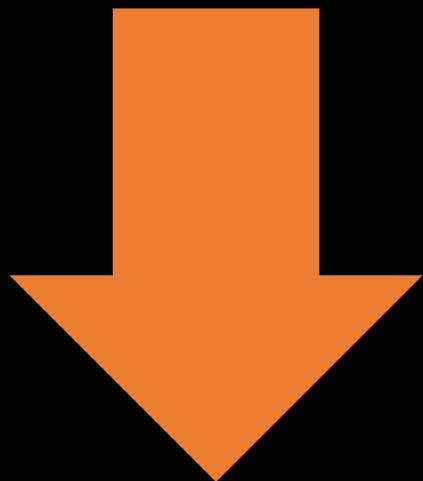
H, He, Dust

Yajima et al. (2017) shows that radiation pressure suppress the dusty gas accretion onto BH.



1. Introduction

Yajima et al. (2017) assumed that dust and gas are completely coupled.

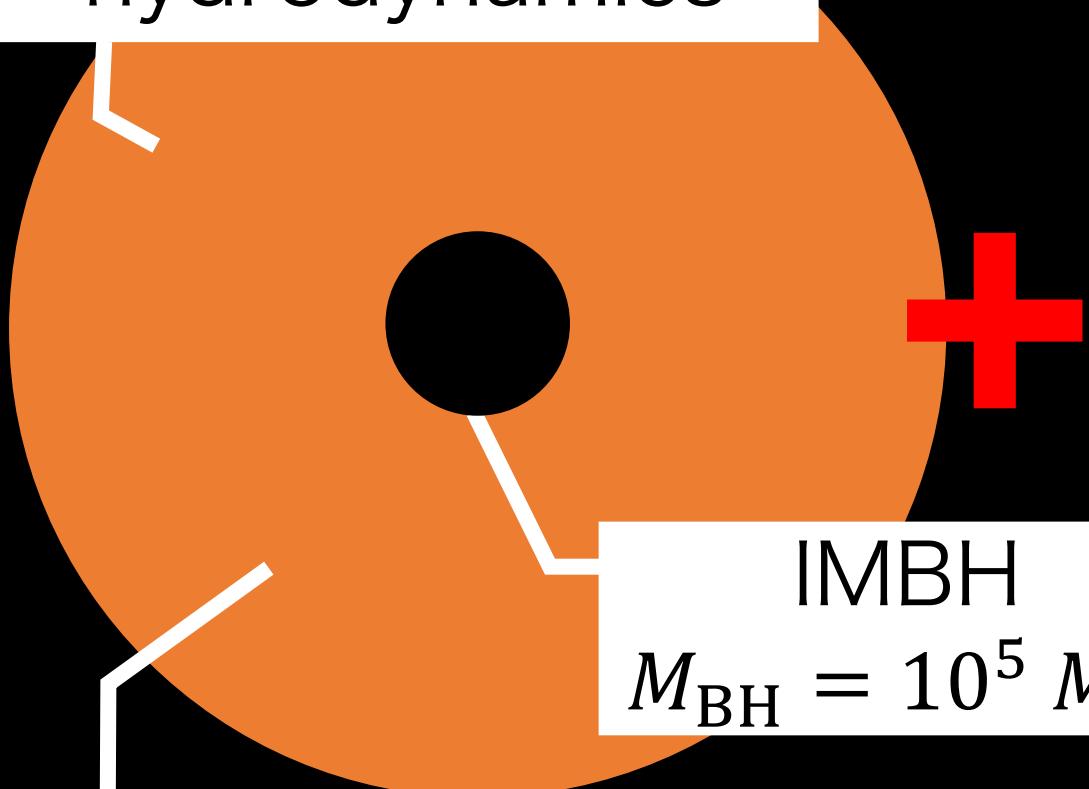


The effect of relative velocity
between dust and gas



1. Introduction

1D radiation
hydrodynamics

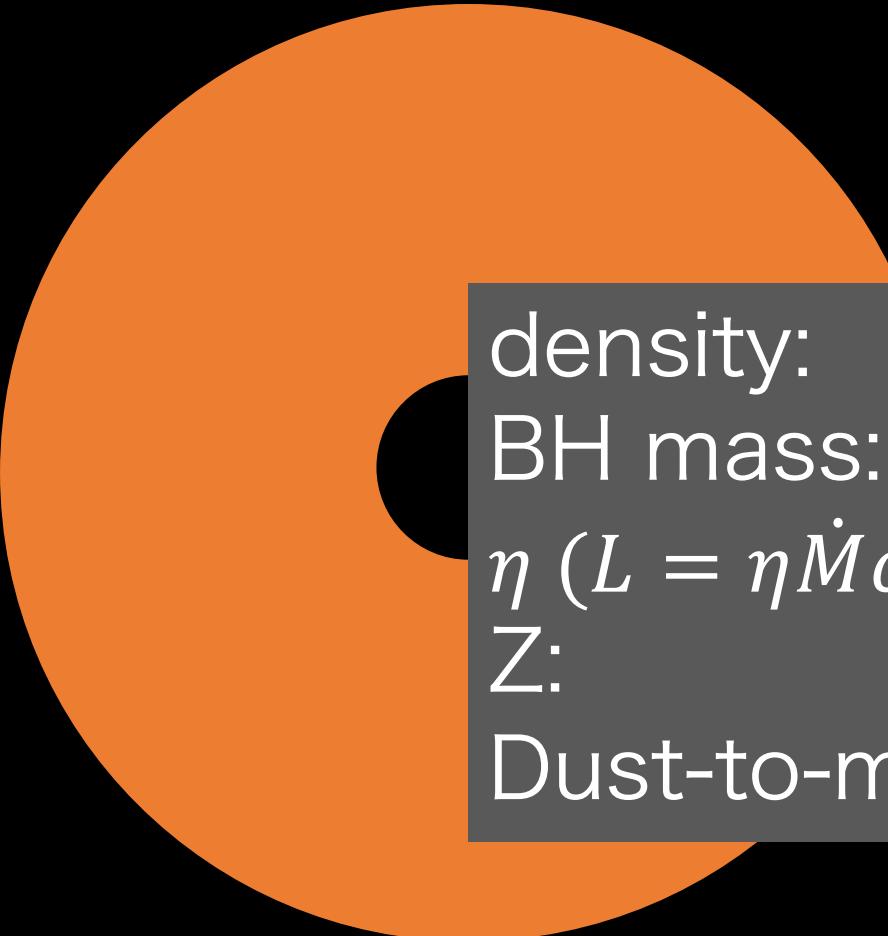


Relative velocity
between
dust and gas
(Ishiki et al. 2018)

IMBH
 $M_{\text{BH}} = 10^5 M_{\odot}$

H, He, Graphite;
 $n_{\text{H}} = 10, 30, 100 \text{ cm}^{-3}$

1. Introduction



density: $10, 30, 100 \text{ cm}^{-3}$
BH mass: $10^5 M_\odot$
 η ($L = \eta \dot{M} c^2$): 0.1, 0.3
Z: 0.1, 1.0 Z_\odot
Dust-to-metal: solar

1. Introduction

Red: relative velocity

Black: completely coupled

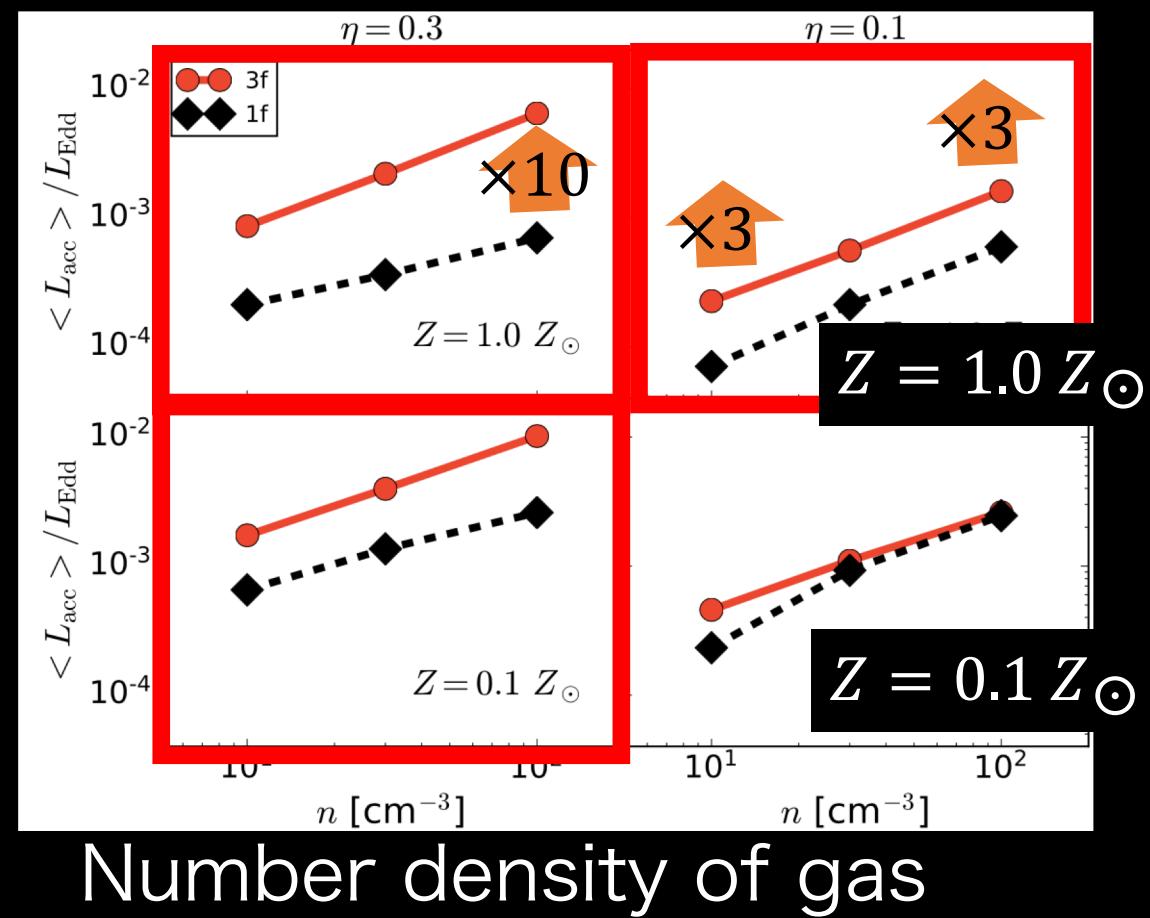
$$L = \eta \dot{M} c^2$$

$$\eta = 0.3$$

$$\eta = 0.1$$

Time averaged BH Luminosity
Eddington Luminosity

The decoupling of dust
from gas promotes the
gas accretion onto BH.



How about Spectral Energy Distribution
(SED) at IR wavelengths?

2. Method

Dust

Graphite

size:

0.1, 0.01 micron

ratio:

$n_{0.1} : n_{0.01} = 1:10^{2.5}$

Temperature:

Absorb energy +

Collision between dust and gas

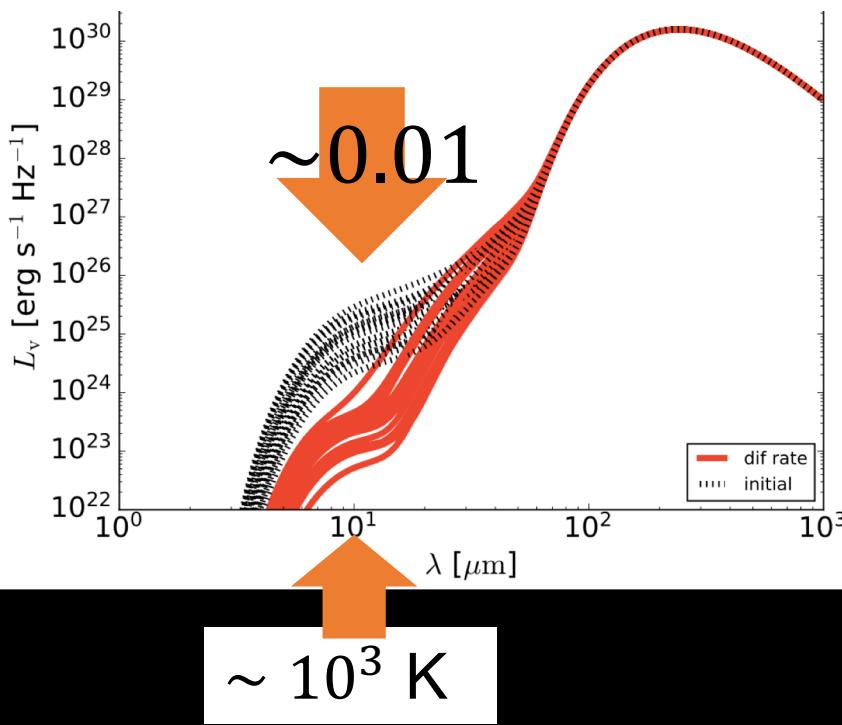
= Emitted Energy

3. Result SED: IR re-emission from dust

SED

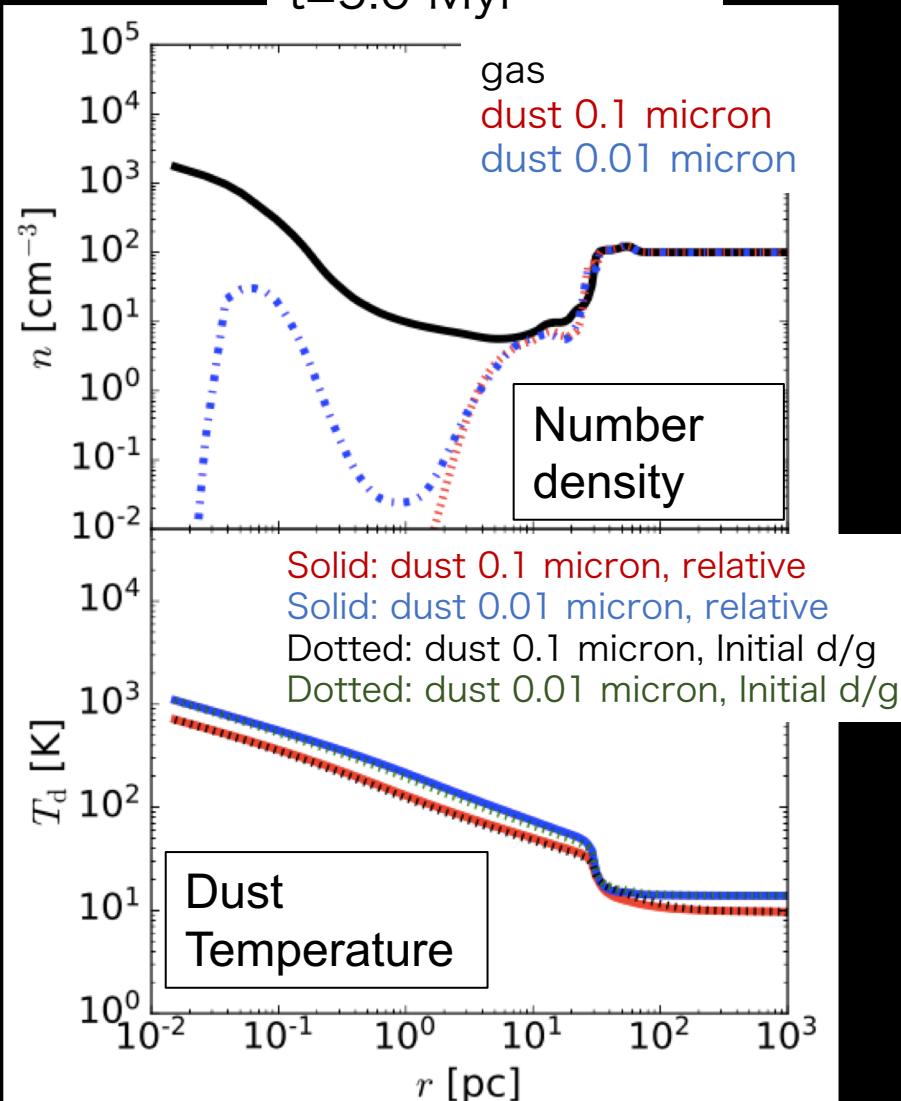
Red: Relative velocity

Black: Initial dust-to-gas mass ratio



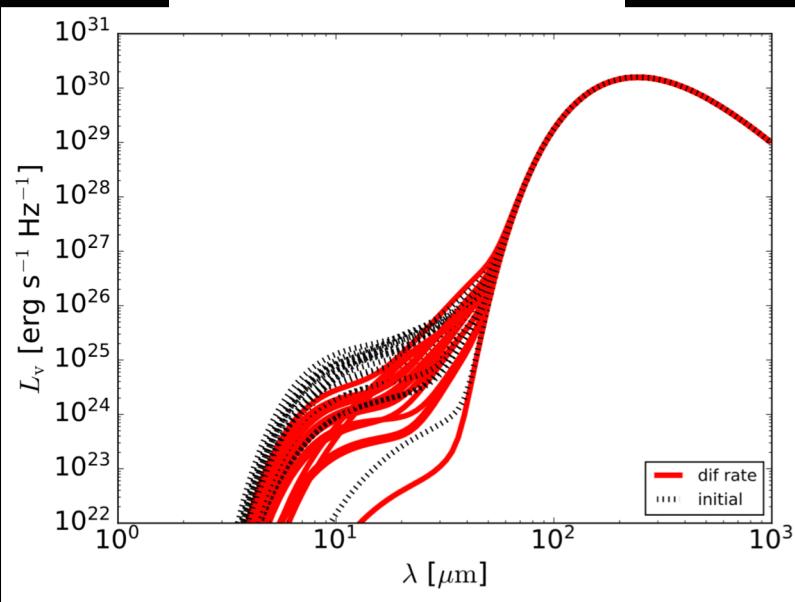
Radiation pressure removes high temperature dust.

$n_H = 100 \text{ cm}^{-3}$,
 $Z = 1.0 Z_\odot, \eta = 0.3$
 $t = 5.0 \text{ Myr}$

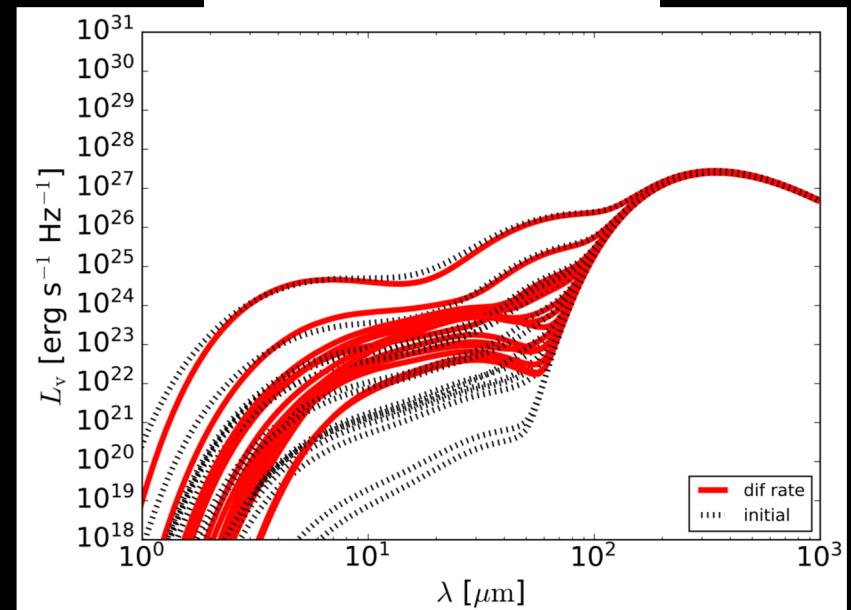


3. Result SED: IR re-emission from dust

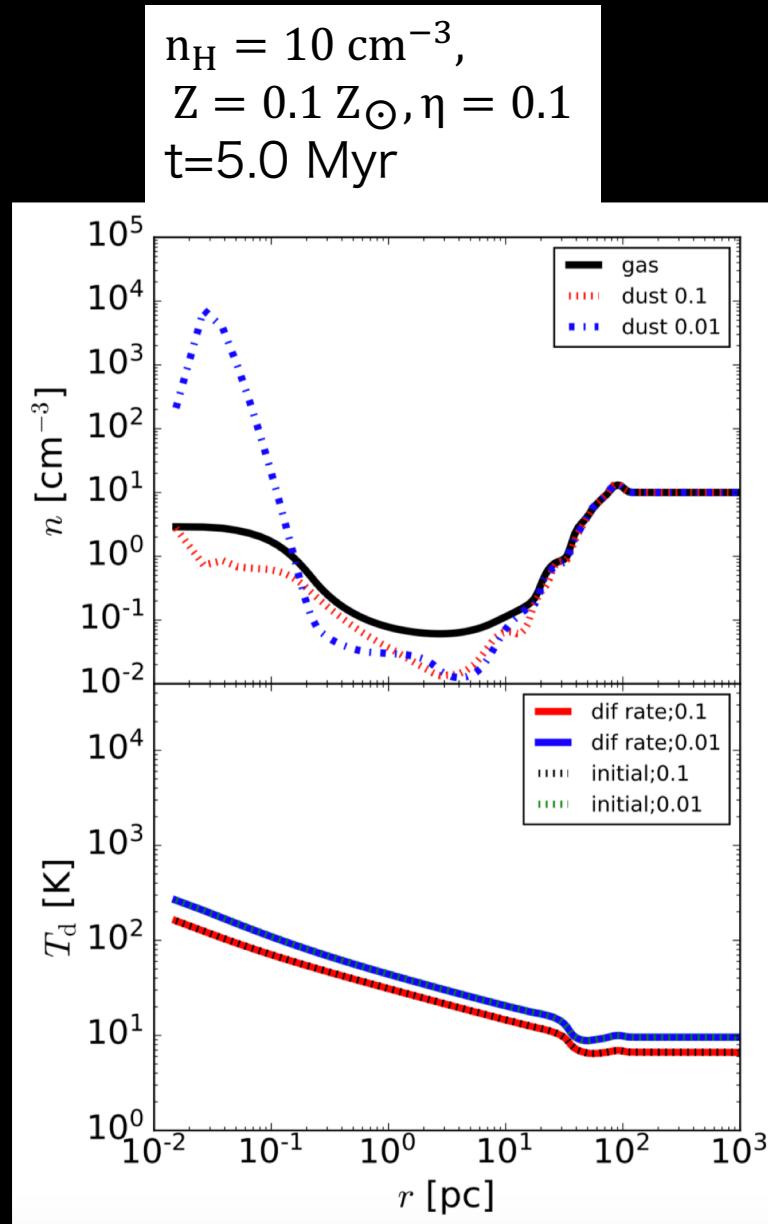
$n_H = 100 \text{ cm}^{-3}$,
 $Z = 1.0 Z_\odot, \eta = 0.1$
 $t=5.0 \text{ Myr}$



$n_H = 10 \text{ cm}^{-3}$,
 $Z = 0.1 Z_\odot, \eta = 0.1$
 $t=5.0 \text{ Myr}$



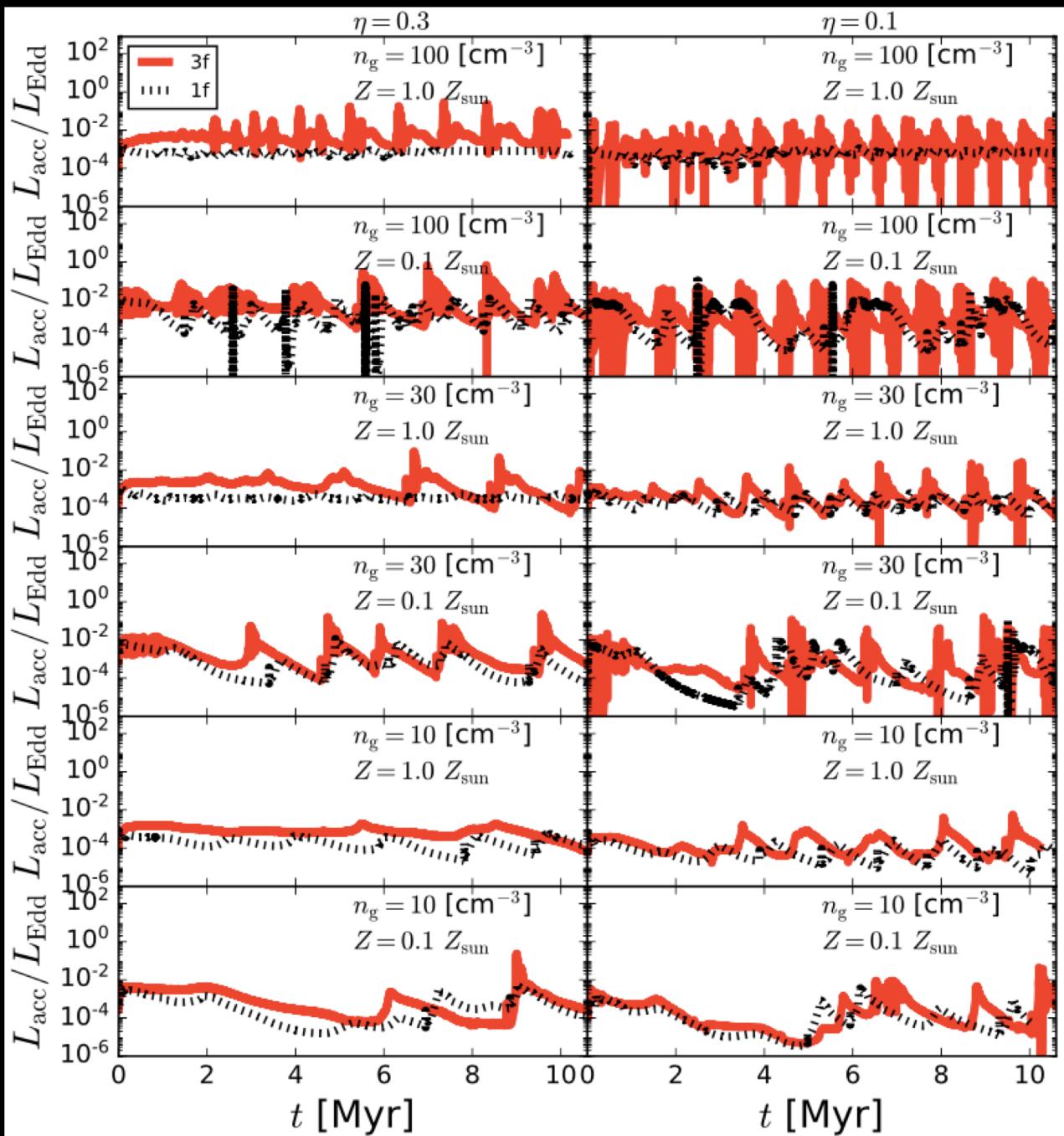
3. Result SED: IR re-emission from dust



Number of high temperature
dust becomes large.

4. Summary

- The decoupling of dust from gas affects SED at IR wavelengths ($\lambda \sim 10^1 \mu\text{m}$).



3. Result Spatial distribution of dust grains

