X53a Dust Grain Growth Explains Huge Dust Mass in Galaxies at $z = 7$–8?

竹内　努, 浅野　良輔, 田村　陽一 (名古屋大学), 野沢　貴也 (国立天文台), 馬渡　健, 井上　昭雄 (大阪産業大学)

Recently huge amount of dust $M_{\rm dust} \simeq 10^{6-7}\ M_\odot$ at $z = 7$–8 has been disvovered by ALMA observations. The suggested timescale of the dust production was a few–several$\times 10^8$ yr, while the stellar mass is several$\times 10^9\ M_\odot$. With such a moderate star formation rate, this amount of dust cannot be easily explained only by a supply from supernovae, especially if we consider the dust destruction by reverse shocks.

Recently, we have succeeded in constructing a consistent theoretical framework to describe the evolution of the total mass, grain size distribution, and chemical composition of dust in galaxies (Asano et al. 2013a, b, 2014; Nozawa et al. 2015). Particularly, our model naturally reproduced the significantly nonlinear relation between metallicity and dust-to-gas mass ratio discovered by *Herschel* (Rémy-Ruyer et al. 2014). The key physical process inducing the nonlinearity is the grain growth in the interstellar medium (ISM).

In this presentation, we show that this model consistently explains the dust mass in these high-z galaxies, as well as the SFR and stellar mass. Hence, we conclude that even at such an early epoch of the Universe, the dust grain growth in the ISM plays a significant role in galaxies.