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Poster No. 11

Ultra-long Gamma-Ray Bursts from Supermassive Population III Stars

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Ref. T.Matsumoto et al. 2015, ApJ, 810, 64
T.Matsumoto et al. 2016, ApJ, 823, 83

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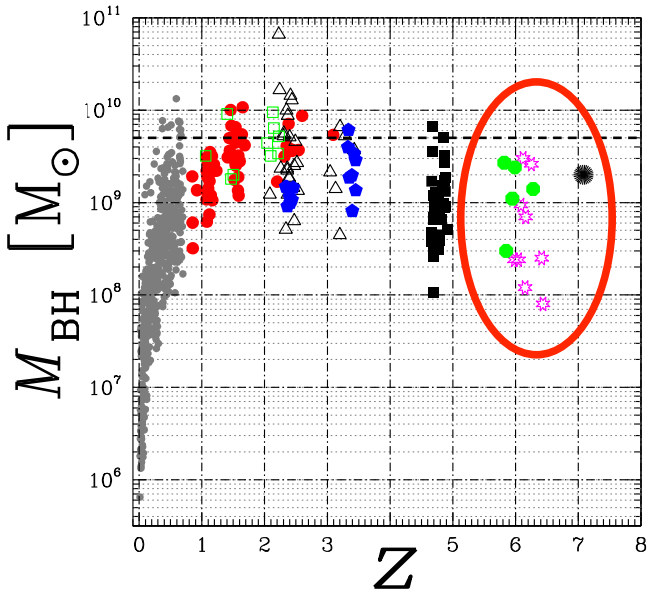
Supermassive Black Holes @ $z \sim 7$

$$M_{\rm BH} \sim 10^9 M_\odot \quad \text{@z ~ 6-7}$$

Fan 2006, Mortlock et al. 2011, Wu et al. 2015

Marziani & Sulentic 2012



Origin??

$$M_{\rm BH}(t) = M_{\rm BH,0} \exp\left[\frac{1-\epsilon}{\epsilon}\frac{t-t_0}{0.45{\rm Gyr}}\right]$$

1. Population III stars (First stars)

$$t_0 \sim 0.18\,{\rm Gyr}(z=20), M_{\rm BH,0} \sim 10^2 M_\odot \rightarrow M_{\rm BH}(t) \sim 10^7 M_\odot$$

2. Supermassive Population III stars (SMSs)

$$t_0 \sim 0.75\,{\rm Gyr}(z=15), M_{\rm BH,0} \sim 10^5 M_\odot \rightarrow M_{\rm BH}(t) \sim 10^9 M_\odot$$

But, SMSs have never observed…

⇒ We study the detectability of SMSs
focusing on Gamma-Ray Bursts produced by collapses of SMSs.

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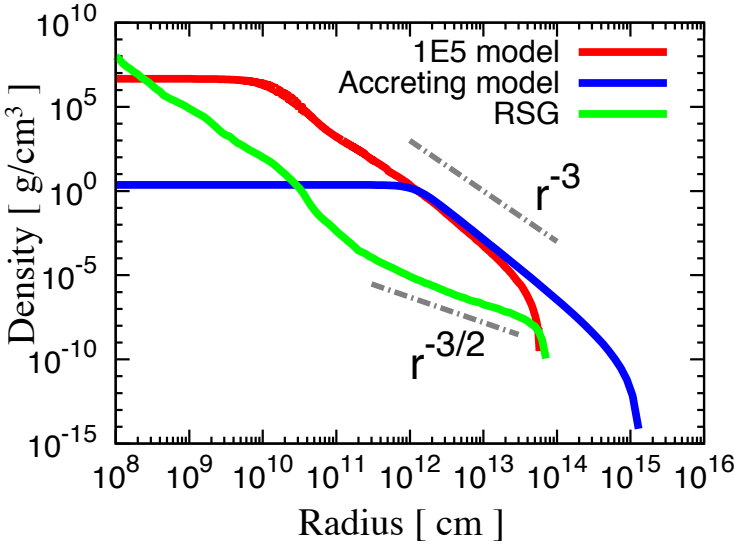
Gamma-Ray Bursts from SMSs

∗**Jets can break out of large envelopes!**

⇒**Ultra-long GRBs**

$$\delta t_\gamma \gtrsim 10^5 \text{ s}$$



∗**Ultra-Luminous Supernovae associate with GRBs!**

∗ A target of NIR telescopes

$$M_c \simeq 10^3 M_\odot \ t_{d,7}^2 v_{ph,10}^3$$

Estimate of the progenitor mass