

White Dwarf Mergers or Collisions in Elliptical Galaxies

Michael Tucker

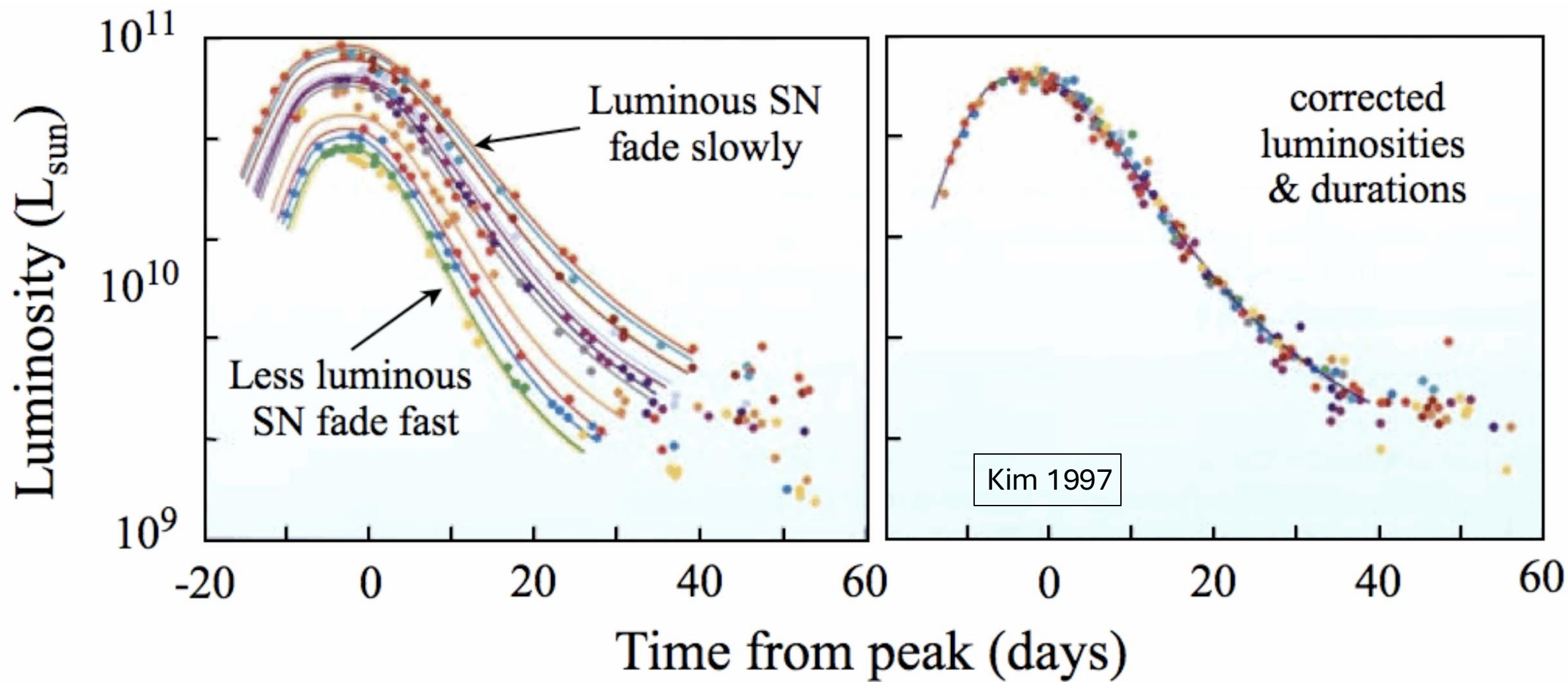
CCAPP Symposium

September 2024

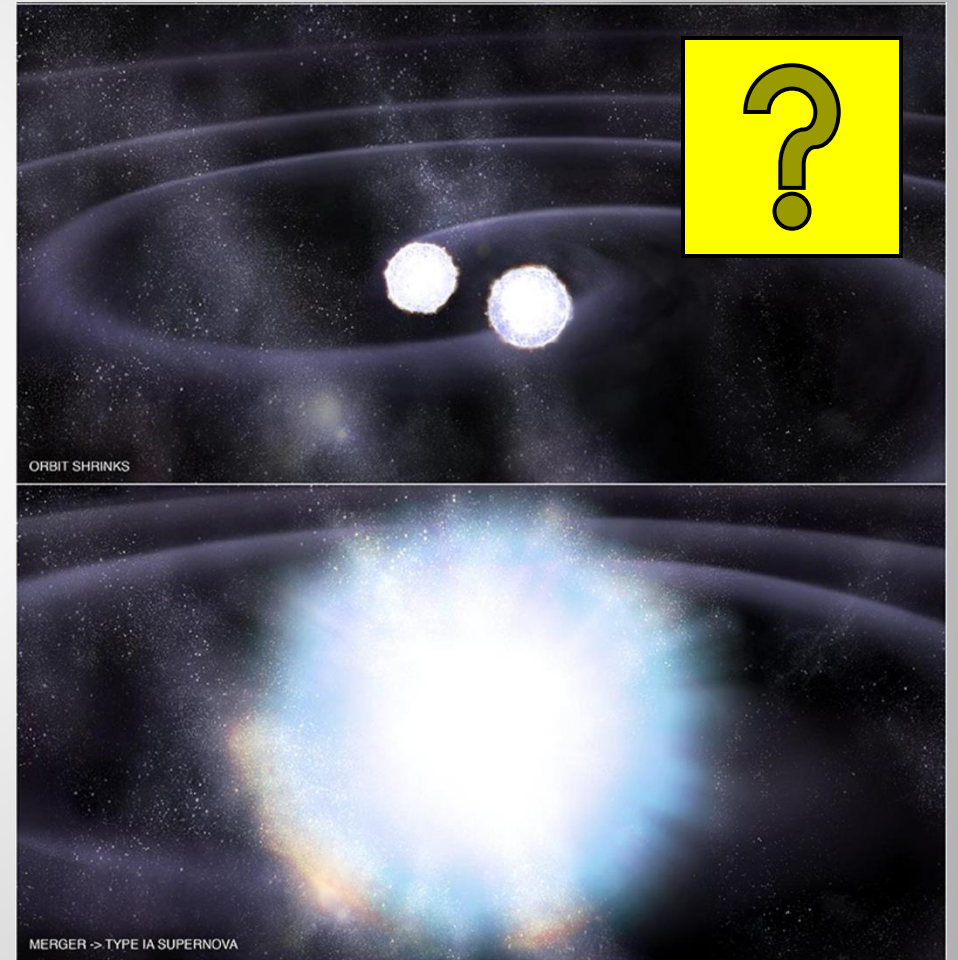
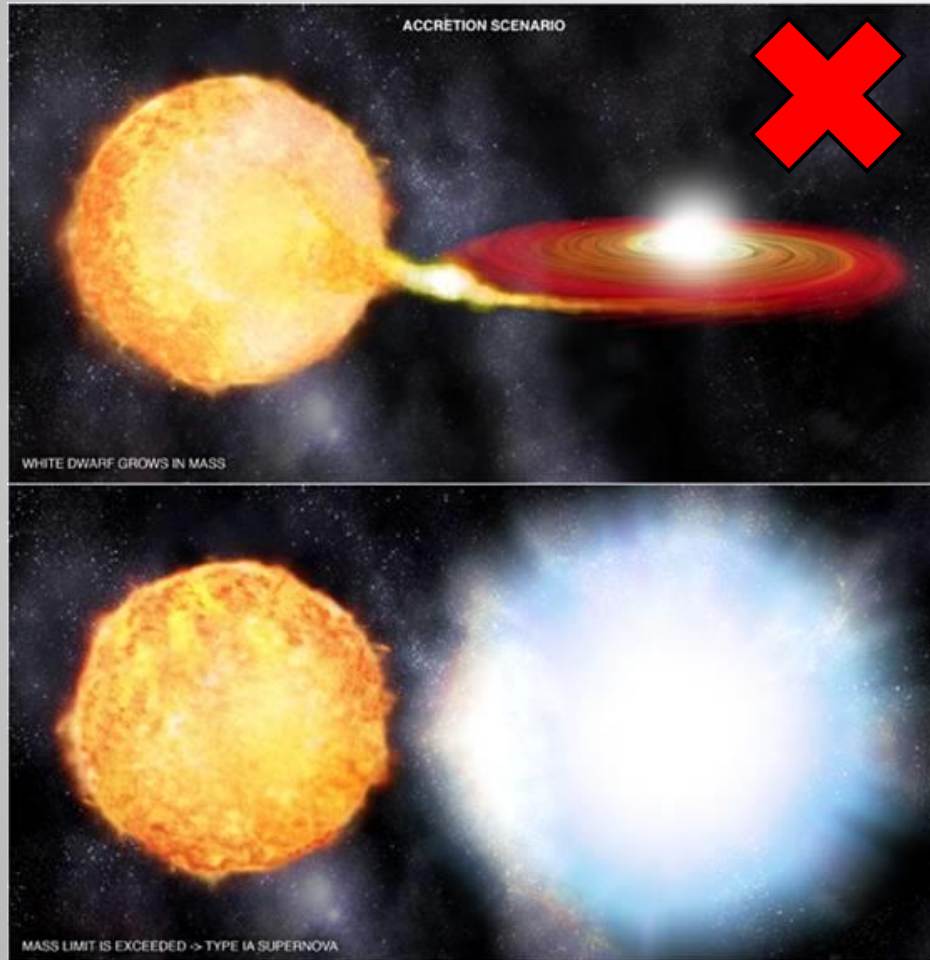


THE OHIO STATE UNIVERSITY

CENTER FOR COSMOLOGY AND
ASTROPARTICLE PHYSICS



Progenitors?

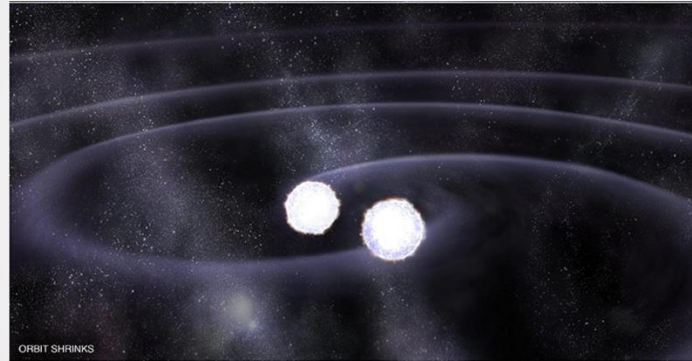


“violent” merger

Inspiral due to gravitational waves and tides, explodes during merger

“slow” merger

Inspiral due to gravitational waves and tides, explodes after merger



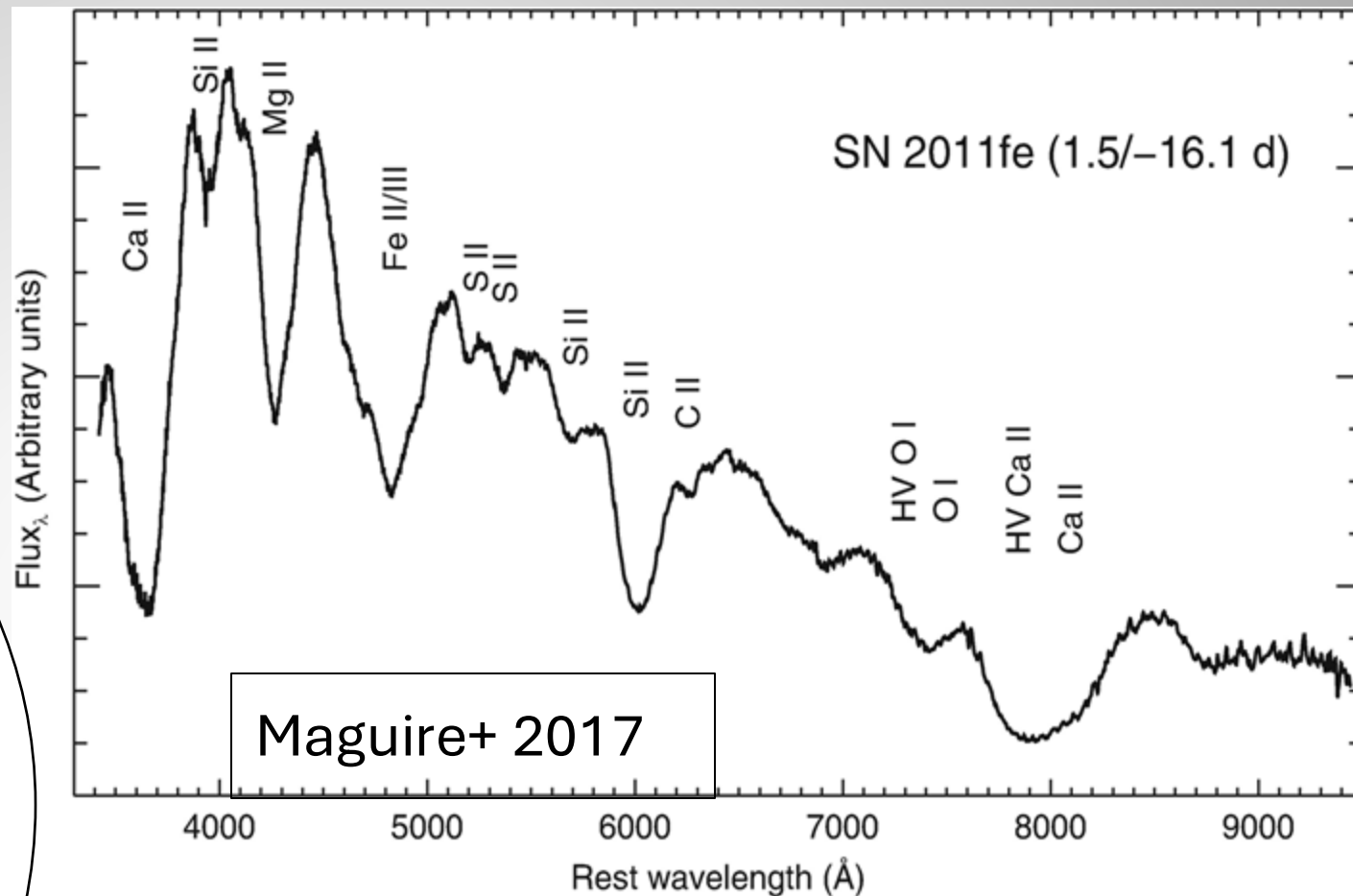
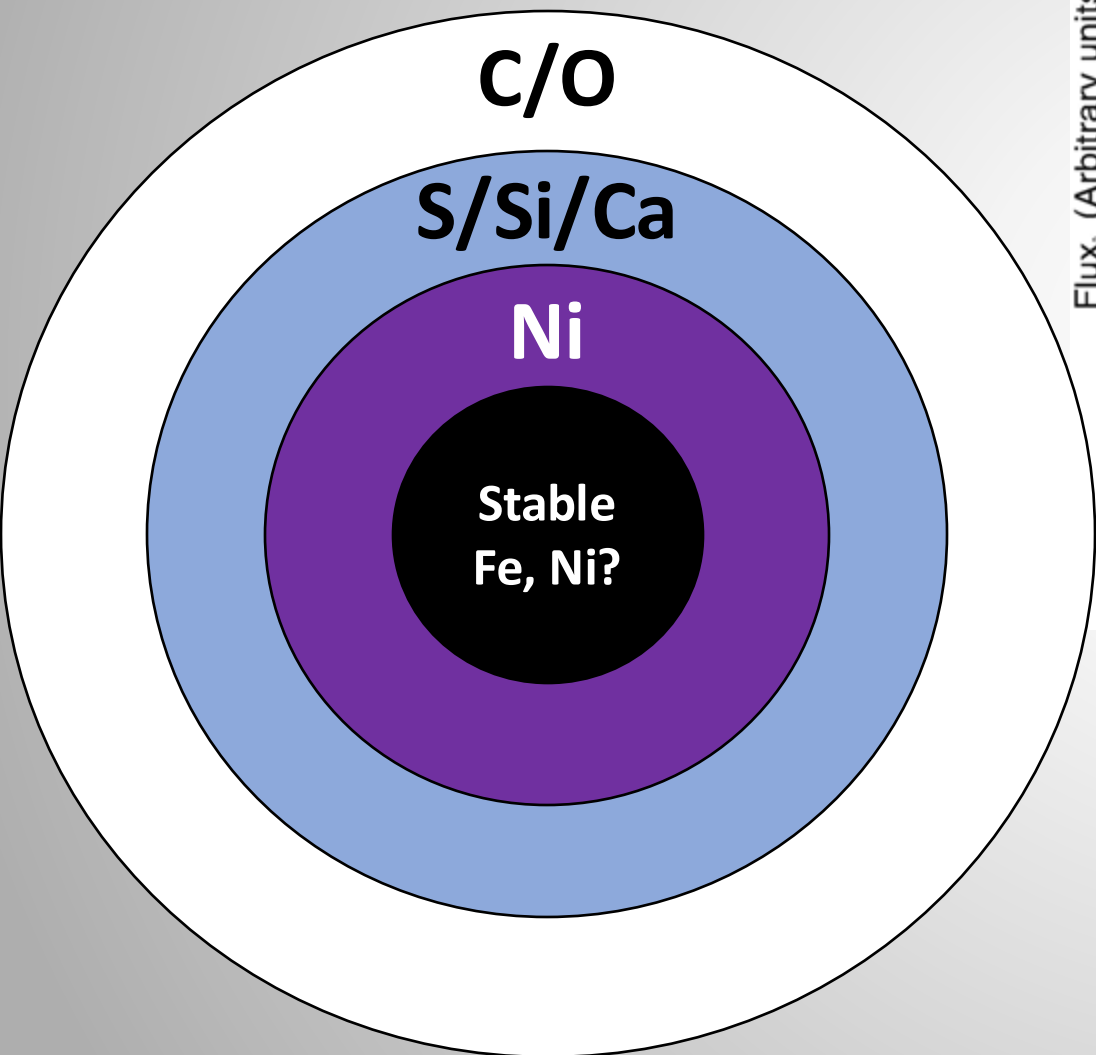
Requires triple- or quadruple-star systems to excite eccentricity~1

direct collision

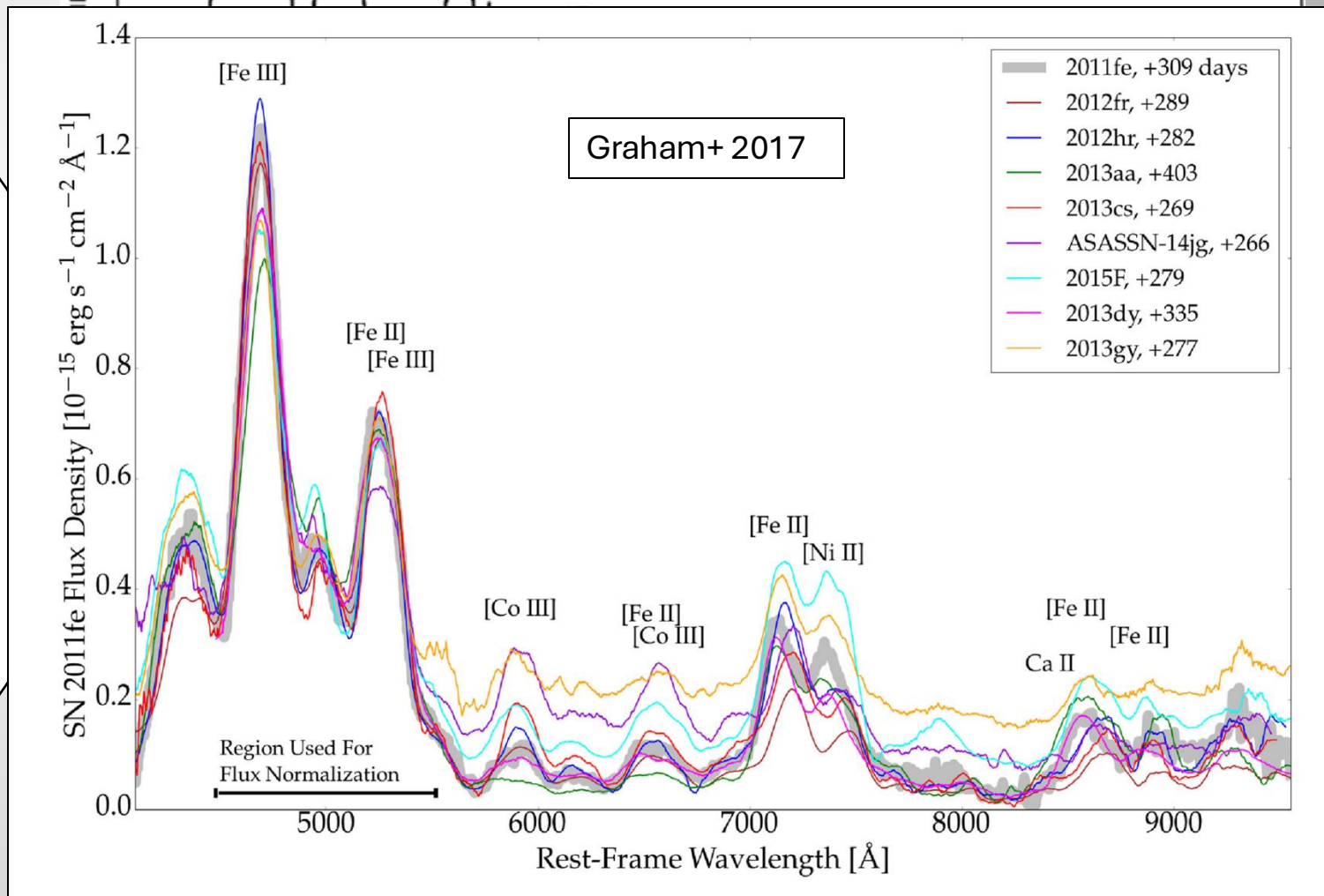
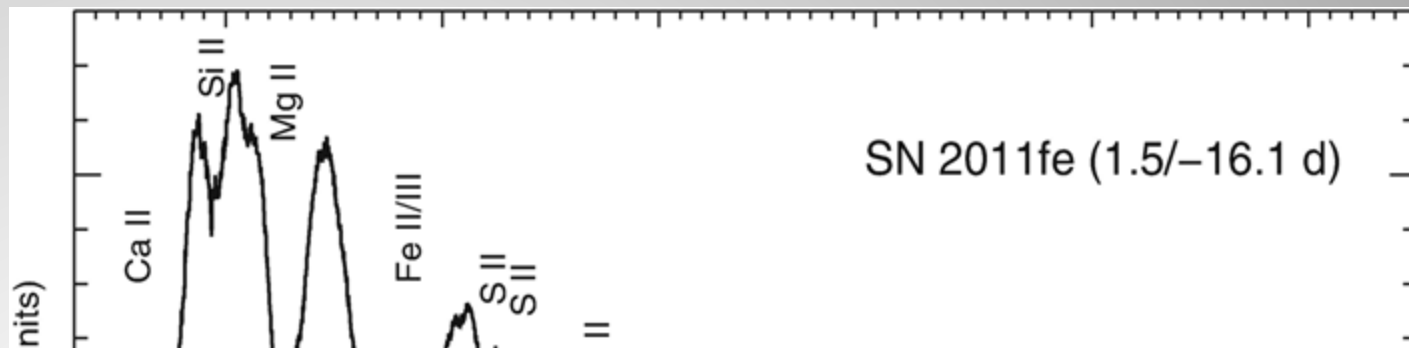
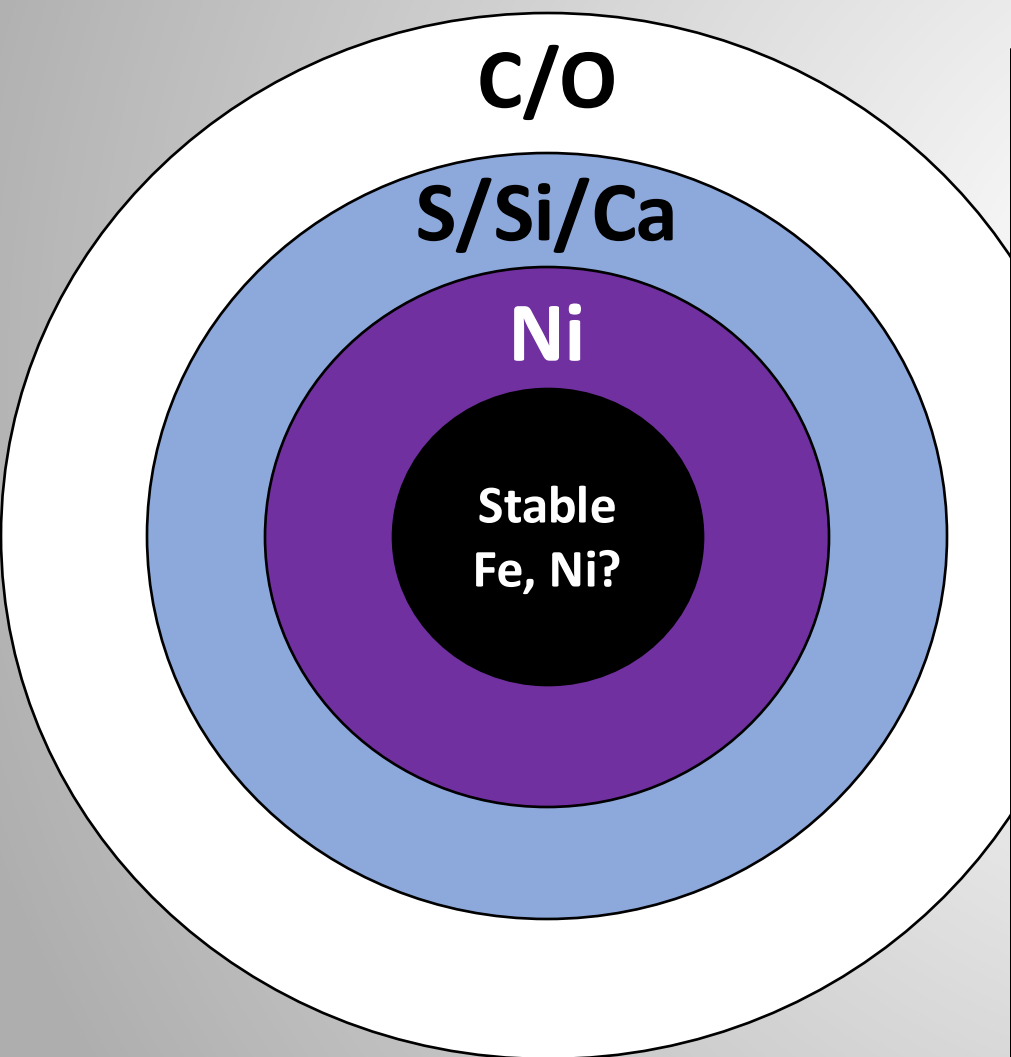
Surface ignition of He layer compresses and ignites C/O core

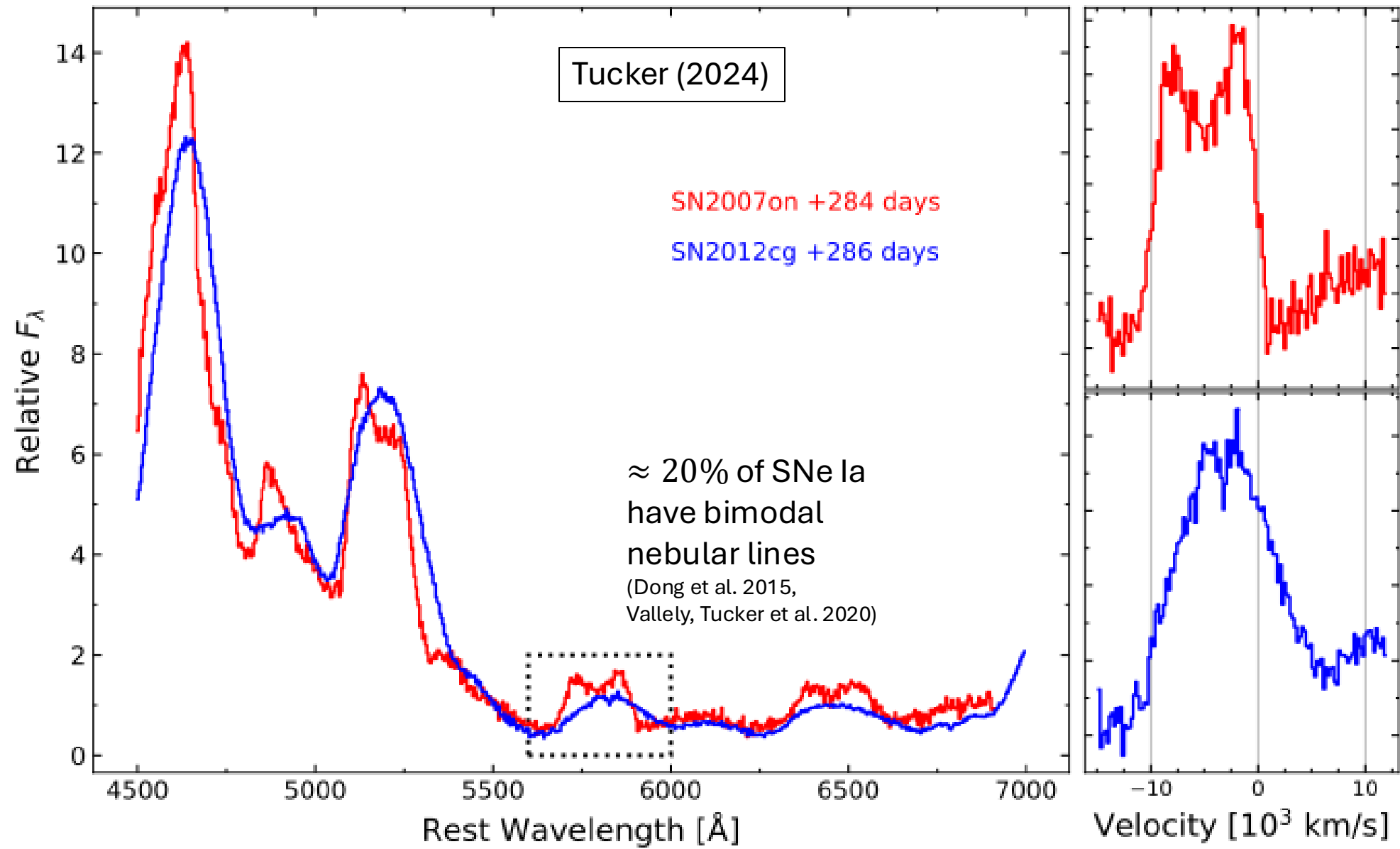
double detonation

The Photospheric Phase

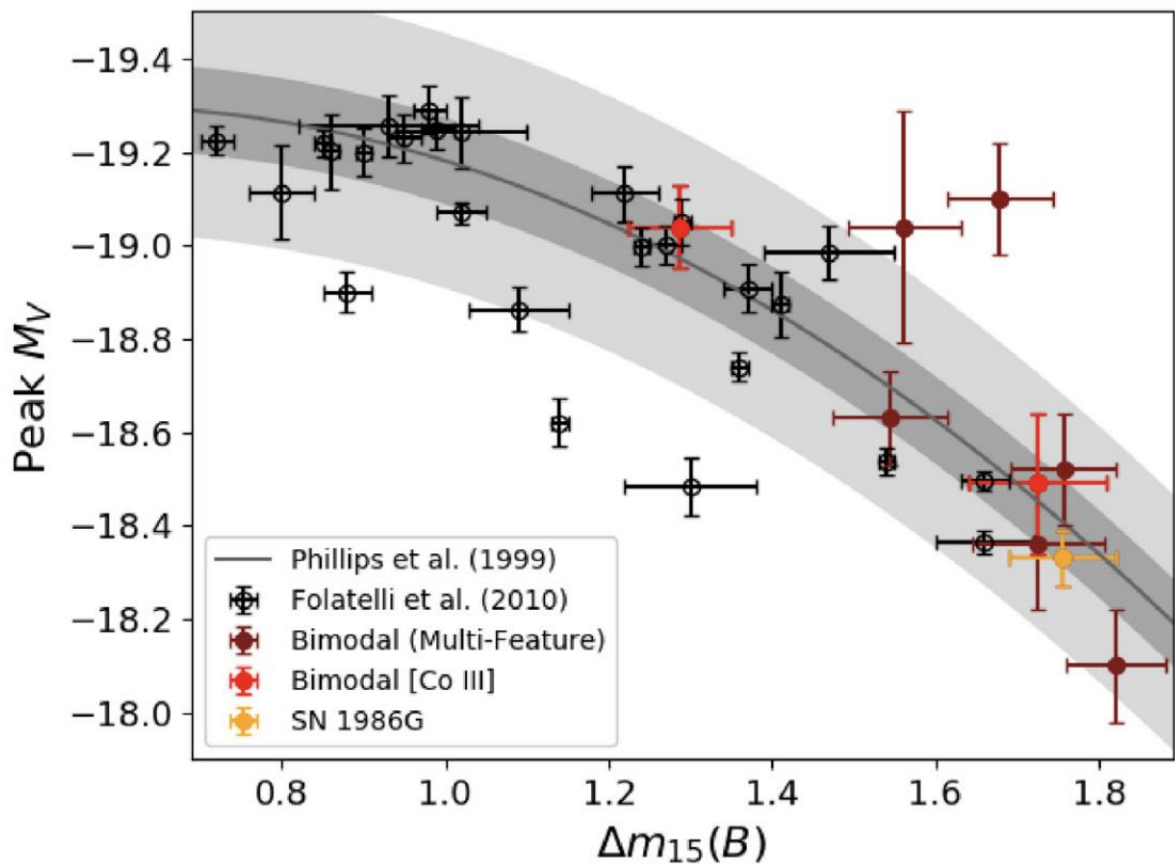


The Nebular Phase

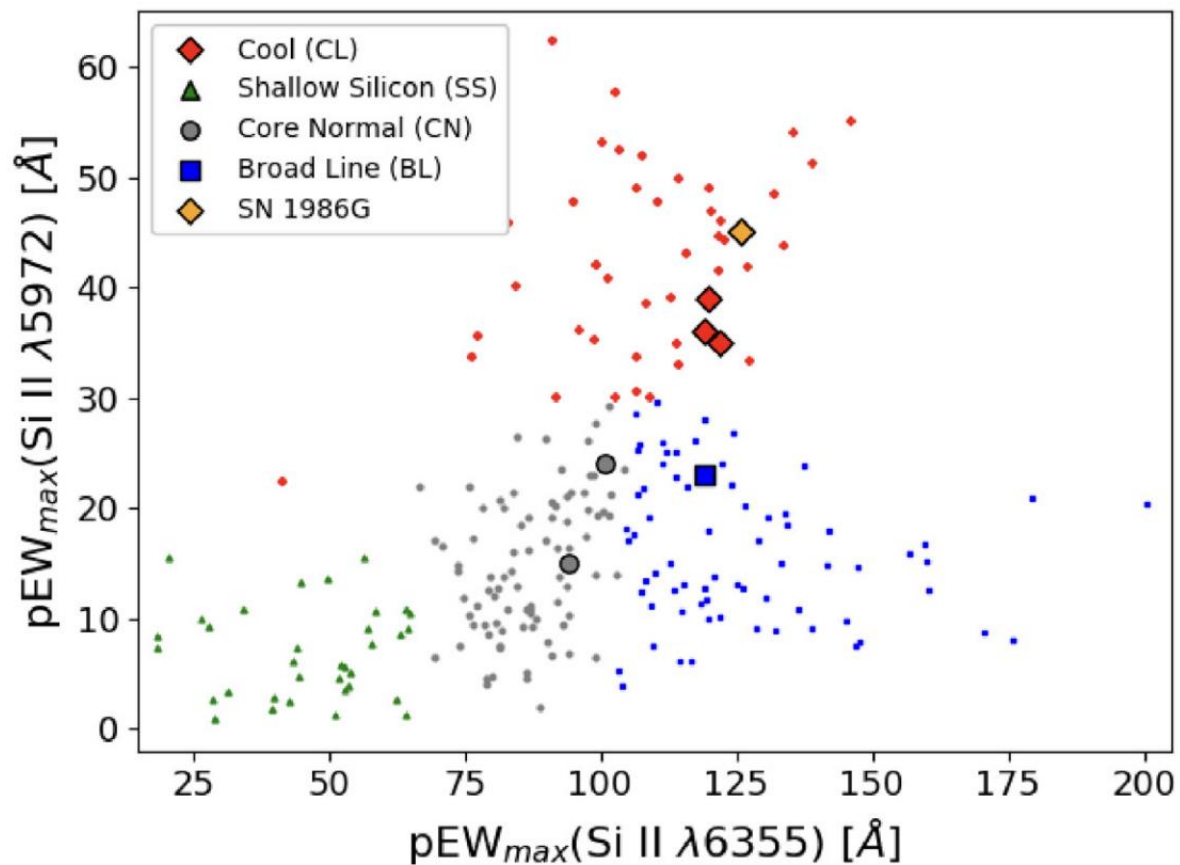




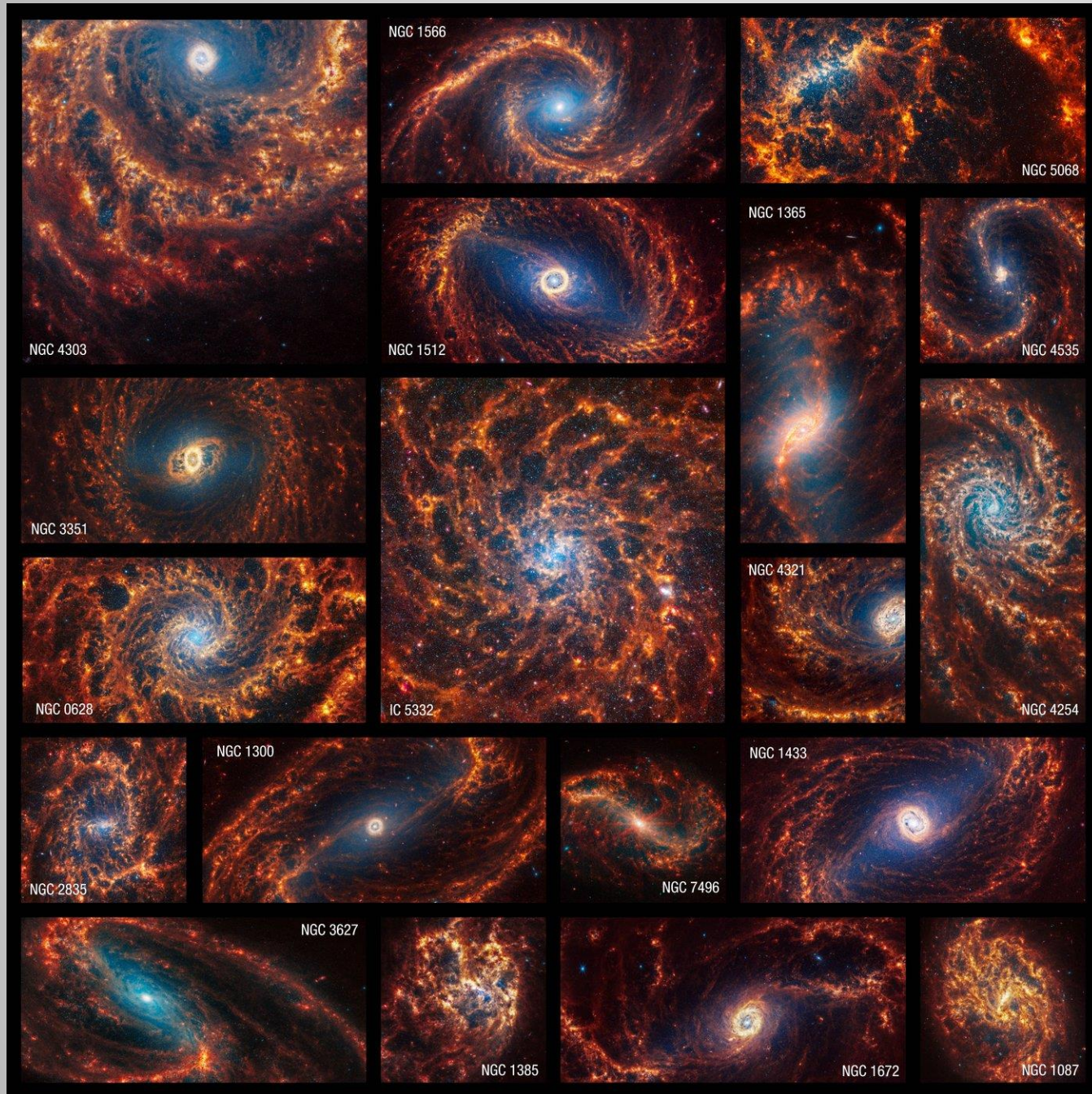
Light curve properties



spectra properties @ maximum



Vallely, Tucker, et al. (2020)

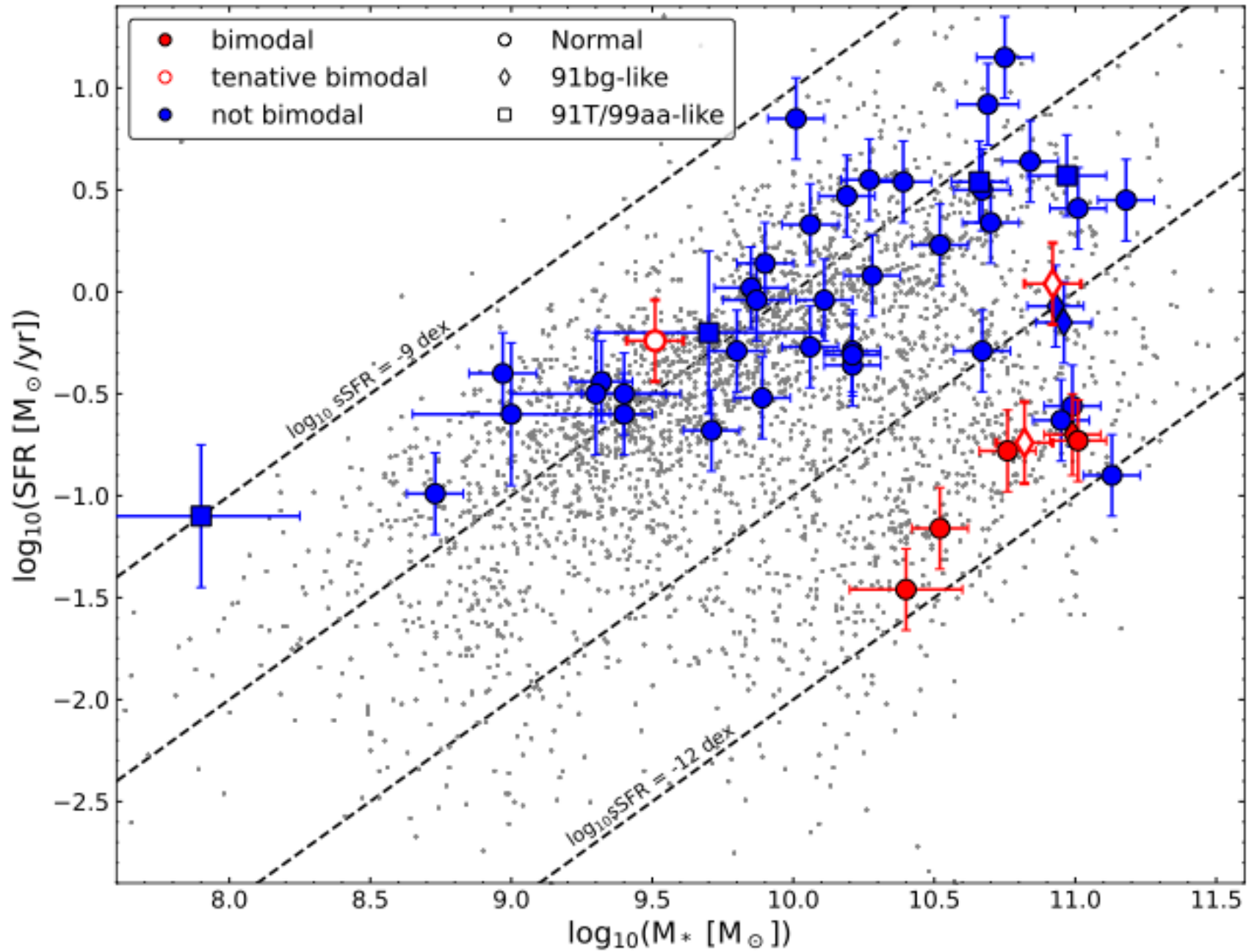


Phangs

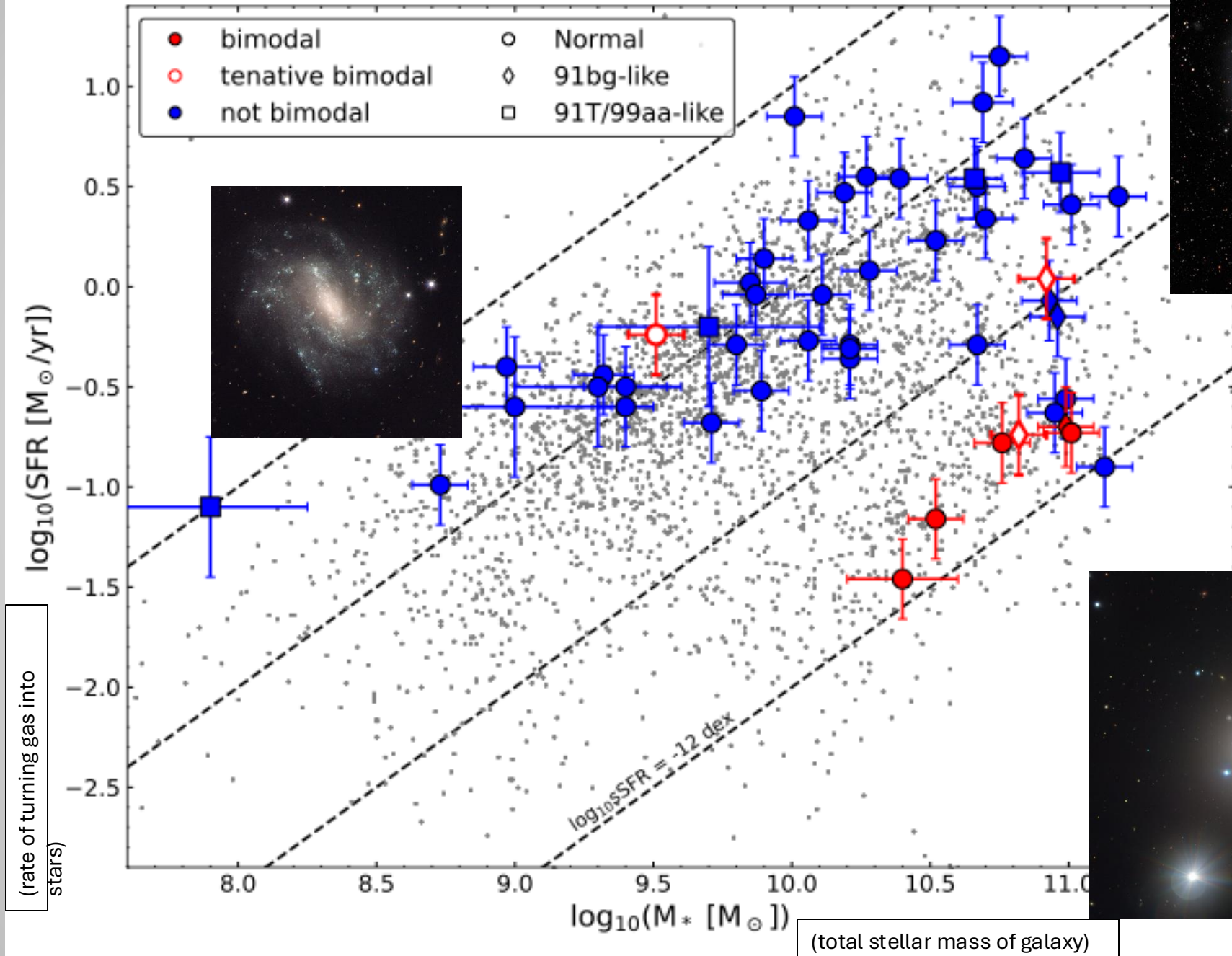


Adam Leroy (CCAPP/OSU)

*NGC 1404
hosted **two**
bimodal SNe Ia



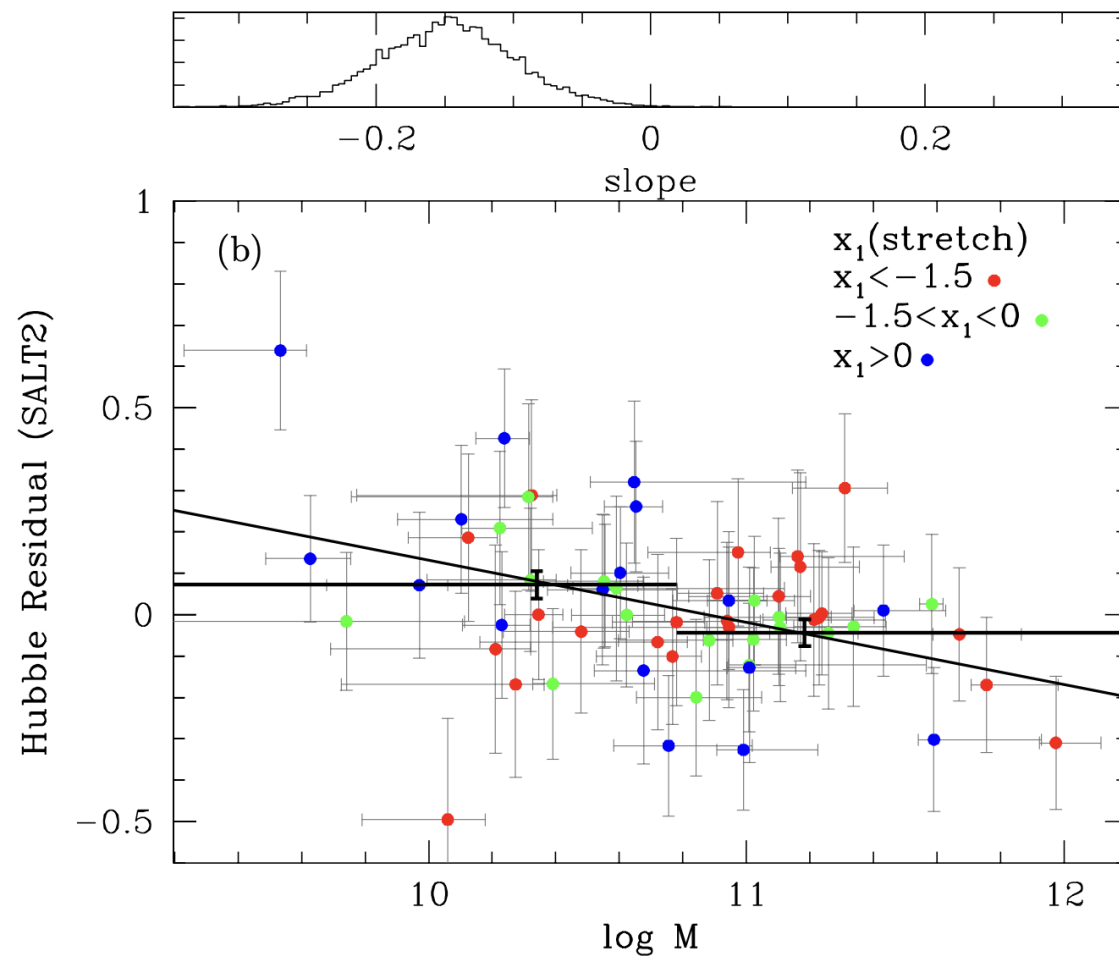
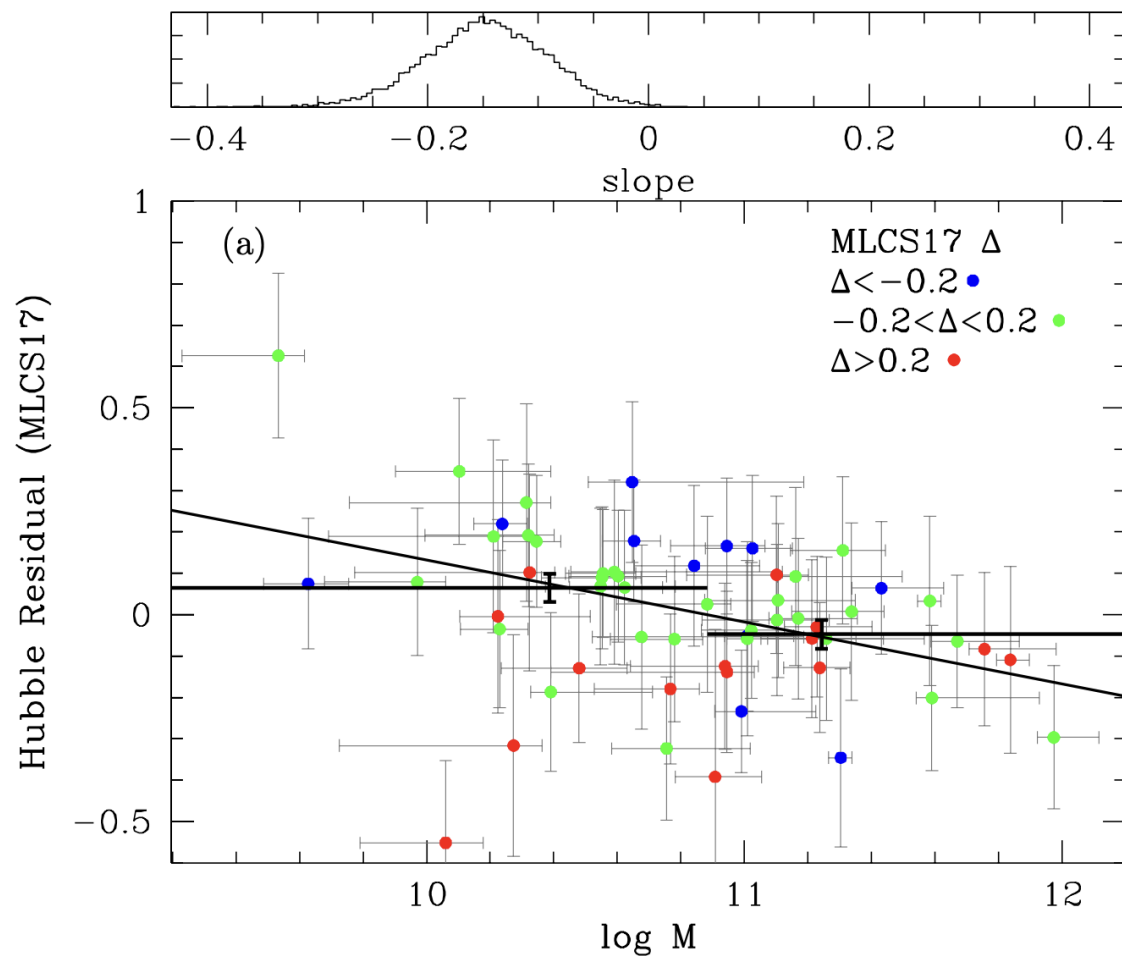
★NGC 1404
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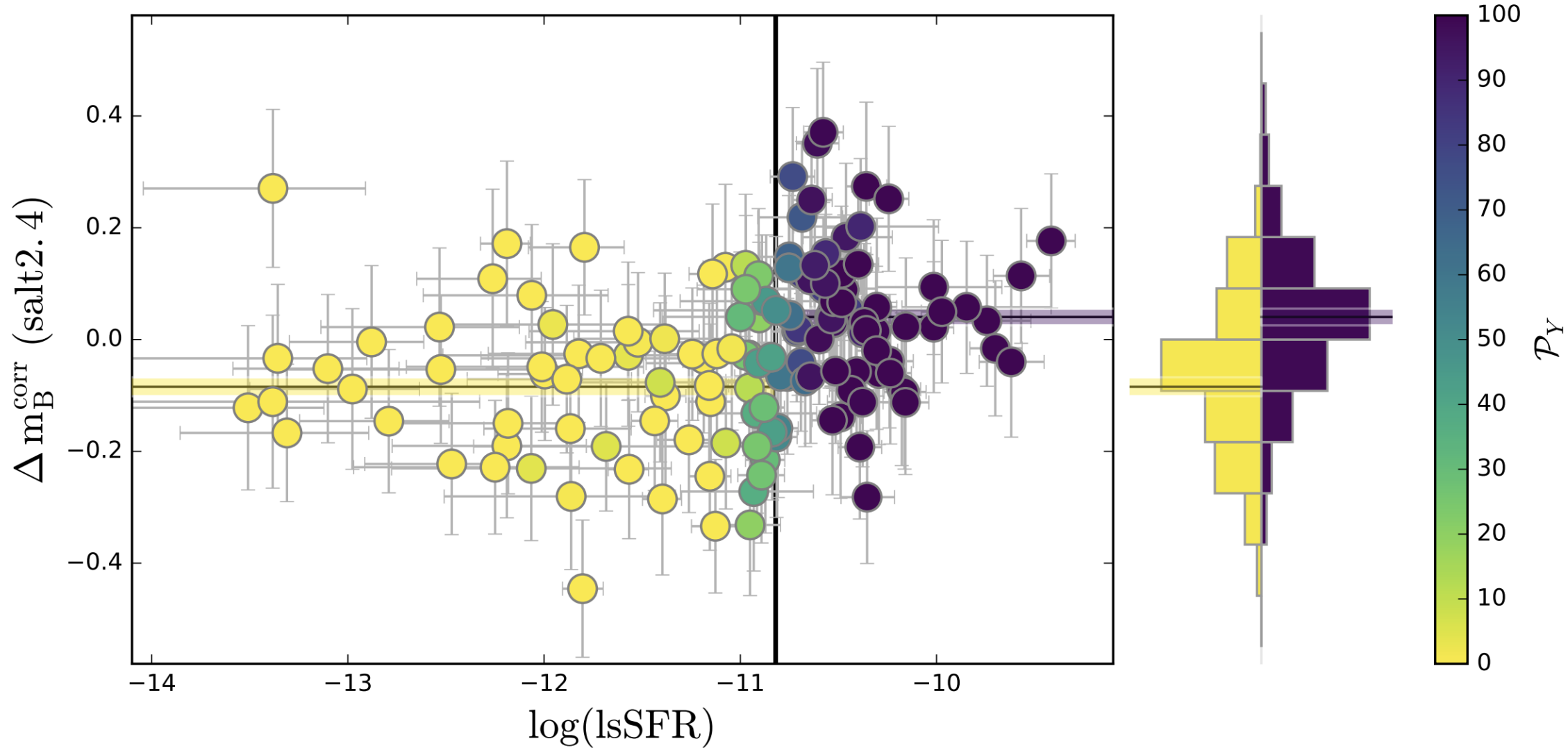
(rate of turning gas into stars)

(total stellar mass of galaxy)

The host-galaxy 'mass step'

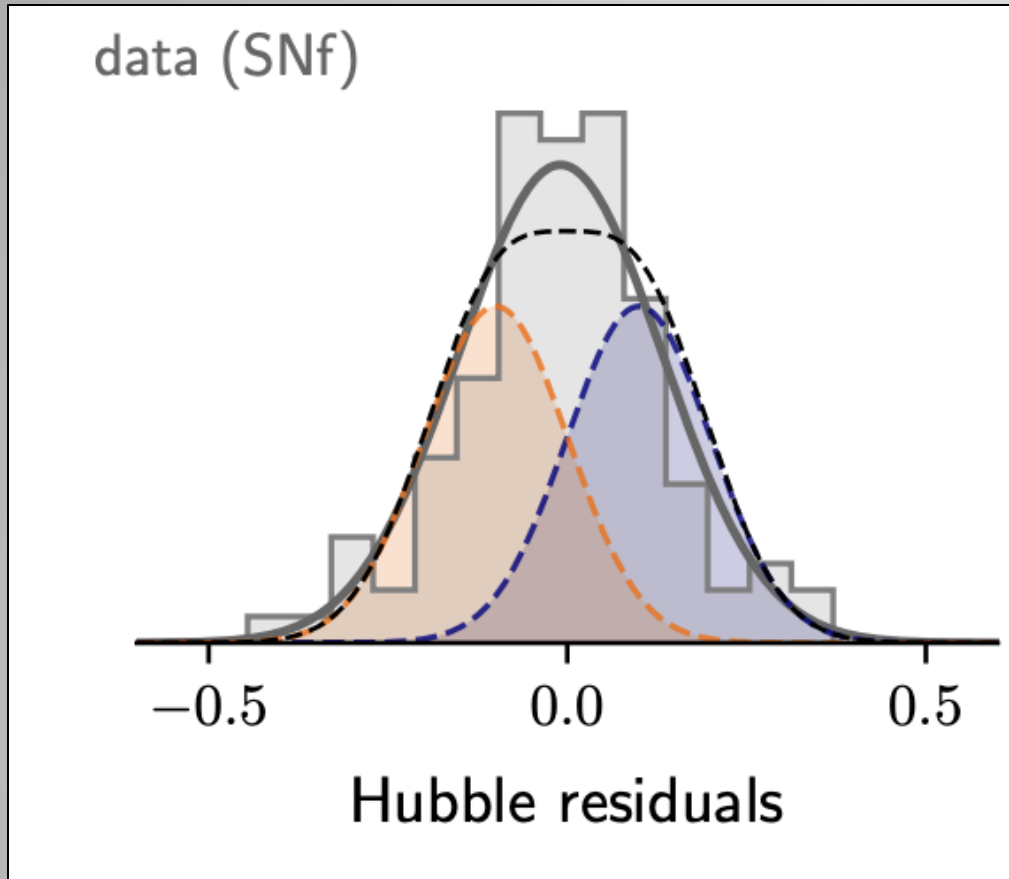


Original papers: Kelly et al. (2010), Sullivan et al. (2010)

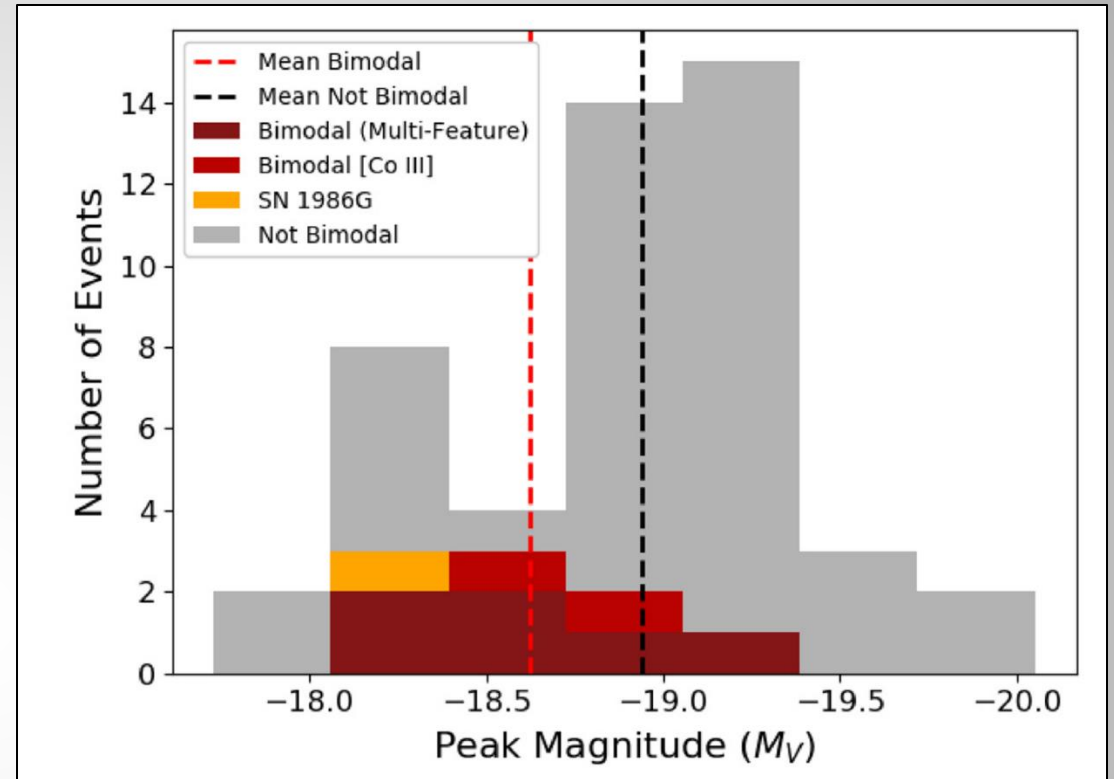


Rigault et al. (2020)

lsSFR = “local specific SFR”, sSFR @ SN location

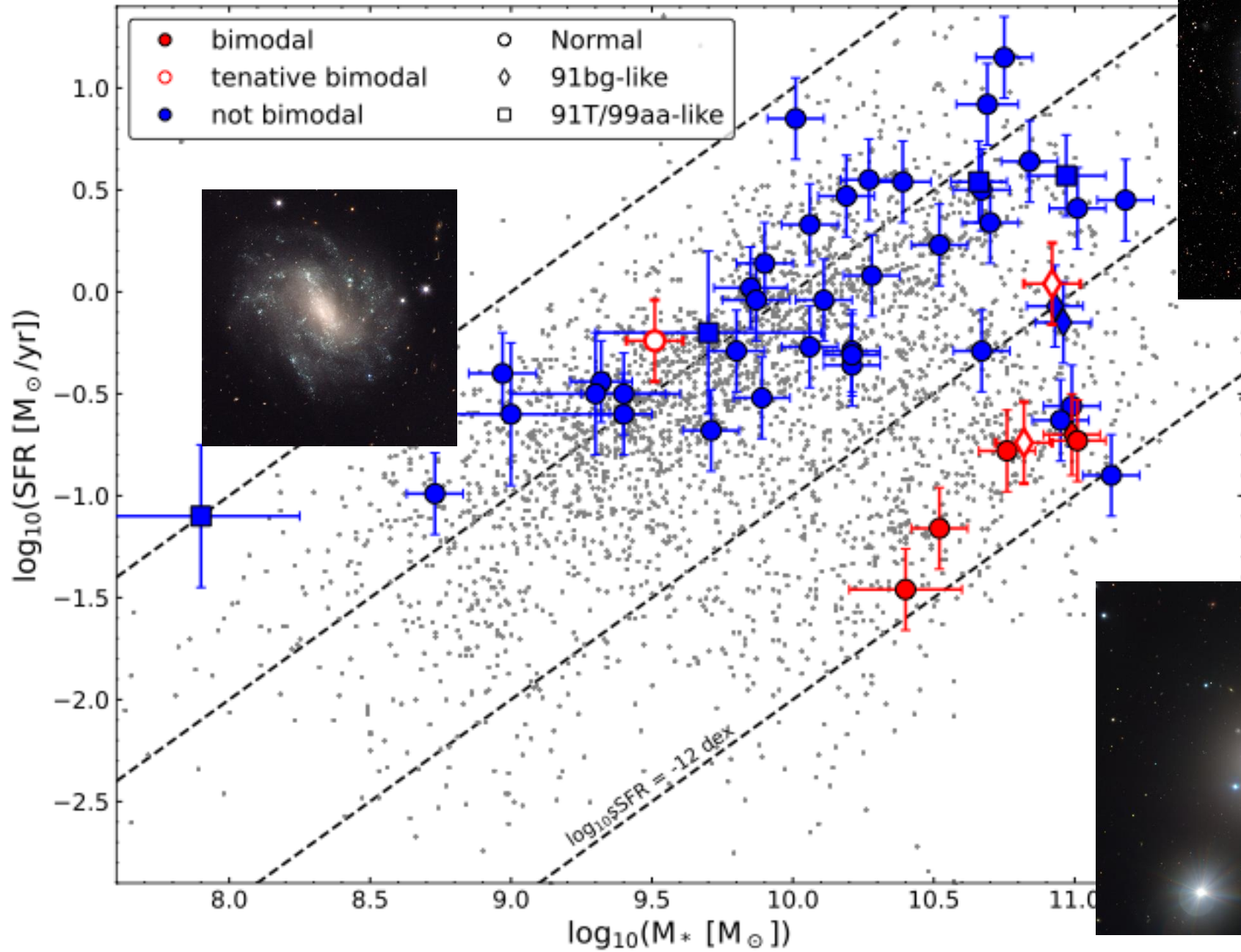


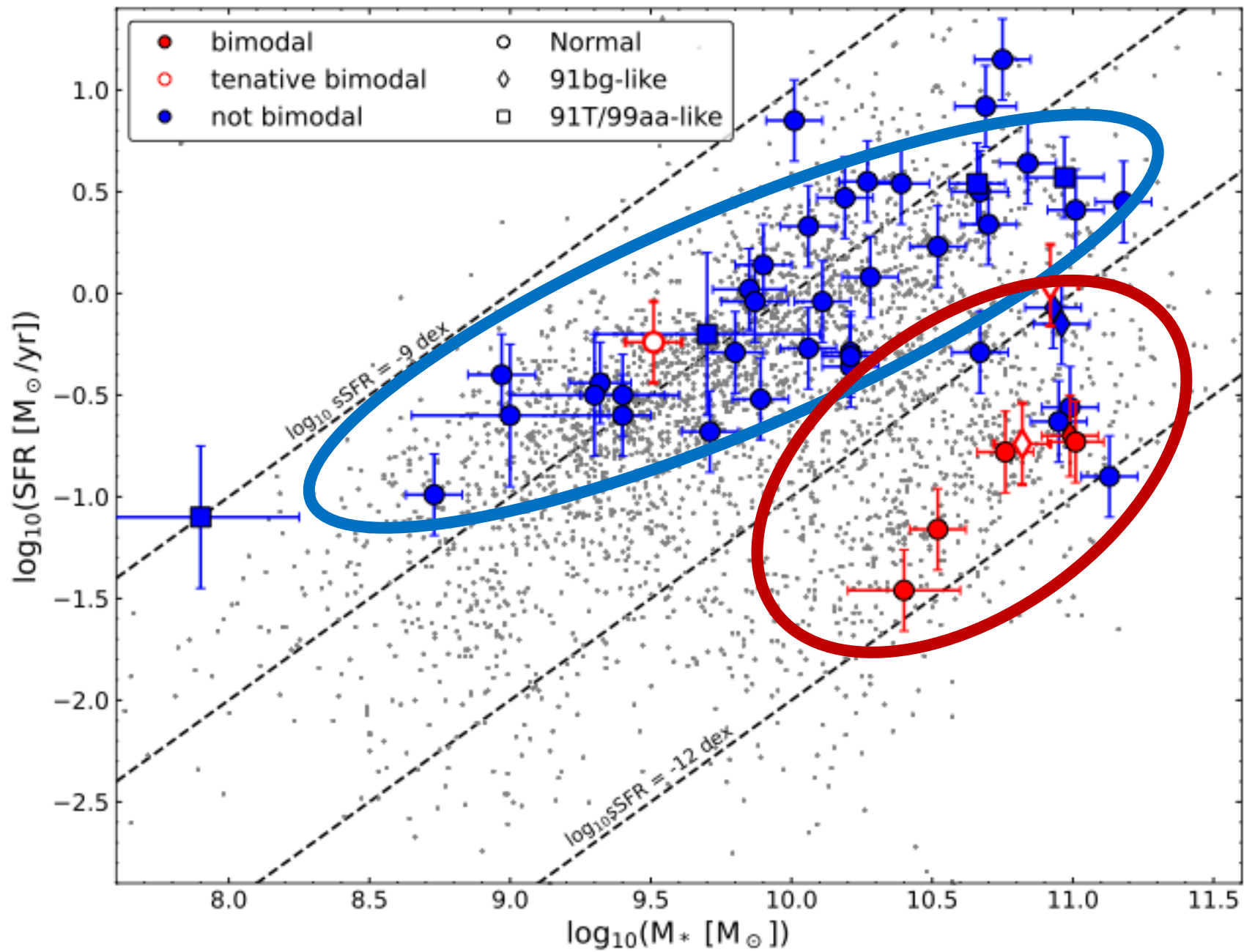
Briday et al. (2022): Two SN Ia populations with an intrinsic luminosity difference of 0.2-0.4 mag, best split by sSFR



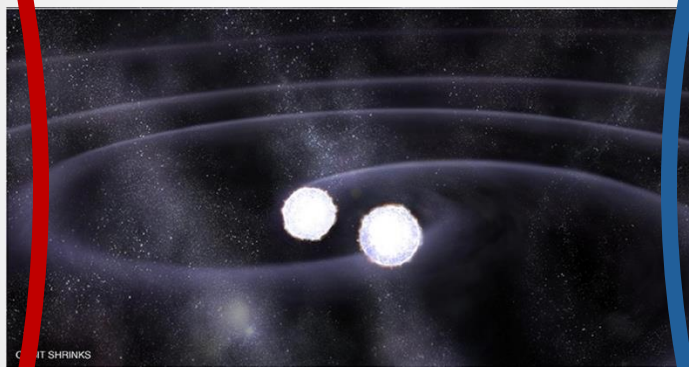
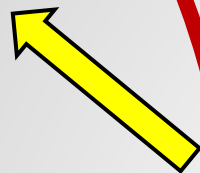
Vallely, Tucker et al. (2020): Bimodal SNe Ia are ~ 0.3 mag fainter than the population average

*NGC 1404
hosted **two**
bimodal SNe Ia





**“violent”
merger**



**“slow”
merger**



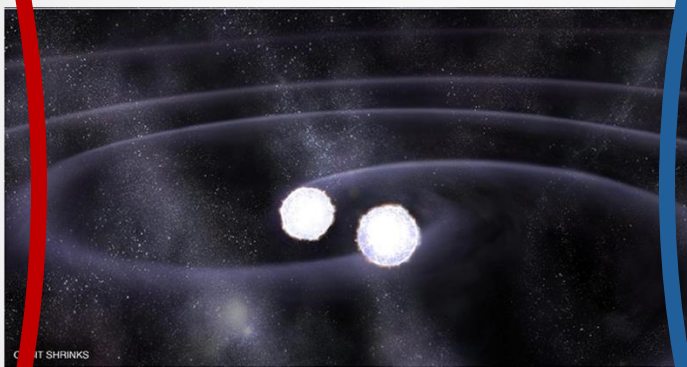
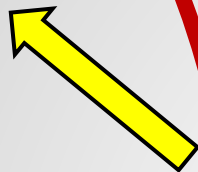
**direct
collision**



**double
detonation**

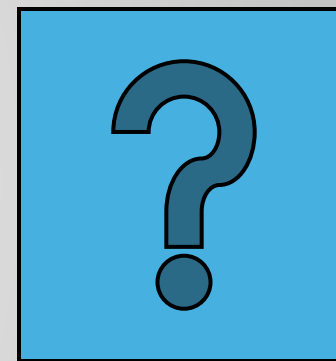
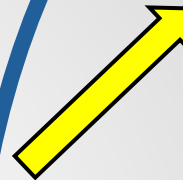


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**double
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