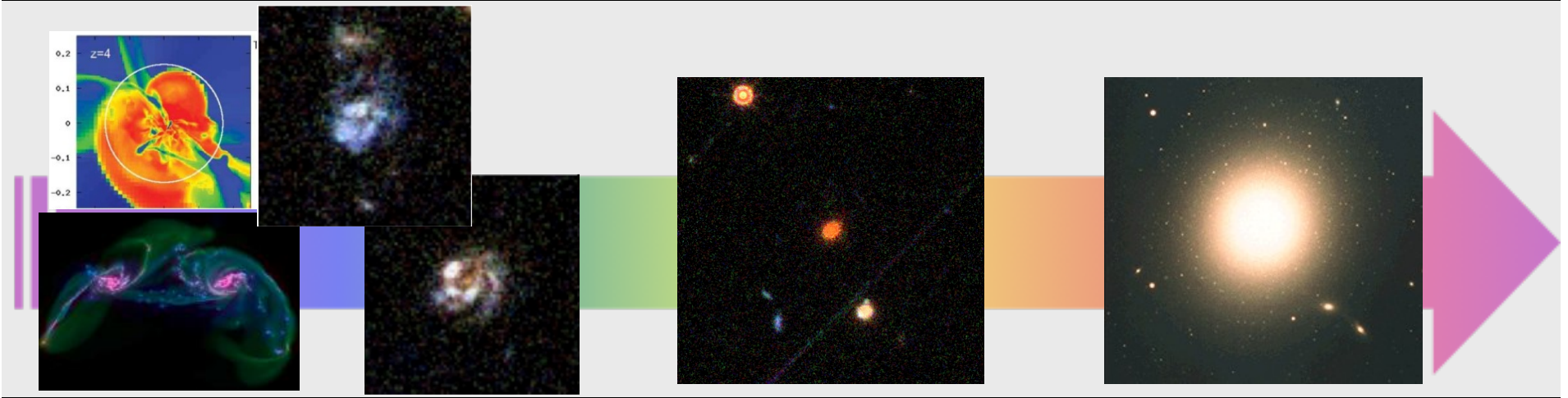


How fast can the Universe make a massive quiescent galaxy?

Pablo G. Pérez-González, Helena Domínguez-Sánchez,
Guillermo Barro & the SHARDS Team

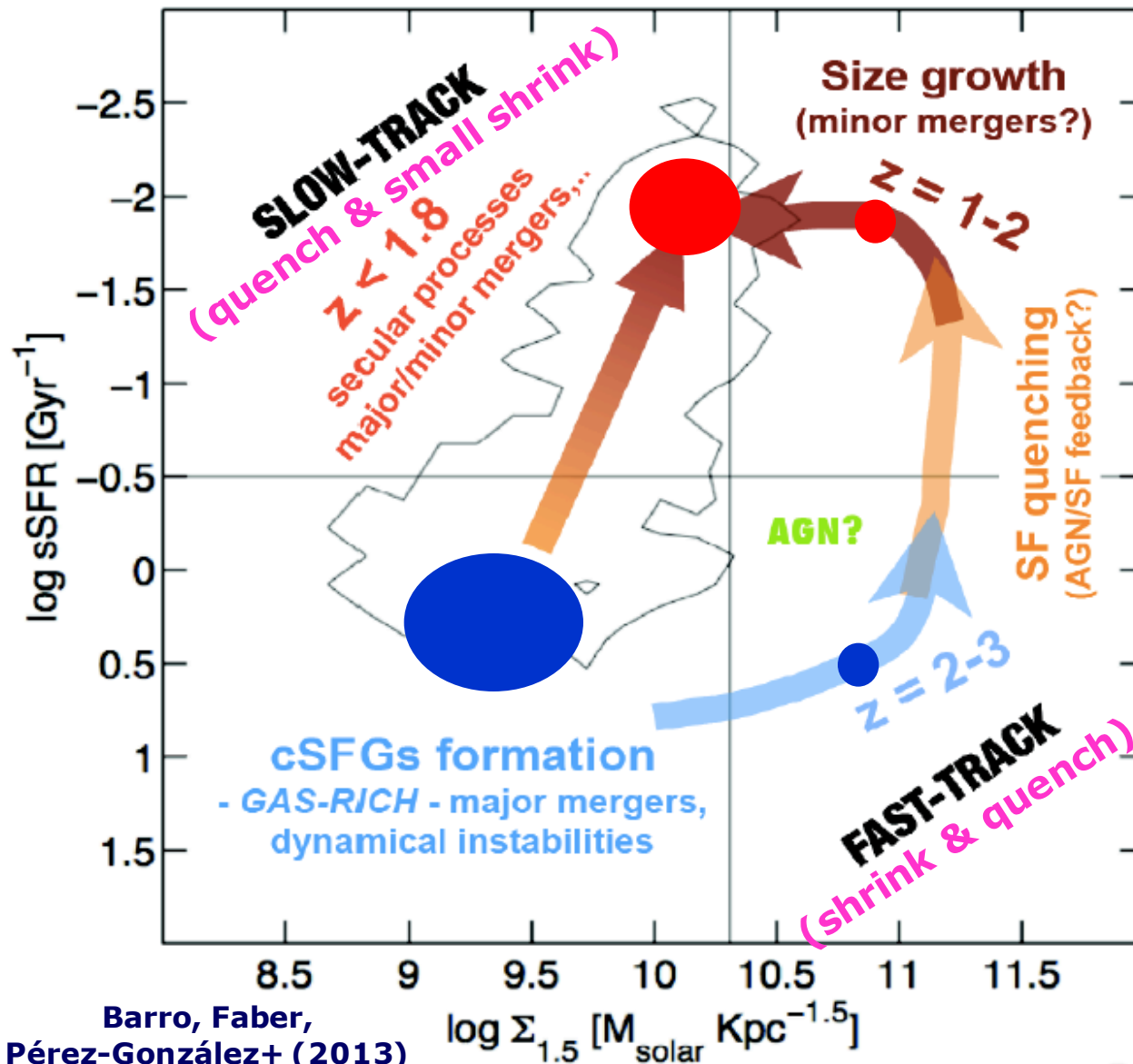


Universidad Complutense de Madrid
UCM, Spain



Transforming a star-forming galaxy into a quiescent galaxy

SF suppression

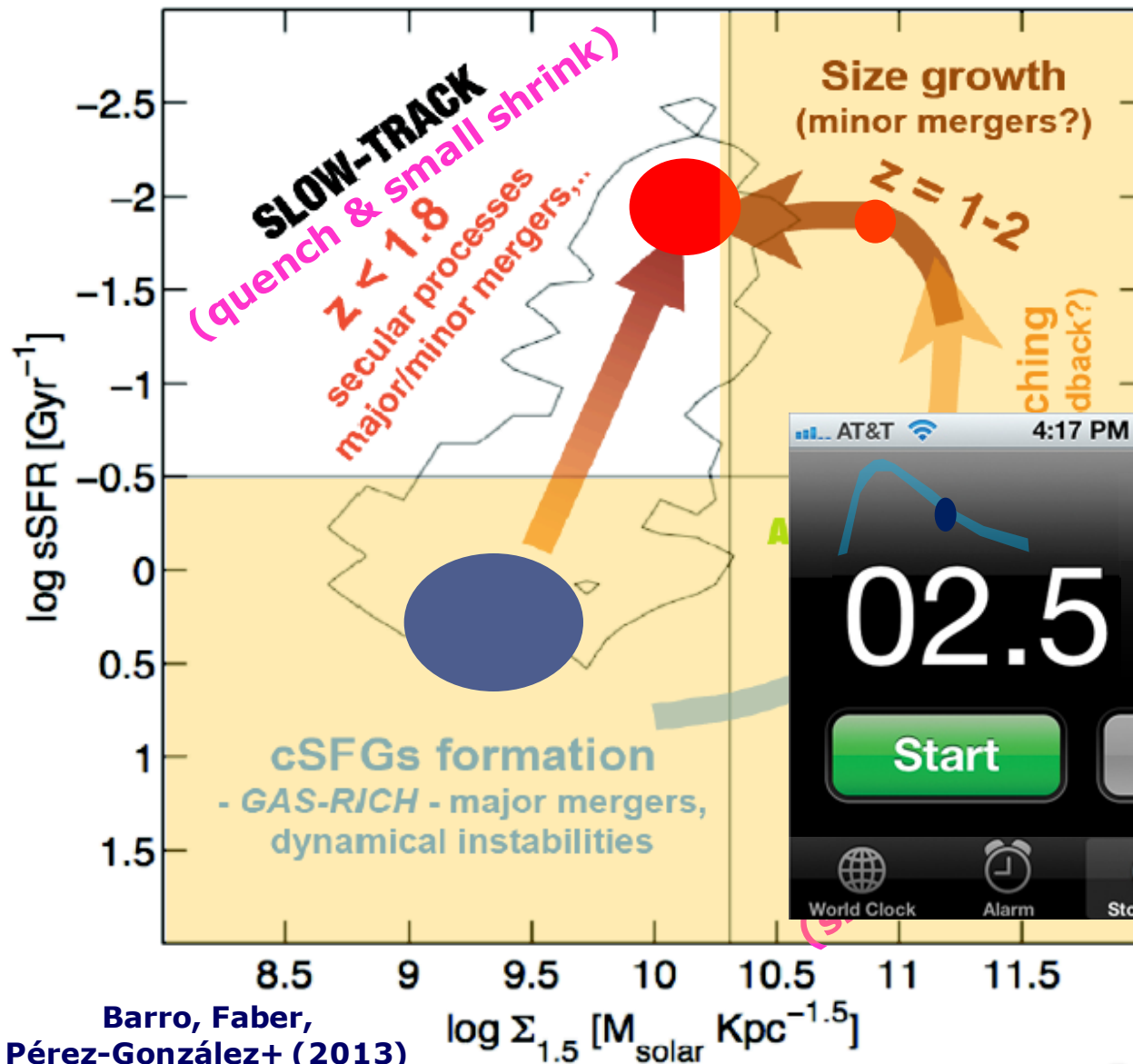


stellar mass 'density'



Transforming a star-forming galaxy into a quiescent galaxy

SF suppression



Barro, Faber,
Pérez-González+ (2013)

stellar mass 'density'



How is it living in the Fast Track?

Mapping the **pathways** of galaxy transformation across **time** and **space**

➡ **The birth:** When did massive galaxies start their formation?

Does z_f depend on certain physical properties?

➡ **The (active) life:** How long does it take to form a massive galaxy?

➡ **The death:** How fast does a massive galaxy die? When do they die? **Why?**

➡ **The after death:** Do massive galaxies resurrect?

$z=4.00$

$\log_{10}(M_*)=10.4$

$SFR=80.0$

$sSFR=3.07\text{Gyr}^{-1}$

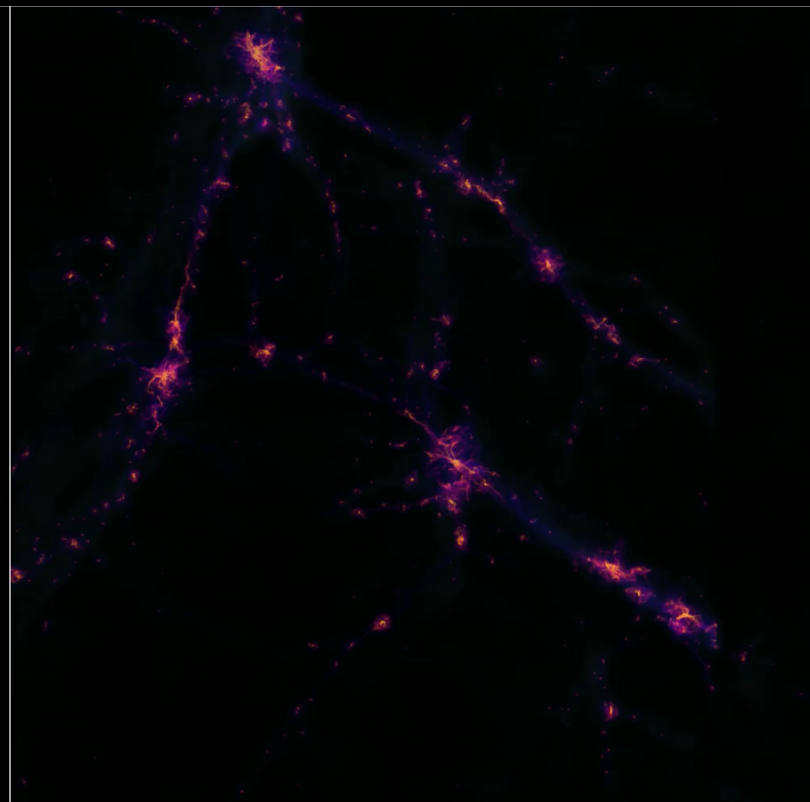


SHY GENEL

ILLUSTIS

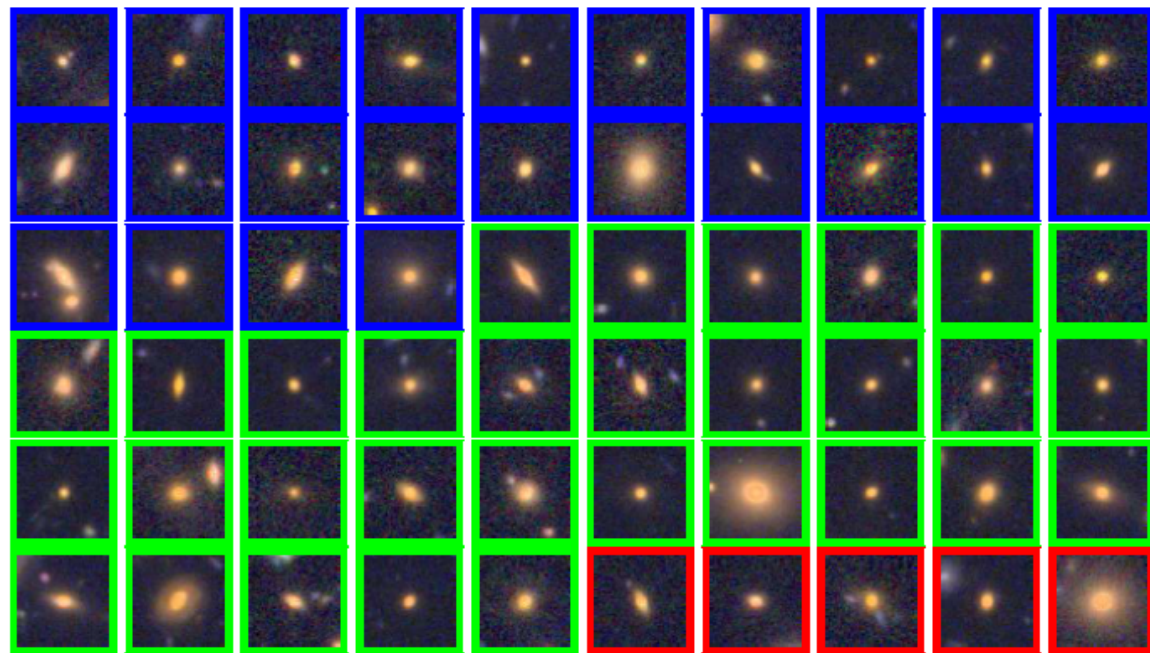


CfA



Some answers: detailed & robust SFHs of $1.0 < z < 1.5$ MQGs

UVJ



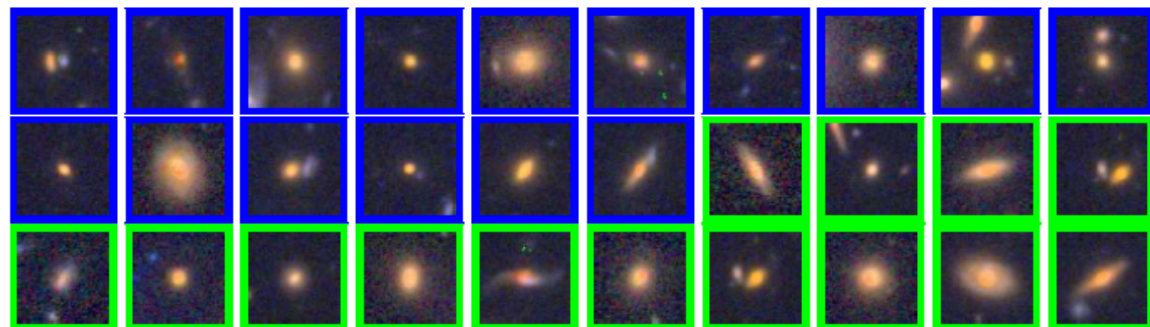
$1.0 < z < 1.5$



$M > 10^{10} M_{\odot}$

Domínguez-Sánchez, Pérez-González+ (2016)

sSFR

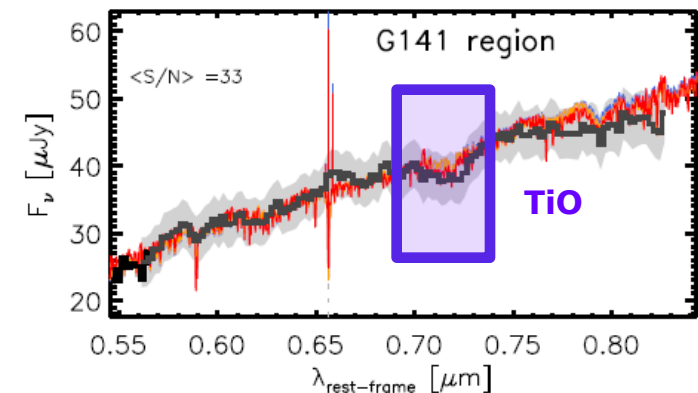
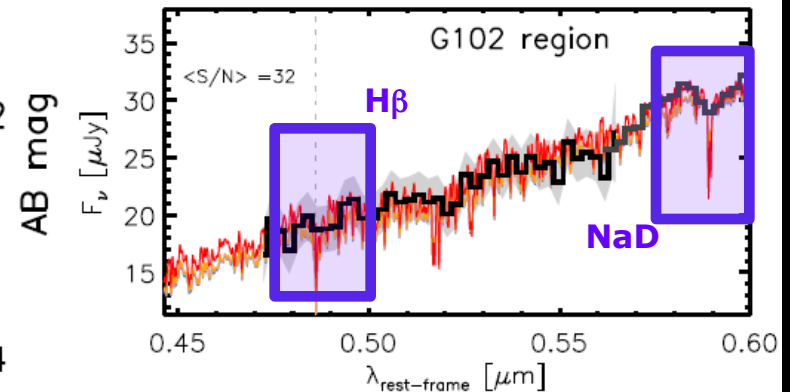
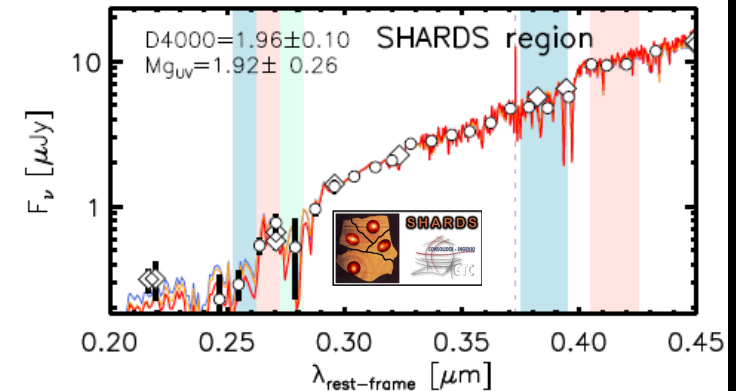
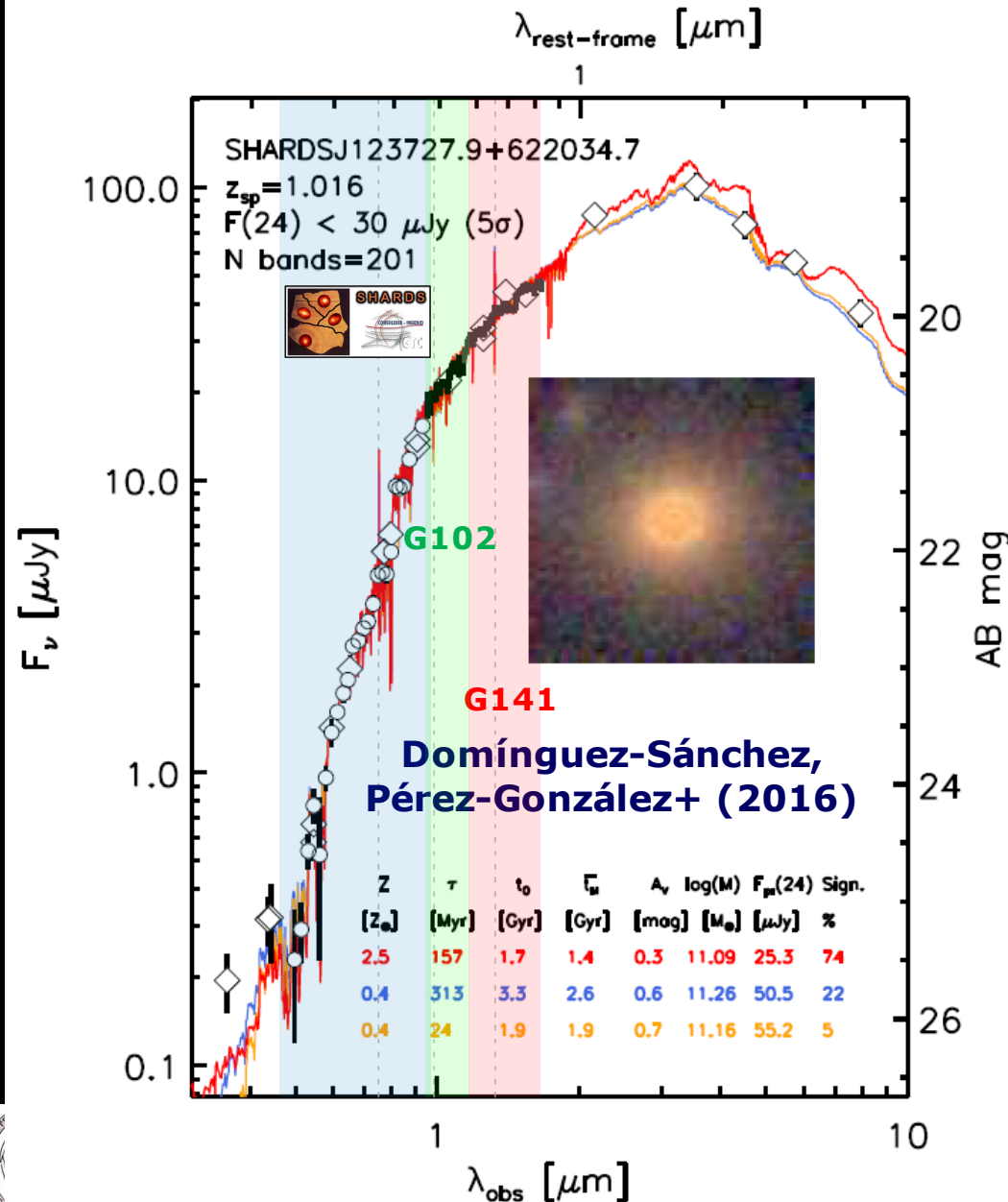


M

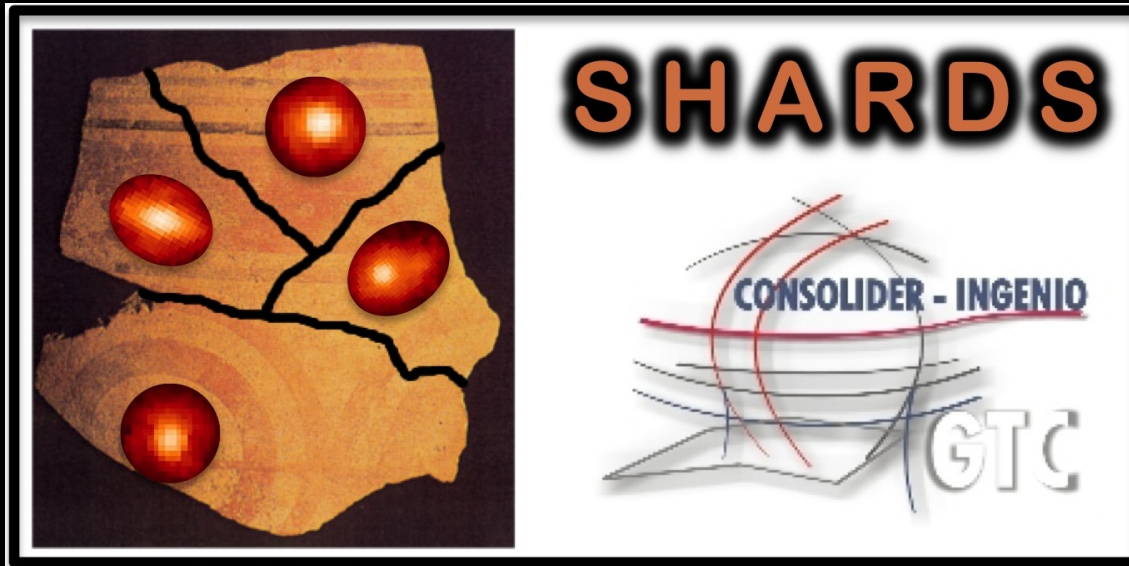
face



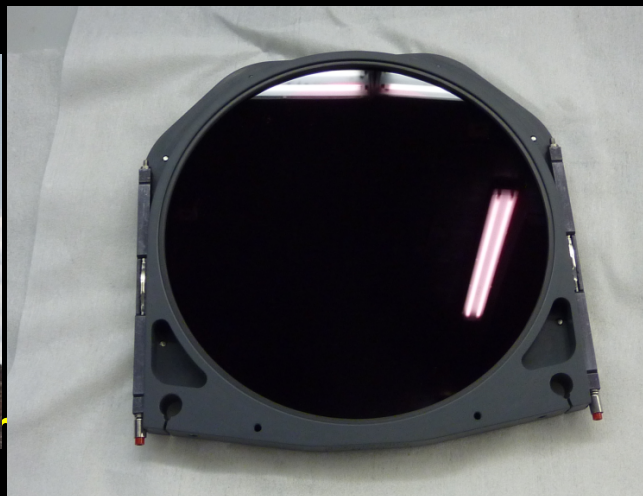
How to get reliable SFHs?: SHARDS + WFC3 grisms (+BB)



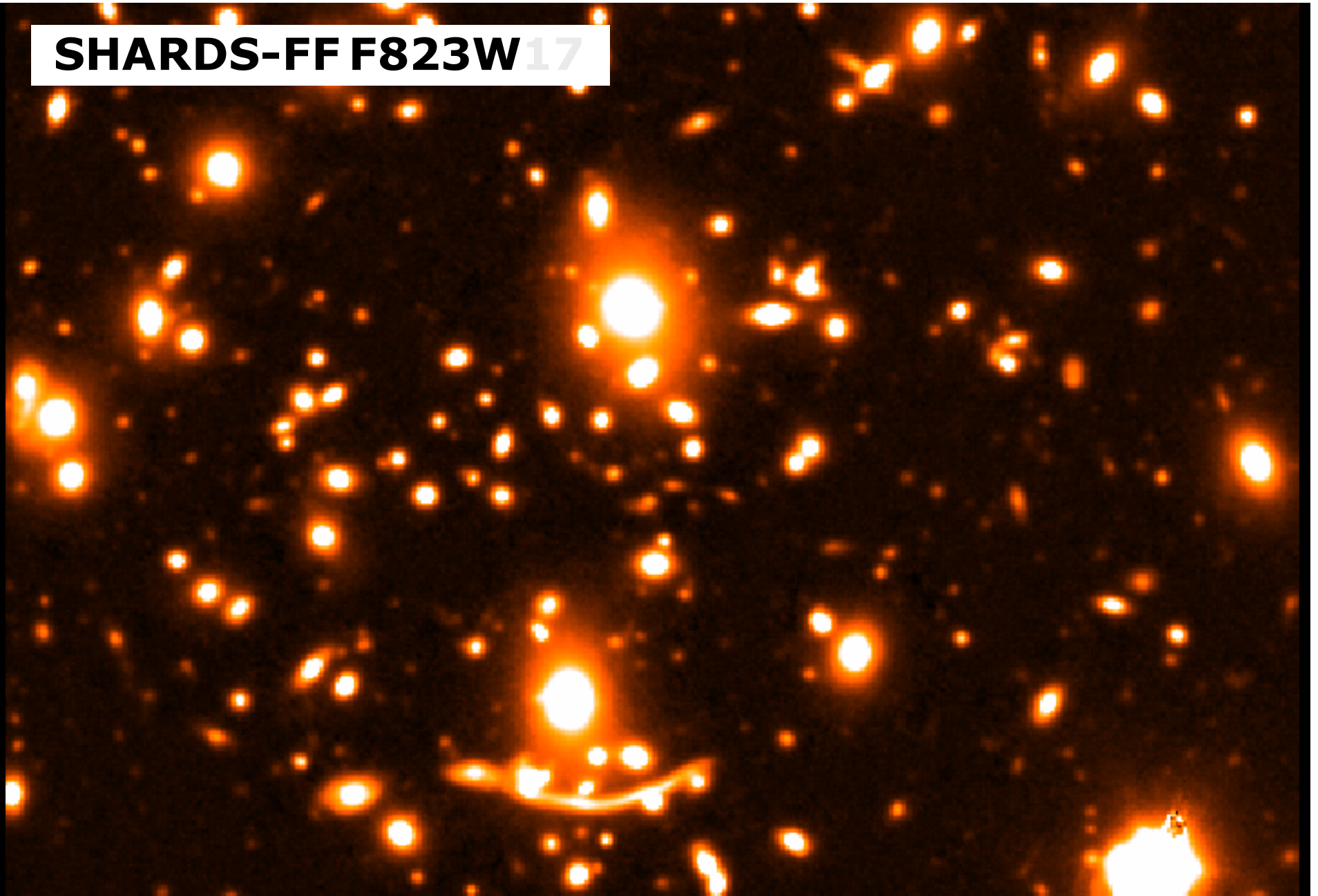
SHARDS@GTC: **S**urvey for **H**igh-**z** **A**bsorption **R**ed and **D**ead **S**ources (500 hours in GOODS-N & HFF)



<http://guaix.fis.ucm.es/~pgperez/SHARDS>



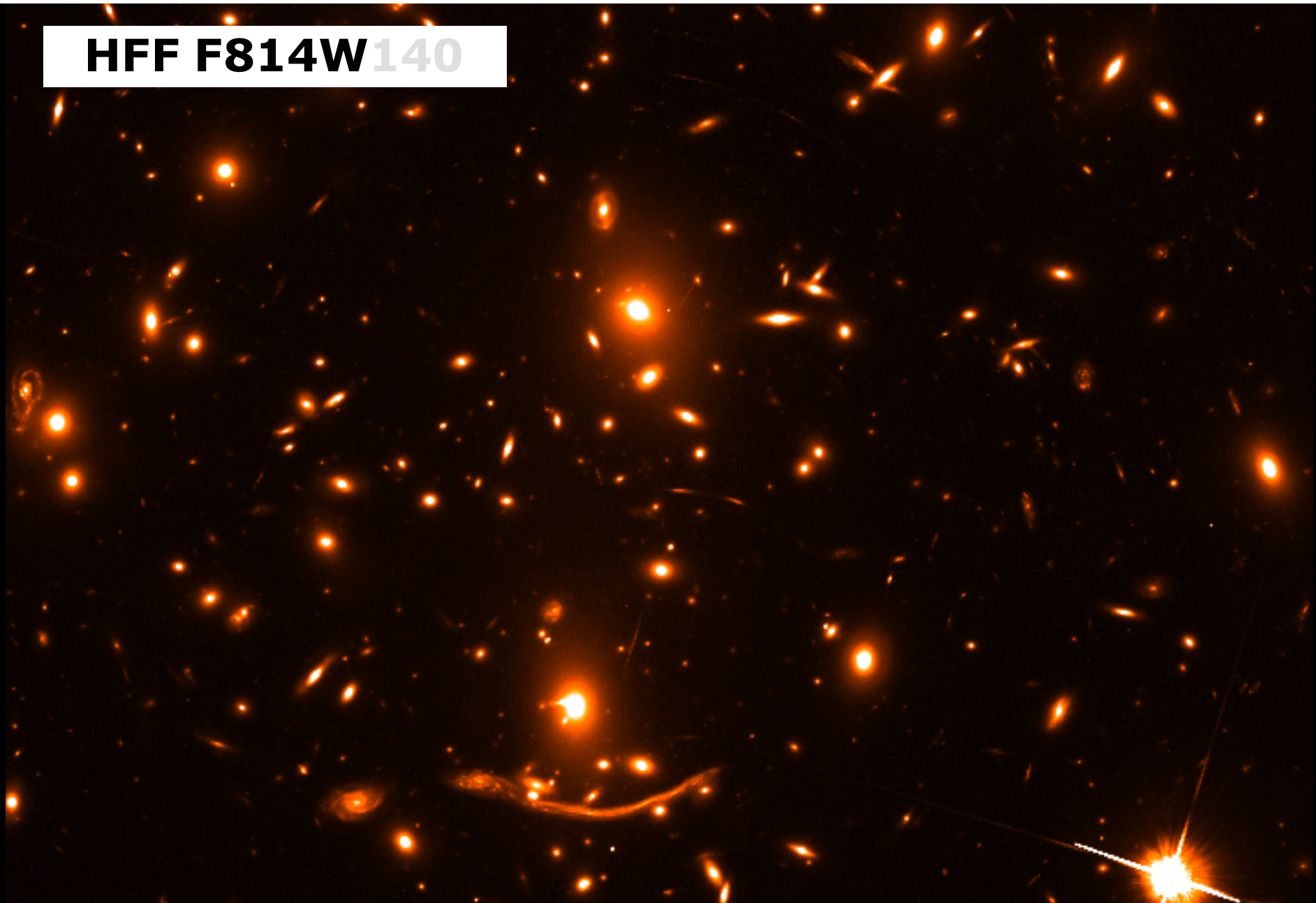
SHARDS-FF F823W17



Mapping the pathways of galaxy transformation across time and space
Avalon, Catalina Island, July 31-August 5, 2016



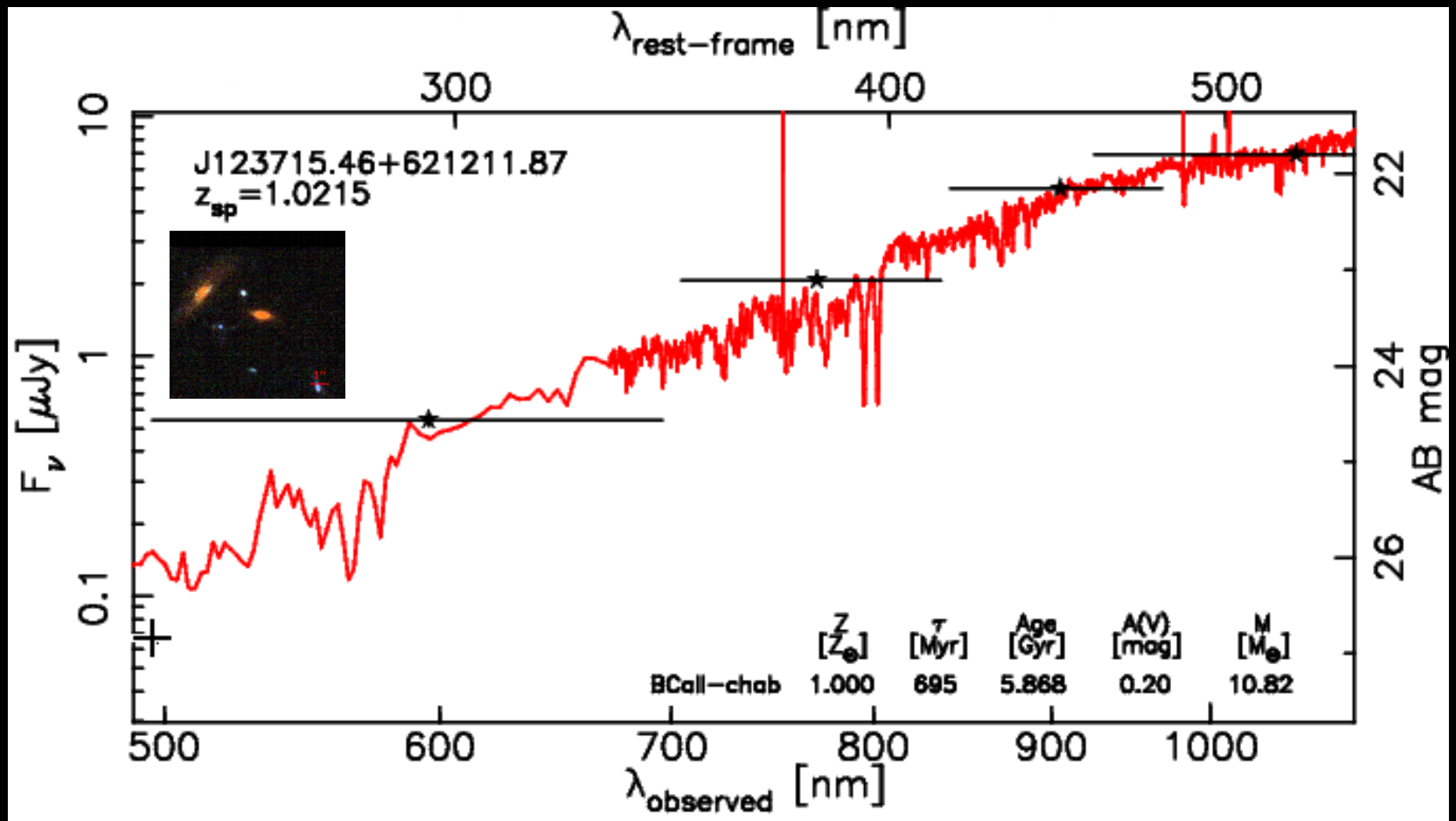
HFF F814W140



Mapping the pathways of galaxy transformation across time and space
Avalon, Catalina Island, July 31-August 5, 2016



SHARDS: SFHs based on absorption indices

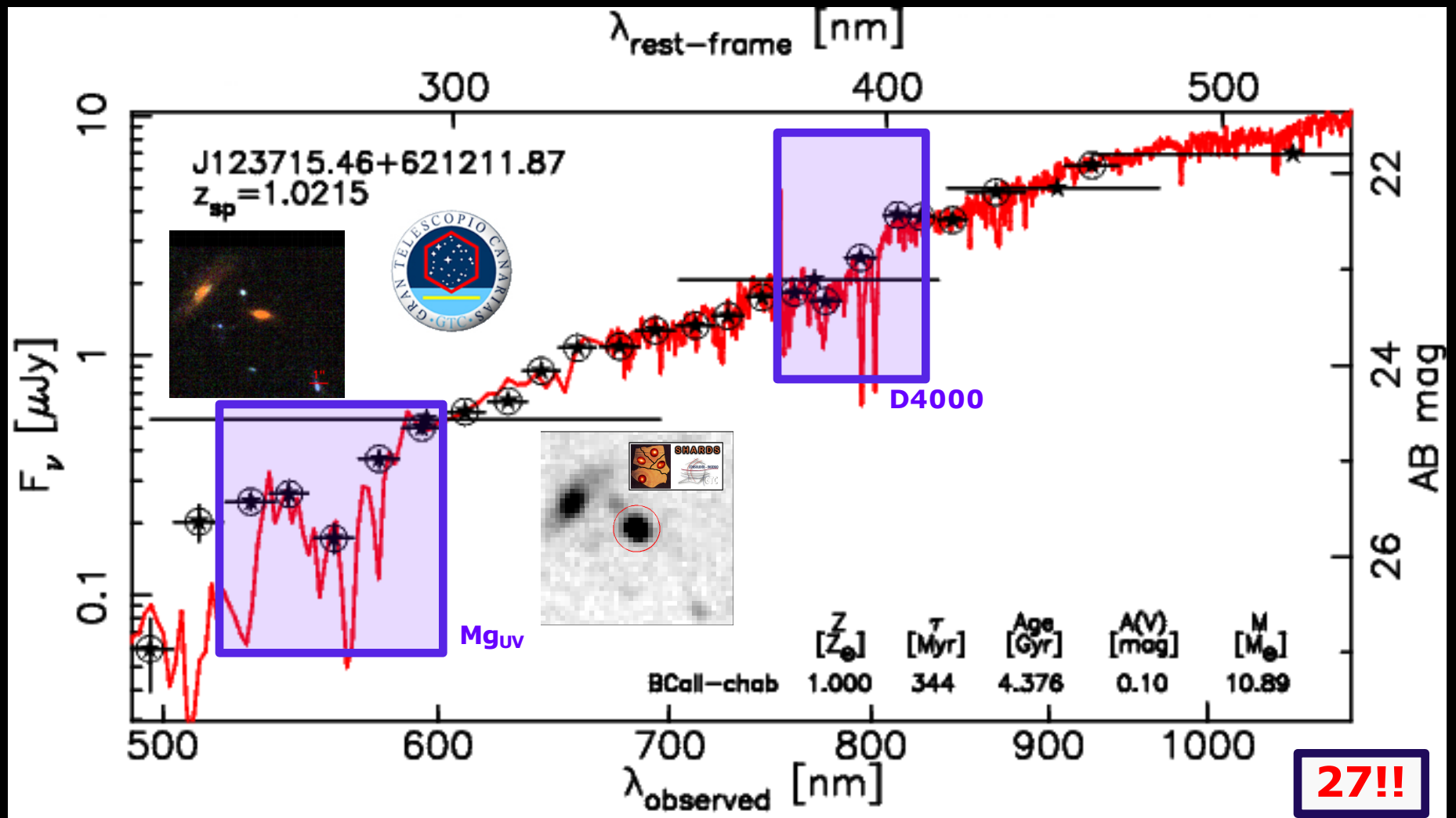


Pérez-González et al. (2013)

Mapping the pathways of galaxy transformation across time and space
 Avalon, Catalina Island, July 31-August 5, 2016



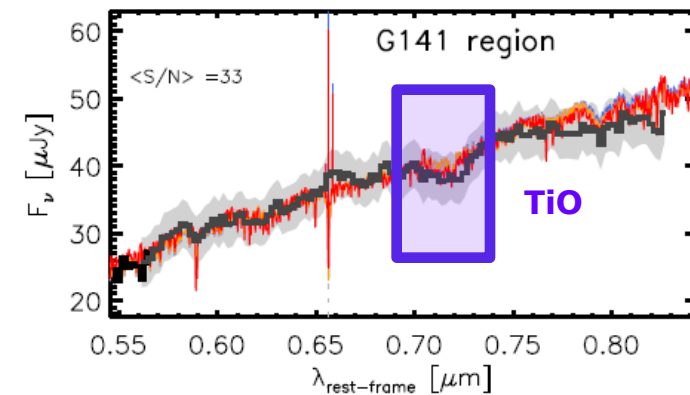
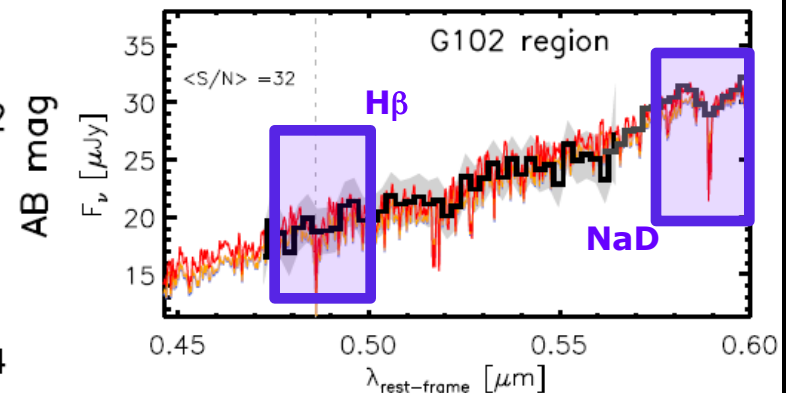
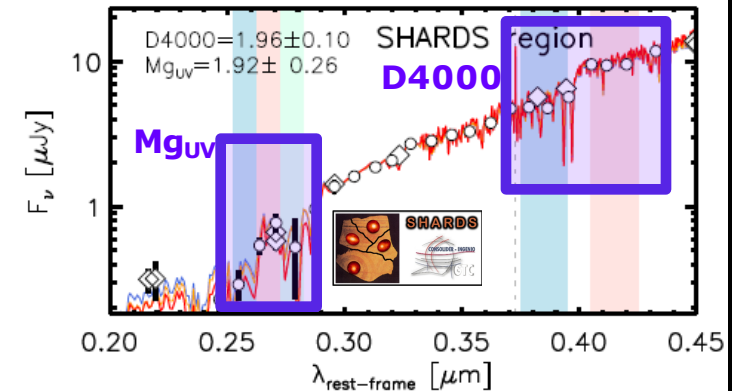
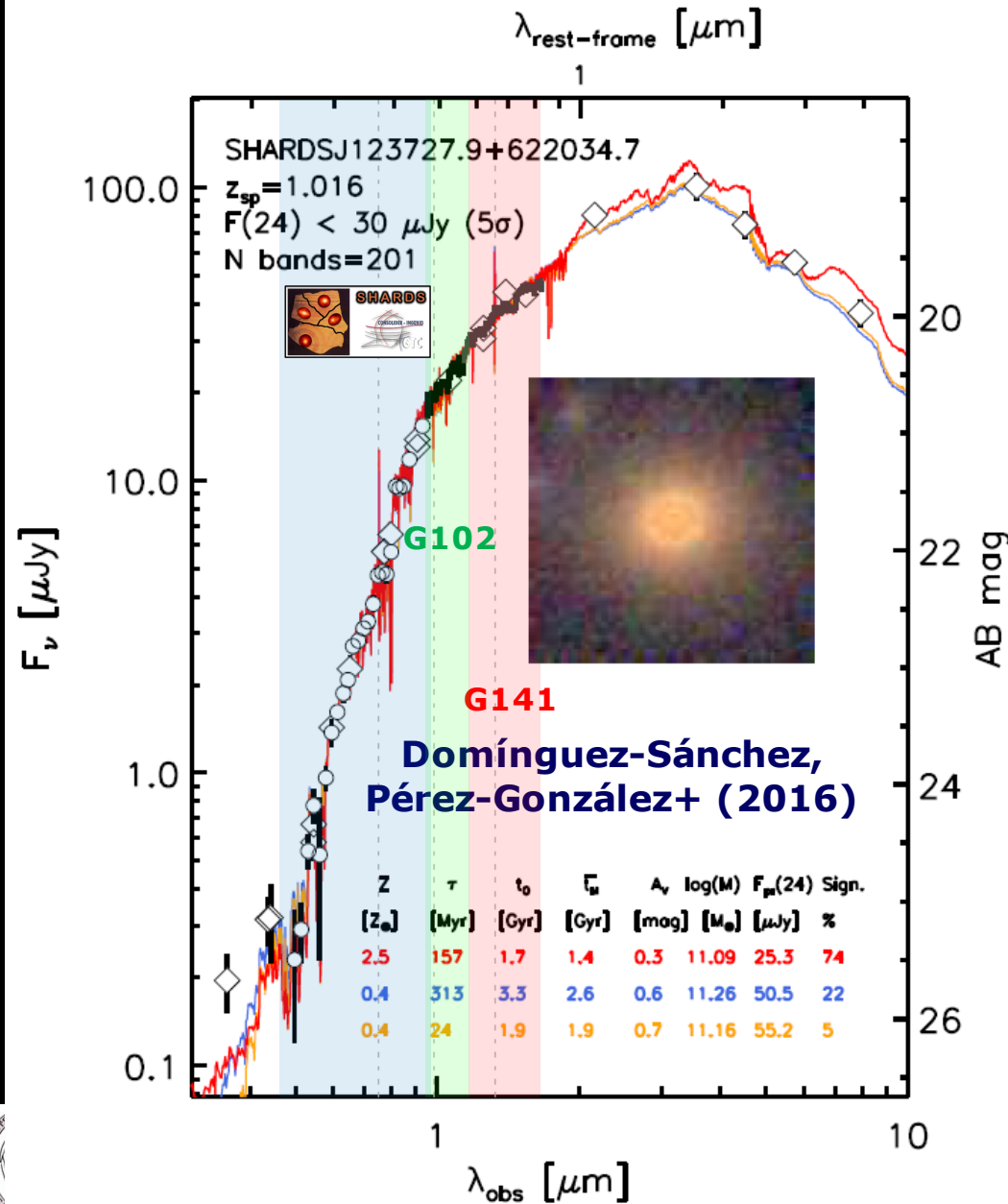
SHARDS: SFHs based on absorption indices



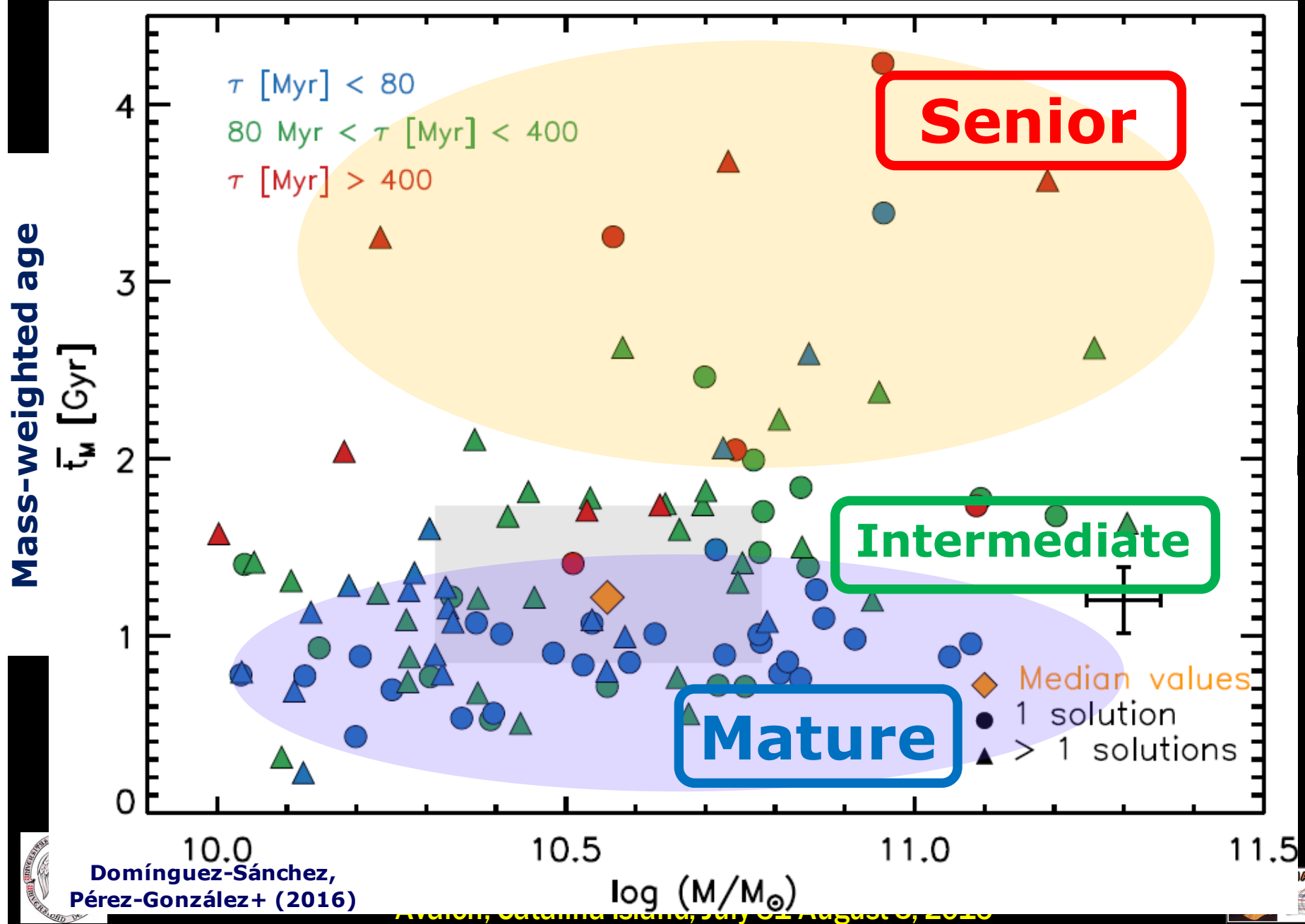
Pérez-González et al. (2013)

Magnitudes for $M > 10^{10} M_\odot$ $z=1-3$ galaxies: (27, 26, 25)

How to get reliable SFHs?: SHARDS + WFC3 grisms (+BB)



Birth: Duality in population of $1.0 < z < 1.5$ MQGs



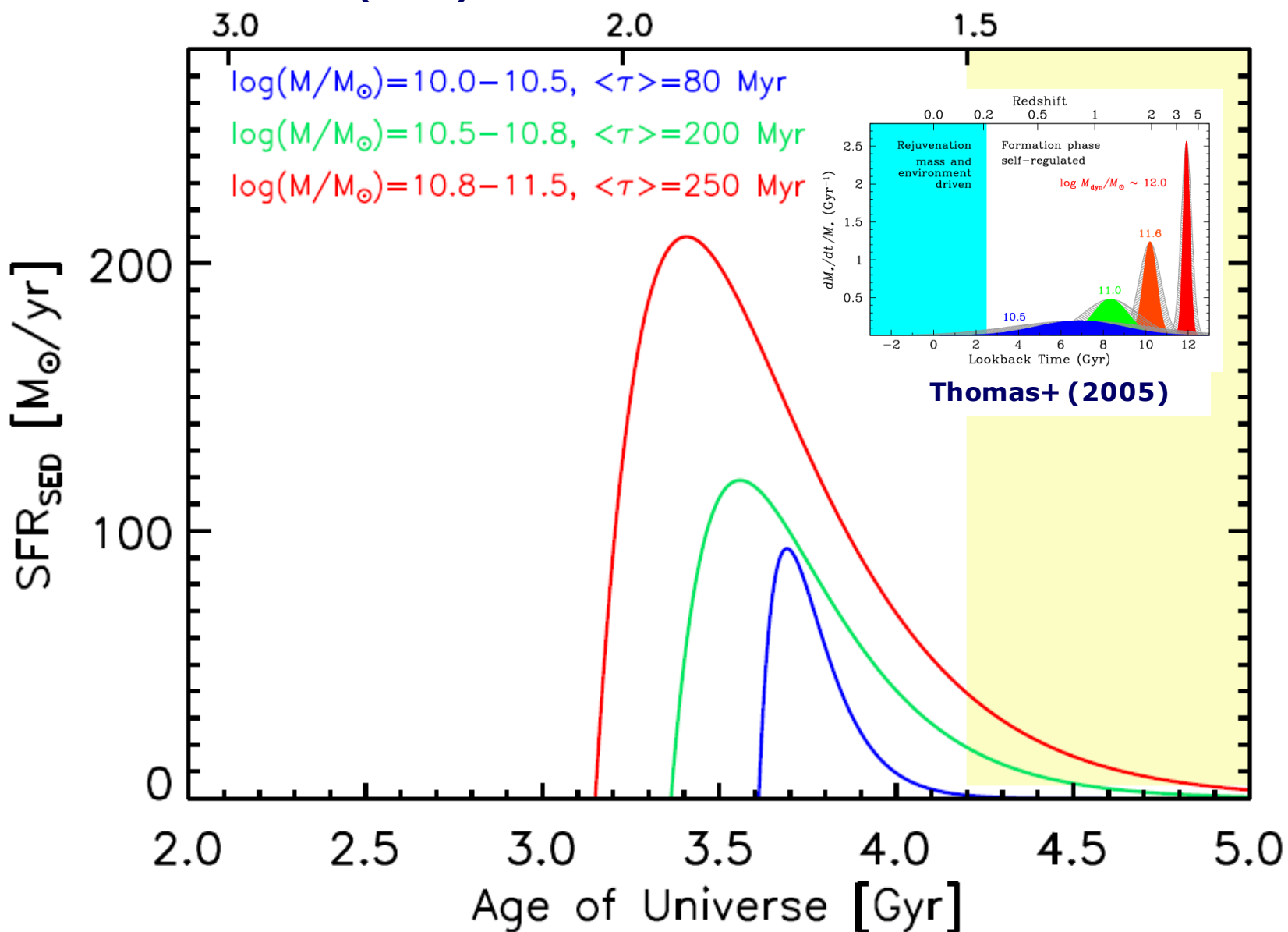
Domínguez-Sánchez,
Pérez-González+ (2016)

Astori, Catania Island, July 02-August 0, 2010

Life: Average SFHs of $1.0 < z < 1.5$ MQGs (by mass)

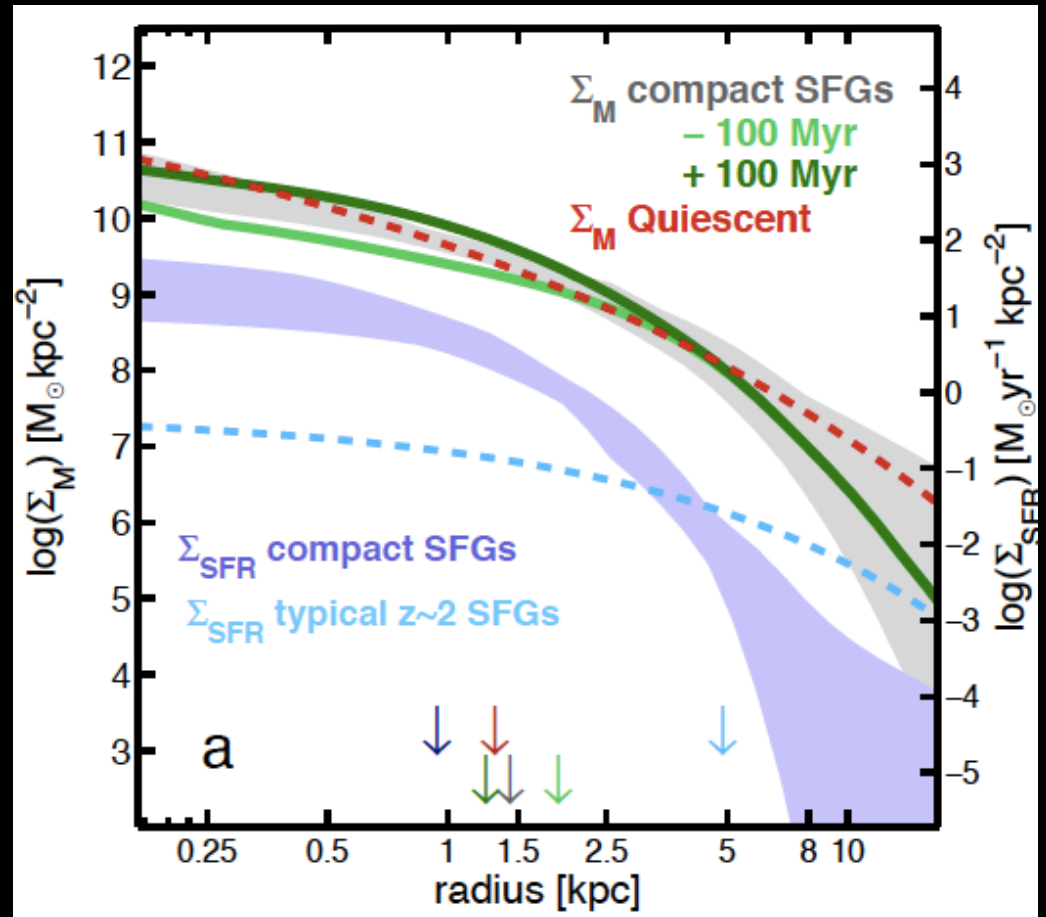
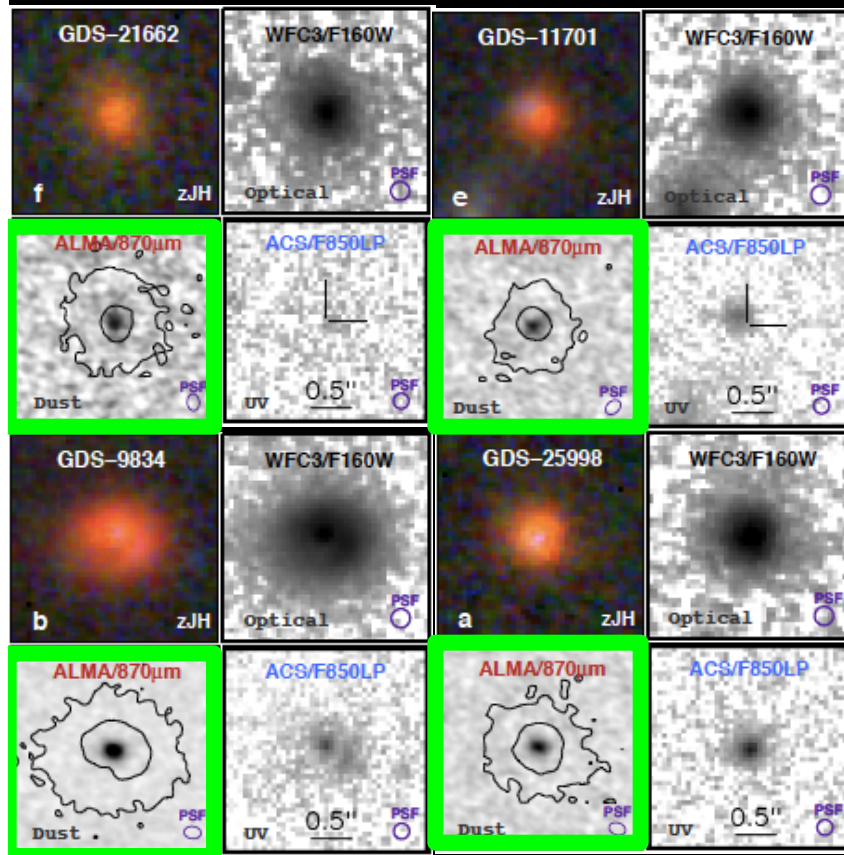
Domínguez-Sánchez,
Pérez-González+ (2016)

redshift



Life: confirmation of SF timescales with ALMA¹

Barro, Kriek, Pérez-González+ (2016)

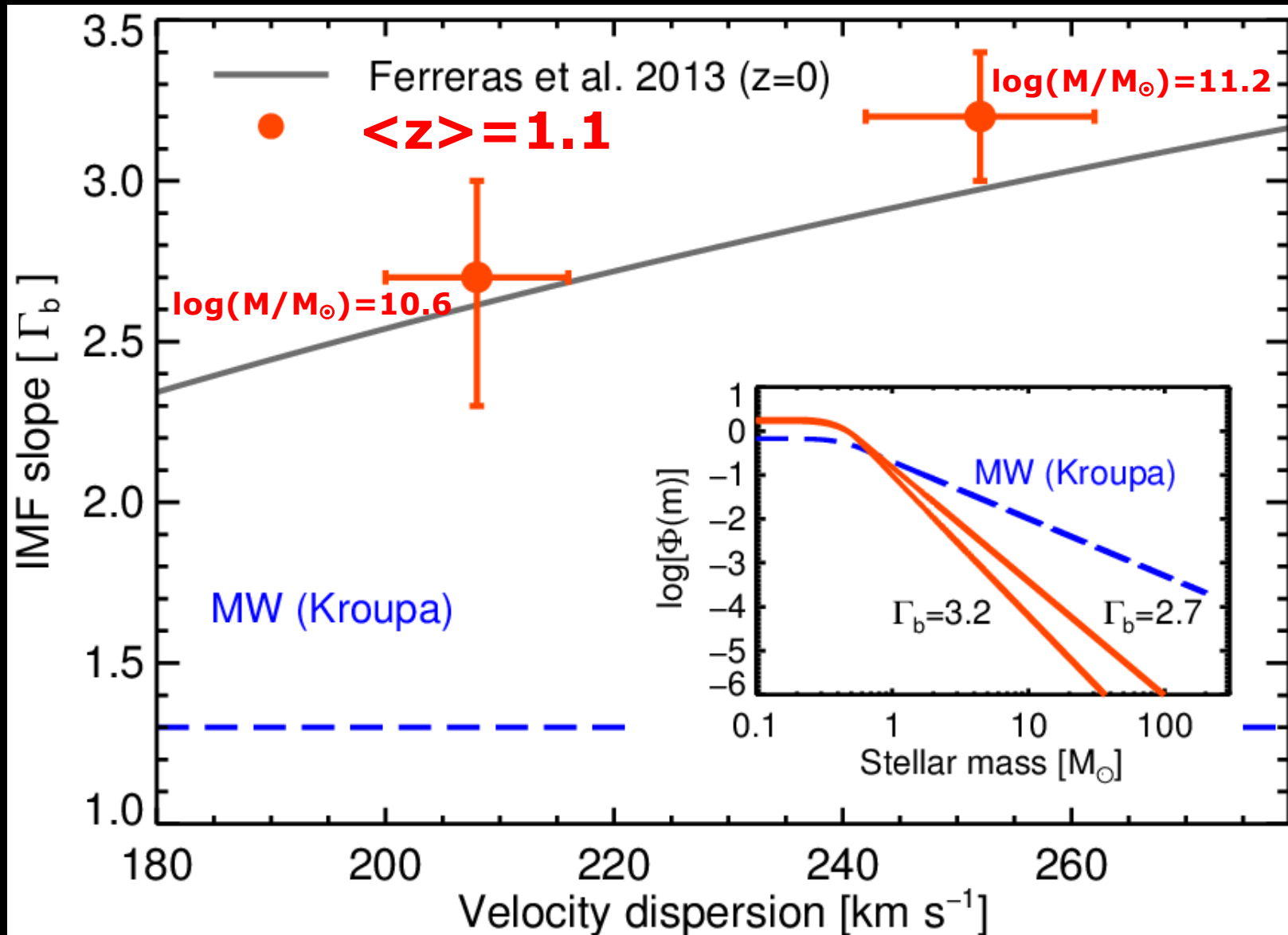


¹ALMA band 7 (870 μm), C34-7 extended configuration (0.14"x0.11" FWHM)
Mapping the pathways of galaxy transformation across time and space
Avalon, Catalina Island, July 31-August 5, 2016

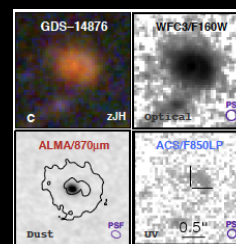


Life: Evidence for bottom-heavy IMF at $z > 1$

Martín-Navarro, Pérez-González+ (2015)



Life and death: SFHs and the main sequence



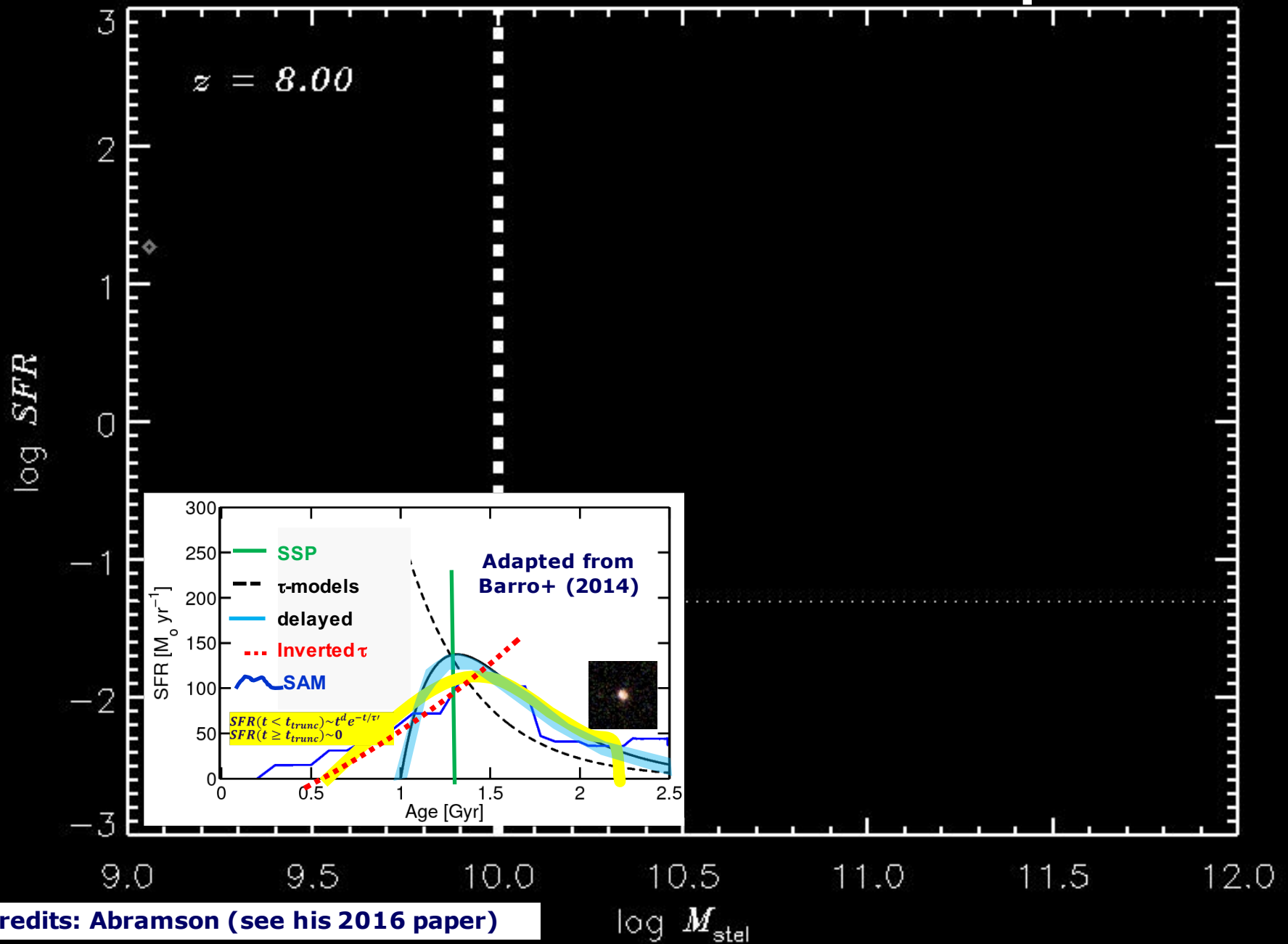
Domínguez-Sánchez,
P-G+ (2016)



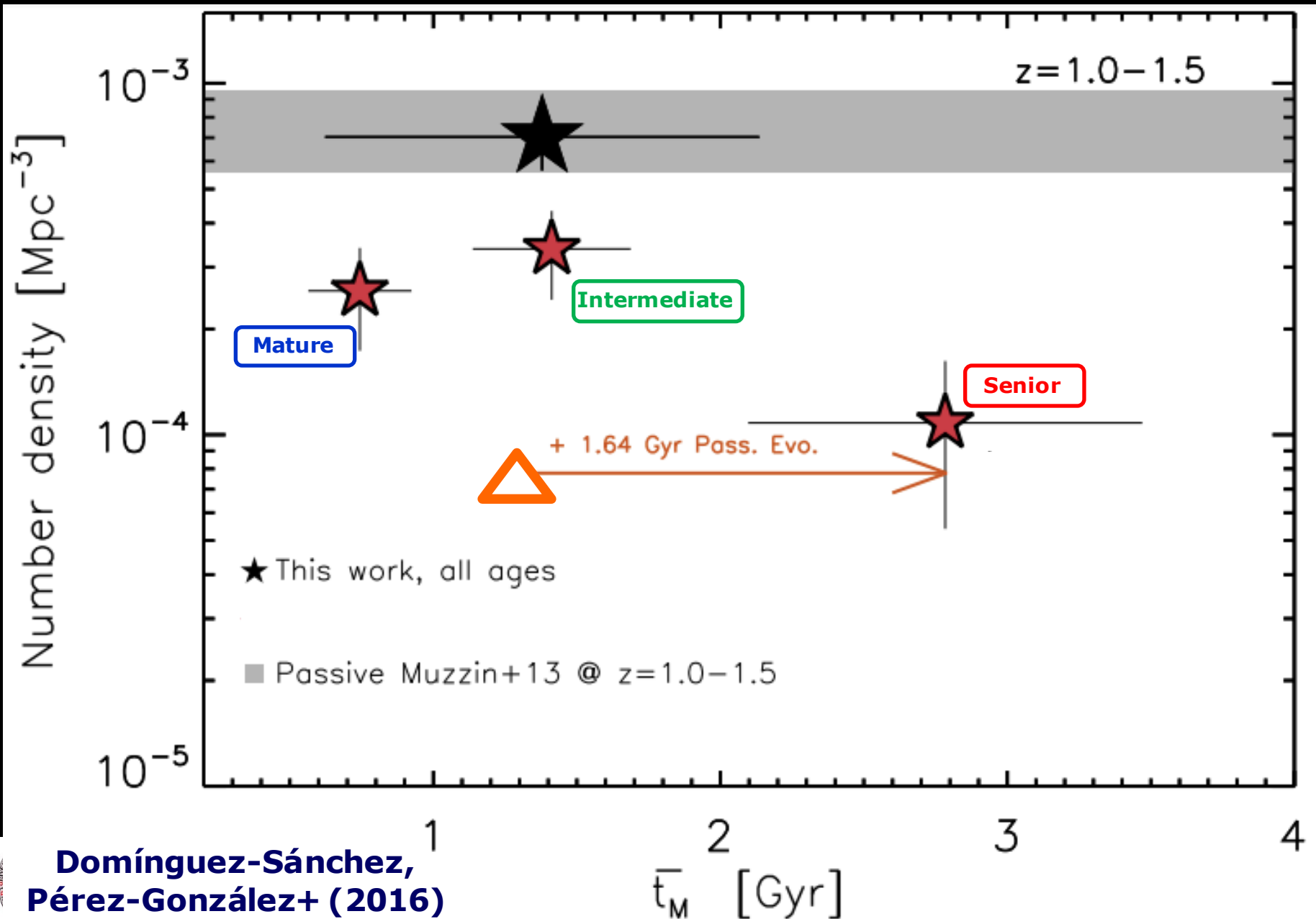
Mapping the pathways of galaxy transformation across time and space
Avalon, Catalina Island, July 31-August 5, 2016



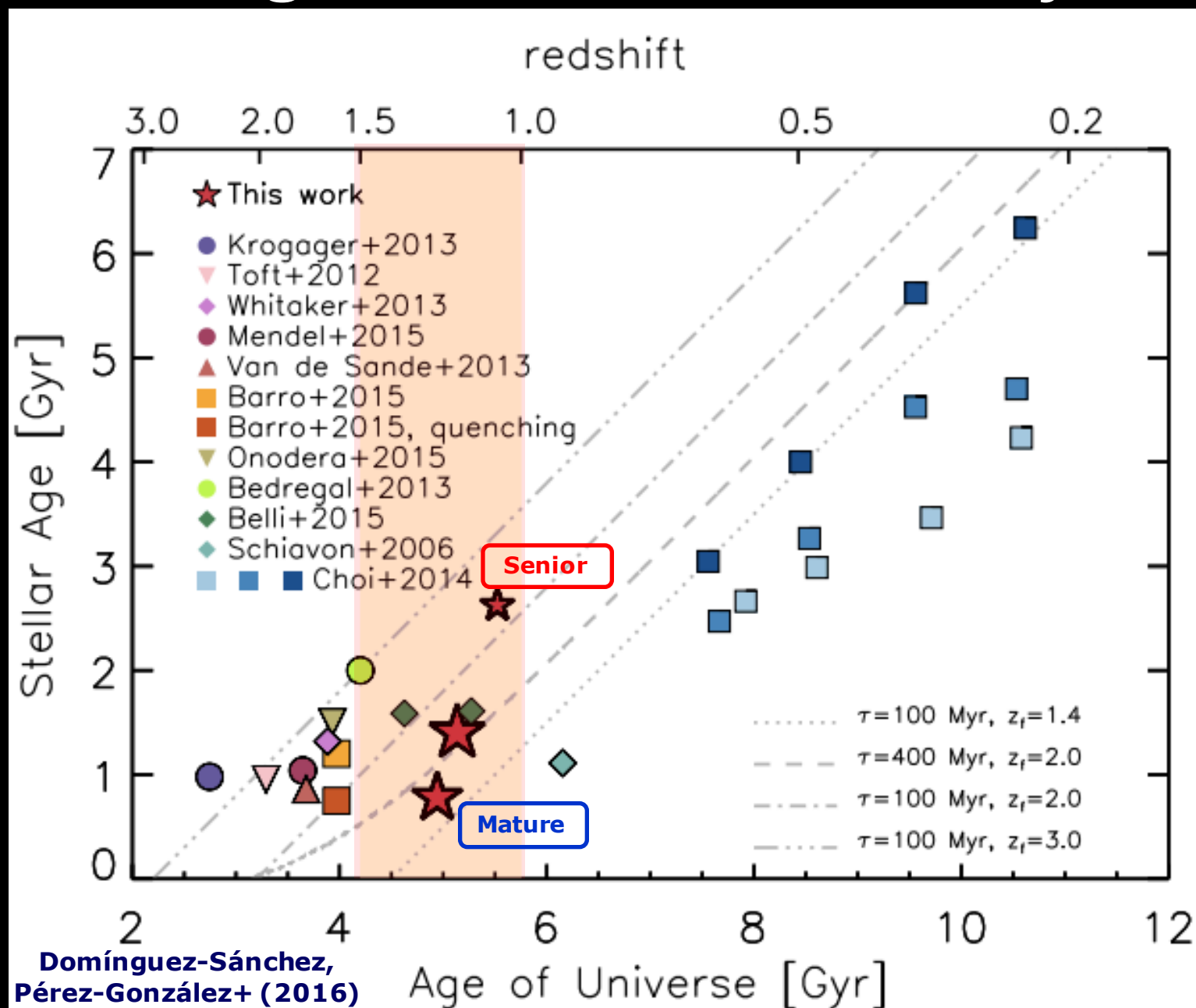
Life and death: SFHs and the main sequence



After death: do galaxies resurrect?



After death: galaxies do resurrect and rejuvenate!



Considerations about time for the “Fast Track” pathway of galaxy transformation into quiescence

- ➔ **The birth:** When did massive galaxies start their formation?
 - ◆ $z_f \sim 2$ for 85% $z \sim 1.2$ dead galaxies, $z_f = 3-4$ for 15% of $z \sim 1.2$ dead galaxies.
- ➔ Does the formation epoch depend on other physical properties?
 - ◆ Downsizing: more massive galaxies start forming stars (~ 0.5 Gyr) earlier and take longer (200 vs 400 Myr) to assemble (resulting in more mass).
- ➔ **The life:** How long does it take to form a massive galaxy?
 - ◆ $\langle \tau \rangle = 200$ Myr, and SF is highly concentrated (1-2 kpc).
 - ◆ Maximum SFRs: 100-200 M_\odot/yr (LIRG rather than ULIRG/SMGs).
 - ◆ Bottom-heavy IMF for massive quiescent galaxies at $z = 1.2$ (SFH effect?).
- ➔ **The death:** How fast does a massive galaxy die?
 - ◆ Delayed exponential SFHs perfectly (but not uniquely) fit SEDs and MS. Maybe slower rise? Maybe need for (more) abrupt truncation?
 - ◆ Galaxies live in the MS for 0.5-0.7 Gyr (or slightly above during tens of Myr), and then become passive very rapidly.
- ➔ **The after death:** Do massive galaxies resurrect?
 - ◆ No, based on number density of “senior galaxies” at $z \sim 2$ and $z \sim 1$.
 - ◆ Caveat: older galaxies show longer SF timescales, i.e., galaxies may have excursions in&out the MS. Or high- z major mergers do the trick.
 - ◆ Red sequence fills up until $z \sim 1$, then passive evolution dominates. Some rejuvenation (residual SF?, accretion of younger satellites?) is necessary.

