SED fitting as a tool for searching peculiar galaxies

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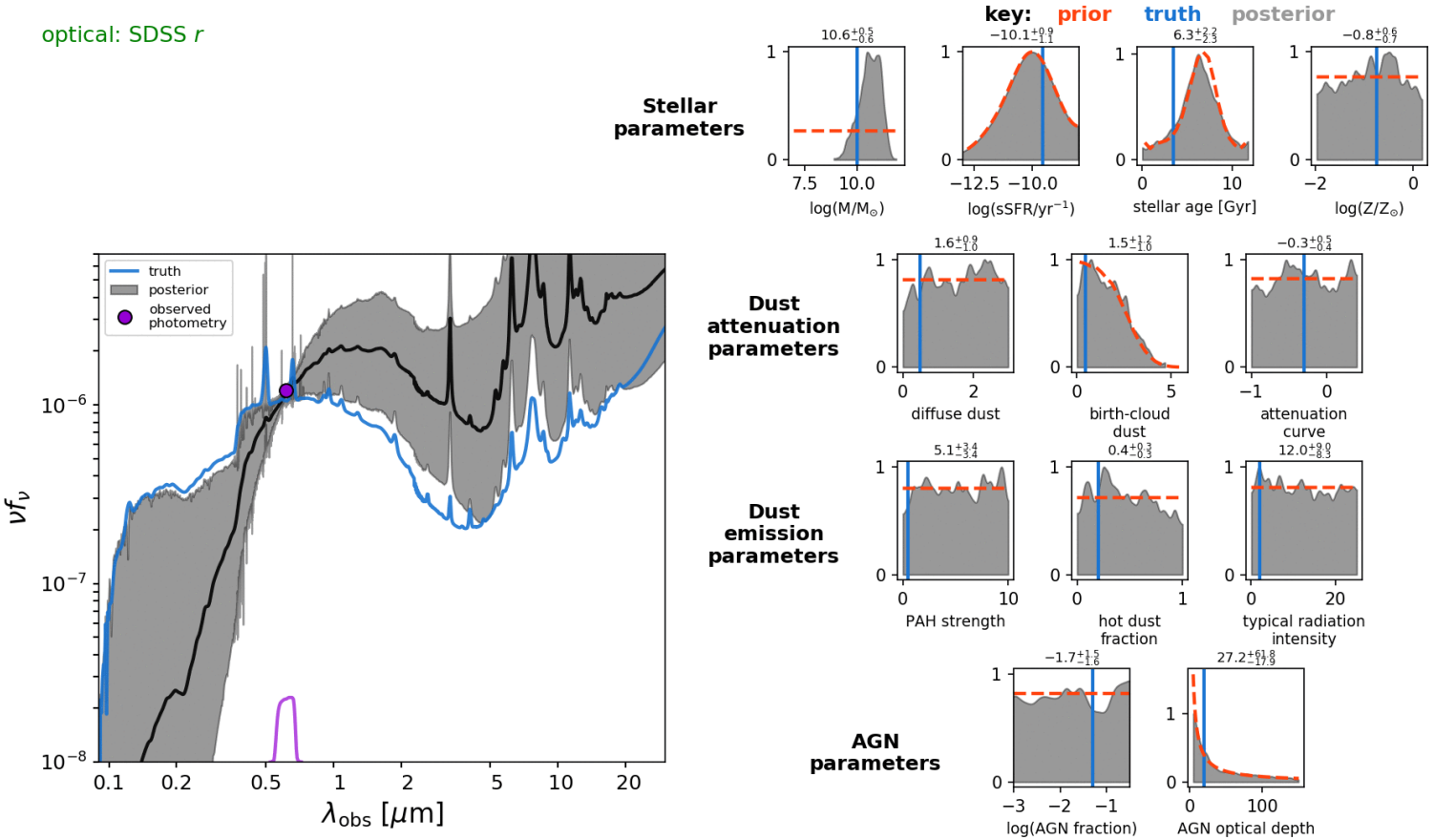
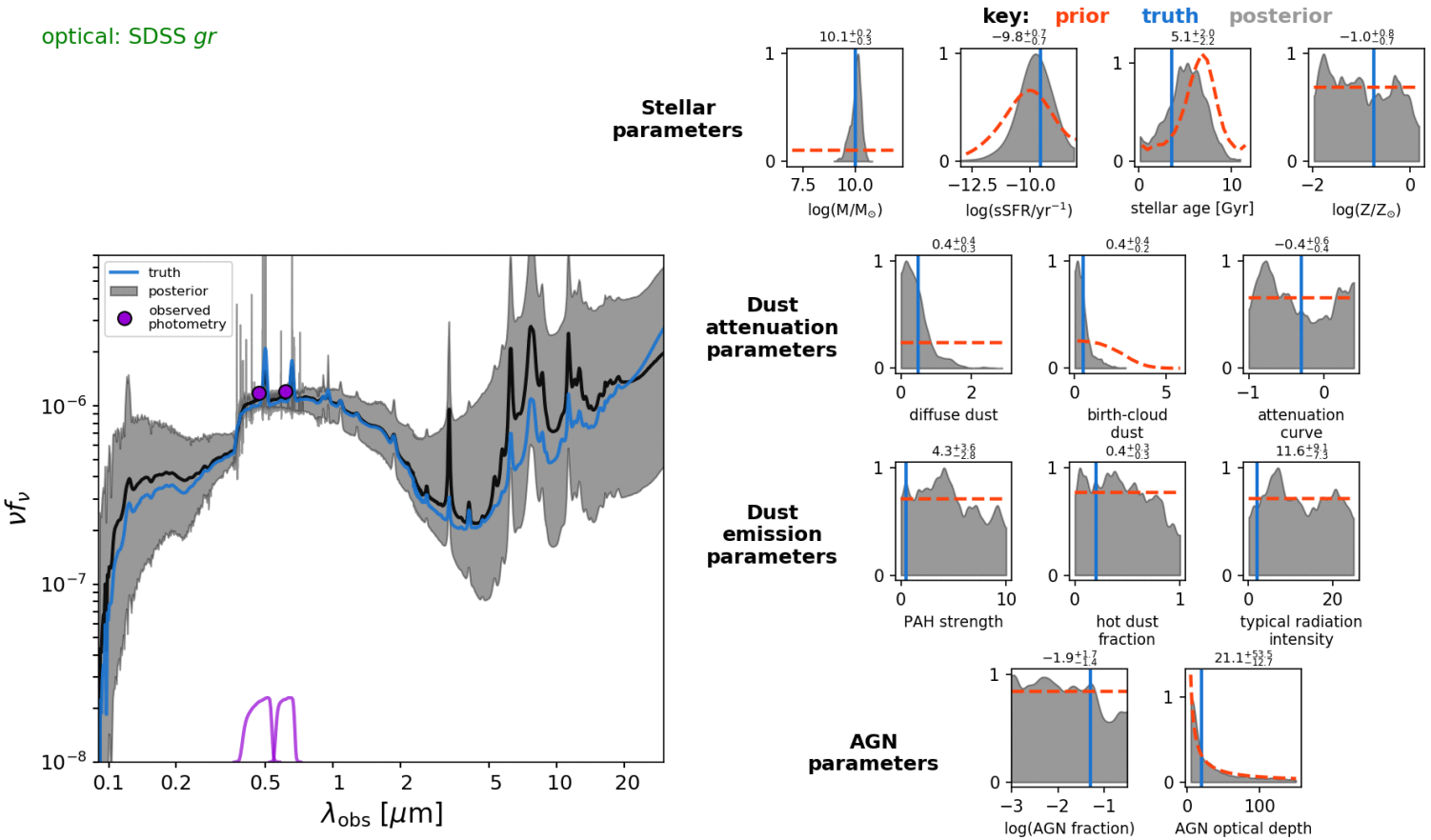
LSST PL Meeting, NCBJ, 13.04.2019

optical: SDSS *r*



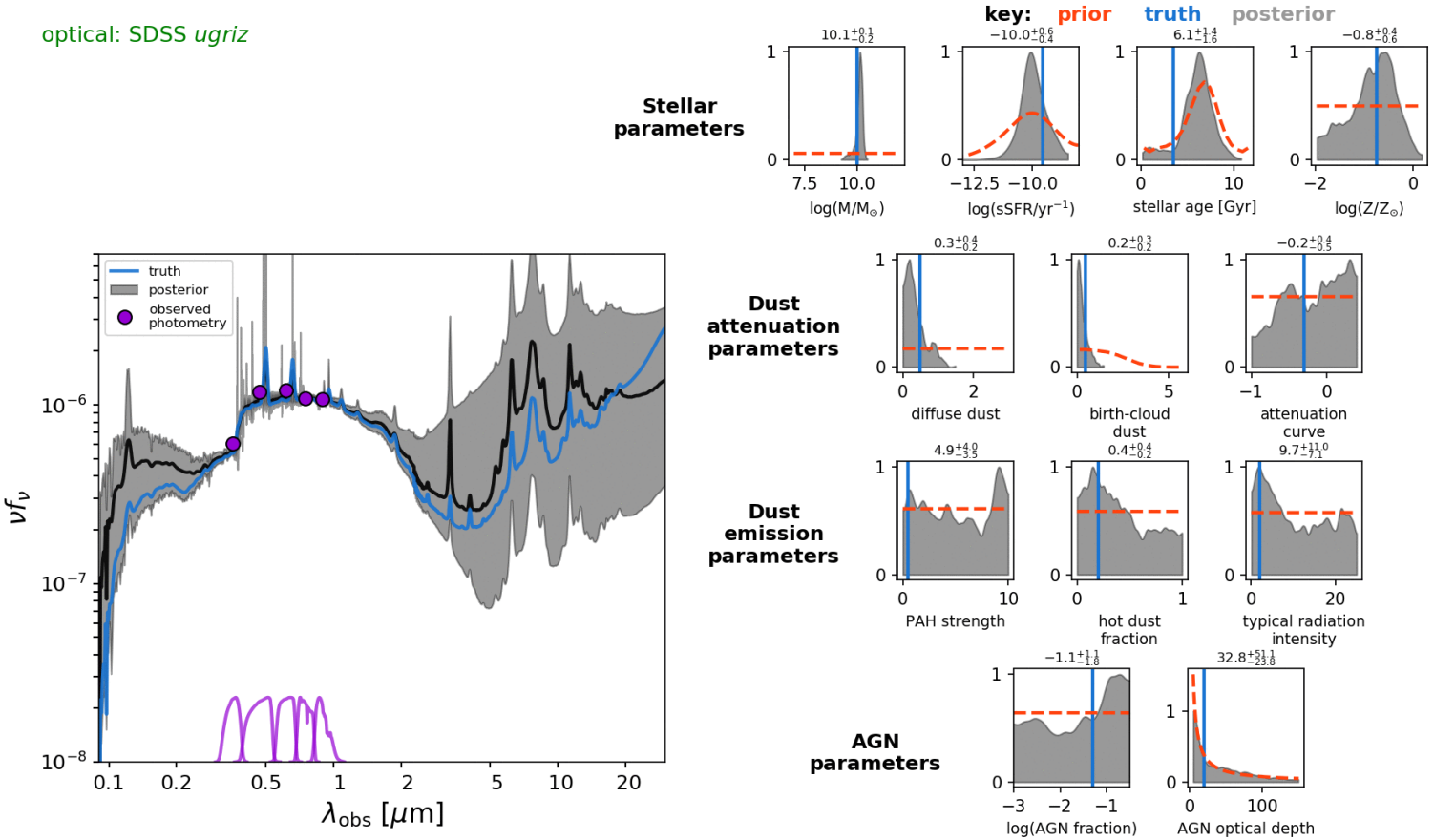
źródło: https://github.com/bd-j/prospector

optical: SDSS *gr*



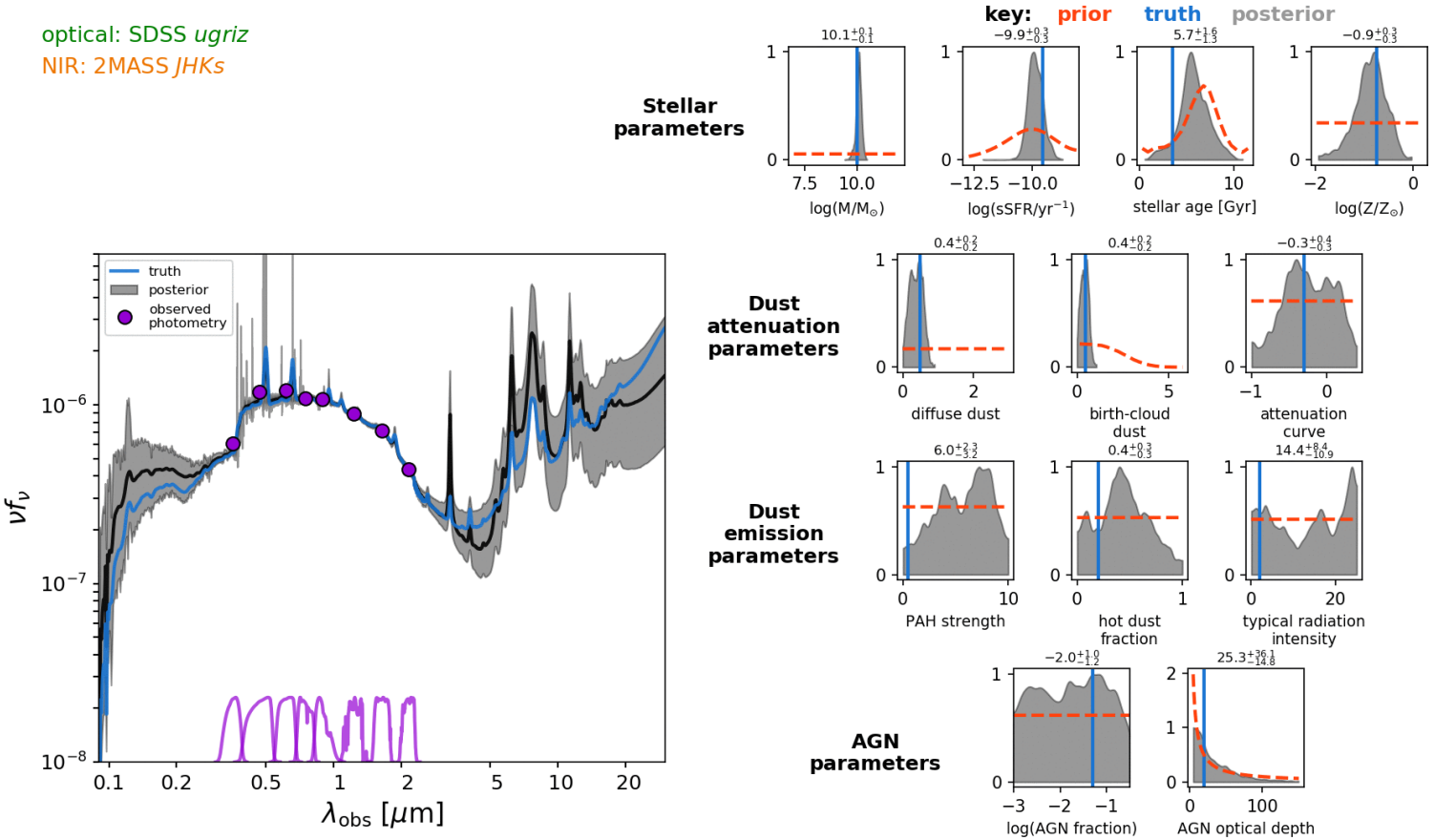
źródło: https://github.com/bd-j/prospector

optical: SDSS *ugriz*



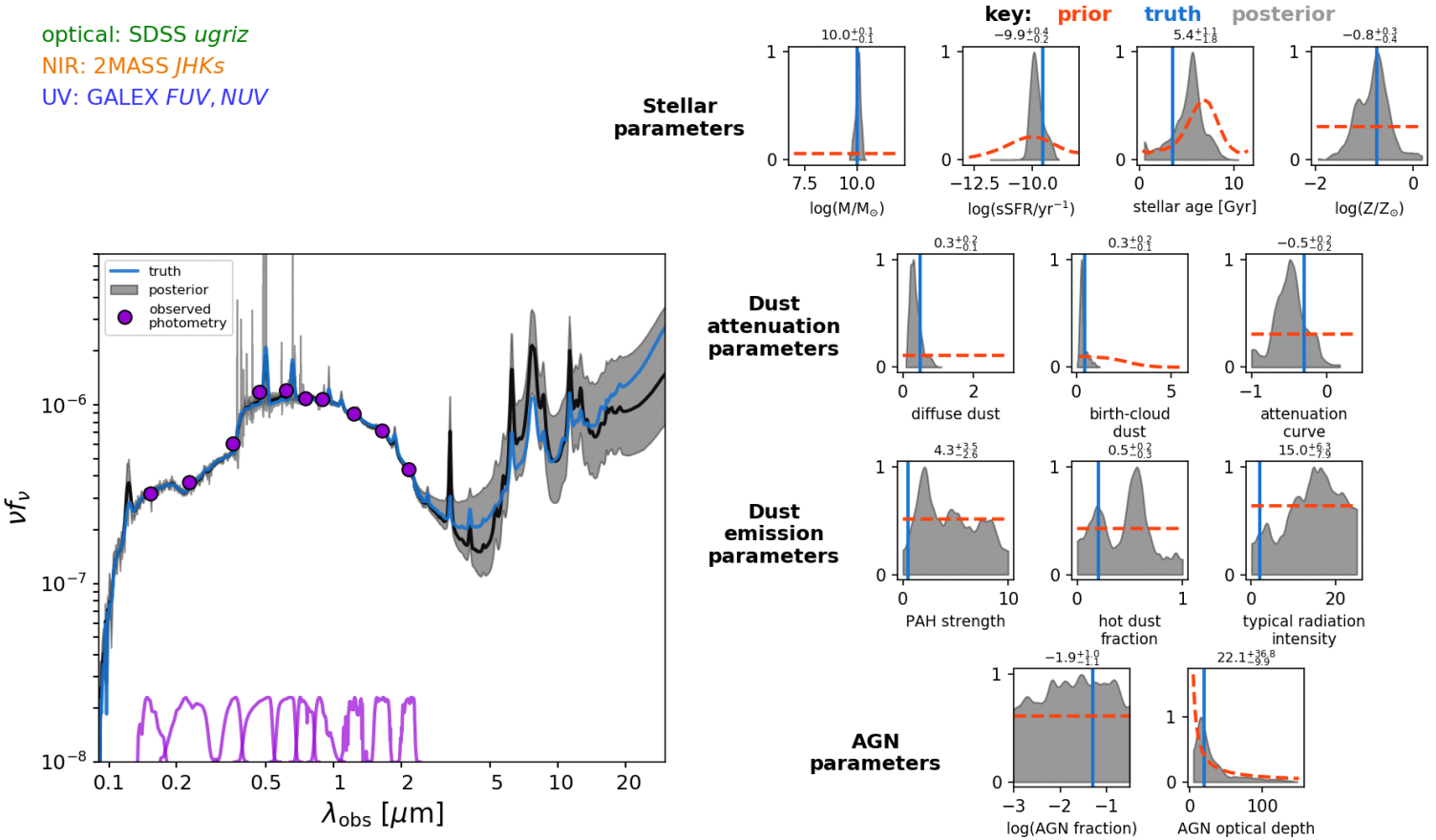
źródło: https://github.com/bd-j/prospector

optical: SDSS *ugriz*
NIR: 2MASS *JHKs*



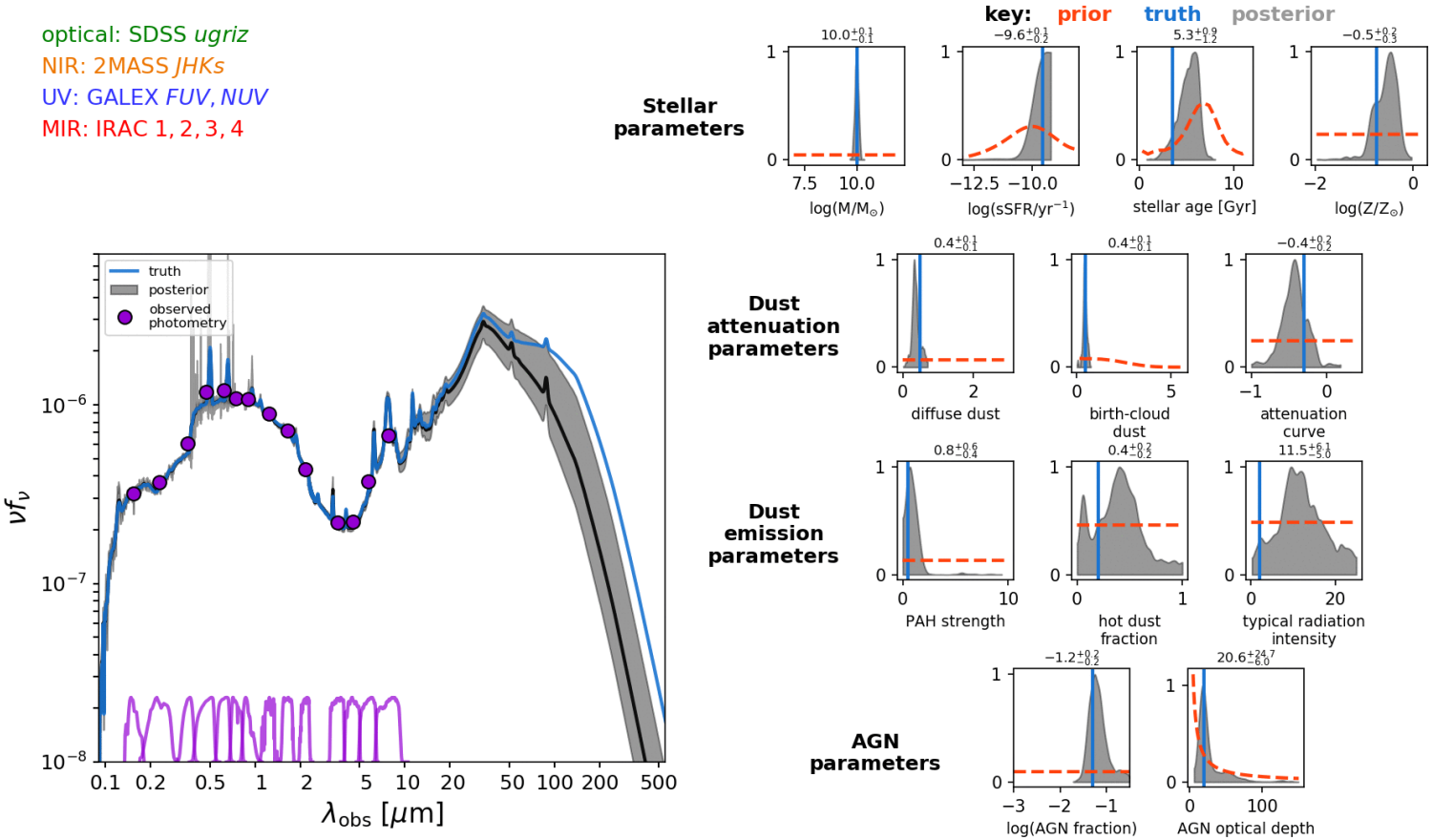
źródło: https://github.com/bd-j/prospector

optical: SDSS *ugriz*
NIR: 2MASS *JHKs*
UV: GALEX *FUV, NUV*



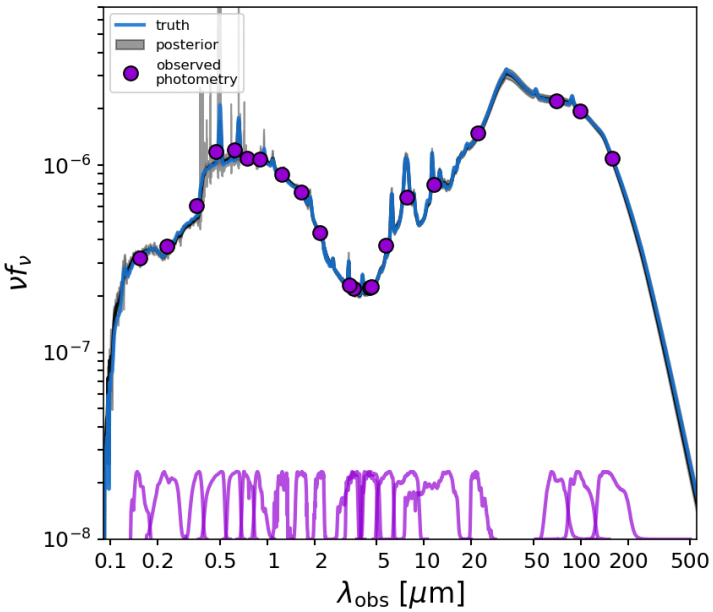
źródło: https://github.com/bd-j/prospector

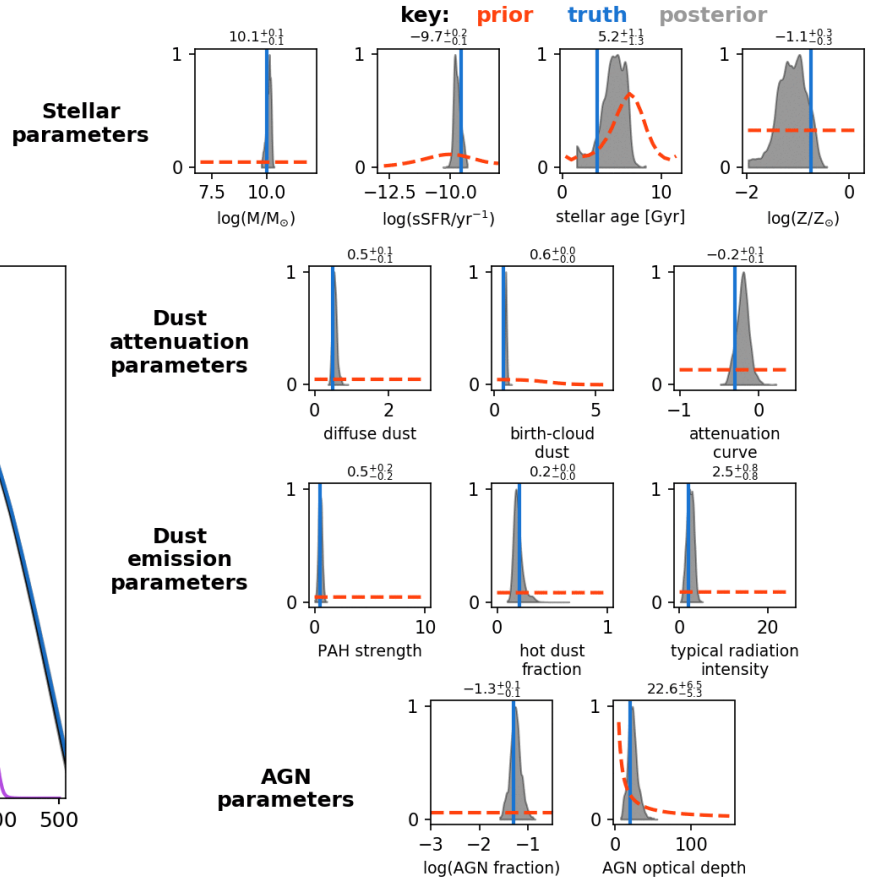
optical: SDSS *ugriz*
NIR: 2MASS *JHKs*
UV: GALEX *FUV, NUV*
MIR: IRAC 1, 2, 3, 4



źródło: https://github.com/bd-j/prospector

optical: SDSS *ugriz*
NIR: 2MASS *JHKs*
UV: GALEX *FUV, NUV*
MIR: IRAC 1, 2, 3, 4
WISE 1, 2, 3, 4
FIR: Herschel PACS/70, 100, 160





źródło: https://github.com/bd-j/prospector

optical: SDSS *ugriz*
NIR: 2MASS *JHKs*
UV: GALEX *FUV, NUV*
MIR: IRAC 1, 2, 3, 4
WISE 1, 2, 3, 4
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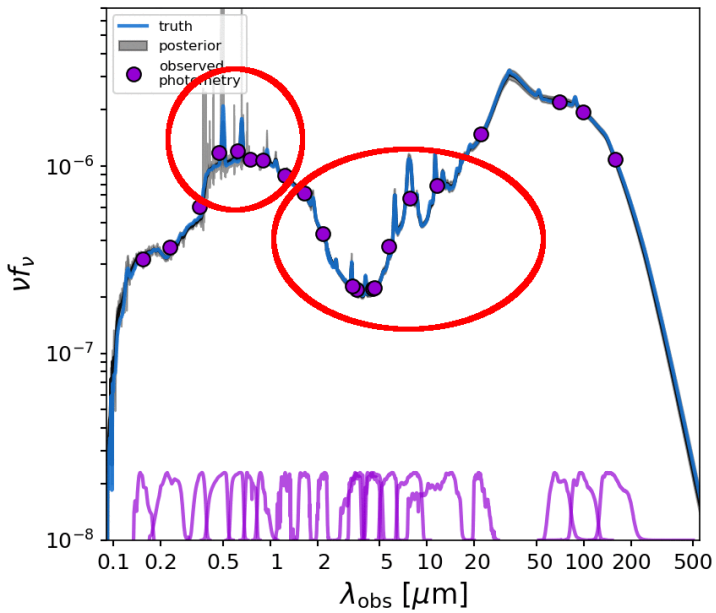
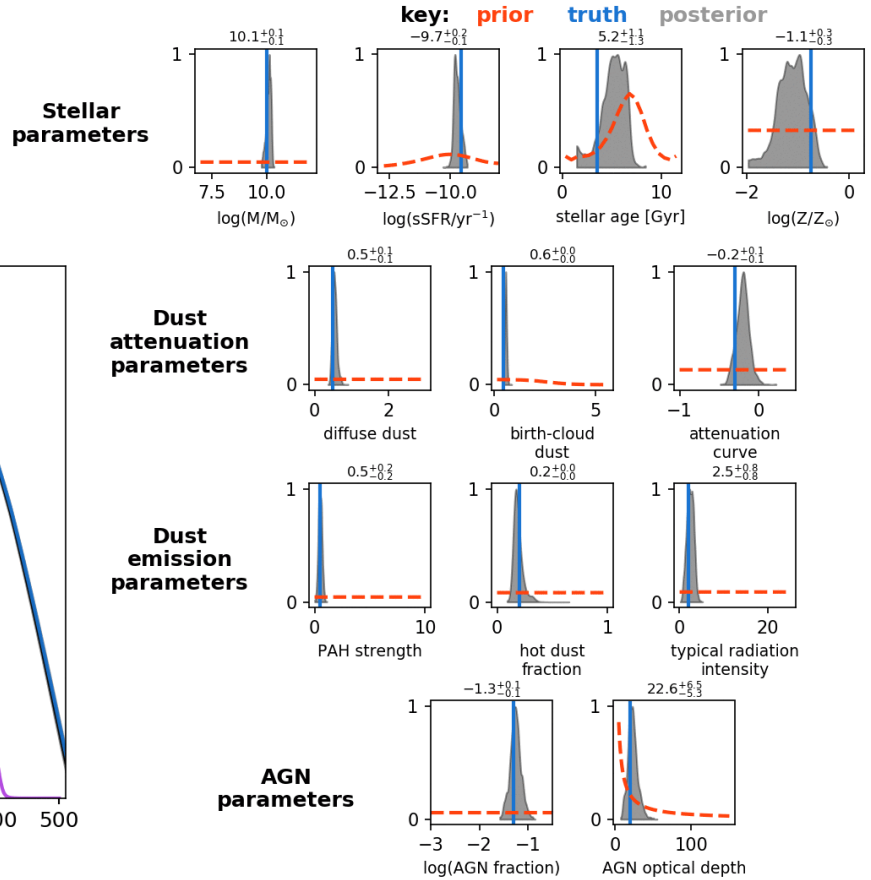
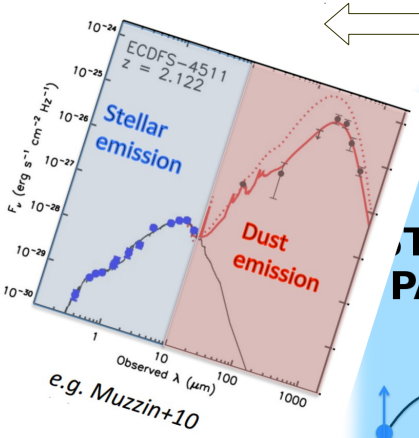


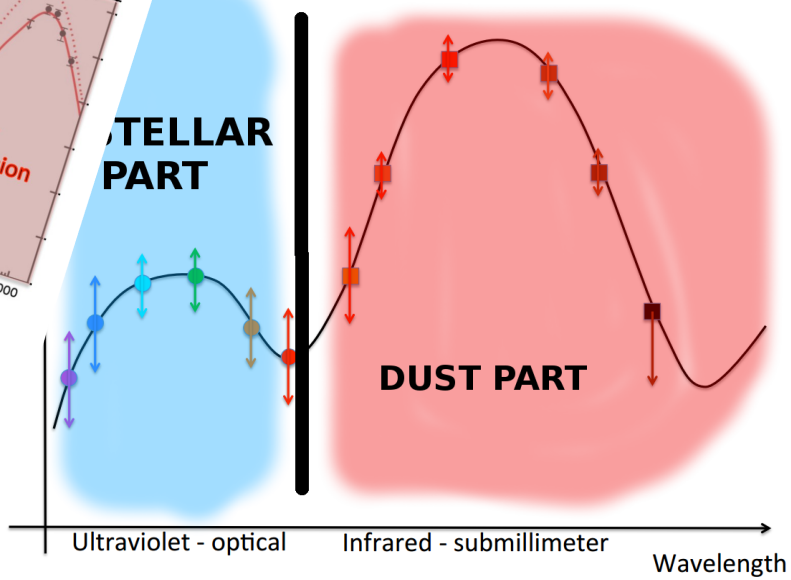


źródło: https://github.com/bd-j/prospector

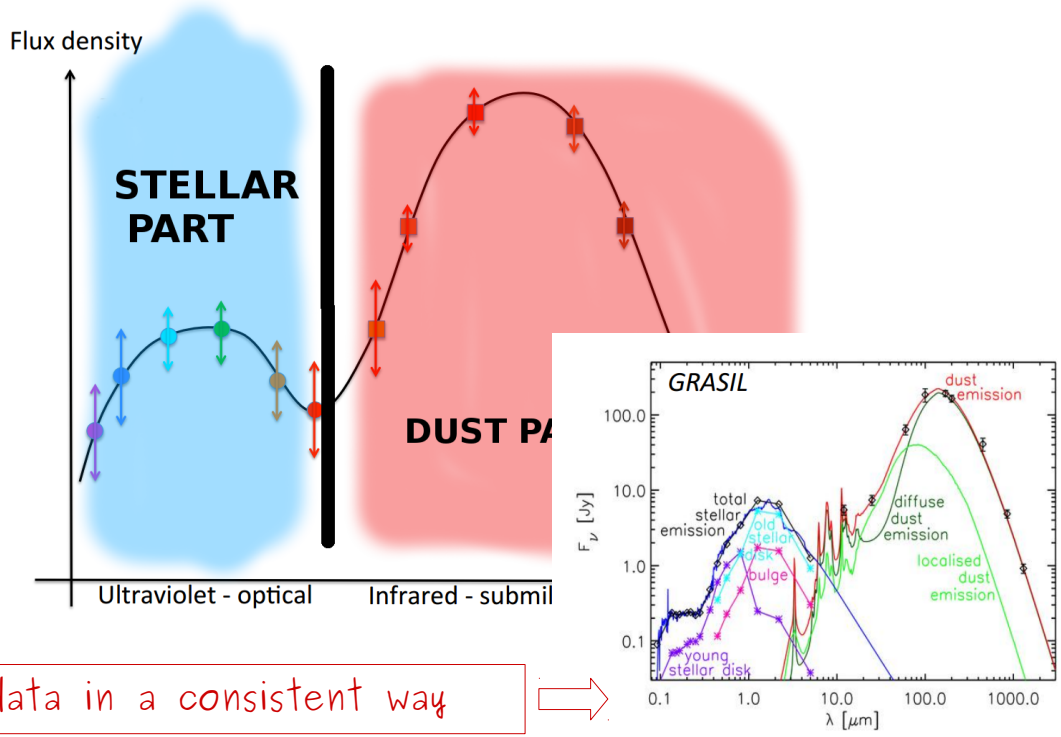
How to fit SED?

stellar & dust emission fitted separately

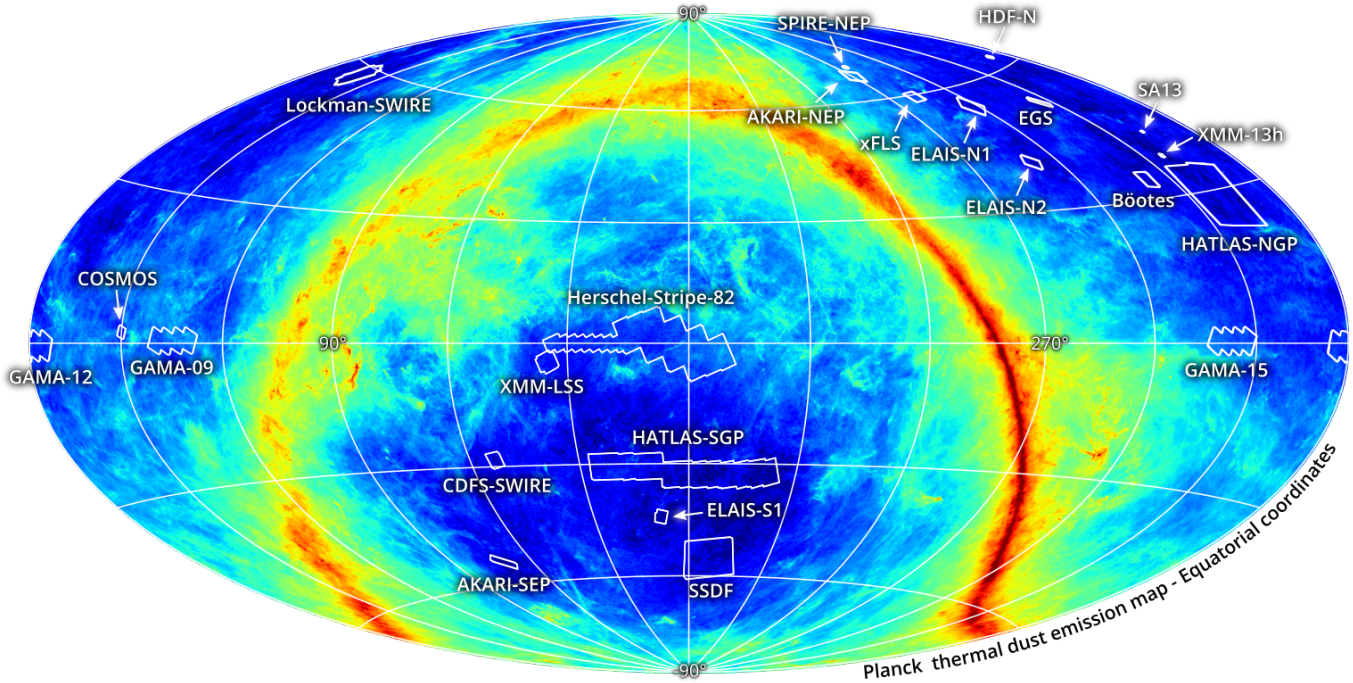




How to fit SED?

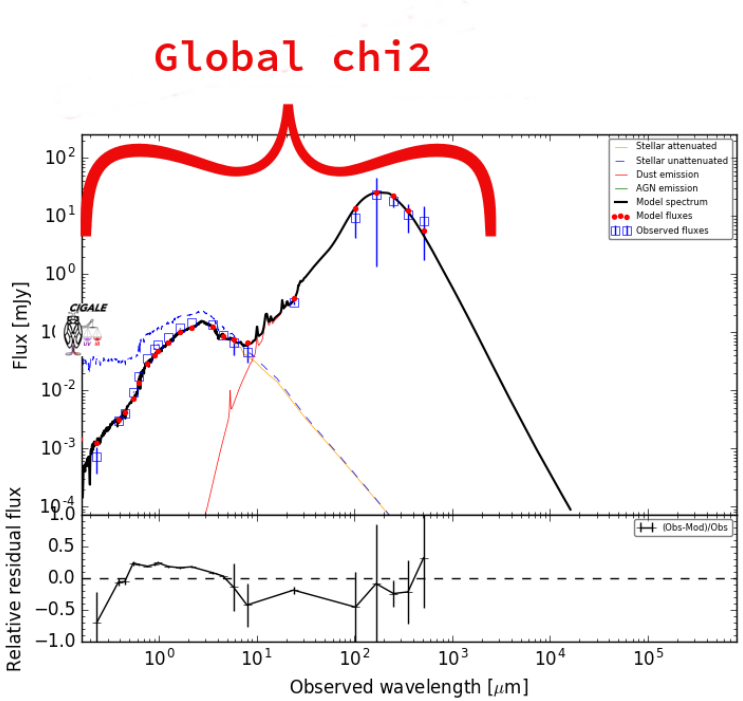


To use all the data in a consistent way

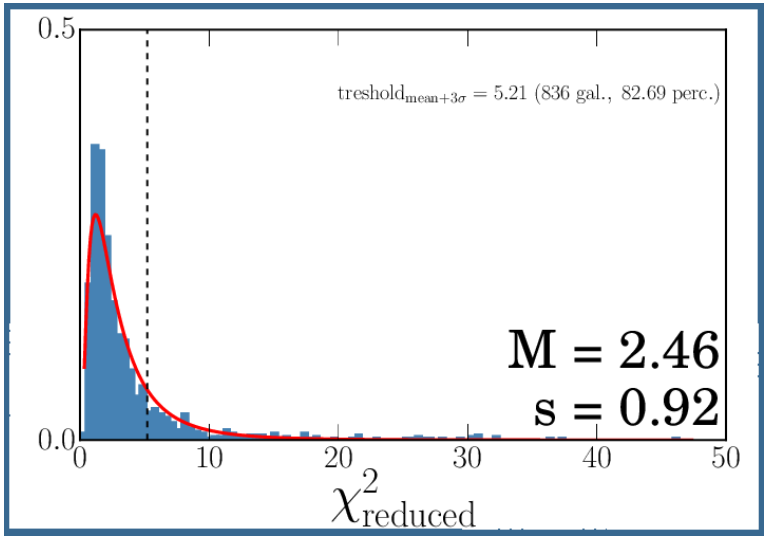


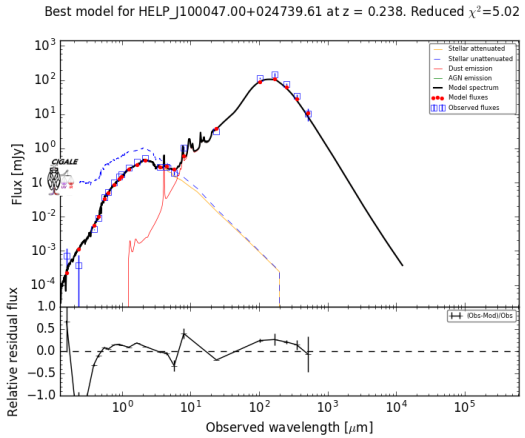
A map of the areas of the sky from which **The Herschel Extra-galactic Legacy Project (HELP)** is compiling data. Each white boundary region is an individual field which contains Herschel Space Observatory imaging. Further data at other wavelengths also exists in these fields. The background colour map shows the dust density of our own Milky Way.

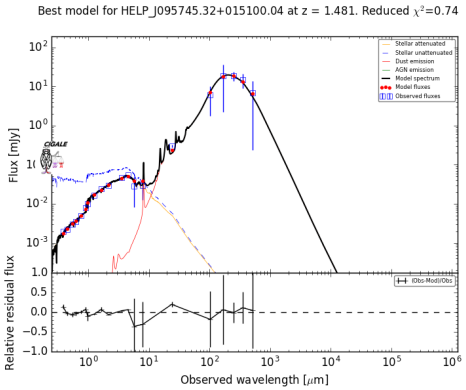
Usually standard approach works good ..

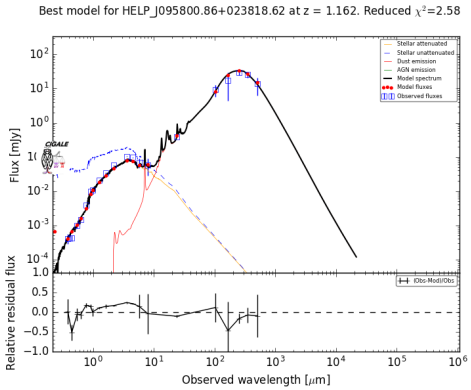


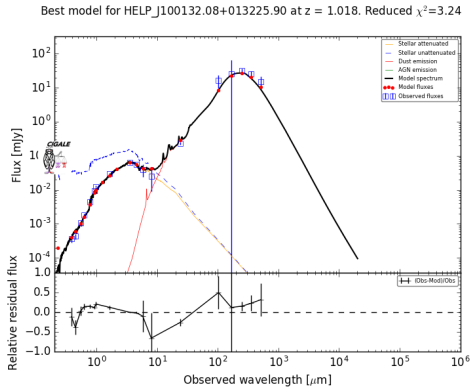
1. select your modules, models and parameters,
2. run CIGALE,
3. check the distribution of χ^2,
4. perform your analysis based on the galaxies with $\chi^2 \leqq \chi^2_{threshold}$.


0.5
0.0
treshold$_{\mathrm{mean}+3\sigma}$ = 5.21 (836 gal., 82.69 perc.)
M = 2.46
s = 0.92
0
10
20
30
40
50
$\chi^2_{\mathrm{reduced}}$

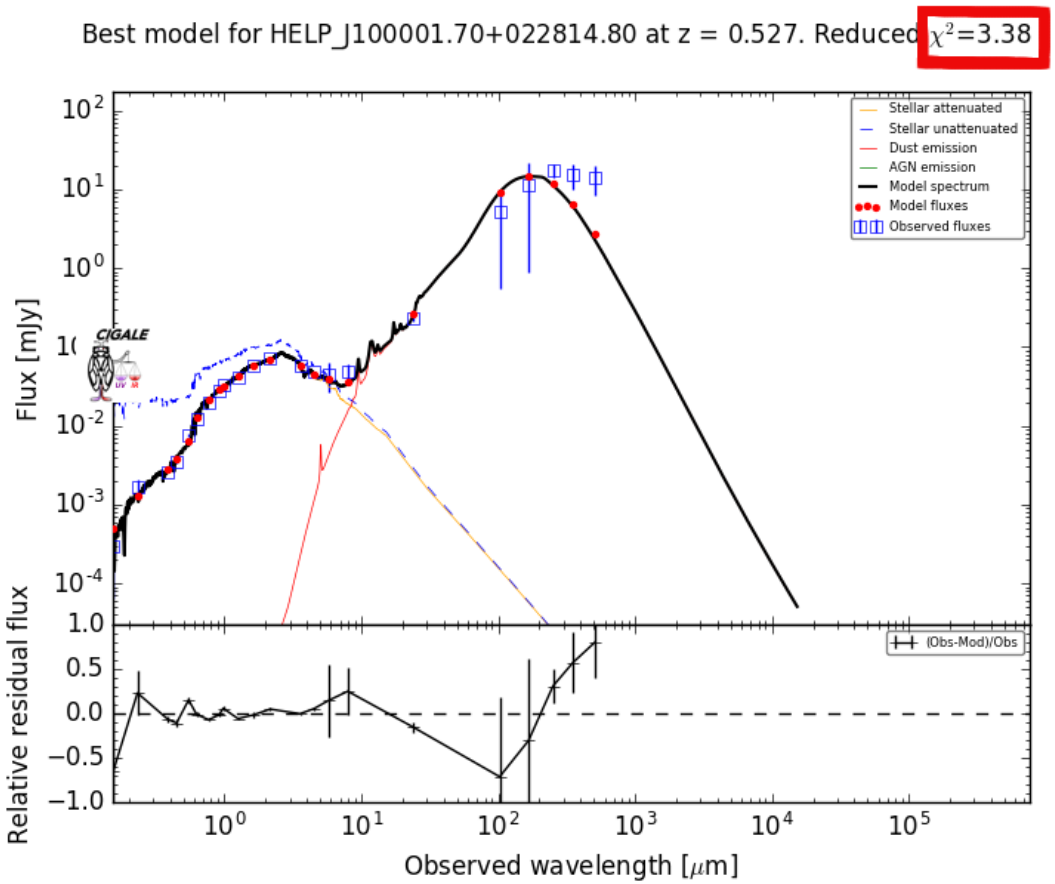

Best model for HELP_J100047.00+024739.61 at z = 0.238. Reduced χ^2=5.02
Flux [mJy]
Relative residual flux
Observed wavelength [μm]


Best model for HELP_J095745.32+015100.04 at z = 1.481. Reduced χ^2=0.74
Flux [mJy]
Relative residual flux
Observed wavelength [μm]


Best model for HELP_J095800.86+023818.62 at z = 1.162. Reduced χ^2=2.58
Flux [mJy]
Relative residual flux
Observed wavelength [μm]

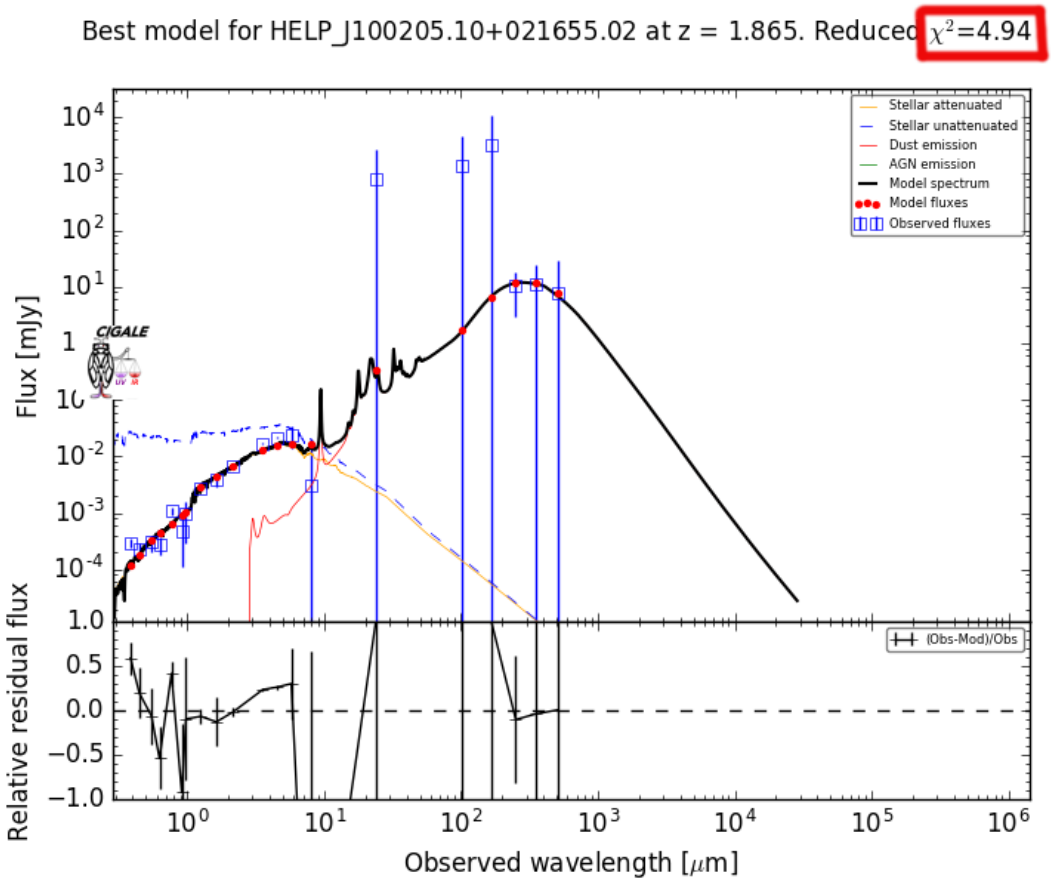

Best model for HELP_J100132.08+013225.90 at z = 1.018. Reduced χ^2=3.24
Flux [mJy]
Relative residual flux
Observed wavelength [μm]

.. but sometimes ..



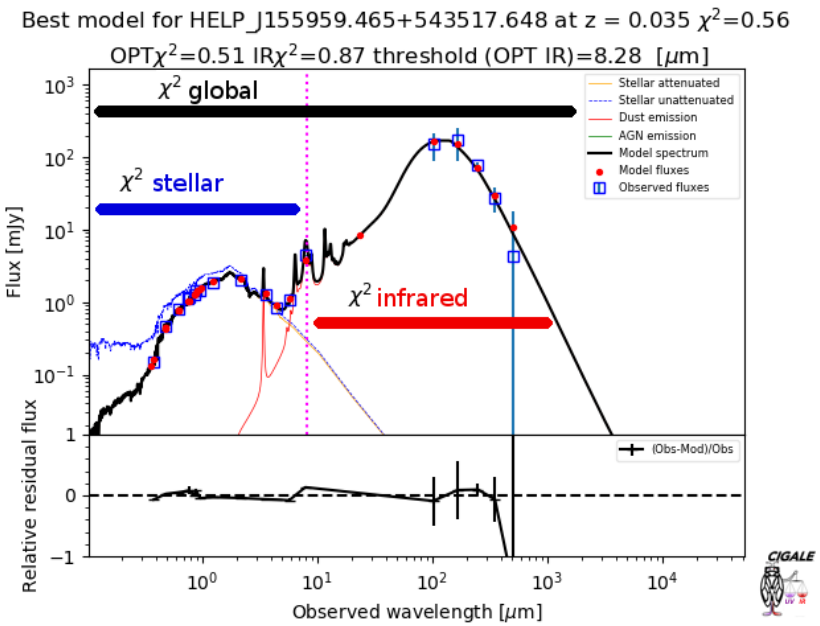
In that case L_{dust} luminosity is wrong.

.. or ..

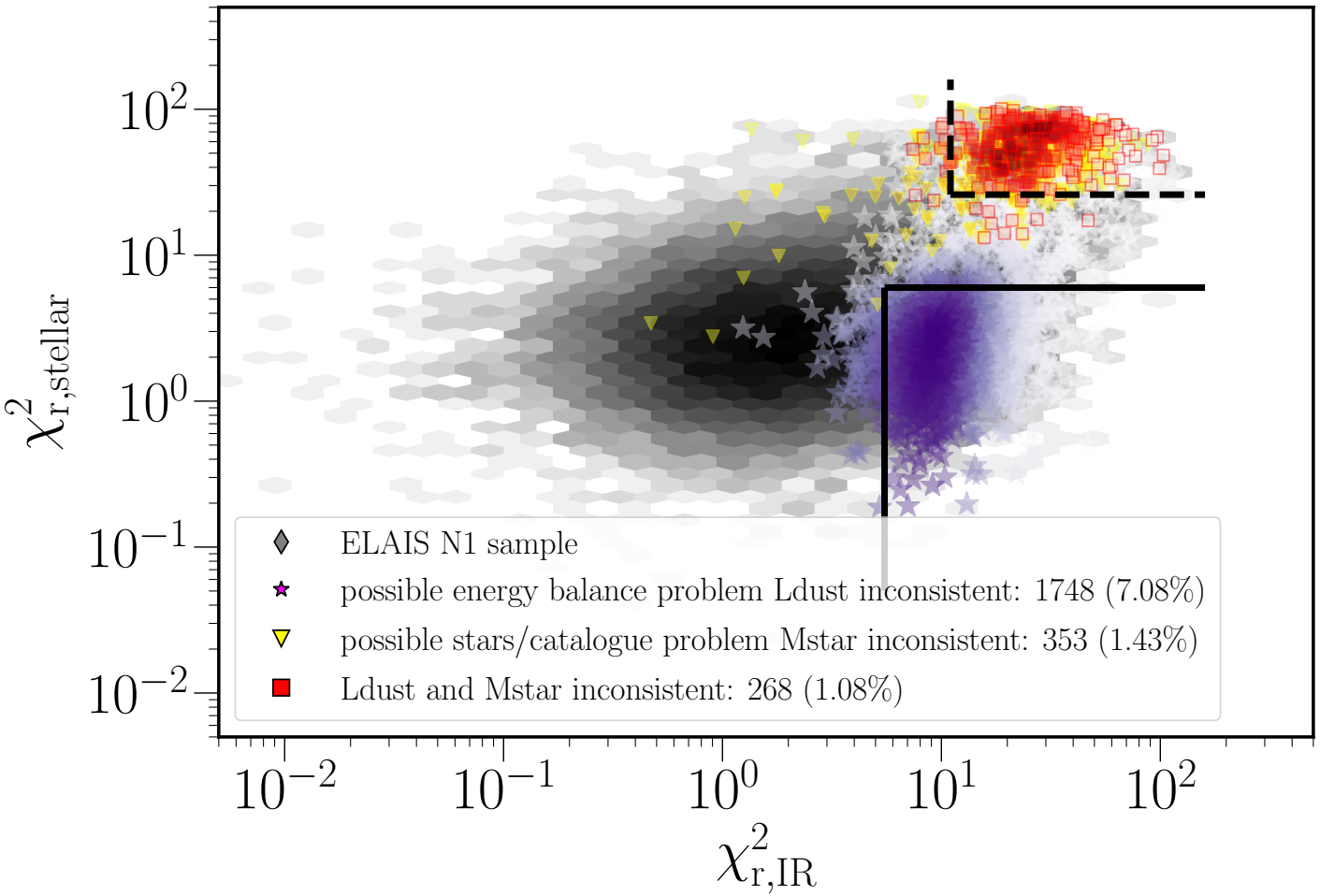


can we really trust it?

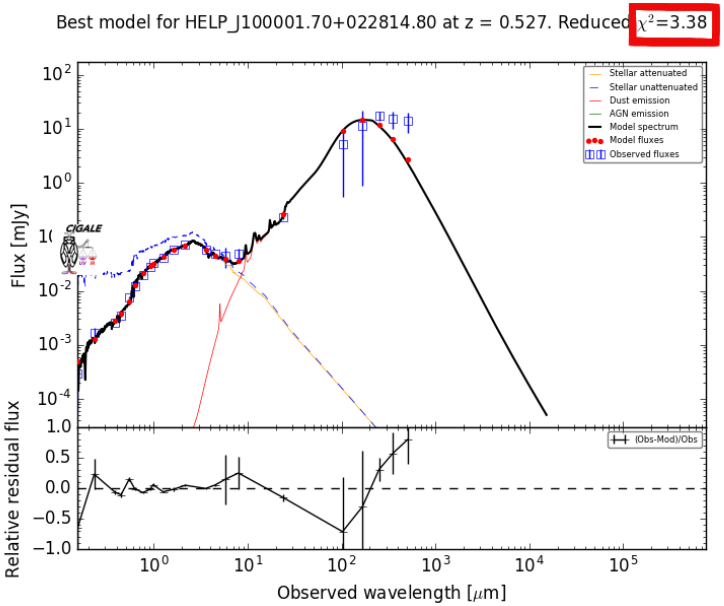
New approach: $\chi^2_{r,OPT}$ & $\chi^2_{r,IR}$

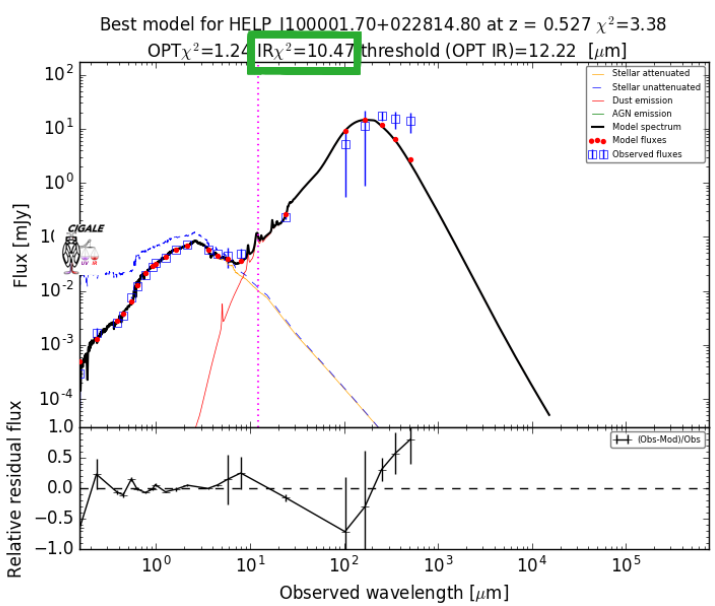


1. define the threshold between UV+OPT and IR χ^2s wavelengths *in our case 8μm (rest-frame)*,
2. check the distribution of χ^2, $\chi^2_{r,OPT}$, and $\chi^2_{r,IR}$
3. perform your analysis based on the galaxies with $\chi^2 \leqq \chi^2_{threshold}$, and $\chi^2_{r,OPT} \leqq \chi^2_{OPT,threshold}$, and $\chi^2_{r,IR} \leqq \chi^2_{IR,threshold}$.

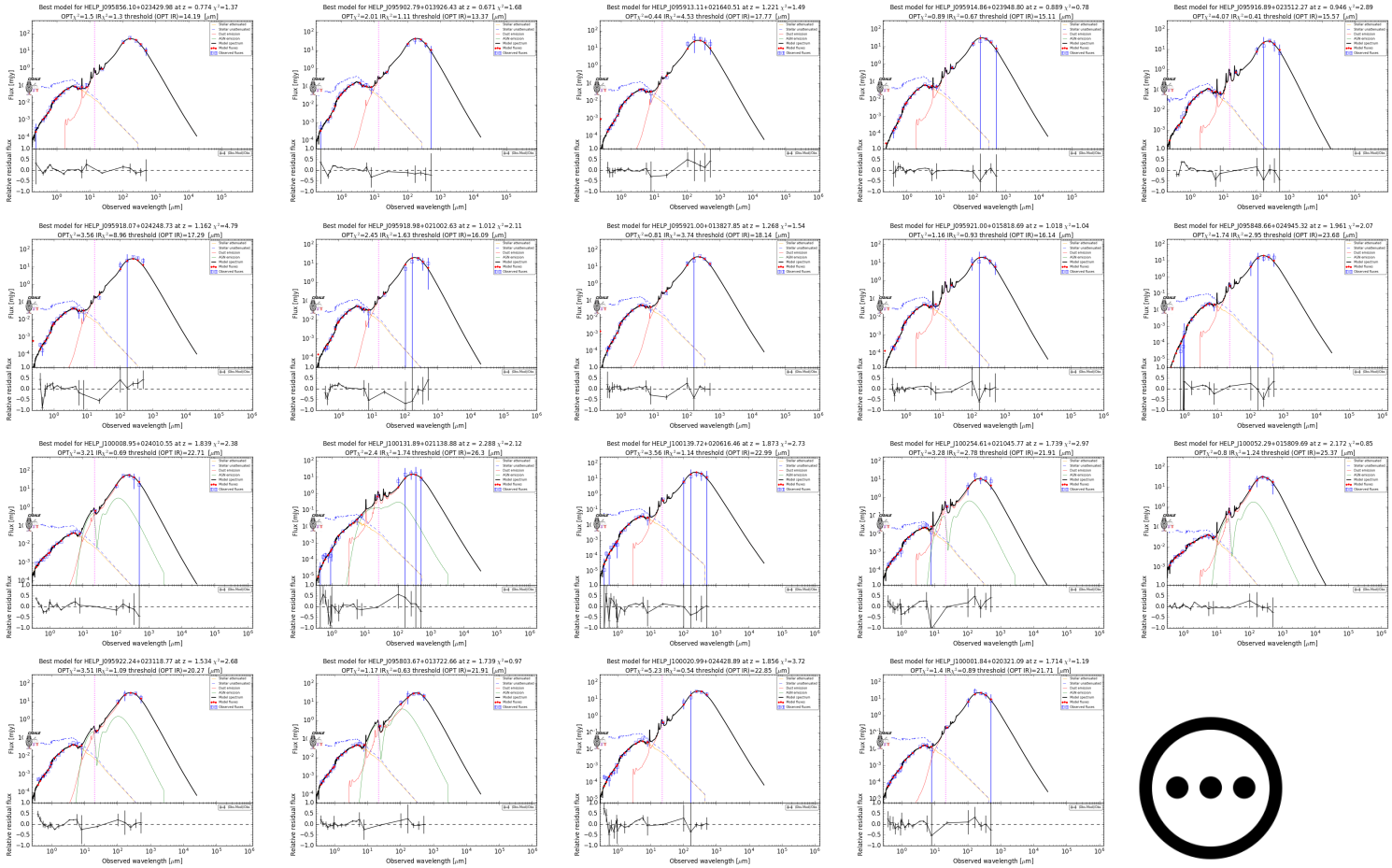

10^2
10^1
10^0
10^{-1}
10^{-2}
$\chi^2_{\mathrm{r,stellar}}$
10^{-2}
10^{-1}
10^0
10^1
10^2
$\chi^2_{\mathrm{r,IR}}$
ELAIS N1 sample
possible energy balance problem Ldust inconsistent: 1748 (7.08%)
possible stars/catalogue problem Mstar inconsistent: 353 (1.43%)
Ldust and Mstar inconsistent: 268 (1.08%)

rejection of bad fits



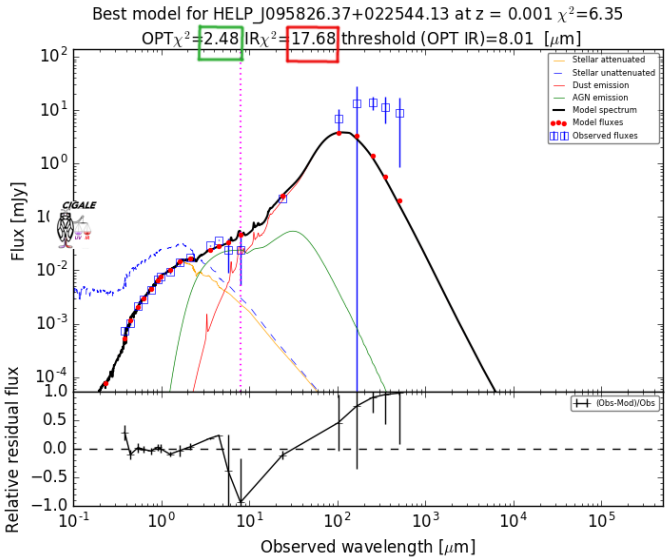


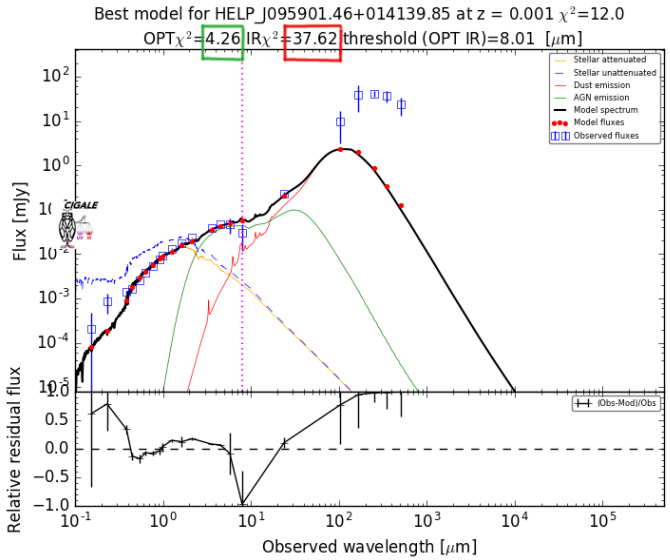
selection of the best fits



Peculiar objects

searching for peculiar objects

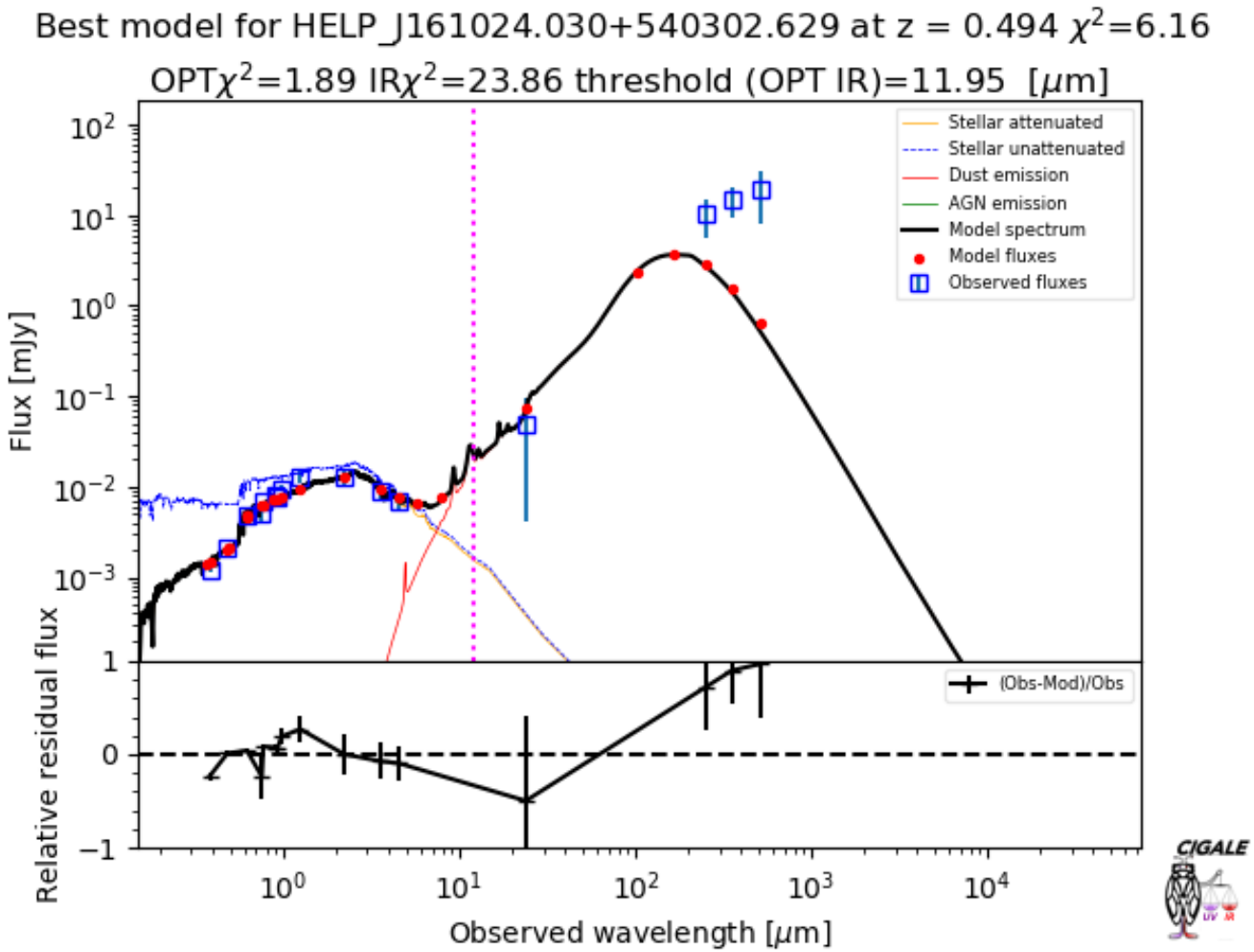




lensed galaxies

Using two χ^2s on the ELAIS N1 sample we select more than **300 possible lensed candidates** among $\sim$40 000, inside the criteria describing galaxies with possible energy budget problem. Based on

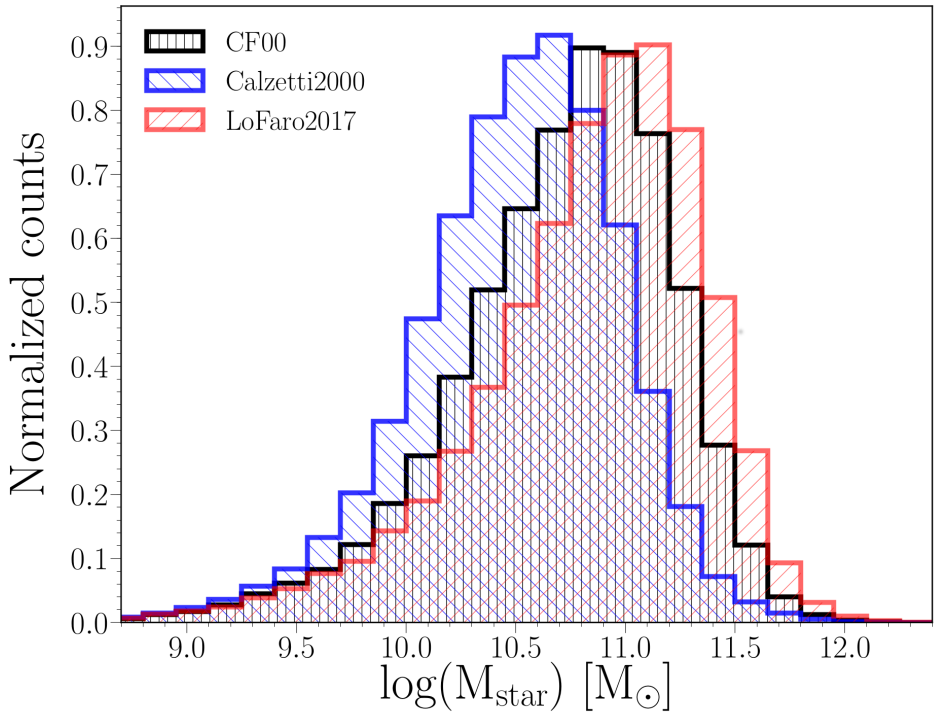
visual inspection we find that the difference between $z_{\mathrm{phot,stellar}}$ and $z_{\mathrm{phot,IR}}$ for all of them is higher than 0.63 (twice the $\sigma_{z_{\mathrm{phot,IR}}}$).



The $z_{\mathrm{phot,IR}}$ is equal to 3.28 $\pm$ 0.43, while $z_{\mathrm{phot,stellar}} = 0.49$.

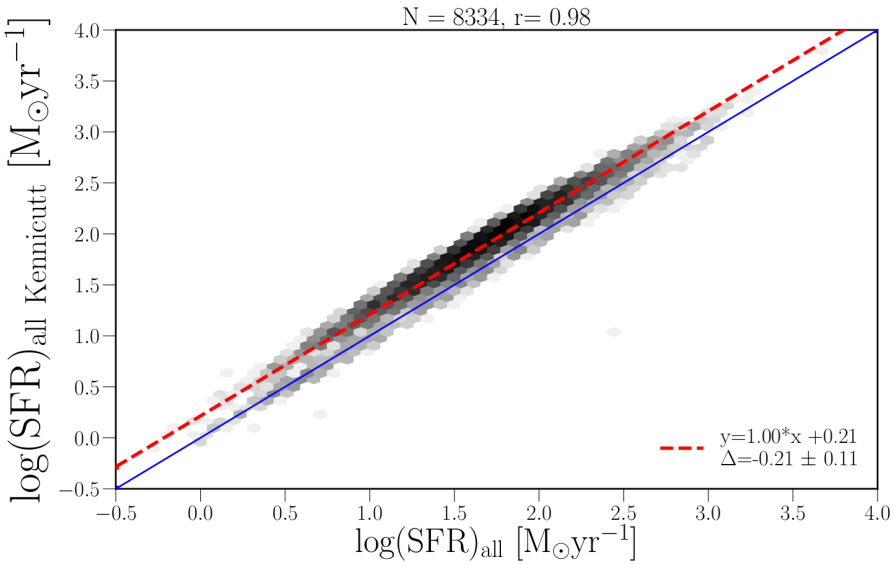
What we can do with normal/deadly boring galaxies?

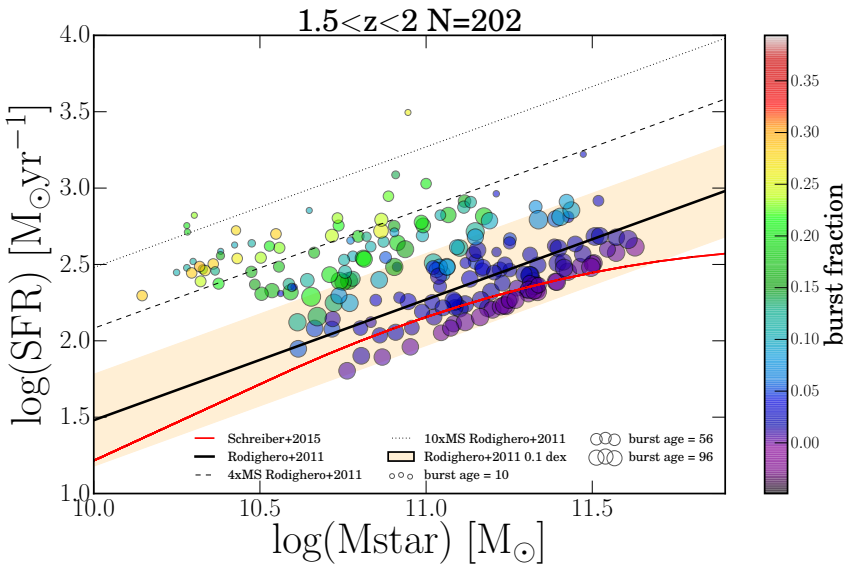
We can check for example the influence of the attenuation curve on the derived physical properties of galaxies ...



(Małek et. al., 2018)

or different recipes for SFR & the influence on the so-called "Main Sequence"...





Thank you for your attention