DustPedia

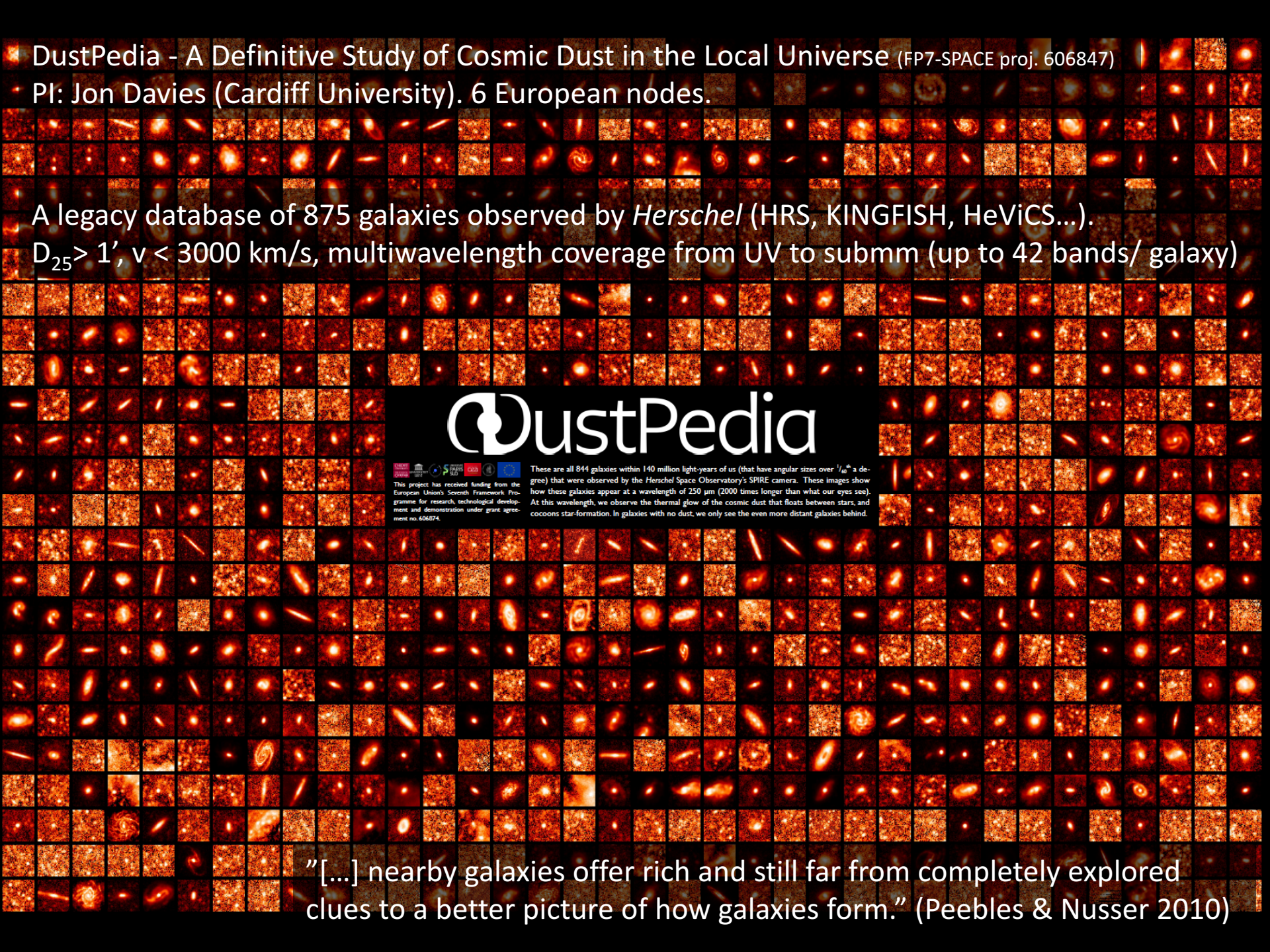
A Definitive Study of Cosmic Dust in the Local Universe

Viviana Casasola
INAF - Osservatorio Astrofisico di Arcetri

Meeting INAF - Macroarea 1, Padova, 13 settembre 2017

DustPedia - A Definitive Study of Cosmic Dust in the Local Universe (FP7-SPACE proj. 606847)
PI: Jon Davies (Cardiff University). 6 European nodes.

A legacy database of 875 galaxies observed by *Herschel* (HRS, KINGFISH, HeViCS…).
D_{25}> 1', v < 3000 km/s, multiwavelength coverage from UV to submm (up to 42 bands/ galaxy)



"[…] nearby galaxies offer rich and still far from completely explored clues to a better picture of how galaxies form." (Peebles & Nusser 2010)

DustPedia

J. Davies (PI)	V. Casasola	J. Fritz	S. Viaene
M. Baes (co-PI)	L. Cassara’	F. Galliano	N. Ysard
S. Bianchi (co-PI)	C. Clark	M. Galametz	….
A. Jones (co-PI)	I. De Looze	S. Lianou	L. Magrini (external)
S. Madden (co-PI)	P. De Vis	A. Mosenkov	M. Smith (external)
E. Xilouris (co-PI)	R. Evans	S. Verstocken	….

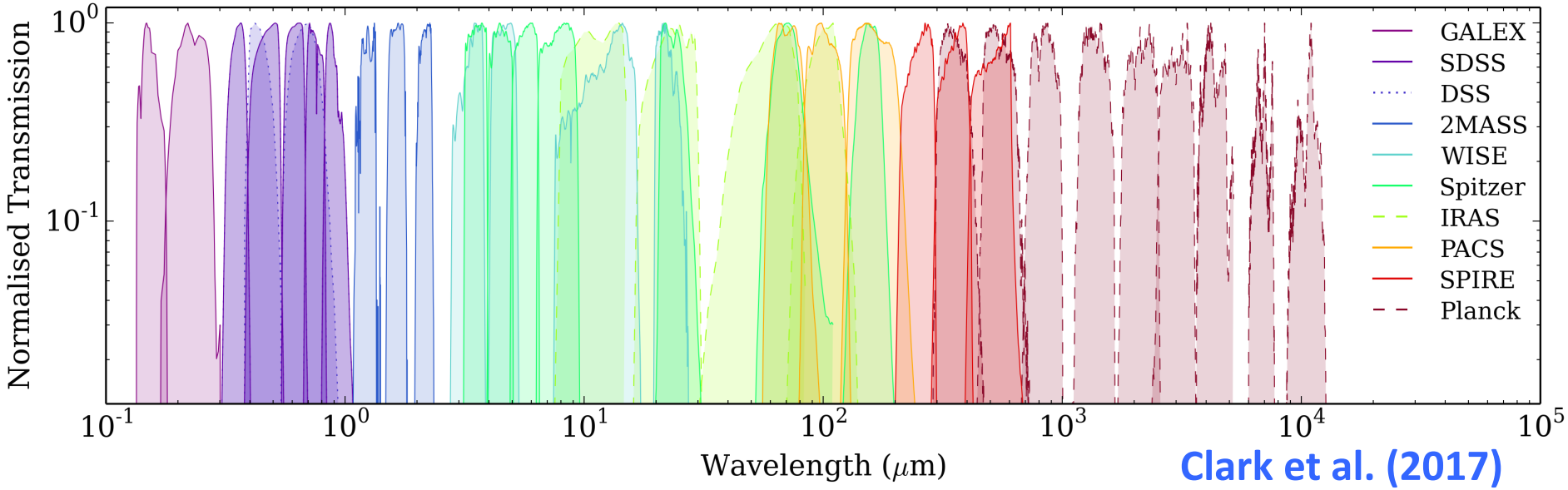
UK | Belgium | Italy | France | France | Greece

DustPedia

DustPedia is capitalizing on the legacy of *Herschel* (Davies et al. 2017).

A database of multi-λ imagery and photometry that greatly exceeds the scope (in terms of λ coverage and n. of galaxies) of any previous local-Universe survey.

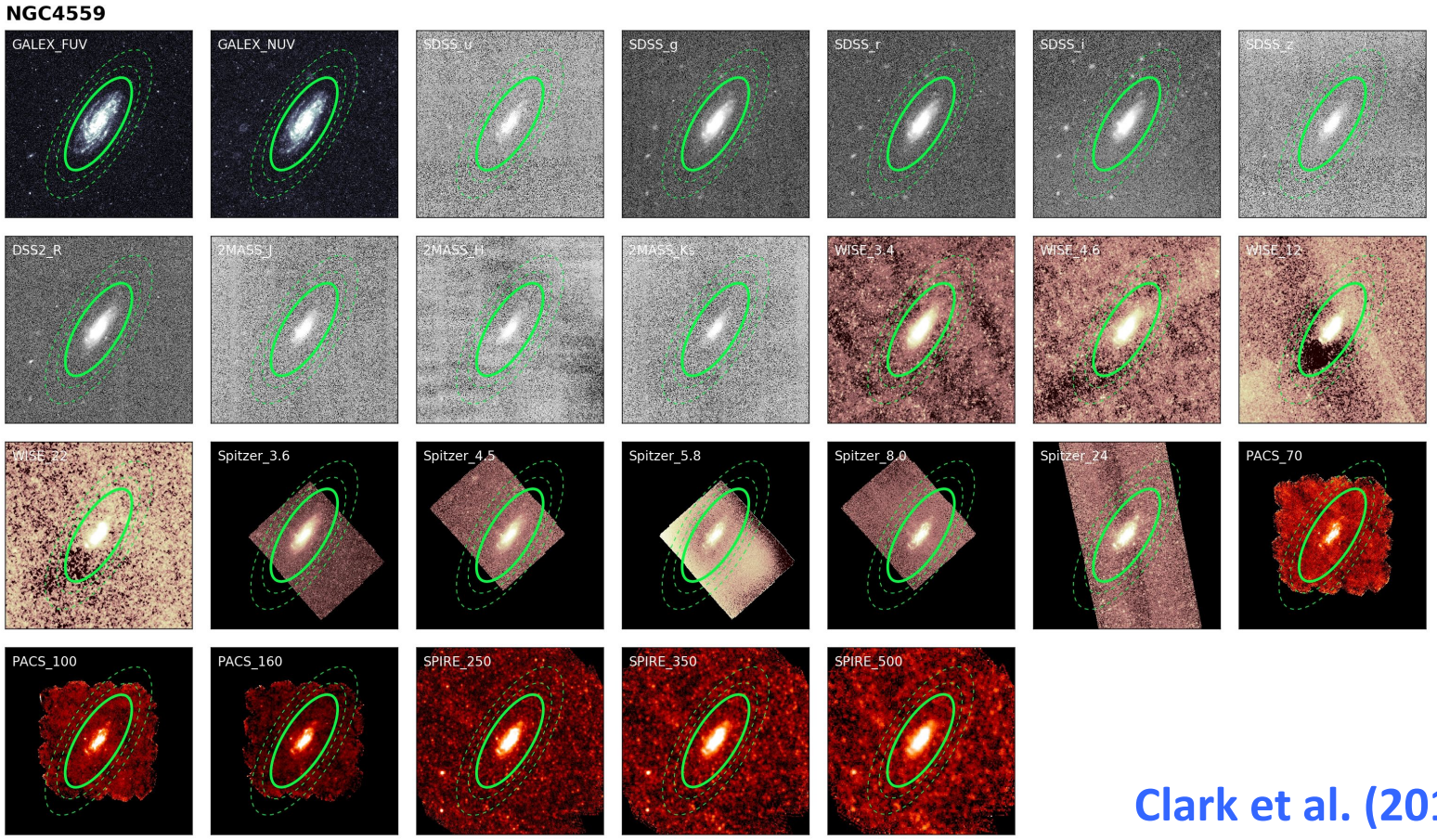
DustPedia database (http://dustpedia.astro.noa.gr/): dedicated *Herschel* reductions, along with standardized archival observations from GALEX, SDSS, DSS, 2MASS, WISE, Spitzer, and Planck.



Clark et al. (2017)

DustPedia

The aperture-matched photometry, combined with the external supplementary photometry, represents a total of 21,857 photometric measurements.



Clark et al. (2017)

Radial distribution of dust, gas, stars, and SFR in DustPedia face-on galaxies

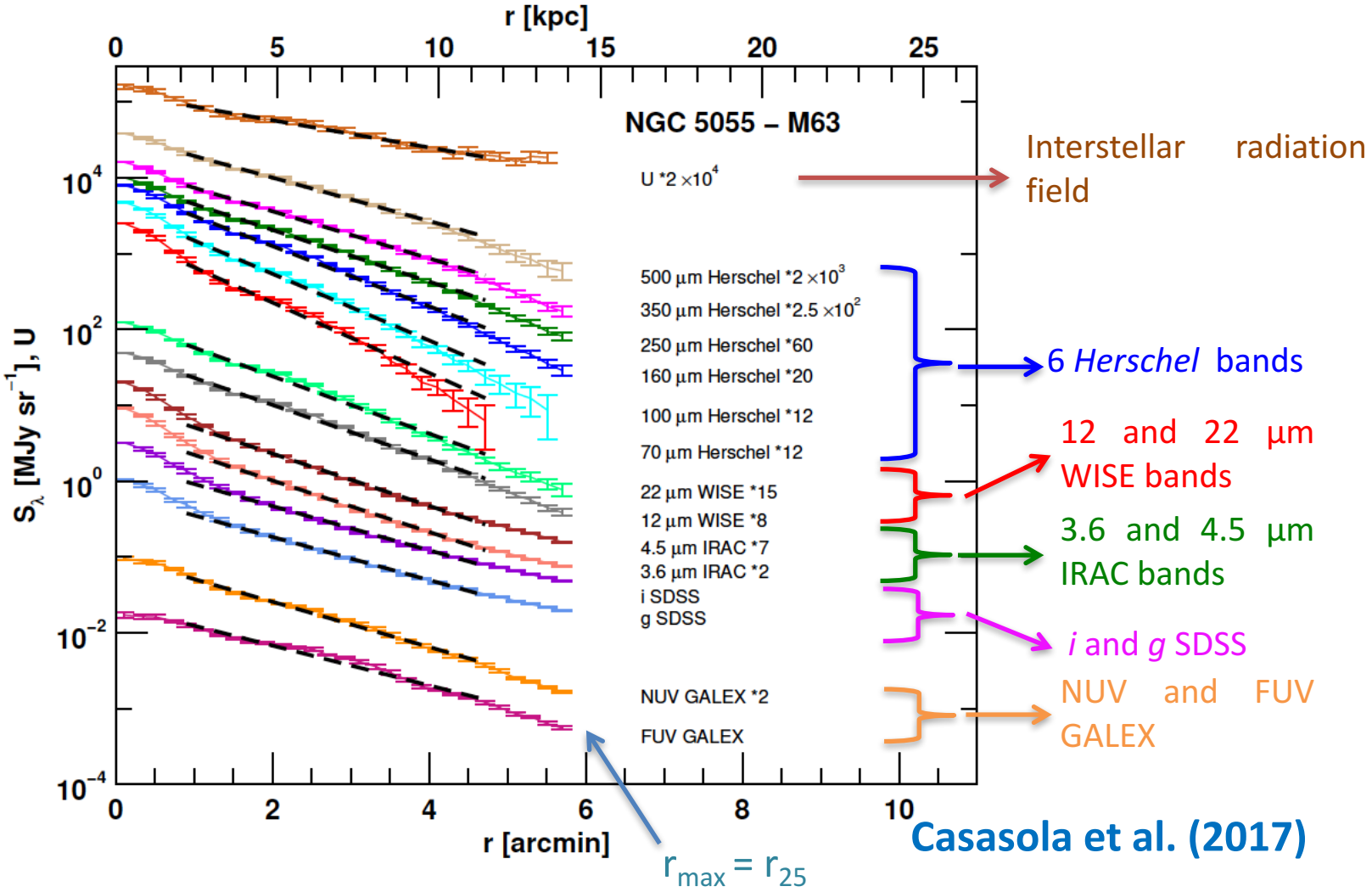
- ✓ Sub-sample of 18 face-on ($(d/D)_{submm}$>0.4), large (D_{submm}>9'), spiral galaxies from the DustPedia sample (Davies et al. 2017), imaged with both PACS and SPIRE in *Herschel* (Clark et al., 2017)

- ✓ Molecular (CO) and atomic (HI) gas maps, and metallicity info from the literature

Casasola et al. (2017)

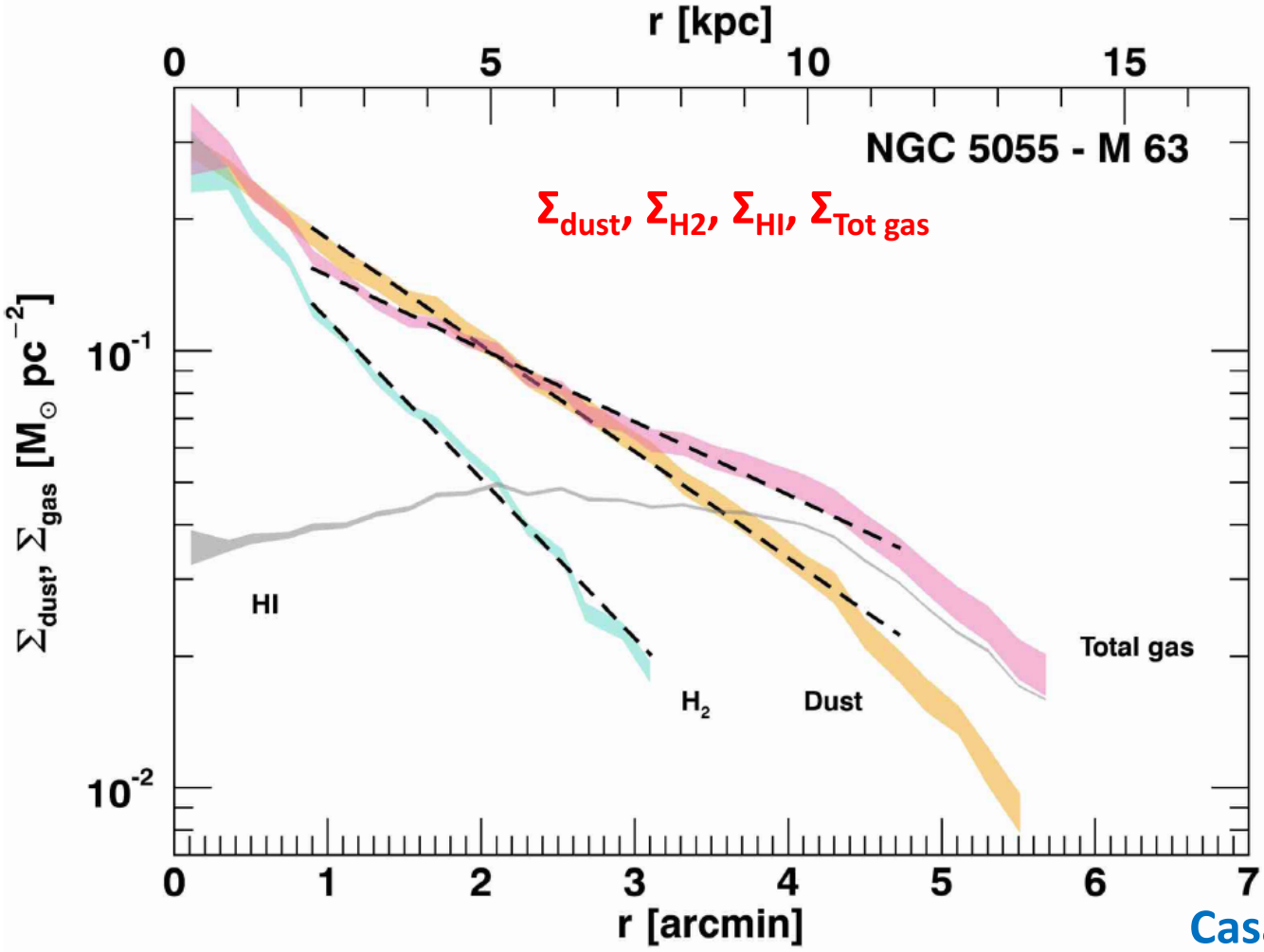
Radial distribution of dust, stars, gas and SFR in DustPedia face-on galaxies

Surface brightness and *U*: Typical plot



Radial distribution of dust, stars, gas and SFR in DustPedia face-on galaxies

Dust and Gas Masses: Typical plot



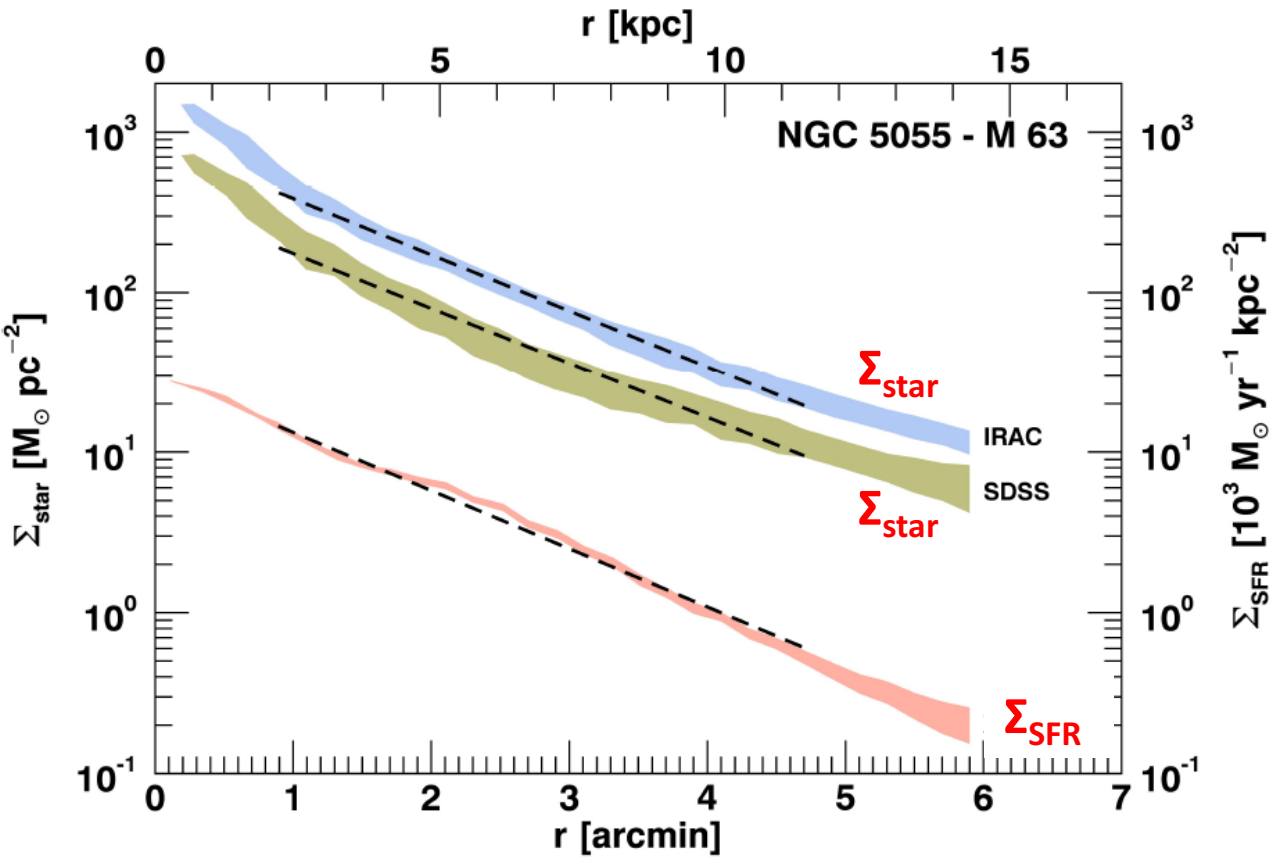
Dust mass:
Comparing a modelled SED with data at each position within a galaxy

THEMIS dust model (Jones+13, Jones+17)

Casasola et al. (2017)

Radial distribution of dust, stars, gas and SFR in DustPedia face-on galaxies

Stellar Mass and SFR: Typical plot



Stellar mass:

- IRAC 3.6 and 4.5 µm
- SDSS & SING optical

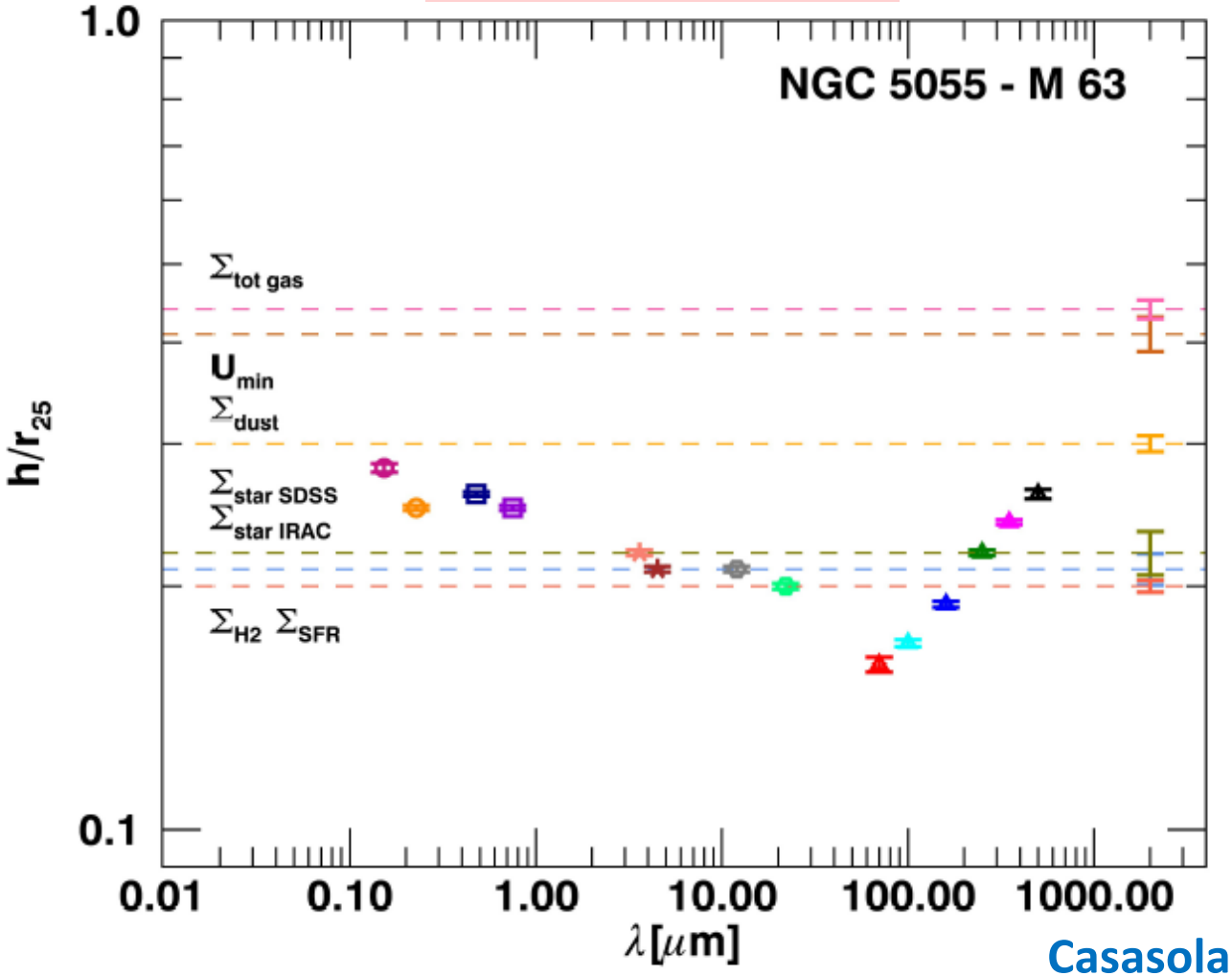
SFR:

GALEX-FUV + WISE-22 µm

Casasola et al. (2017)

Radial distribution of dust, stars, gas and SFR in DustPedia face-on galaxies

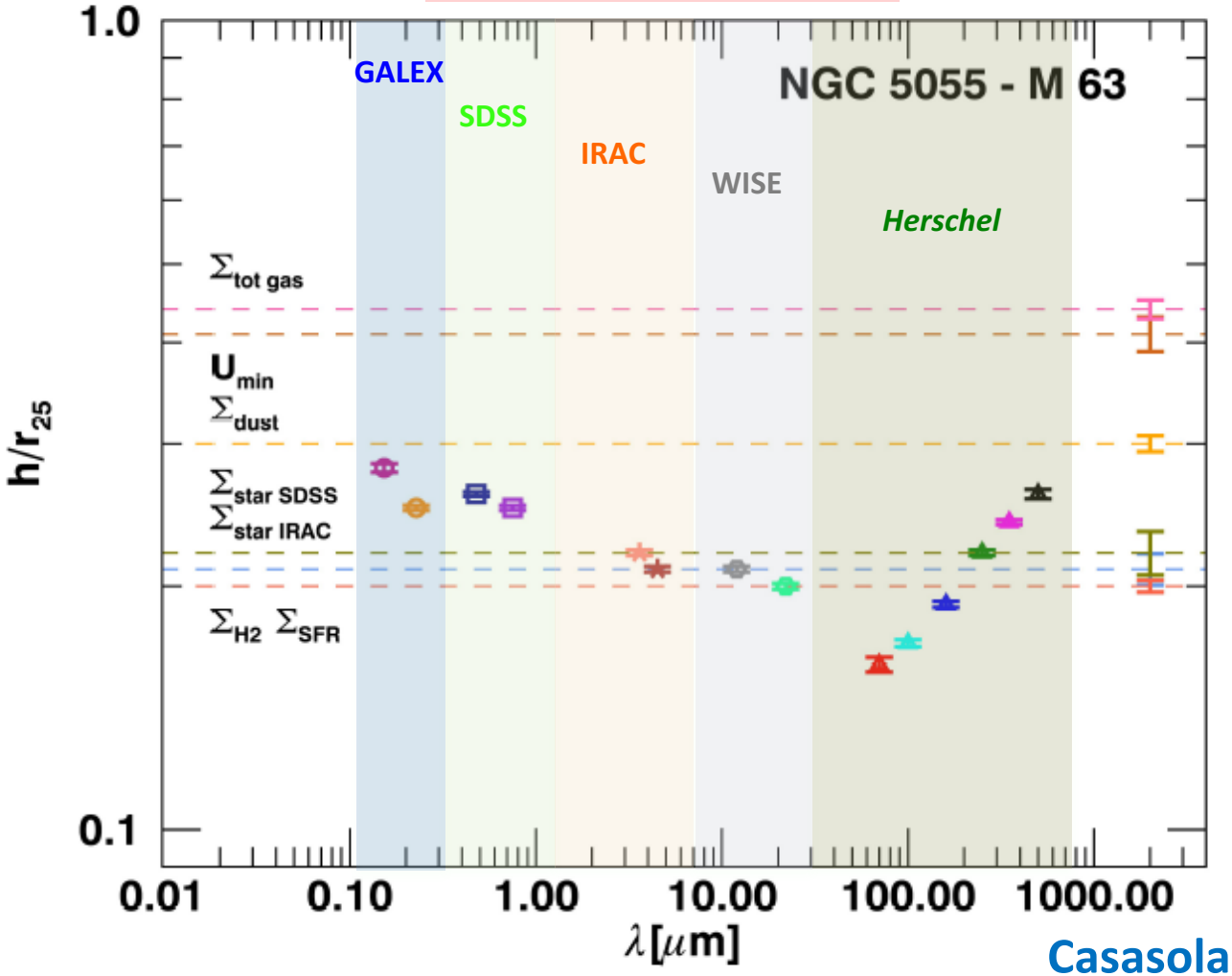
Scale-length vs. λ



Casasola et al. (2017)

Radial distribution of dust, stars, gas and SFR in DustPedia face-on galaxies

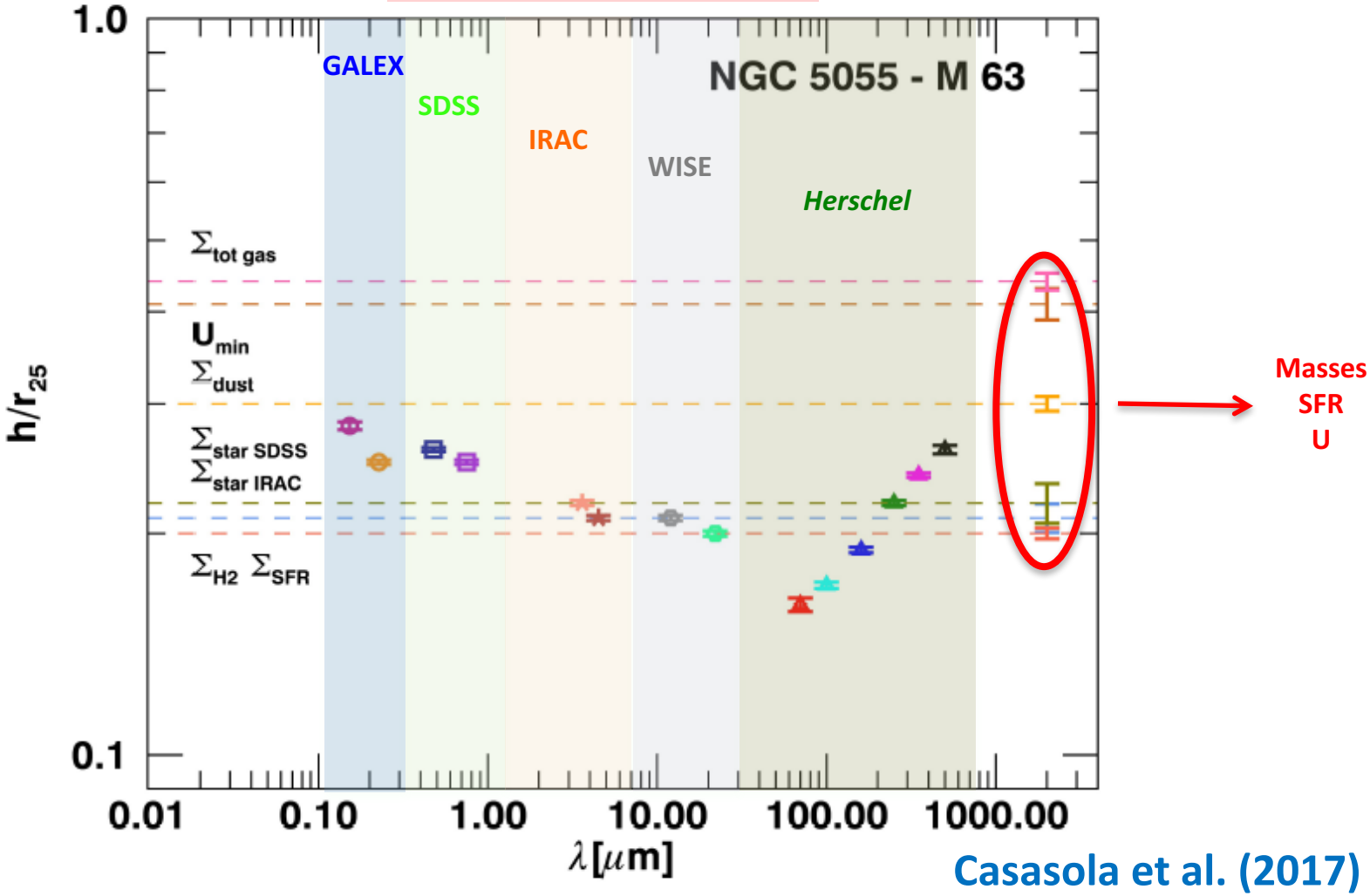
Scale-length vs. λ



Casasola et al. (2017)

Radial distribution of dust, stars, gas and SFR in DustPedia face-on galaxies

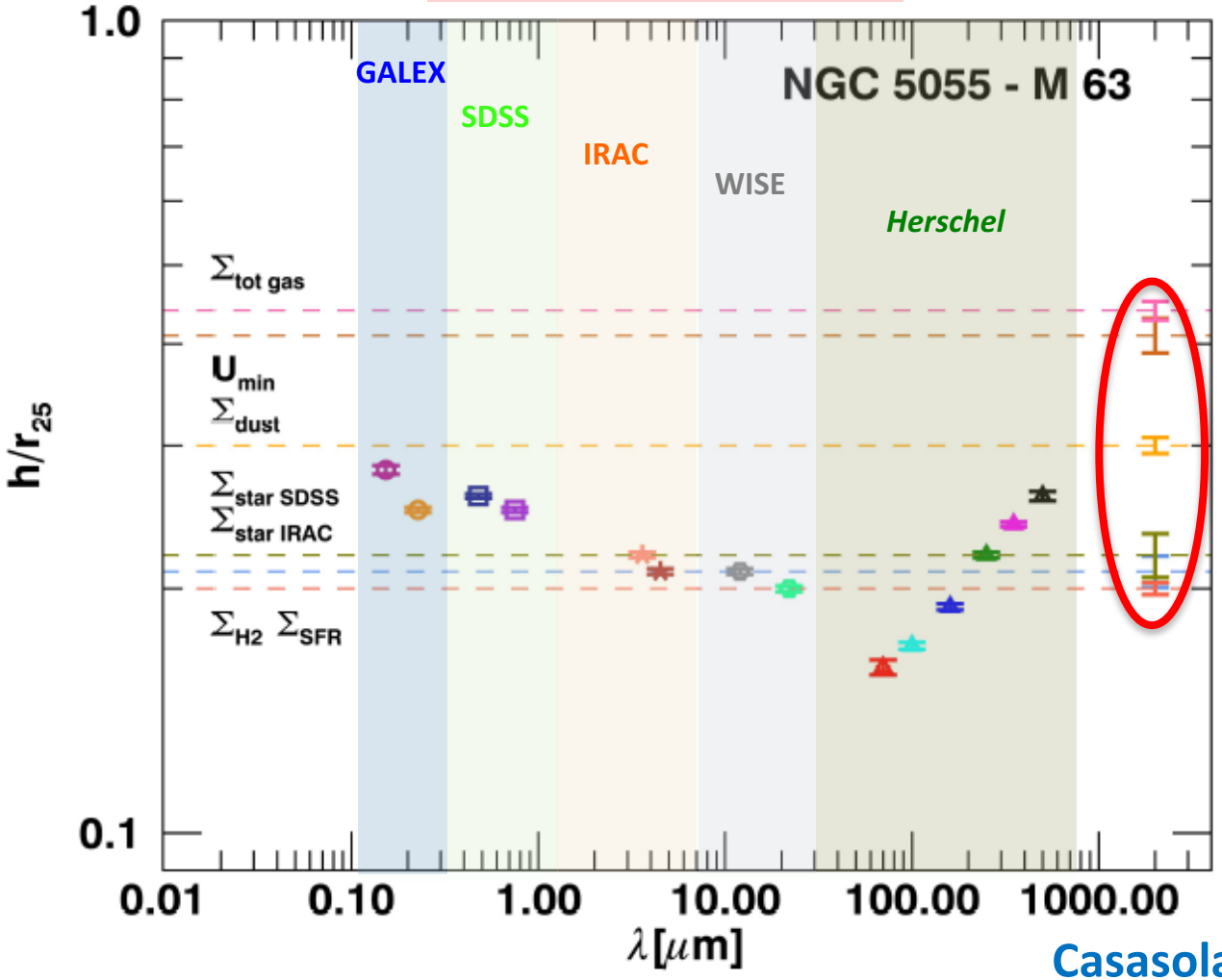
Scale-length vs. λ



Casasola et al. (2017)

Radial distribution of dust, stars, gas and SFR in DustPedia face-on galaxies

Scale-length vs. λ



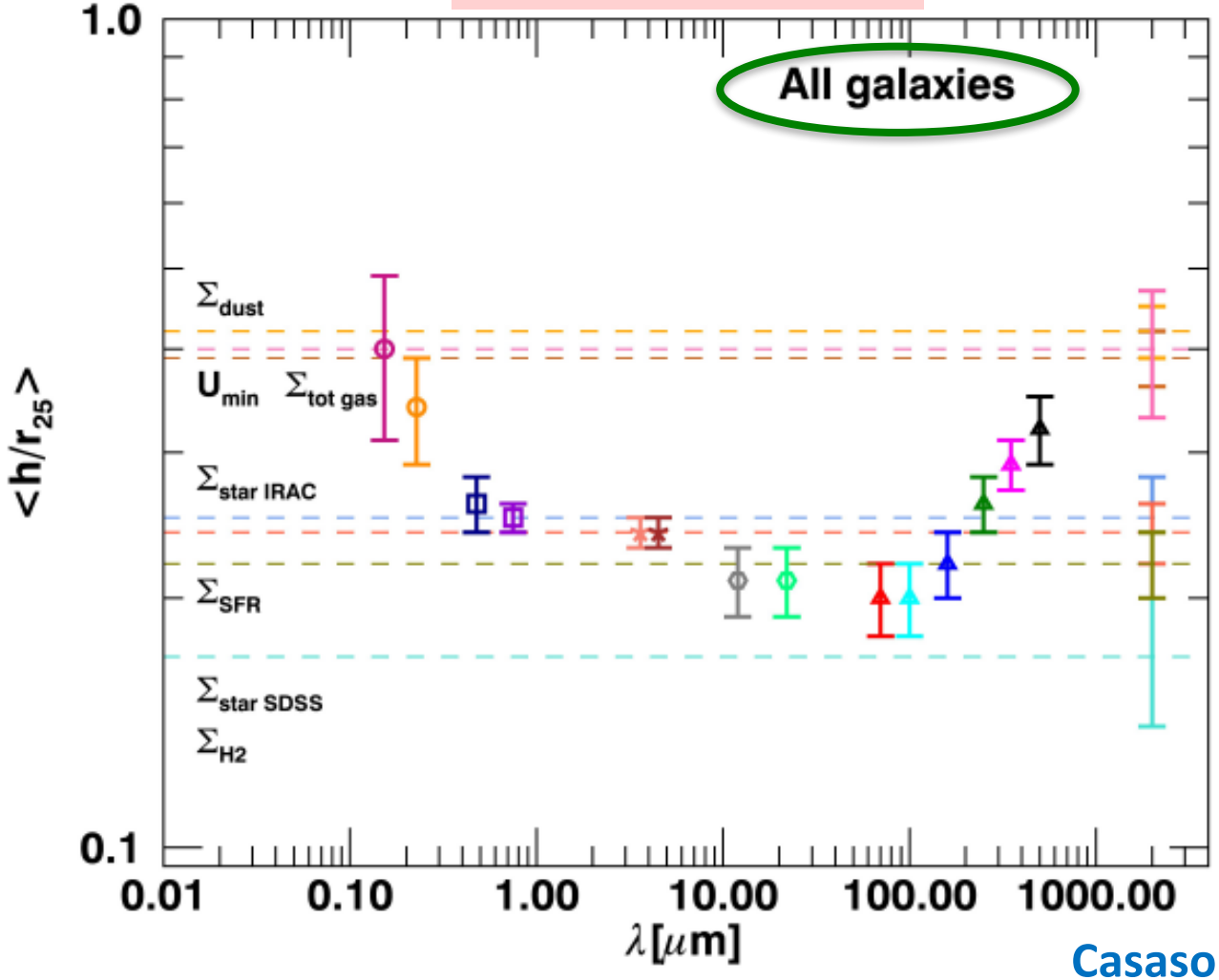
Each galaxy has its own peculiar behavior

Masses
SFR
U

Casasola et al. (2017)

Radial distribution of dust, stars, gas and SFR in DustPedia face-on galaxies

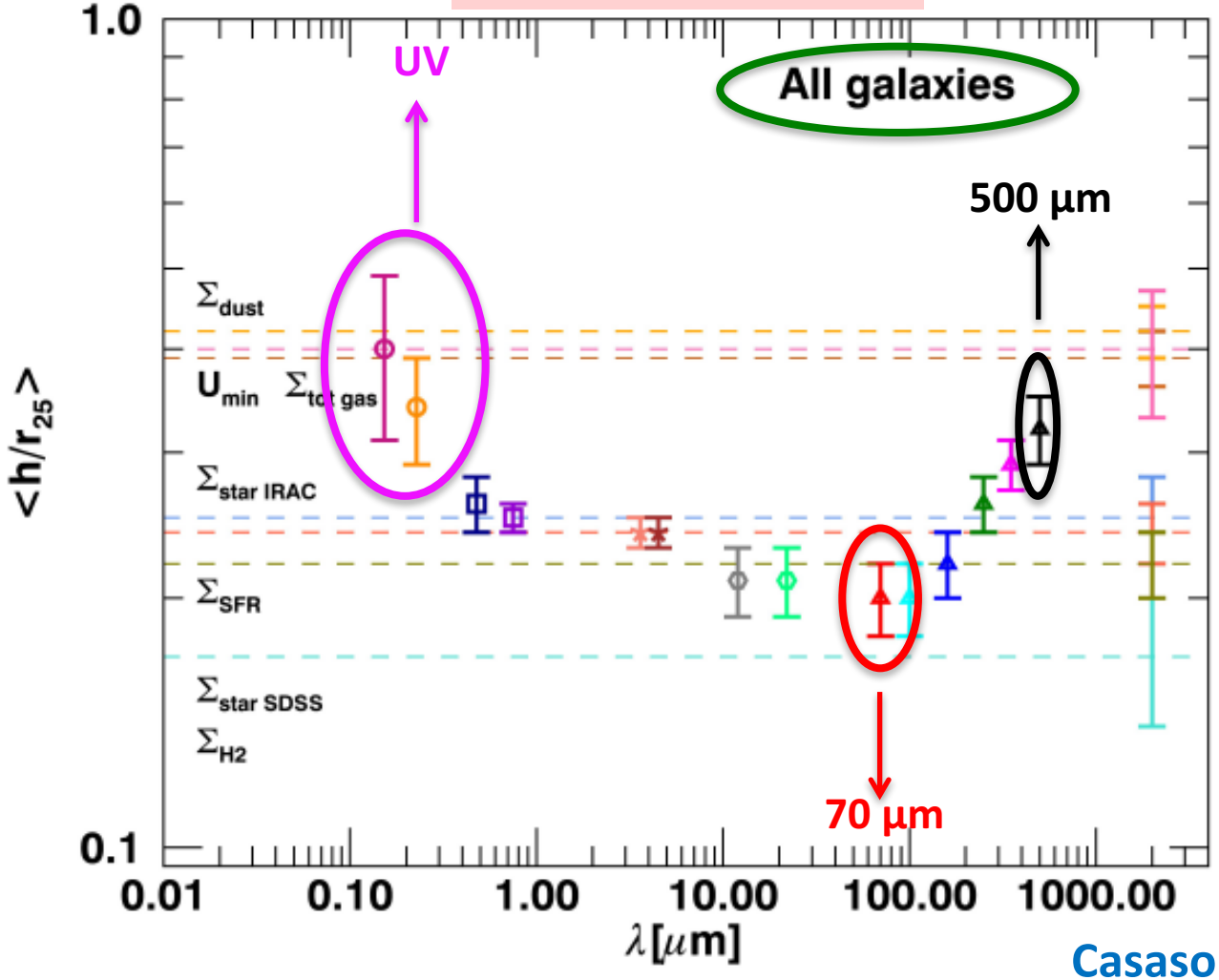
Scale-length vs. λ



Casasola et al. (2017)

Radial distribution of dust, stars, gas and SFR in DustPedia face-on galaxies

Scale-length vs. λ

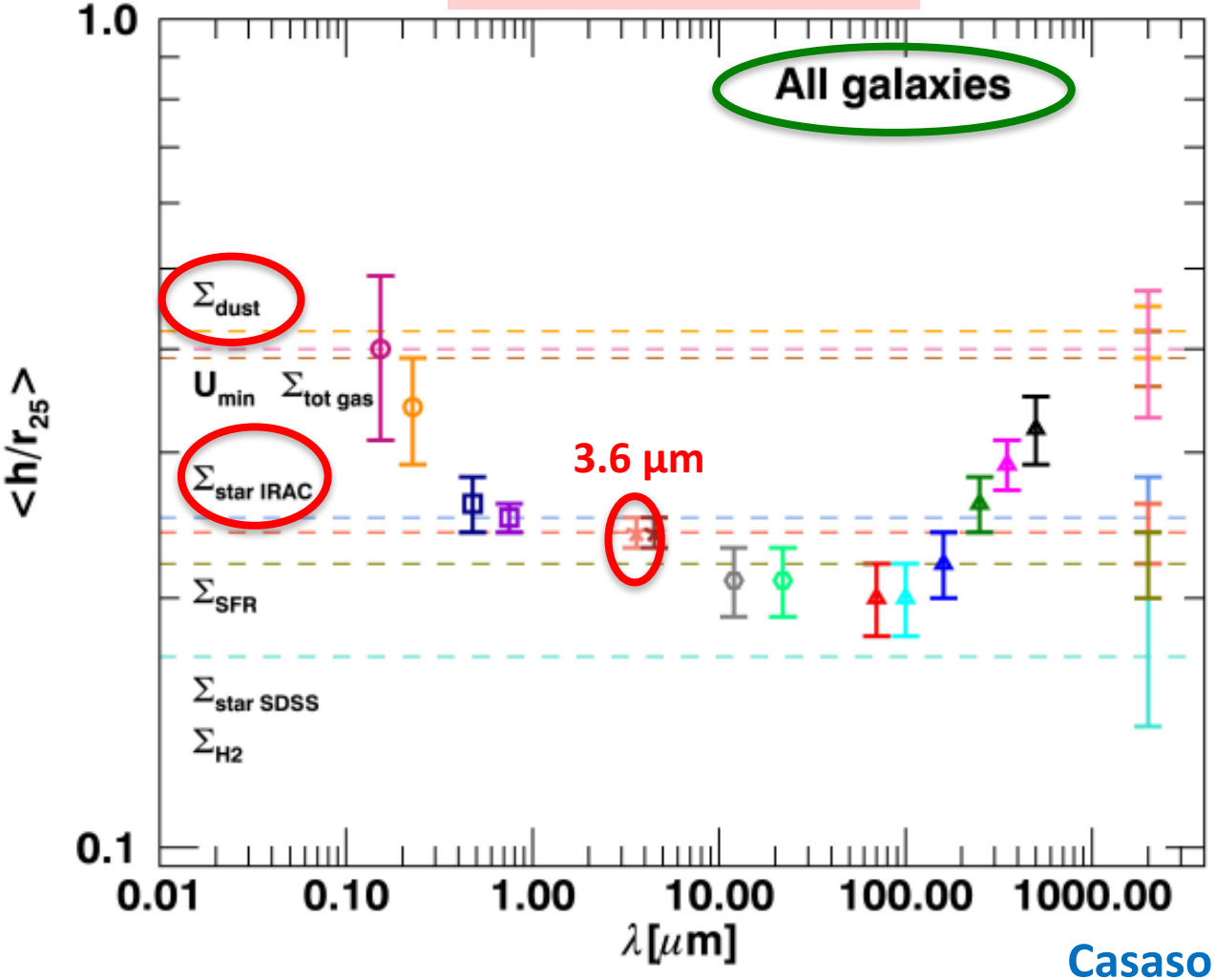


<h/r$_{25}$> decreases from UV to 70 µm, and increases at 500 µm.

Casasola et al. (2017)

Radial distribution of dust, stars, gas and SFR in DustPedia face-on galaxies

Scale-length vs. λ



<h/r25> decreases from UV to 70 μm, and increases at 500 μm.

MAIN RESULT: Scale-length of **DUST is 1.8 times the stellar** one.

Casasola et al. (2017)

Radial distribution of dust, stars, gas and SFR in DustPedia face-on galaxies

✓ **DUST scale-length is ~1.8 times the stellar one:**

- ✧ could be explained by a change in the typical lifetimes of grains against destruction by shocks, with a longer lifetime at larger radii (e.g., Sauvage+05)

- ✧ in agreement with radiative transfer analysis of dust extinction in edge-on galaxies (e.g., Xilouris+99, Bianchi+07, De Geyter+14)

Casasola et al. (2017)

Radial distribution of dust, stars, gas and SFR in DustPedia face-on galaxies

✓ **DUST scale-length is ~1.8 times the stellar one:**

- ✧ could be explained by a change in the typical lifetimes of grains against destruction by shocks, with a longer lifetime at larger radii (e.g., Sauvage+05)
- ✧ in agreement with radiative transfer analysis of dust extinction in edge-on galaxies (e.g., Xilouris+99, Bianchi+07, De Geyter+14)

First 'direct' confirmation of the large gradients in the dust disks

Casasola et al. (2017)

Radial distribution of dust, stars, gas and SFR in DustPedia face-on galaxies

- **Casasola et al. (2017)** is the **first** scientific **DustPedia** publication
- The 42 UV-submm bands for 875 **DustPedia** galaxies: scientific cases (individual and statistical studies)
- Science within **DustPedia** is 'exploding': low metallicity galaxies, elliptical galaxies, morphological classification, extended dust in edge-on systems, radiative transfer modelling, scaling laws, global dust absorption, and environmental effects
- Science outside **DustPedia**: see **DustPedia** database http://dustpedia.astro.noa.gr/
- The **DustPedia** database will also contain the results of the SED fitting and radiative transfer modelling performed on this data, for each galaxy

Casasola et al. (2017)

Documento di visione strategica INAF

8. Formation and Evolution of Galaxies and Cosmic Structures

[… the basic key question is: **which physical processes drive the transformation of galaxy properties?** Astronomers can hint at the answer(s) by observing the properties of nearby galaxies in great details, and at the same time looking at the distant Universe to examine the properties of galaxies at different epochs in the past …]

Documento di visione strategica INAF

8. Formation and Evolution of Galaxies and Cosmic Structures

Origin and fate of galaxies the galaxy stellar mass function and morphological differentiation. Feedback processes among the different components of galaxies (stars, gas, dust) and AGN. Role of DM halos. External and internal	Detailed observations of gas kinematics, outflows, inflows. Connection with CGM and IGM	SKA, ALMA VLT, ELT WEAVE
	Observations of molecular gas	ALMA JVLA IRAM PdBI & NOEMA
	HI content of galaxies	SKA
mechanisms (environment and relationship with the Cosmic Web) regulating the efficiency of star formation and the structural parameters of galaxies	ISM in the MIR and FIR	SPICA?
	Connection between the central region and the growth of galaxies at high redshift	JWST ELT
	Link the galaxy evolution markers (size, mass, shape of galaxies, presence of disk instabilities) with the driving mechanisms	Euclid LSST VST

Grazie!

Meeting INAF - Macroarea 1, Padova, 13 settembre 2017