Euclid Legacy Science

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on the basis of the work of legacy coordinators and EC members, and using information from Jarle Brinchmann

The importance of legacy science

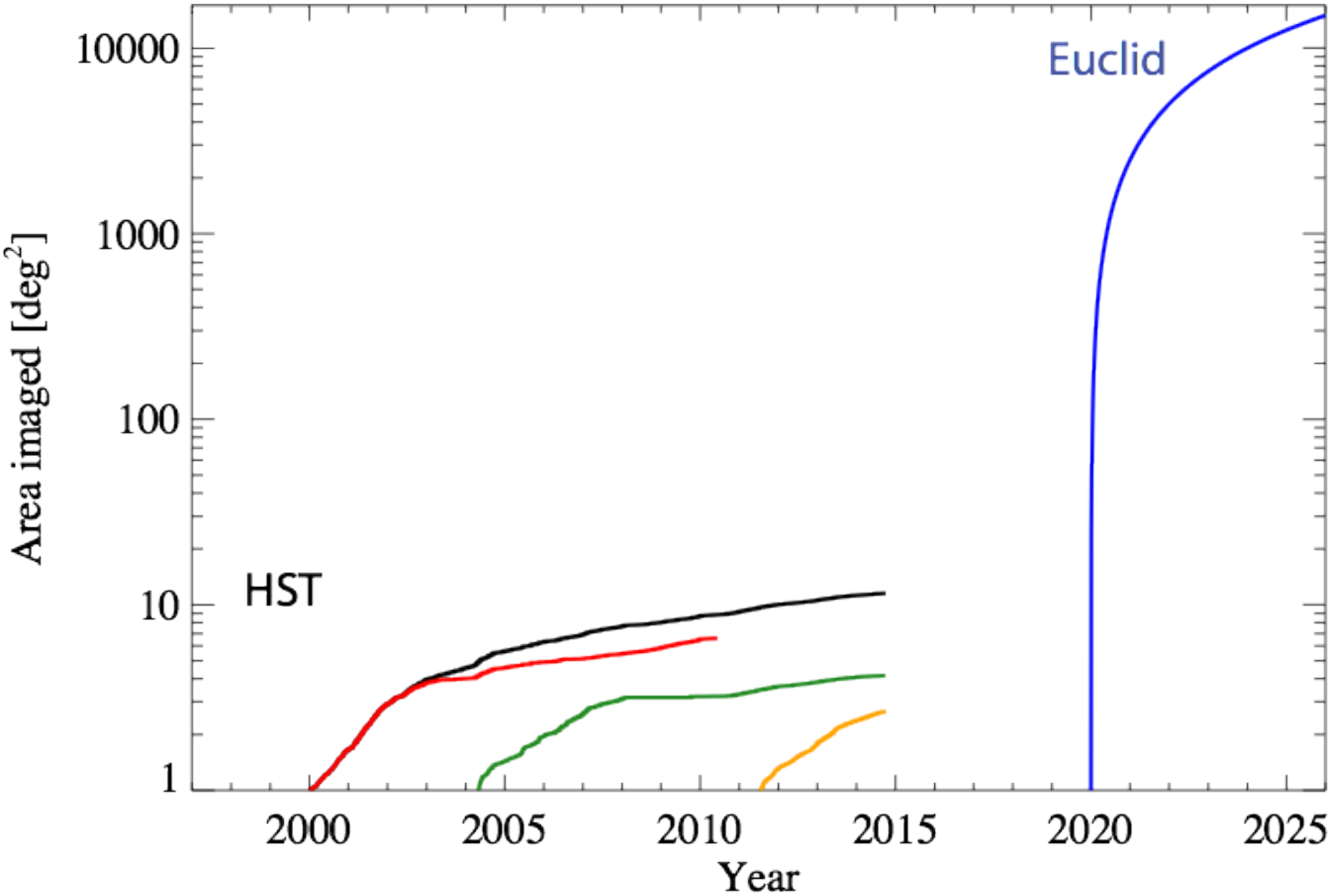
- Easy to use/access for the general astronomers leads to major and lasting impact (e.g. POSS, IRAS, SDSS, H(U)DF).

- Early in the mission legacy will be the **main** conduit of scientific results and will be responsible for the image of the mission.

- The number of legacy science papers is likely to significantly exceed that of cosmology papers.

- With a good data archive and a survey that as far as possible optimises for legacy science Euclid will likely be a cornerstone of extra-galactic astronomy for a decade or more

The leap in high resolution imaging



Euclid legacy in numbers

What	Euclid	Before Euclid
Galaxies at 1<z<3 with good mass estimates	~2×10^8	~5×10^6
Massive galaxies (1<z<3) w/ spectra	~few x 10^3	~few tens
Hα emitters/metal abundance in z~2-3	~$4\times10^7/10^4$	~10^4/~10^2?
Galaxies in massive clusters at z>1	~2×10^4	~10^3?
Type 2 AGN (0.7<z<2)	~10^4	<10^3
Dwarf galaxies	~10^5	
T_{eff} ~400K Y dwarfs	~few 10^2	<10
Strongly lensed galaxy-scale lenses	~300,000	~10-100
z > 8 QSOs	~30	None

Legacy Science Working Groups

Extra-solar planets
Lead: Beaulieau, Zapatero-Osorio, Kerins

Milky Way and Resolved Stellar Pops
Lead: Tolstoy, Ferguson

Local Universe
Lead: Poggianti, Warren

Galaxies and AGN
Lead: Elbaz, Cimatti, Brinchmann

Primeval Universe
Lead: Cuby, Finbo

Clusters of Galaxies
Lead: Weller, Moscardini, Bartlett

Supernovae and transients
Lead: Tao, Hook, Cappellaro

Strong lensing
Lead: Kneib, Meneghetti

CMB Cross-correlations
Lead: Agnanim, Baccicalupi

Cosmological Theory
Lead: Amendola, Kunz

Cosmological simulations
Lead: Fosalba Teyssier

General progress from last year

- Reorganization of the SWG work package structure. This has not been completed, and the idea is to have a more uniform work package structure.

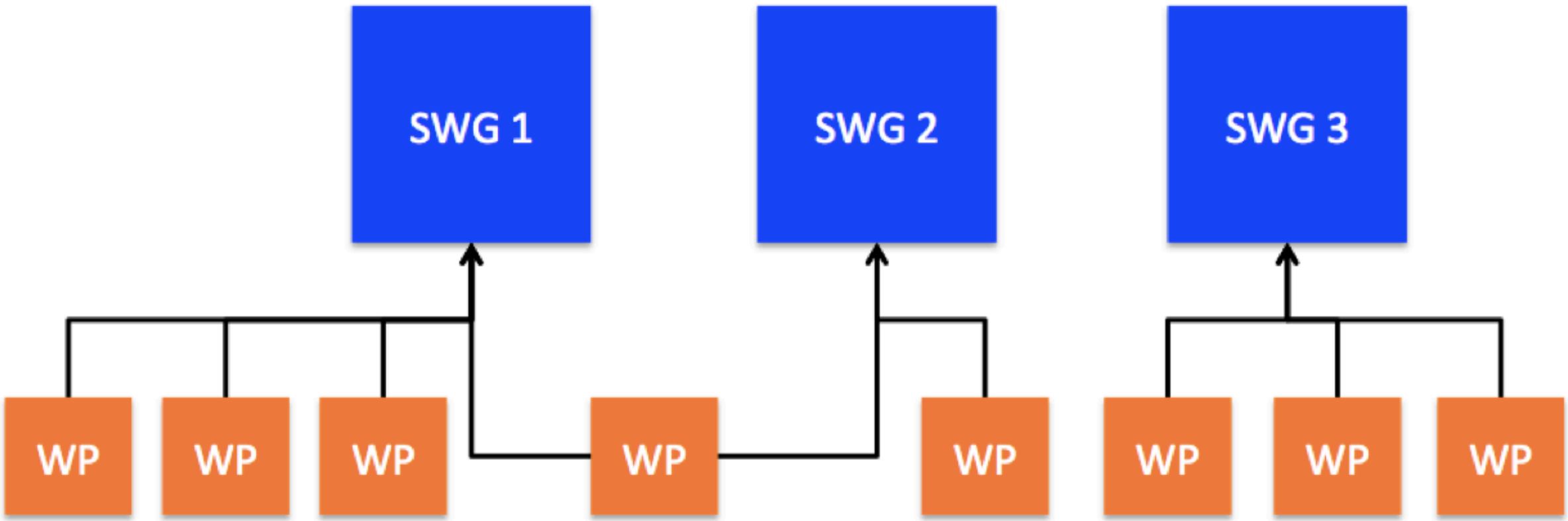
- The discussion of choice of grisms for the spectroscopic survey, described by a document lead by Andrea Cimatti

	Report on science cases and optimization of the new NISP grism	Ref. EUCL-UBO-RP-8-001 Version: 0.1 Date: 01/03/14 Page: 1/14

General progress from last year

- From ESAs side there has been an effort to start setting up a working group on solar system science. This is not currently integrated into the legacy SWGs but should be at some point. See Bruno Altieri's presentation from the last Garage Days: http://wiki.cosmos.esa.int/euclid/index.php20141016_Paris#Transient_phenomenas_with_Euclid

Reorganization of the working packages



The discussion of choice of grisms

Configuration	Grisms	Position angles (PA)	Integration time (s)	Survey
Red Book Baseline	2 blue (1.10-1.45 μm) 0.68<z(Hα)<1.21	0°, 90°	2 x 565	Wide and Deep
	2 red (1.45-2.0 μm) 1.21<z(Hα)<2.05	0°, 90°	2 x 565	Wide and Deep
3R + 1B	1 blue (TBD μm) TBD<z(Hα)<TBD	TBD	1 x 565	Deep only
	3 red (1.25-1.8 μm) 0.90<z(Hα)<1.74	PA1, PA1, PA2, PA3 (TBD) (1 PA repeated)	4 x 565 (1 PA repeated)	Wide & Deep

The discussion of choice of grisms

- Removal of the blue grism eliminates the possibility to detect ANG at z> 8 from Lyman alpha emission and to detect the Balmer and D4000 break at 1.75<z<2.12

- New limits on the red grism do not permit to measure 1.74< Hα emission <2.05, where ground-based observations are impossible due to the poor atmospheric transmission

The discussion of choice of grisms

GRISM	Desirable wavelength Range	Resolution	Main scientific cases (Deep Survey)	Notes
Blue	0.92 – 1.25 μm	TBD	Evolution of star-forming galaxies and AGNs, evolution of quiescent galaxies, rarest Lyα emitters and QSOs at z>6.6, cool stars, brown dwarfs, SNe. Cross-checks with LRG clustering.	Detailed E2E simulations required. Optimal definition of the spectral range and overlap with red grism TBD
Red	1.25 – 2.0 μm	As in SRD	Same as above for the Legacy Science. General competitiveness with ground-based spectroscopic surveys. Unique role at 1.5<z<2 w.r.t. DESI. Larger discovery space.	The impact of the extension of the blue-cutoff to 1.2 μm and/or of the red cut-off to 2 μm on core science should be investigated with E2E simulations

WG Scientific progresses

SWG Local Universe and Galaxies

- **Very large samples** → distribution functions
- **Very large volume** → Rare sources, probing the extremes
- **Exquisite imaging** → morphological studies, mergers, strong galaxy-scale lenses, ..
- **Weak lensing** → Galaxy evolution as a function of halo properties, galaxy alignment, ...

WG Morphology
Resp: Pierre-Alain Duc & Chris Conselice

- Automated classification only for Euclid

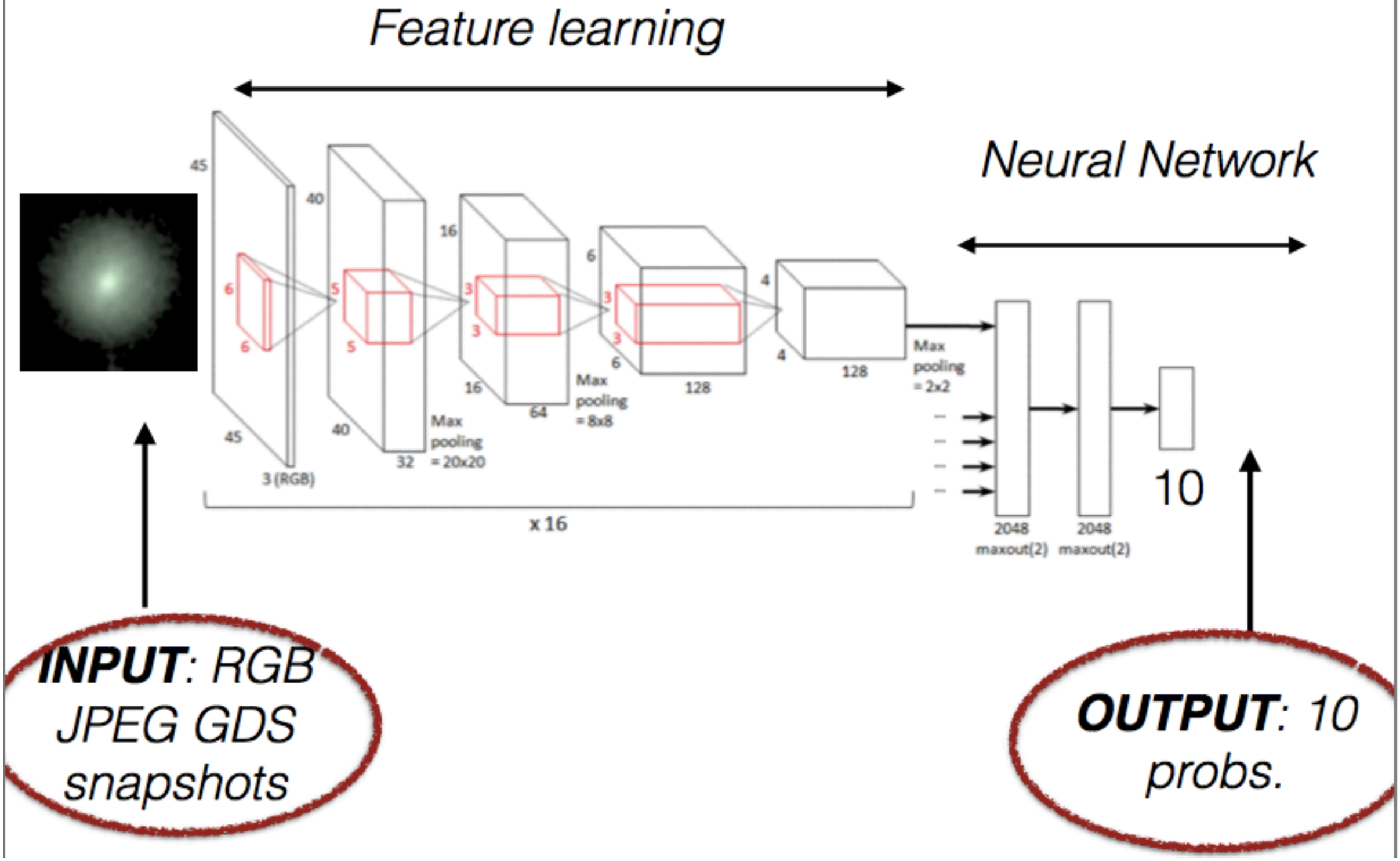
- Which automated? Classical methods (CAS etc) are able to reproduce visual at ~20%, search for automated classification which can do better

- “Visual” automated classification - method succefully tested on Galaxy Zoo and extended to the CANDELS survey by Marc Huertas-Company : it reproduces visual at~0.2%

- Impact on the Euclid pipeline - training required - working group just started to discuss this

CONVNET for CANDELS

- **TRAIN**: ~50.000 redundant galaxies in GDS (~10 days)
- **CLASSIFY**: GDN, COSMOS, UDS, GDS (~8h/field)



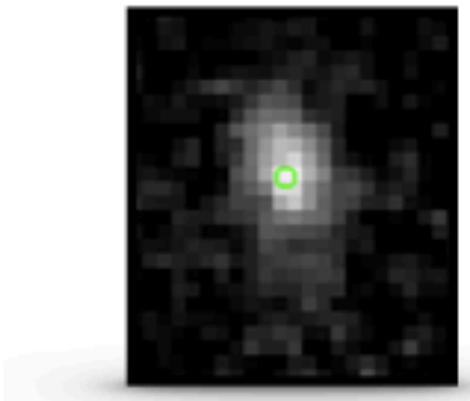
Courtesy Marc Huertas-Company

Catastrophic “errors”

fsph_v > 0.7 and fsph_a < 0.3 or fsph_v < 0.3 and fsph_a < 0.7

~15/8000=0.2%

with respect to the CANDELS Kartaltepe et al. 2014



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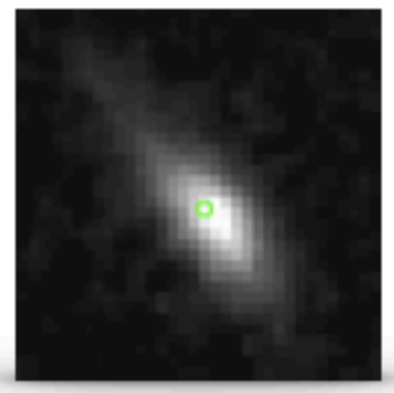
firr = 0.0 / 0.22



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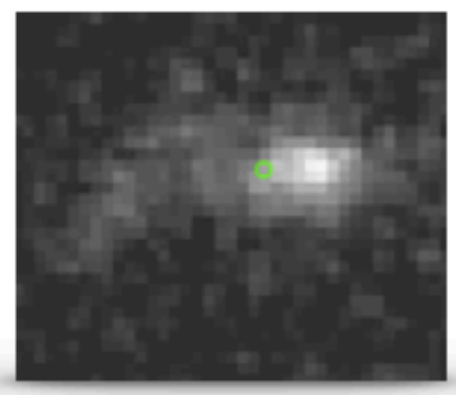

fsph=0.76 / 0.11
fdisk = 0.6 / 0.66
firr = 0.39 / 0.53

VISUAL / AUTO

Courtesy Marc Huertas-Company

Application to EUCLID

- Working with EUCLID VIS emulated images on GOODS-S, COSMOS and UDS
- Training set being currently built
- First estimates, required mag cut I < 22.5 given the EUCLID expected depth
  - —> *Morphologies for a significant fraction of objects up to z<1.5 (TBC)*
  - *Possible Prior/Input for WL and/or PHZ??*

Courtesy Marc Huertas-Company