ASTRODEEP

Unveiling the power of the deepest images of the Universe

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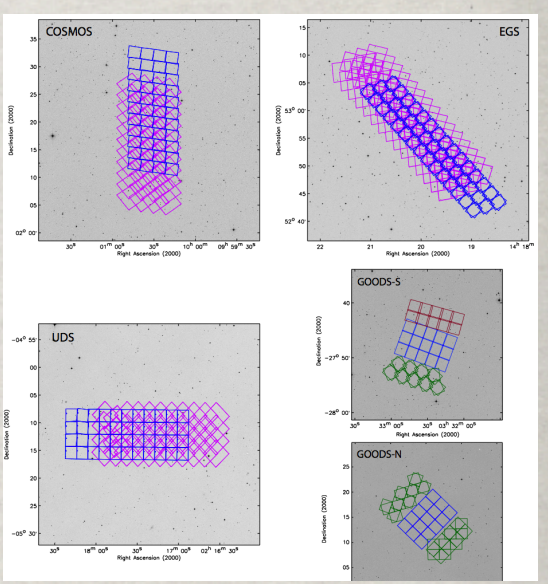
Scientific aim: study the birth and early phase of galaxy evolution. When did first stars and galaxies appear? How did galaxies build up and assembled? Which are the main physical processes involved?

Methodology: concentrate all the major telescope from space and ground on few selected regions of the sky and observe as long (=as far) as possible

The data that are the subject of ASTRODEEP covers only 1/1,000,000 of the sky but are the result of the largest programs ever executed on major telescopes from space and ground.

ASTRODEEP's aim: making Europe the world leader in the exploitation of the deepest multi-frequency data.

We will focus on the 5 key extra-galactic survey fields, the target of public observing programs.
They include data from space, notably from HST, XMM, Herschel and Spitzer, and from several optical and far-IR ground based facilities.



Most of the data have already been obtain in recent years
They are the result of a miscellanea of programs from several groups
All the data are public
The ASTRODEEP leaders (including US team) are involved in all these surveys -> we have direct access to data and analysis tools

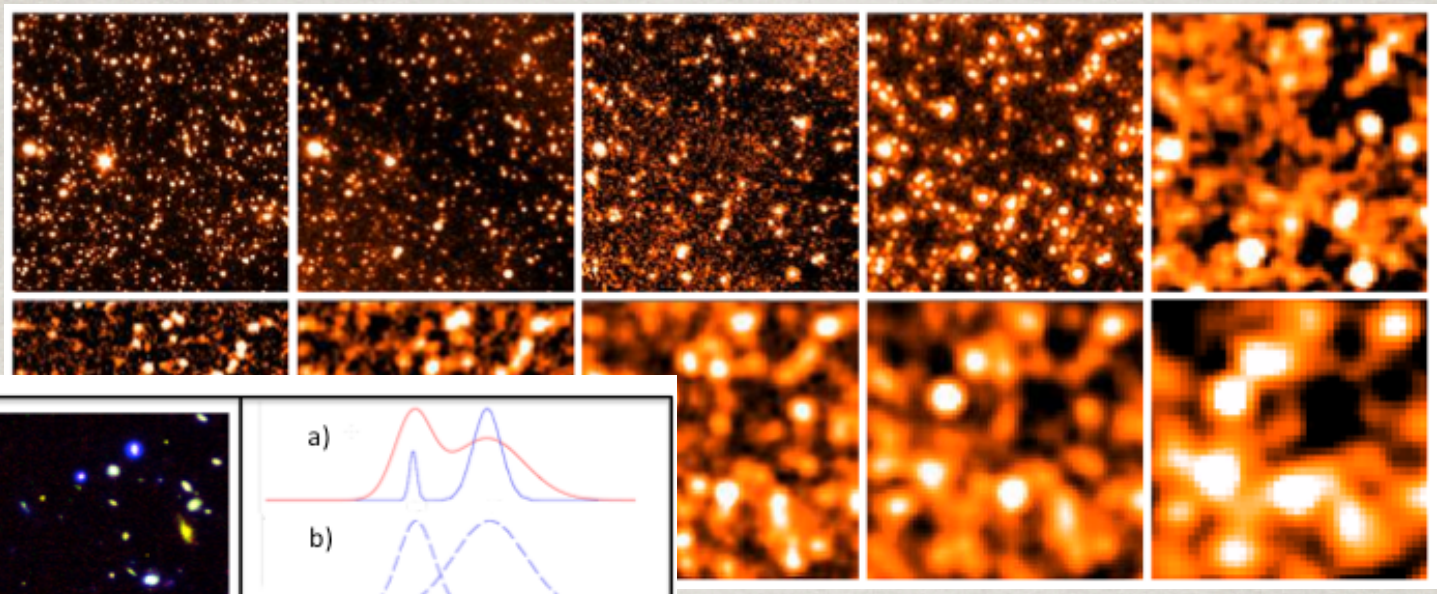
They have an emphasis on the development of new technologies and the delivery of "useful" service to the broad community.

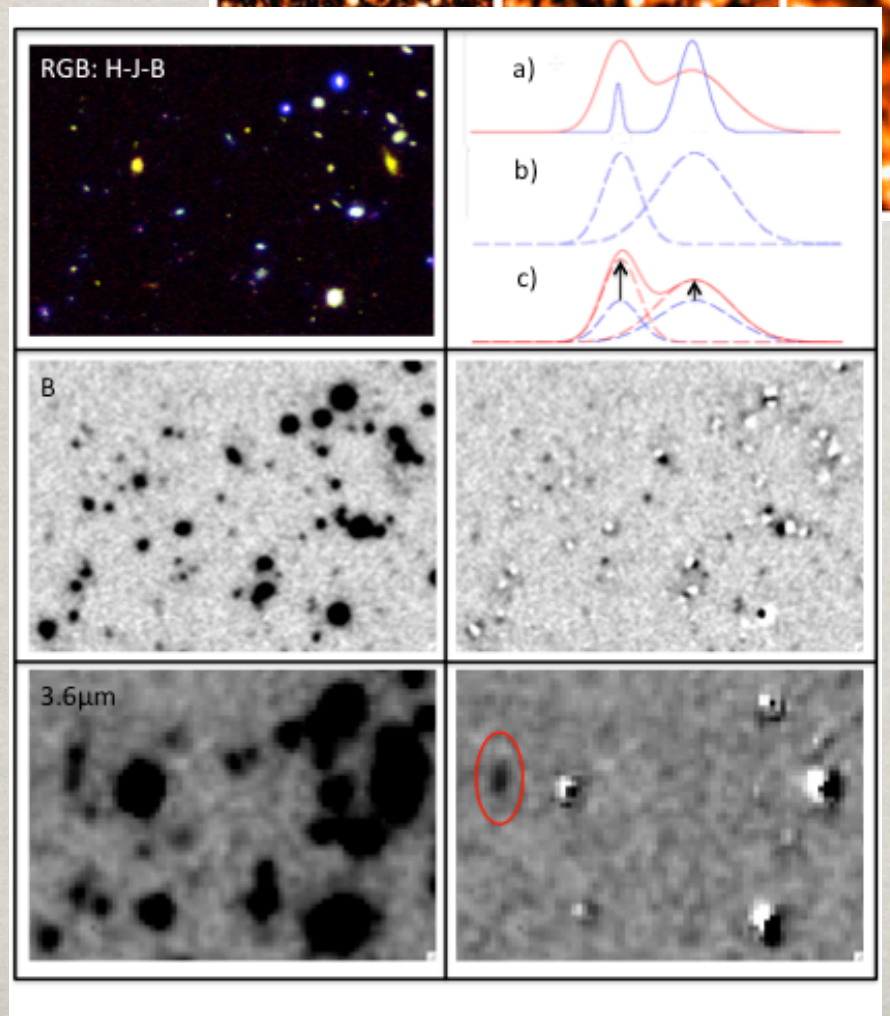
1) More emphasis on deliverables and dissemination of results;
2) A more formal structure of deliverables, milestone etc;
3) Need to carefully justify all expenses: must be directly linked to our specific goals

ASTRODEEP Main goals and plans

1. Develop and fully validate new tools for data analysis of ultradeep surveys;
2. Analyze all the data from public surveys in a coherent and well characterized way;
3. To deliver the final catalogs to the worldwide community;
4. To use these data to address some of the hottest question about early galaxy evolution;
5. To establish the know-how for the future space missions, most notably EUCLID.

1 Develop and fully validate new tools for data analysis of ultradeep surveys;





The key unresolved problem is how to cope with the different resolution and depth of the various datasets.
Several solutions have been proposed but never fully explored and characterized.

One of the ASTRODEEP goal is to fully characterize the different approaches and to develop state-of-the-art software that implements them.
Deliverables: - Scientific publications
- Software will be publicly distributed.

2 Analyze all data from public surveys in a coherent and well characterized way

		GOODS-N	EGS-CANDELS	UDS	UDS-CANDELS	COSMOS	COSMOS-CANDELS	GOODS-S	HUDFs
	Area / Wave.	150′²	150′²	1°²	150′²	1°²	150′²	150′²	15′²
HERSCHEL	500μm	9 mJy	12.8 mJy	13.4 mJy	13.4 mJy	9.5 mJy	9.5 mJy	9 mJy	9 mJy
	350μm	7.2 mJy	8.9 mJy	9.3 mJy	9.3 mJy	6.6 mJy	6.6 mJy	7.2 mJy	7.2 mJy
	250μm	5.7 mJy	10.7 mJy	11.2 mJy	11.2 mJy	8.0 mJy	8.0 mJy	5.7 mJy	5.7 mJy
	160μm	2.7 mJy				11 mJy	11 mJy	2.4 mJy	2.4 mJy
	100μm	1.1 mJy	3.7 mJy	4.0 mJy	4.0 mJy	5 mJy	5 mJy	0.8 mJy	0.8 mJy
	70 μm							1.0 mJy	1.0 mJy
Spitzer	70 μm	2.4 mJy	3.5 mJy	18 mJy	18 mJy	10 mJy	10 mJy	3.1 mJy	3.1 mJy
	24 μm	21 μJy	50 μJy	230 μJy	230 μJy	60 μJy	60 μJy	20 μJy	20 μJy
	16 μm	32 μJy						52 μJy	52 μJy
	8 μm	1.7 μJy	4.8 μJy	10.2 μJy	10.2 μJy	17.3 μJy	17.3 μJy	1.7 μJy	1.7 μJy
	5.8 μm	1.4 μJy	3.9 μJy	8.3 μJy	8.3 μJy	13.4 μJy	13.4 μJy	1.4 μJy	1.4 μJy
	4.5 μm	0.2 μJy	0.6 μJy	1.2 μJy	1.2 μJy	2.0 μJy	2.0 μJy	0.2 μJy	0.2 μJy
	3.6 μm	0.1 μJy	0.3 μJy	0.6 μJy	0.6 μJy	1.1 μJy	1.1 μJy	0.1 μJy	0.1 μJy
VLT/VISTA/ UKIDSS	2μm(K)	25.6	23.8	25.0	26.0	25.0	26.0	26.8	27.2
HST-WFC3	1.6 μm(H)	27.8	26.7	---	26.7	---	26.7	27.8	29.9
	1.2 μm(J)	27.8	26.7	---	26.7	---	26.7	27.8	29.9
	1 μm(Y)	28.0	---	---	---	---	---	28.0	30.0
VLT/VISTA	1μm(Y)	---	---	24.6	26.5	26.7	26.7	26.7	26.7
HST-ACS	0.85μm(Z)	27.6	---	---	---	---	---	27.6	29.4
	0.75 μm(I)	28.7	27.8	---	27.8	27.2	27.8	28.7	29.9
	0.6 μm(V)	28.2	27.9	---	27.9	27.2	27.9	28.2	30.1
	0.45μm(B)	28.2	---	---	---	---	---	28.2	29.7
CFHT/VLT LBT	0.36μm(U)	28.2	27.0	27.5	27.5	27.7	27.7	28.0	28.0
GALEX	0.14-0.28	26.0	25.0	25.0	25.0	25.0	25.0	26.0	26.0
XMM	2-10 keV	1.5×10^{-15}	---	3×10^{-15}	3×10^{-15}	3×10^{-15}	3×10^{-15}	4×10^{-16}	4×10^{-16}
XMM	5-10 keV	4×10^{-15}	---	1×10^{-14}	1×10^{-14}	1×10^{-14}	1×10^{-14}	7×10^{-16}	7×10^{-16}
Chandra	0.5-2 keV	2×10^{-17}	5×10^{-17} erg cm^{2} s^{-1}	---	---	2×10^{-16}	2×10^{-16}	1×10^{-17}	1×10^{-17}

Final database: more than 200,000 galaxies, each with full multiwavelength information.
In addition we will provide 2nd level analysis (distance, mass, star-formation rate etc)

3 To deliver the final catalogs to the worldwide community;

Dissemination of the results is a key feature of ASTRODEEP:

- Guaranteed through the participation of CDS, the main european centre for astronomical data archive and dissemination;
- ASTRODEEP dedicated website, including server for data, images and catalogs, papers;
- All catalogs will be made available in VO format;
- major international conference (open to all astronomers)
- Outreach program for the general public.

4 To use these data to address some of the hottest question about early galaxy evolution;

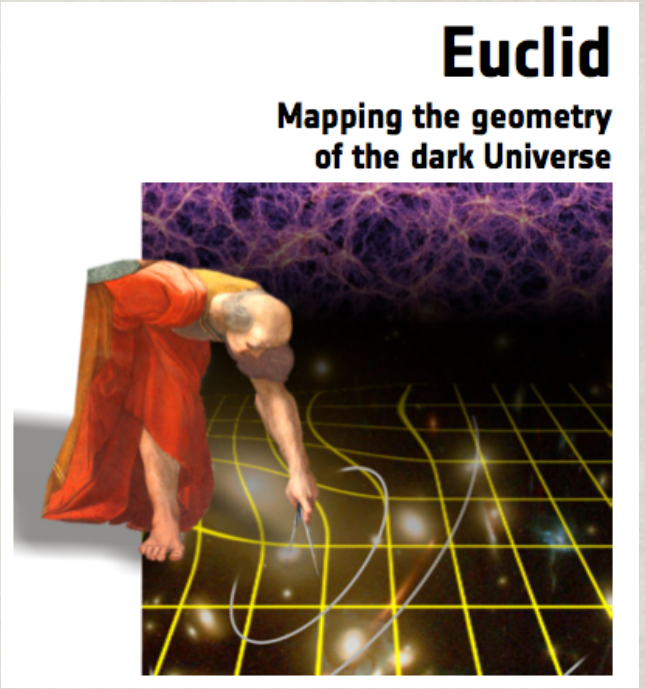
- The first galaxies and cosmic re-ionization
  When did the first galaxies appear?
  What and when reionized the Universe?

- A complete history of cosmic star formation
  Which physical processes trigger the formation of stars?
  Which is the connection between star-formation and Quasars?

- Red & Dead and massive galaxies at high z
  What terminates the process of star-formation rate?
  When did the giant galaxies formed?

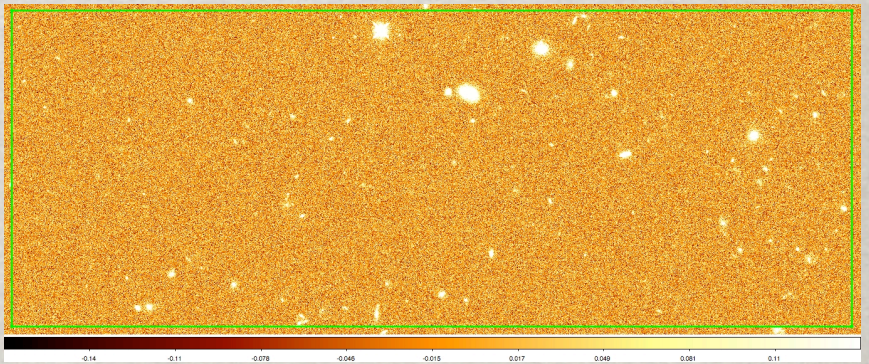
5 To establish the know-how for the future space missions, most notably EUCLID.

Euclid is the next ESA space mission. It will survey half of the sky to investigate the nature of dark matter and dark energy.

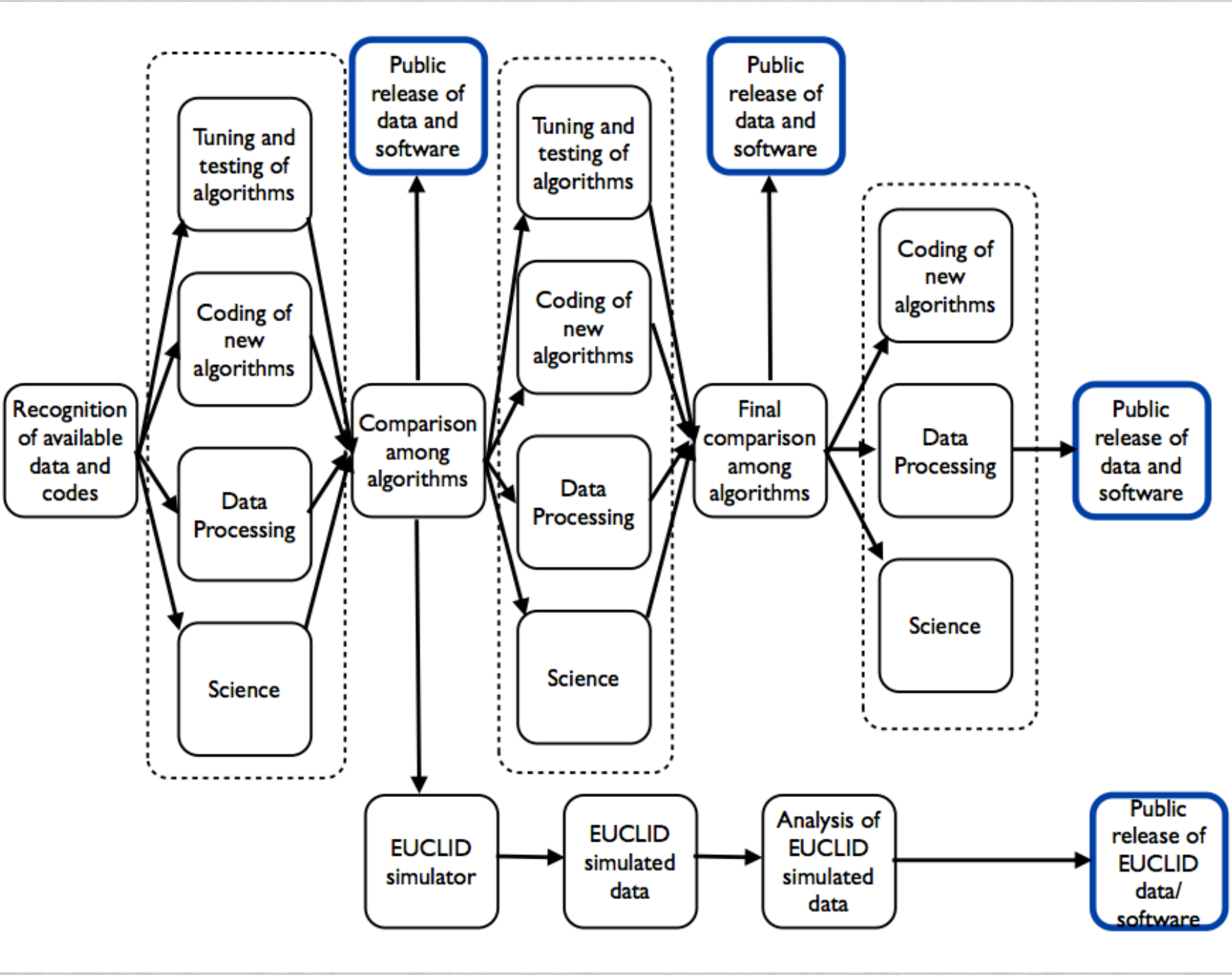


Its deep observations are a 10000x scaled version of the ASTRODEEP data.

Our goal is to use the ASTRODEEP data to simulate the Euclid deep surveys and to test our analysis software on the huge dataset expected from Euclid



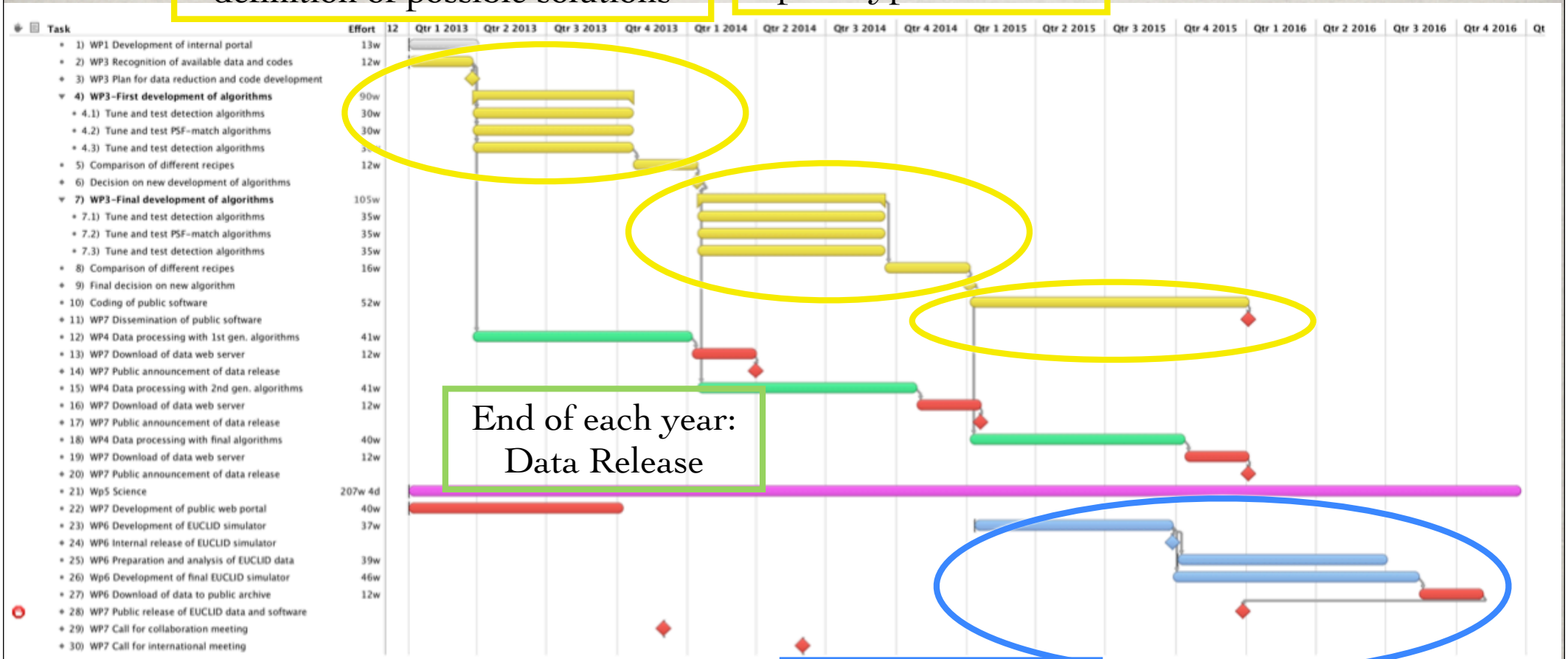
WP1000 Management	WP1 Management
	WP2 ScientificManagement
WP2000 Algorithms	WP3 Development and testing of algorithms
WP3000 Data Processing	WP4 Data Processing and catalog production
WP4000 Science	WP5 The physics of early galaxy evolution
WP5000 Euclid deep	WP6 Simulations of the Euclid deep survey
WP6000 Dissemination	WP7 Dissemination & outreach


Recognition of available data and codes
Tuning and testing of algorithms
Coding of new algorithms
Data Processing
Science
Public release of data and software
Comparison among algorithms
Tuning and testing of algorithms
Coding of new algorithms
Data Processing
Science
Public release of data and software
Final comparison among algorithms
Coding of new algorithms
Data Processing
Science
Public release of data and software
EUCLID simulator
EUCLID simulated data
Analysis of EUCLID simulated data
Public release of EUCLID data/ software

1st year: Test, comparison, individuation of problems, definition of possible solutions

2nd year: Explore possible solutions with prototype software

3rd year: Final coding of public software



End of each year: Data Release

Last 2 years: Euclid

additional noise??) - > LIst of positions, fluxes -> Images with realistic PSF and noise
Rome+Edin.: Optical-to-IRAC, eventually including position noise and varying backgr.
CEA: Predicted flux at 24mic-1mm-21cm
CEA: HSO images (included noise effects, such as low frequency)
Edin: ALMA + Scuba2 images

Different implementation of TFIT-like codes
Rome+Edin: exchanging images and cross-check results - no exchange of code for now.

Long-wavelength photometry
CEA+ Edin: derive long-wave photom. on 24mic + HSO images

Archival tools / browsing tools
Rome+CDS: test page with goods-s data set.

Web Site
Rome+CDS: design and installation in CDS. Explore joomla as a web content editor

Multifrequency detection: David contacts Men'shchikov and explore interest in collaboration.
Other detection algorithms

Background estimates: Each one describes the procedure adopted. implement in simulated images and possible use simulation to test the validity of the procedure.

Super-resolution
Rome+Edin. further test using also CLEAN and other methods.