The Euclid Consortium Newsletter - Winter 2015

News from the Bridge

I often reported in the previous newsletters and Euclid Consortium Annual meetings on the progress of the Euclid project, or on the contributions of countries, agencies, laboratories and industries. But a project like Euclid is also the leading figures who leave their mark on it in contributing during some of its most important phases. In such a long project, most of these figures only spend a few years working on it and then take a different road.

It is important that we do not forget these major players of Euclid and pay tribute to the impact they have had on it. At a time when we are looking back on the progress made in Euclid over 2015 by the Euclid Consortium, I would like to take this opportunity to remind you of Sami Niemi and Jamie Denniston and their outstanding contributions to VIS at MSSL, Fabio Pasian from OATS in Trieste who led the Euclid Consortium Ground Segment for years and in particular during the hard selection and construction periods, Georges Meylan at EPFL who organised and led so well the Swiss contribution to the Euclid Consortium, Steve Warren and his non conventional views on the Legacy Science within Euclid, who had the hard task to preserve it and make it more present in the Science Coordination Group and the Science Working Groups. On behalf of the Euclid Consortium I would like to thank them warmly and take the opportunity of the publication of this new Euclid Consortium newletter to leave in it their last imprint to Euclid through our mark or recognition.

Finally I would like to express my appreciation of Jarle Brinchmann and Stefania Pandolfi for their remarkable editing work, enthusiasm, tenacity and patience who eventually made this newsletter happen and back again despite so much difficulties. I wish long life to it!

Yannick Mellier

From the editors

Dear reader, welcome back! The Euclid Consortium newsletter is back again after a long hiatus. It is good to be back again and to contribute to the communication within the consortium. While the newsletter probably looks similar to previous versions, some changes have been made under the hood to transition the newsletter into a web-based version. This should hopefully commence from the next version.

In this newsletter you will find a few updates on the project - it is great to see that the actual pieces of the satellite and instrument exists, it makes the mission feel more real! There is also a piece on the tools designed for the software development within Euclid - another crucial part of the whole mission. Oh, and you will find a crossword in there too!

As we always say, this newsletter only exists because you help make it — if you have some ideas for contributions or feedback on the newsletter do not hesitate to let us know. Finally, the newsletter would really benefit from some fresh blood — if you are interested in helping with the Euclid newsletter — please get in touch with Jarle.

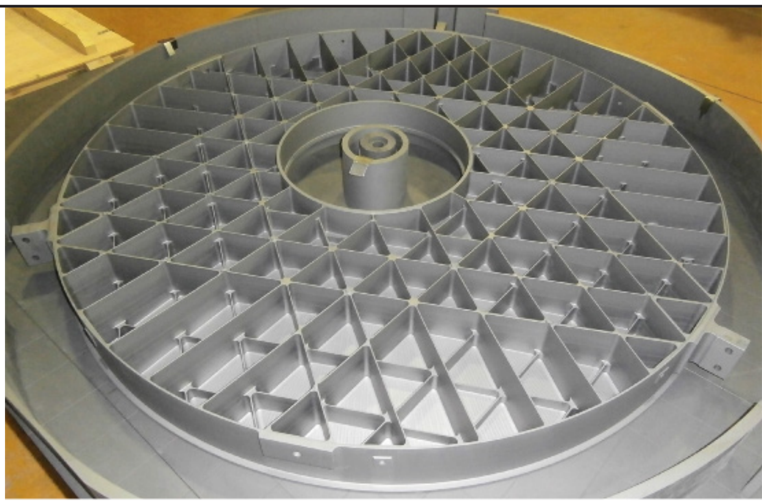
Jarle Brinchmann & Stefania Pandolfi

Contents

An update from the Euclid project

An ESA project life is marked by the occurrence of "Reviews" to check the project development on a regular and formal basis. These are held at all levels of the project, starting from the highest level "mission", down to "space segment", be spacecraft platform or instruments, "ground segment" be operations ground segment or science ground segment, or even at a lower level, as the case of the Payload Module review. At every level the review is conducted under the responsibility of the immediately higher level and in general is performed by independent experts.

Euclid is no exception. We started in February 2014 with the Mission Requirement Review (MRR). This was the first of the five main reviews that will be held until on-orbit commissioning. In September-October 2015 the Mission Preliminary Design Review (M-PDR) was carried out. The board, formed by ESA senior technical managers and co-chaired by the ESA Inspector General Mr. Tolker-Nielsen and the Director of Science Mr. Giménez-Cañete, met on the 20th of October and declared the review successful. This positive declaration was based on the extensive work performed by a technical and scientific panel co-chaired by Anders Elfving and Timo Prusti which scrutinised the status of the project from a mission perspective. The review highlighted a number of important points that need special attention by the project in the short or medium term. It would be too long to describe them here, but they concern: the spacecraft mass, the opto-structural distortions, the radiation effects on the CCDs, the spectrometer performance, the in- and out-of-field stray light, the dichroic verification and the mission level planning.



The main Euclid mirror, M1 for the Flight Model, commonly known as the "blank. The mirror is made from sintered SiC powder followed by light-weight machining. The optical surface (on the other side of the image) is CVD (Chemical Vapour Deposition) cladded and ground ready for a long process of fine polishing.

The mission level reviews are preceded by — or carried out in parallel to — lower level reviews. All the elements are now well in progress in their development. It may be useful to briefly look at them one by one:

Space Segment: Payload Module: is under the industrial authority of Airbus Defense & Space (formerly Astrium SAS) of Toulouse. They successfully passed the PDR in June 2014. Virtually all the subcontractors are already in place, e.g. Boostec for the SiC structures, OBJ for the dichroic, AMOS and REOSC for the mirrors polishing and coating, Sener for the M2 mechanism, Airbus-NL for the NISP radiator and struts, just to name few. The authorisation to start manufacturing the last SiC structure, the optical bench (a baseplate made of four large SiC carved slabs brazed together supporting all the instruments cold units and the optics) was given recently.

Space Segment: Service Module: is under the industrial authority of Thales Alenia Space Italia of Torino (TAS-I) who are also the overall industry Prime Contractor and are ultimately responsible for "the spacecraft", meaning the entire space segment minus the instruments. The Spacecraft Requirements Review took place together with the mentioned MRR. TAS-I's initial activity to flow-down spacecraft requirements to subsystem level was followed by an intensive work called "industrialisation". Together with ESA's project team, competitive Tenders were evaluated to select all the subsystem responsibles: e.g. the On-Board Computer and Data Management, the Telemetry and Telecommand, the Structure and Thermal Control, the Attitude and Orbit Control, Sunshield and solar array, only to name the most important. The subsystem selection was completed in the beginning of 2015 and the exercise is now continuing for the selection of the lower level units, e.g. antenna point mechanisms, propulsion thrusters, etc. In parallel the system design has advanced to be submitted to the System PDR whose Board met on the 9th of July 2015. The successful outcome of this review allowed the Prime Contractor's activities to transit to the Phase C/D, which will last until the Flight Acceptance Review.

Space Segment: Instrument VIS: is under the responsibility of the Euclid Consortium and MSSL is the main actor. VIS passed the Instrument PDR in April 2014 and completed the pending activities by December 2014. Now the first VIS subsystems are having their Critical Design Review. An important part of VIS are the 36 CCDs required for its focal plane. The VIS CCDs are procured directly by ESA from the industry e2v of Chelmsford and delivered to MSSL. This industrial activity was broken down into two parts: a qualification phase, recently successfully completed and a flight production phase just started. All the structural and engineering models have been delivered and the production of the flight wafer dies is well advanced.

Space Segment: Instrument NISP: is under the responsibility of the Euclid Consortium and CNES and LAM/CPPM are the main actors. NISP held the Instrument PDR in May 2014 and completed the pending activities by September 2015. The NISP focal plane is based on 16 HgCdTe NIR detectors. These state-of-the-art detectors are procured directly by ESA and delivered to LAM/CPPM. Also in this case the procurement is organized in two steps: firstly during an Evaluation and Qualification phase, ESA works directly with the industry Teledyne Imaging Systems of Camarillo, US, to develop suitable NIR detectors for NISP, supported by the EC and NASA JPL and GSFC, then NASA (JPL lead) will procure and test the flight models from Teledyne in the following production phase. The first phase has been recently completed and NASA has started the flight models production.

Unfortunately the NISP development took longer than expected due to various criticalities in many areas, including the detectors. Therefore a thorough review of the schedule was performed by CNES and ESA and a substantial schedule delay (from 7 to 15 months) was confirmed. This delay has now been factored in the overall Euclid development.

Ground Segment: Mission Operations: is under the responsibility of ESA-ESOC in Darmstadt. Similarly to nearly all ESA's missions ESOC operates the spacecraft and instruments during the entire life of the mission. The preparation is on going and a Customer Requirements Review was held in December 2013. The next milestone will be the Ground Segment Requirement Review that will be held in mid 2016.

Ground Segment: Science Operations: is under the responsibility of ESA-ESAC in Villafranca. Like in all ESA's science missions, ESAC prepares the instruments operations and coordinates the data distribution and processing. The development of the SOC at ESAC together with the EC SDC's forming the Science Ground Segment (SGS) was scrutinised in a System Requirements Review (SRR) that was held early 2015 and culminated with a successful board in March 2015.

Ground Segment: EC-SGS: is under the responsibility of the Euclid Consortium and is led by INAF of Trieste. The SDC's and the OU's are distributed into 8 European Centres and a US one. The SGS-SRR confirmed that this vast and distributed system is progressing adequately to support the Euclid mission. However the processing power required for the pipelines delivering the LE3 product (final scientific deliverables) was judged to require substantial improvement.

Launch Segment: is under the responsibility of Arianespace, contracted by ESA to procure the Soyuz launcher and perform the launch operations from the ESA's CSG of Kourou. Presently a contract is in place for the definitions of the launcher interfaces in support of the spacecraft development. Also the progress in this area was reviewed in the spring 2015 and found adequate. Improvements on the launcher environment cleanliness was identified as a major item for the next phase.

An important objective of the M-PDR with direct scientific relevance is to check that the required spacecraft, telescope, and instrument performances are adequate to ensure the Euclid core science. A large amount of work was carried out by the members of the Euclid Consortium to assess performances: we mention the work on straylight, construction of the reference survey, and instrument performances. Members of the Euclid Science team (EST) were directly involved in the SGS SRR. The EST has organised a Calibration Review which was completed by the end of 2014. The panel was chaired by Jason Rhodes and consisted of independent scientists with the best expertise in instrumental and scientific calibrations, and operations. The panel recommendations were evaluated by the EST and followed up by the EST or passed to the project team if necessary. This activity served as an input to the M-PDR.

All in all the entire Euclid mission is proceeding very well. We have now baselined a new schedule as a consequence of the above mentioned NISP delay. The new plan is now to launch in December 2020, which is a 9 months delay with the previous planning, however a three months contingency margin is now embedded in this more consolidated schedule. The project counts on the commitment and cooperation from all parties to maintain this new launch date.

Giuseppe Racca & René Laureijs

Introducing the EC Diversity Committee

Earlier this year, the EC Board endorsed the formation of a EC Diversity Committee. This committee will be in charge of monitoring various aspects of diversity within the consortium as well as proposing ways to foster an inclusive work environment. Here we briefly introduce the motivation behind the establishment of the Diversity Committee as well as its current members.

Diversity in the work environment promotes innovation and excellence, both essential components in achieving outstanding science. Ensuring equal access for all groups will not only broaden the available talent pool, but also provide more universal benefits as more diverse teams generally outperform homogeneous ones. Members of homogeneous groups carry the assumption of shared perspectives. When confronted with a socially different group, the anticipation of conflicting opinions results in people working harder and more diligently to present their arguments. Additionally, members of diverse teams are found to be more open to consider alternatives and challenge entrenched assumptions, which leads to more innovative solutions to problems.

At the same time, diversity in teams creates the potential for conflict and miscommunication. The various dimensions of diversity, such as gender, race, ethnicity, religion, sexual orientation, age, and disability, shape our interactions with one another. In a large collaboration such as Euclid, with members from many different countries, it is important to be aware that different work styles, cultural stereotypes, and unconscious bias affect how we communicate and work together.

Providing an inclusive and supportive work culture also encourages the participation of underrepresented groups. The notion that underrepresented groups are not choosing to enter or stay in science because of a lack of innate skill or drive is misguided. Studies in social psychology suggest that instead, experiencing a sense of belonging is an important factor of continued participation. An actively supportive environment, characterized by mutual respect and awareness and appreciation of different opinions and perspectives, fosters commitment to the goals of the group and benefits the collaboration as a whole.

Experience from many different fields has highlighted that organizational structures and procedures are an essential tool in promoting and monitoring diversity efforts. The diversity committee aims to provide this organizational framework, in establishing a clear vision on the code of conduct for the consortium and providing resources and practical suggestions for fostering an inclusive environment. At the same time, the committee and EC board are very much aware of the need of working in concert with the legal rules and regulations of the various EC member countries and institutions.

The current members of the diversity committee listed below are envisioned as the initial core group of people to kickstart the consortium's approach to diversity issues. We tried to assemble a team of diverse voices, representing different countries, project areas (science, instrumentation, software development) and seniority. However, since we want to collectively shape and define the particular scope and objectives of the committee, we expect to rotate the committee membership with service terms of the order of 2–3 years. We encourage members to share their concerns and ideas with the committee at any time and to express any interest in serving on the committee in the future.

Current members of the diversity committee

Stefanie Wachter (MPIA, Germany, wachter@mpia.de) - Chair

Jarle Brinchmann (Leiden Observatory, Netherlands, jarle@strw.leidenuniv.nl)

Anna di Giorgio (IAPS/INAF, Rome, Italy, Anna.DiGiorgio@iaps.inaf.it)

Daniel Eisenstein (CfA, USA, deisenstein@cfa.harvard.edu)

Andre Füzfa (UNamur, Belgium, andre.fuzfa@unamur.be)

Sabrina Pottinger (UCL, UK, s.pottinger@ucl.ac.uk)

Sybille Techene (IAP, Paris, France, techene@iap.fr)

Progress of the Science Ground Segment

After the Preliminary Requirements Review (PRR) was successfully passed, the Science Ground Segment (SGS) underwent the System Requirements Review (SRR). To prepare for this milestone, the SGS proceeded to the next level of requirements definition and architectural design (from the global view to the sub-system level). Simultaneously, we initiated development of core systems and of those additional systems required to support the development phase of the mission (namely, the e-infrastructure designed by the SGS System Team).

All SRR activities were closed in June 2015, with the data-pack delivery to ESA in mid-January, and an internal review was held beforehand with the support of many EC members. With the SRR, the requirements on the SGS have been stabilised and formally approved, the external interfaces and pipeline interfaces validated. By the time of the SRR, the maturity status of the data processing pipeline software was generally set at the level of proof-of-the-concept prototypes provided by the OUs. However, some codes were already on track to reach the performance required; and there were as well some prototypes already integrated with the preliminary e-infrastructure and tools provided by the SGS System Team. One of the aims of the staff working on the SGS was actually to demonstrate that some of the modules were already in a ready-to-be-run status.

To reach this ambitious goal at such an early phase of the development, some significant steps were previously carried out to demonstrate the feasibility of transparently deploying and running pipelines on all Science Data Centres (SDCs). As a matter of fact, this was the goal of the SGS System Team Challenge #3, which was designed and prepared at the end of 2013 and successfully performed during the month of January 2014. In a nutshell, the exercise demonstrated that using the virtualisation concept, i.e. deploying Virtual Machines in the SDCs and using an Infrastructure Abstraction Layer (IAL) to run the code, we are actually capable of isolating hardware specificities and obtaining homogeneous results. Basically, the exercise was performed with the VIS, NISP-I and NISP-S instrument simulators and performed four steps:

1. fetching, on the basis of metadata provided by an archive prototype, and storing in the local SDC storage area the appropriate input data for the pipelines;
2. launching the simulators as jobs to be run across clusters (when available in SDCs) or on dedicated nodes, in accordance with Processing Orders defined remotely or locally (manually by each SDC leader);
3. producing and storing the output data from the simulators into the local SDC storage area;
4. sending the appropriate metadata to the archive prototype to record the processing performed.

The ST Challenge #3 demonstrated that the SGS is on good track to be able to distribute the processing of Euclid data on the various SDCs while keeping the data transmission across the network to a minimum. On this topic, the network bandwidth between all of the SDCs is being regularly monitored to allow detecting in advance possible bottlenecks.

At the SRR kick-off meeting, a demonstration of ST Challenge #4, which included access to the Euclid prototype archive, was successfully performed. The SRR Panels and Board concluded that the goals of the review had all been reached and provided a set of recommendations to be fulfilled in the short and longer terms.

Andrea Zacchei, Fabio Pasian, Marc Sauvage

Updates from the Science Working Groups

The Weak Lensing SWG

The weak lensing working group remains active in many different areas. Since the last newsletter we have had our annual meetings jointly with OU-SHE and OU-LE3 in Frascati near Rome October 22-25 2013 and in Paris December 9-11 2014; as well as meeting at the annual general meeting in Marseille and Lausanne, and having bi-monthly telecons during this period. Our most recent meeting was in London, November 4-6 2015. Here we highlight just a few of the many areas in which we are making progress in preparation for the weak lensing science of Euclid.

The intrinsic alignment (IA) of galaxies mimics the coherent distortions of galaxy images across the sky generated by weak gravitational lensing which Euclid will measure with unprecedented precision. If ignored, IA could easily constitute the limiting systematic effect in cosmological constraints from weak lensing. To calibrate IA in Euclid data both model-independent mitigation strategies and good models of this astrophysical effect are essential. However, the physical understanding of IA is still severely lacking for the galaxies that Euclid will target, as observational constraints are currently very poor and models complicated due to the intricate dependence of IA on galaxy evolution, non-linear gravitational processes, and gas physics. Therefore a Tiger Team for Intrinsic Alignments was formed with the remit to improve our understanding of galaxy intrinsic alignments, and to make sure that Euclid is capable of producing excellent constraints on weak gravitational lensing while having full control over possible contaminations by IA. In 2013 the team, which comprises about 15 active members, was able to acquire 'International Team' status at the International Space Science Institute (ISSI) in Bern, Switzerland and secured funding for two week-long workshops. The first meeting took place in early November, providing an excellent opportunity to bring everyone in the team up to speed, which was then followed by a second workshop in June 2014. These resulted in three review articles Joachimi et al. (2015), Kiessling et al. (2015) and Kirk et al. (2015) that are now accepted for publication.

SWG members continue to improve our understanding of shape measurements and recent studies such as Viola et al. (2014) and Hoekstra et al. (2015) have shown the importance of knowing the intrinsic ellipticity distribution of the galaxies. As noise changes the observed distribution, this can only be achieved by observations of the Euclid Deep field. Fortuitously the current parameters (40 sq.deg. with 40x the nominal integration time) are well matched for this purpose. Another consequence is the need to characterize the statistics of the background very well, and this is something we are working actively on characterizing.

We are constantly updating and filling in requirements both for the ground segment and the instrument teams. This involves addressing previously held assumptions and making analyses more complex. One major assumption that we have recently relaxed is that the systematics are scale independent. In Euclid the chips, field-of-view, and the survey strategy all introduce particular scale-dependency into systematics. In Kitching et al. (2015) we found that by modeling this scale-dependency can go a long way to finding margin in some requirements. There is also work on the optimization of correlation function measurements (Kilbinger et al., in prep) and on mass mapping requirements (Pires, Jullo, in prep).

The WLSWG has excellent and close relations with the ground segment OUs. Our telecons are now shared with OU-SHE and OU-LE3 and rotate on a three weekly basis between these groups. If you would like to join, to learn more about the weak lensing and help prepare for the weak lensing science of Euclid you are very welcome, please contact Tom, Henk and Martin.

Tom Kitching, Henk Hoekstra & Martin Kilbinger

Galaxy Clustering SWG Activity

Over the past year, the Galaxy Clustering Science Working Group (GC SWG) has been involved in a broad range of tasks. These range from evaluating the science performances of the NISP instrument and the calibration plan for the resulting spectroscopic data, to the definition of a number of specific-science work-packages (WPs) and their interfaces to the corresponding activities by the Science Ground Segment.

A major structuring of the GC SWG has been undertaken, defining eight WPs, each dealing with a specific topic. WPs include, for example, one looking at how to best account for the Euclid-NISP specific mask and selection effect, one optimizing the sample selection, and one accounting for the covariance of the various parameters to be estimates from the galaxy clustering measurements. A full list is available on the wiki pages of the WPs on Euclid Redmine.

Each WP is coordinated, typically, by two co-leads, and they have all prepared a document describing the general remit of their own WP activities. These documents are also available on the specific wiki pages of the WPs.

A significant effort by members of the GC SWG has then been devoted to contributing to the study of other aspects of the project that will directly impact the quality of the galaxy clustering measurements. These include the flux calibration of the spectroscopic data (through the Euclid Calibration Group) and the overall performances of the NISP spectrograph. The latter has varied significantly for two reasons. First, as a consequence of the modification to the grism configuration introduced nearly two years ago (adopting a single long Red grism for the Wide Survey observations). Second, the performances were found to be affected more severely than originally expected by the zodiacal background light and the stray-light due to reflections from bright in-field and out-field sources. A specific "Spectro Tiger Team", led by Anne Ealet (Marseille) was thus set up early this year, involving people from the instrument, survey, simulation and GC SWG groups, to provide quantitative answers, in view of the Mission Preliminary Design Review (MPDR). Last September, the Tiger Team released a comprehensive "Spectroscopy Performance Report", presenting the results of extensive simulations addressing the role and consequences of the above effects, together with other contributions (as e.g. the persistency of infrared detectors and cosmic rays).

The GC SWG has regular telecons three Mondays per month, dedicated to (1) reports from the WPs, (2) general Euclid reports, and (3) a joint telecom led by the OU-LE3 GC WPs. The next GC SWG meeting will be held jointly with OU-LE3, in Milan, on January 25-27, 2016.

Luigi Guzzo, Will Percival, Yun Wang

Theory

The goal of the EC Theory SWG is to increase the science return of the mission by studying cosmological models beyond the current standard model and how to constrain them with Euclid data. The work is articulated in several work packages that investigate topics from inflation to modified gravity, from dark matter to inhomogeneous models, from relativistic effects to synergy with additional cosmological probes. Before launch, our work is mostly devoted to forecasting future constraints, to deriving theoretical predictions and to prepare the codes needed for the data analysis.

The other principal activities of the Theory SWG concern the parameter definitions document and the Theory Review. The parameter definitions document now contains the definitions for the standard models and for several interesting competing alternatives. In collaboration with the Simulation WG we are also selecting relevant models to be analysed through N-body simulations. The first edition of the Theory Review, illustrating the cosmology and fundamental physics that can be achieved with the Euclid satellite has been published in Living Reviews in relativity (http://relativity.livingreviews.org/Articles/lrr-2013-6/). The editorial board, led by Valeria Pettorino, is currently working on updating it to include the current specifications and to expand the theoretical overview.

The Euclid Theory SWG runs several general and task-specific telecons, announced on the theory mailing list and on the theory pages of the Euclid redmine wiki. Once a year we have face-to-face WG meetings and/or splinter sessions at the EC meeting, open to anyone in the Euclid Consortium.

Luca Amendola & Martin Kunz

Galaxy Cluster SWG

A major effort for the Cluster SWG was to produce a comprehensive analysis of the strength of the Euclid cluster sample in the context of cosmological parameter estimation. This work was published in Sartoris et al. (2015, arXiv:1505.02165). There we show forecast constraints on the parameters that describe a variety of cosmological models. Moreover we describe the analytical approach used to estimate the photometric and spectroscopic cluster selection function for Euclid.

From the photometric selection, we found that Euclid should be able to detect galaxy clusters with a minimum mass of $0.9\text{-}1\times10^{14}\ M_\odot$ with a S/N>3. As a result, the Euclid photometric cluster catalogue can be expected to contain about 2×10^6 objects, with 20% of these at redshifts z≥1.

Making use of this sample, we also produce forecasted constraints on the main cosmological parameters, including primordial non-Gaussianity, modified gravity and neutrino density. Our results from the Fisher Matrix analysis of the cluster number density and power spectrum show that Euclid clusters will be significantly complementary in constraining the amplitude of the matter power spectrum σ_8 and the mass density parameter $\Omega_{m,0}$.

The dynamical evolution of dark energy will be constrained to $\Delta w_0=0.03$ and $\Delta w_a=0.2$ with free curvature Ω_k, resulting in a (w_0,w_a) Figure of Merit (FoM) of 291. Including the Planck Cosmic Microwave Background (CMB) covariance matrix as a prior, i.e information on the geometry of the universe, improves the constraints to $\Delta w_0=0.02$ and $\Delta w_a=0.07$ and a FoM=802 (see figure 1).

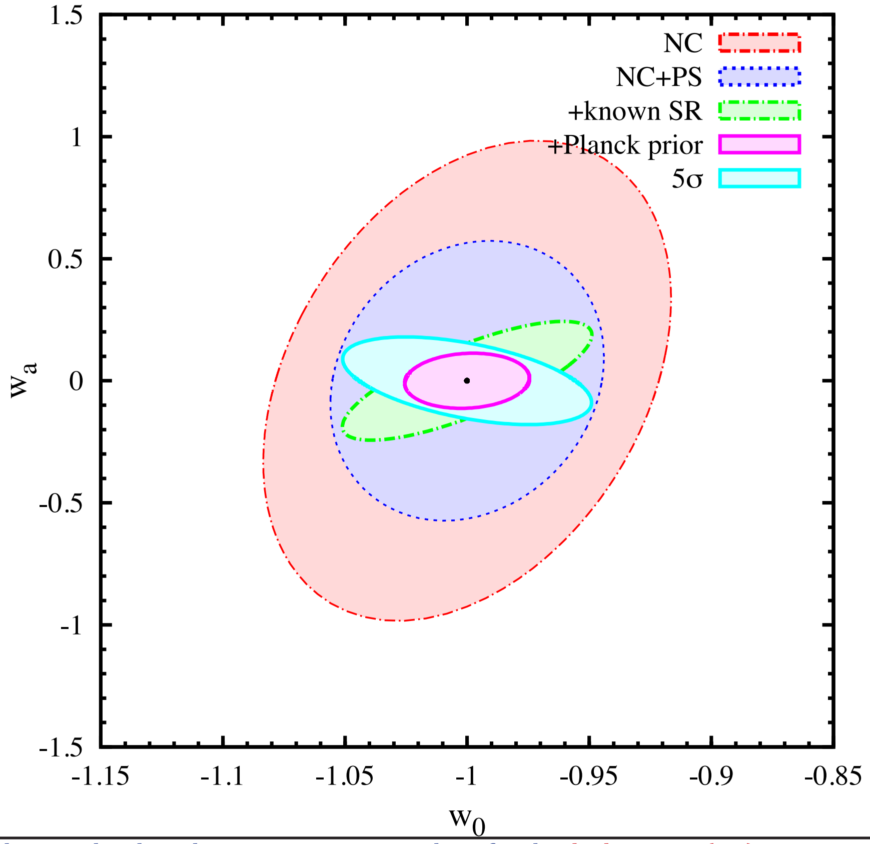


Figure 1: Constraints at the 68% level on the parameters w0 and wa for the dark energy (DE) equation of state (EoS) evolution. We show forecasts for the S/N ≥3 Euclid photometric cluster selection obtained by (i) NC, the number counts (red dash-dotted contours), (ii) NC+PS, the combination of number counts and power spectrum (PS) information (blue dotted contours), (iii) NC+PS+known scaling relation (SR), i.e. by additionally assuming a perfect knowledge of the nuisance parameters (green dash-dotted contours) of the scaling relation, and (iv) NC+PS+known SR+ Planck prior, i.e. by also adding information from Planck CMB data (magenta solid contours). With cyan solid lines we show forecasts for the $N_{500,c}/\sigma_{field} \geq 5$ Euclid photometric cluster selection in the case NC+PS+known SR+Planck prior (labelled 5σ). The Planck information includes a prior on the ΛCDM parameters and the DE EoS parameters.

The amplitude of primordial non-Gaussianity, parametrised by f_{NL} will be constrained to $\Delta f_{NL} \approx 6.6$ for the local shape scenario, from Euclid clusters alone. Using only the cluster distribution from Euclid, the growth factor parameter γ, which is a proxy for deviations from General Relativity, could be constrained to $\Delta\gamma = 0.02$, and the neutrino density parameter to $\Delta\Omega_\nu=0.0013$ (or $\Delta\,\Sigma m_\nu=0.01$).

We emphasise that knowledge of the observable-mass scaling relation will be crucial to constrain cosmological parameters from a cluster catalogue. Thanks to its imaging and spectroscopic capabilities, it will be possible with the Euclid mission to calibrate the masses of galaxy clusters at least up to redshifts of z=1.5, with better than 10% or 30% accuracy, using the weak lensing or spectroscopic surveys, respectively. This information will be further complemented by wide-area multi-wavelength external survey data that will be available when Euclid flies.

B. Sartoris for the SWG.

Exoplanet SWG

One effort done for the exoplanet SWG has been to measure masses of microlensing events combining several epoch of high angular resolution images, this to test the Euclid/WFIRST approach.

The major limitation of exoplanetary microlensing analyses has been the host star mass and distance uncertainty. Microlensing has the ability to detect exoplanets orbiting host stars ranging from just over a solar mass down to the brown dwarf regime, and it can find them at distances ranging from the vicinity of the Sun all the way to the central Galactic bulge. Microlensing light curve models give the mass-ratio and projected separation, while the mass and distance to the lens system can only be determined using additional constraints. In particular, high angular resolution observations currently done with HST and/or the Keck are giving additional constraints. First they separate the source+lens from subarcsec blending stars. We use this constraint, with other observables, and then we can derive masses at 20% or better. When combining an epoch obtained several years earlier (or later) with the ones from the moment of the microlensing event, it is possible to detect a centroid shift due to the source and lens relative proper motion. Then, we can constraint the amplitude and direction of the relative proper motion and ultimately the masses of the planetary system to 10 % or better. We are currently developing this method that will be applied to up to a large fraction of both Euclid and WFIRST targets.

Work done in collaboration with V. Batista (IAP), J.B. Marquette (IAP), D. Bennett (USA) and A. Fukuy (Japan) and collaborators. The work has been publised in [Batista, Beaulieu, Bennett et al (2015, ApJ, 808, 170)] and [Bennett et al (2015, ApJ, 808, 169)].

Jean-Philippe Beaulieu, Eamonn Kerins, Maria Rosa Zapatero Osorio

Galaxy & AGN SWG

The main task for the galaxy & AGN SWG since the last newsletter has been to assess impact of the proposed changes to the near-IR grisms on the science relevant for this group. The changes will remove the blue grism for the wide survey, and this limits the number of galaxies for which we will have multiple emission lines in the spectrum, and would make spectroscopic studies of passive galaxies in the wide survey of very limited use. However we found that the expected gain in sensitivity and depth in the red would make up for this in the wide survey. The SWG also studied the case for a blue grism for the deep survey. This appears to be very beneficial and the SWG is pleased that the Euclid Science Team has endorsed this capability.

The SWG also took part in the restructuring of work packages across the Euclid consortium. Some of these work pacakges are in collaboration with other SWGs - for instance the morphology work package tries to collaborate broadly across the science areas and results from this have been presented at recent EC meetings..

Jarle Brinchmann, Andrea Cimatti, David Elbaz

Euclid software common development tools

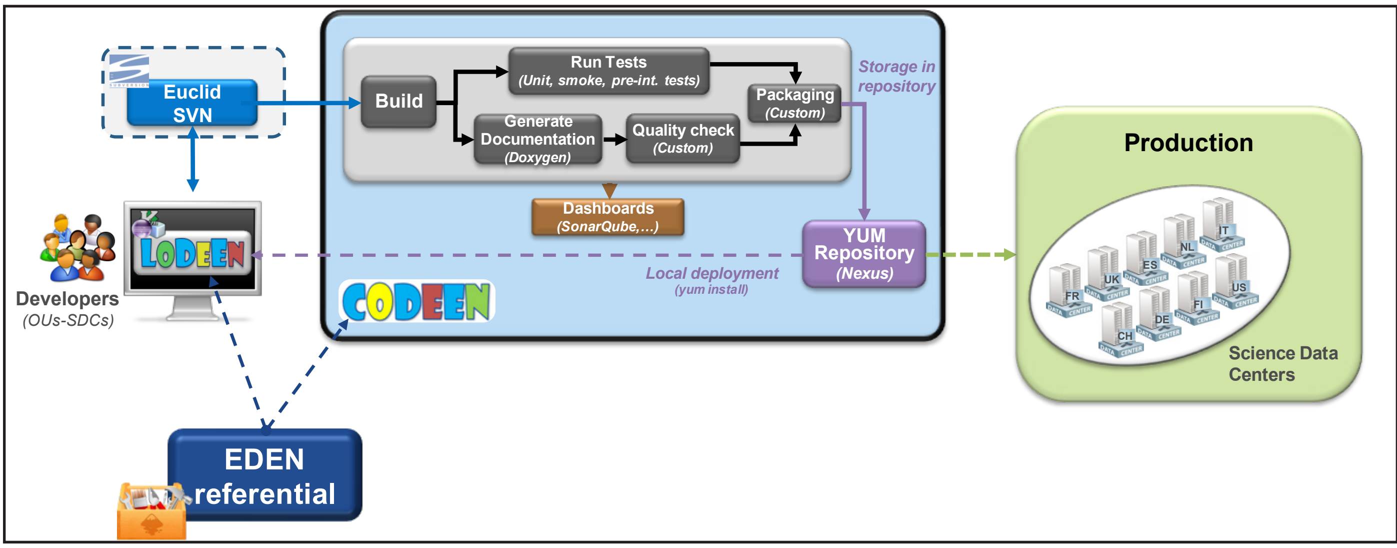
While all Euclid scientists are on a track to reach the essence of dark matter and dark energy, the SGS (Science Ground Segment) System Team have to tackle a more concrete IT subject:

How can we enable these hundreds of scientists and developers, located in different labs, in different countries, to jointly develop Processing Functions (PF) and elements of the Euclid pipeline and to successfully operate it.

In the SGS System Team, the Common Tools team is responsible for defining and maintaining a set a common tools and rules. These tools and rules aim to enable all algorithms to be developed and maintained in a coherent way and to ensure the global coherence and compatibility between all processing chain components, while enabling quick iterations between developments in laboratories and tests in production-like environments.

With this objective in mind, we have designed the following common pillar bricks (see figure below):

- The Euclid Development ENvironment (EDEN)
- The LOcal Development ENvironment (LODEEN)
- The COmmon DEvelopment ENvironment (CODEEN)



EDEN, a common reference

EDEN is the (theoretical) reference that defines:

- the Operating System (currently CentOS7)
- the languages (C++, Python)
- System and scientific common libraries
- Software development rules
- Software development common tools (compilers, visualization, design, ...)

and associated versions that have to be used for PF codes development.

EDEN is versioned and maintained according to the Euclid Community's needs, according to Change Requests raised by developers and addressed through a dedicated process (a new version is foreseen twice a year).

The maintenance of a single reference system enables us to guarantee homogeneous practices between development teams, and to guarantee inherent compatibility between PF codes.

LODEEN, a Virtual Machine implementing EDEN

LODEEN is the development Virtual Machine (VM) that implements the EDEN reference system. This is ready to be used on a developer's laptop.

It provides to the whole Euclid SGS an environment that is

- Similar to the production environment
- Deployable on any system (whatever the O/S, configuration, ...)
- Connected to our central Configuration Management System (currently we use SVN)

Having all developers working on a single development environment enables us to focus all our maintenance & support efforts on one single system.

CODEEN, the Continuous Integration & Deployment Platform

Based on the Jenkins engine, the CODEEN platform enables continuous integration and deployment of Euclid software. Based on standards adopted by Euclid developers' community, CODEEN realizes all the following software factory activities (both on-demand and by nightly build):

- Source code extraction (SVN)
- Generation of binaries (custom Elements framework based on cMake)
- Documentation generation (Doxygen, Sphinx)
- Quality check (Sonar)
- Unit & pre-integration Tests
- Projects Dashboards (SonarQube)
- RPM Packaging and repository (Nexus)
- Products distribution (yum, CernVM-FS)

This platform is adapted to collaborative software development approach, enabling iterative design and incremental build. It has been created by a group of Euclid engineers (coming from CNRS, CNES, ISDC and ROE) in order to ease the production and integration of Euclid pipeline software.

Main developers' community events

Two types of events animate Euclid developers' community:

- The annual Developers' Workshop, aiming to help and train this community for developing Euclid software in accordance with Common Tools and rules,
- The SGS Challenges, aiming to progressive setup and integrate PF prototypes and SGS services.

For more information, please have a look to the Euclid Developer's wiki, and do not hesitate to contact the Common Tools support team.

Adrien Calvayrac, Maurice Poncet

An update from VIS

The VISible (VIS) instrument will enable distortions in the shape of galaxies to be evaluated using weak gravitational lensing. This will allow mapping of dark matter and provide insights into the accelerating expansion of the Universe. The instrument provides bespoke engineering solutions to achieve the mission's science objectives. VIS consists of five subsystems which are developed by institutes and industrial partners across the UK, Italy, Switzerland and France.

The Focal Plane Assembly is comprised of 36 4k x 4k pixel CCDs developed by e2v specifically for Euclid, Readout Electronics (ROE) that drive the CCDs and implement high precision video processing in order to sample the observed Point Spread Function (PSF); each ROE is powered by an independent Power Supply Unit (RPSU). Our understanding of the PSF drives optical performance enabling shear measurements to be made with the necessary precision. Characterisation of PSF has been performed at various wavelengths across the VIS band and is compliant with requirements. Simulations performed of PSF performance show good agreement with experimental data, see Figure1.

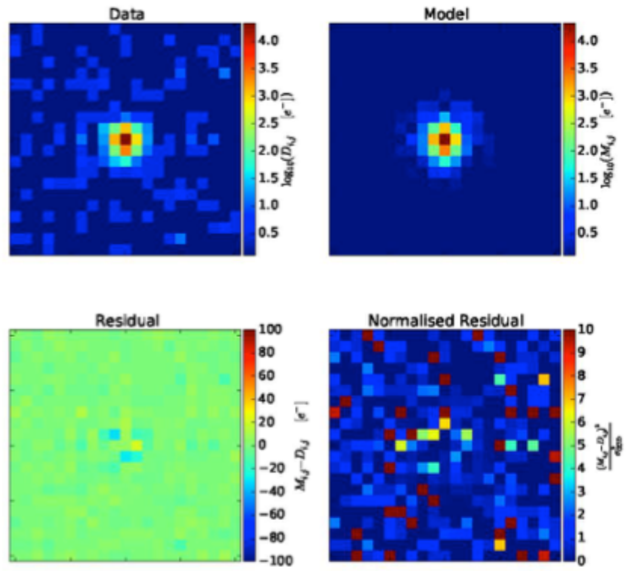


Figure 1: Comparison of modelled PSF and experimental data collected at 600 nm

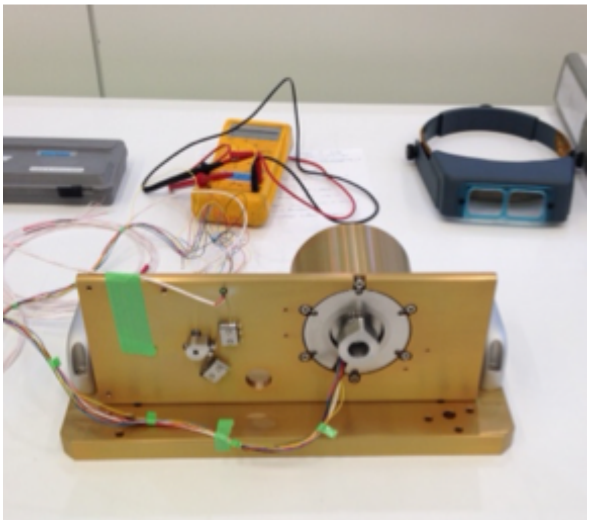
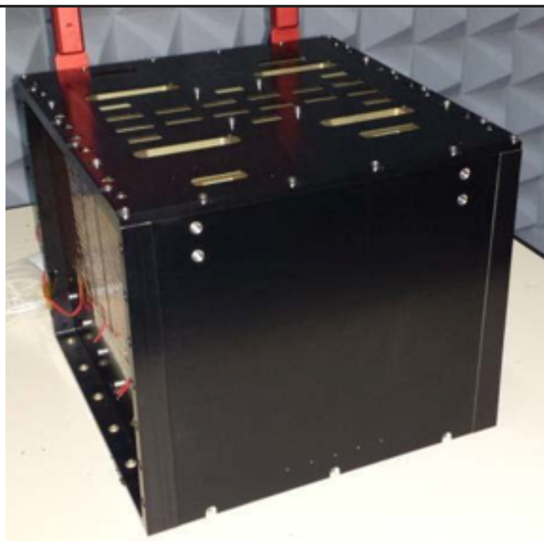


Figure 2:

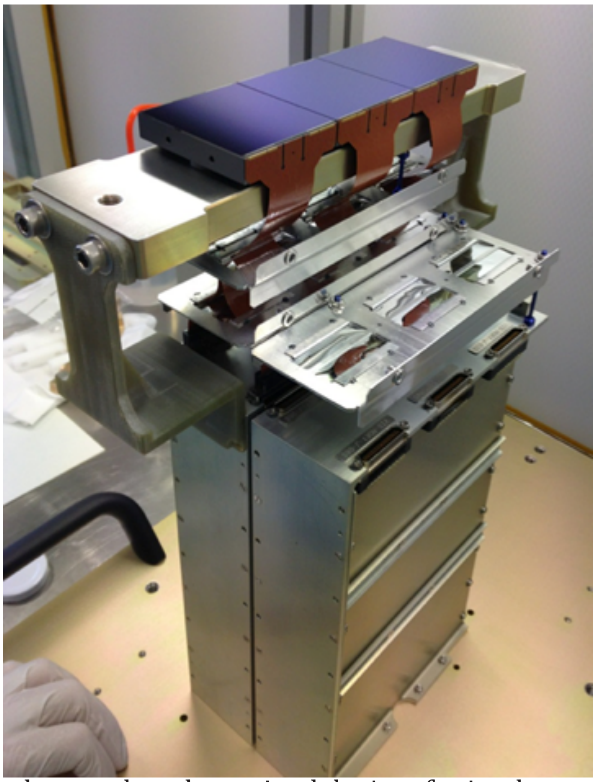
Left: The electrical model Readout Shutter Unit

Right: The electrical model calibration unit

Below: The Structural Thermal Control and Data Processing Unit



The Readout Shutter Unit (RSU) blocks the science beam during the 74 seconds needed to read out data from each exposure of the CCDs. The Calibration Unit (CU) provides a means to monitor variations in the instrument optical performance throughout the duration of the mission. Individual LEDs will emit at a single wavelength and a combination of up to six different wavelengths spread evenly across the VIS band will be chosen in order to provide the needed spectral coverage. The light sources must comply with stringent requirements relating to photon flux, wavelength and full width half maximum as well as operating in cryogenic conditions. The LEDs are currently undergoing a qualification programme in or-



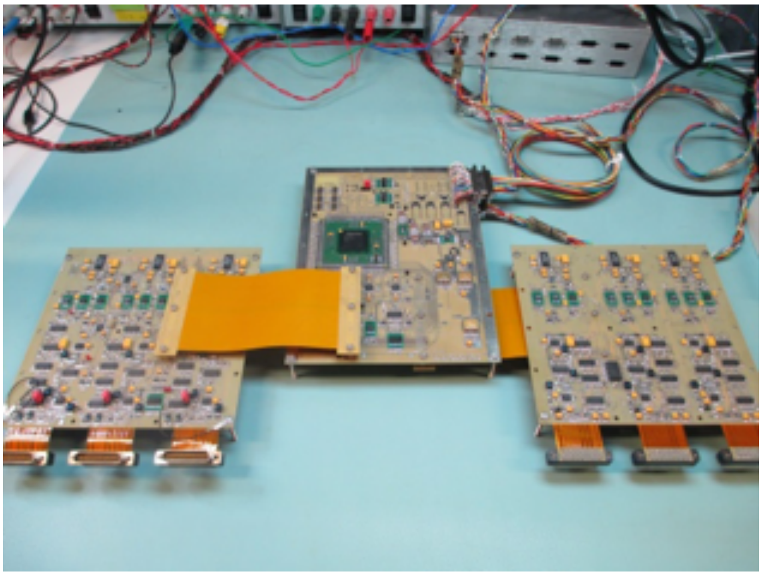


Figure 3. Left: The Electrical Model Focal Plane Assembly. Above: The Electrical Model Readout Electronics (in test configuration)

der to select the optimal devices for implementation for the Flight phase. There are two warm electronics units mounted within the service module which are integral to the operation of VIS; The Power and Mechanisms Control Unit (PMCU) which drives the opening and closing of the RSU, provides thermal monitoring of the Focal Plane Assembly and power to the CU, and the Control and Data Processing Unit (CDPU) which ensures synchronous operation of the instrument subsystems, compresses the data obtained by the ROE and transmits data packets to ground. We have now entered Phase C of the project cycle meaning that deliverable hardware is under manufacture and test as shown in Figures 2 and 3.

In order to validate the operation and performance of the VIS instrument an Electrical Model (EM) and a Structural Thermal Model (STM) are delivered to the European Space Agency to allow integration with the spacecraft enabling performance verification to take place prior to delivery of the Flight Model instrument. This approach is implemented to minimise the technical risks associated with the manufacturing and testing of the Flight Model VIS Instrument. The photos depict STM and EM subsystems that will be delivered to the Agency in 2016, it should be noted that EM models are not mechanically representative of the flight design and the STM models are not electrically representative.

A key activity for the remainder of the 2015 and beginning of 2016 is the completion of the Critical Design Review process. The design and performance of the subsystems is currently undergoing review by the European Space Agency, the outcomes of the review will be used to further enhance performance of the instrument and provide assurance that manufactured of Flight Model hardware can begin. By mid-2016 the electrical and optical performance of the detector chain (3 CCDs + ROE + RPSU) will be verified as well as instrument level electrical operation

Sabrina Pottinger

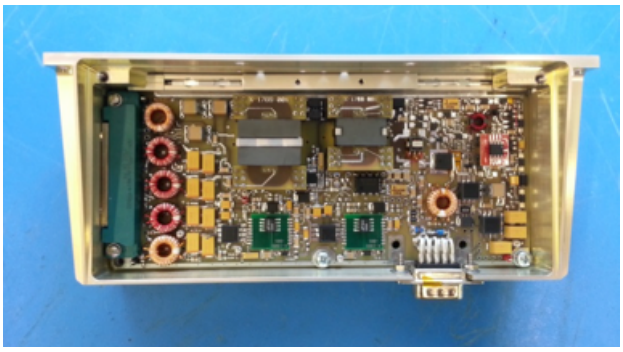
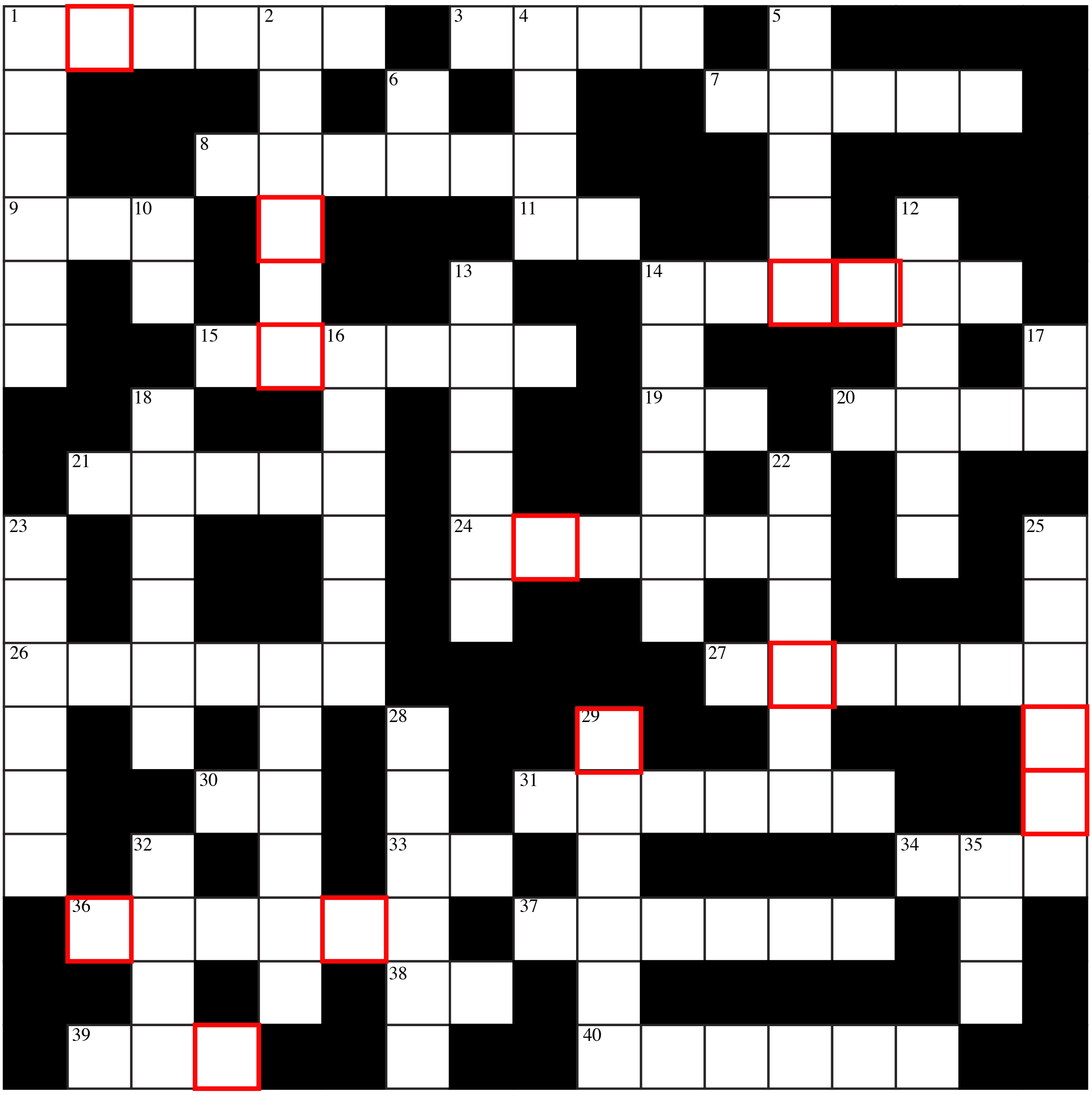


Figure 4. Above: The Electrical Model Readout Electronic Power Supply Unit. Right: The Electrical Model Power Mechanism Control Unit.

The Acronym Crossword - Do you know your acronyms well?



Across

1. SCR
3. EPER
7. APE
8. IFAR
9. 2dF
11. ABCL
14. PSU
15. SCS
19. UTR
20. CDMU
21. TMT
24. CCD
26. LET
27. CV
30. TBW
31. KiDS
33. TBC
34. EOL
36. LVDS
37. FOM
39. ESSWG
40. AGN

Down

1. CDS
2. AGES
4. F-CDPU
5. DWG
6. HgCdTe
10. MOS
12. TAS
13. ELA
14. SKA
16. DES
17. CaC
18. GSDR
22. RT
23. ECA
25. EIQT
28. LGPL
29. CDR
32. KO
35. NCR

Contact list

Euclid Consortium Lead	Yannick Mellier	mellier@iap.fr
ESA Project Scientist	René Laureijs	rlaureij@rssd.esa.int
ESA Project Manager	Giuseppe Racca	Giuseppe.Racca@esa.int
ECL Advisory and Coordination Support Lead	Michel Berthe	michel.berthe@cea.fr
Mission Survey Scientist	Roberto Scaramella	kosmobob@oa-roma.inaf.it
Mission System Engineer	Jerome Amiaux	jerome.amiaux@cea.fr
Calibration WG Lead	Stefanie Wachter	wachter@mpia.de
EC SGS Project Manager	Andrea Zacchei	zacchei@oats.inaf.it
EC SGS Deputy Project Manager	Christophe Dabin	Christophe.Dabin@cnes.fr
EC SGS Scientist	Marc Sauvage	marc.sauvage@cea.fr
VIS Project Manager	Sabrina Pottinger	sjp@mssl.ucl.ac.uk
VIS Instrument Lead	Mark Cropper	msc@mssl.ucl.ac.uk
VIS Instrument Scientist	Ruymán Azzolini	r.azzollini@mssl.ucl.ac.uk
NISP Project Manager	Thierry Maciaszek	thierry.maciaszek@lam.fr
NISP-P Instrument Scientist	Knud Jahnke	jahnke@mpia.de
NISP-S Instrument Scientist	Anne Ealet	ealet@cppm.in2p3.fr
COMS Responsible	Eugenie Girin	girin@iap.fr
EC Editorial Board Chair	Peter Schneider	peter@astro.uni-bonn.de
EC Editorial Board co-Chair	John Peacock	jap@roe.ac.uk
Science Coordinators	Henk Hoekstra	hoekstra@strw.leidenuniv.nl
	Tom Kitching	t.kitching@ucl.ac.uk
	Luigi Guzzo	luigi.guzzo@brera.inaf.it
	Will Percival	will.percival@port.ac.uk
SWG Legacy Coordinators	Chris Conselice	christopher.conselice@nottingham.ac.uk
	Jarle Brinchmann	jarle@strw.leidenuniv.nl
	Luca Amendola	l.amendola@thphys.uni-heidelberg.de

EC Board Members

	Werner Zeilinger	werner.zeilinger@univie.ac.at		André Fuzfa	kp@dark-cosmology.dk
	Hannu Kurki-Suonio	hannu.kurki-suonio@helsinki.fi		Kristian Pedersen	andre.fuzfa@unamur.be
	Yannick Mellier	mellier@iap.fr		Olivier Le Fèvre	Olivier.LeFevre@lam.fr
	Ralf Bender	bender@usm.lmu.de		Hans-Walter Rix	rix@mpia.de
	Andrea Cimatti	a.cimatti@unibo.it		Roberto Scaramella	kosmobob@oa-roma.inaf.it
	Huub Röttgering	rottgering@strw.leidenuniv.nl		Per Lilje	per.lilje@astro.uio.no
	António da Silva	asilva@astro.up.pt		Lucia Popa	lpopa@spacescience.ro
	Francisco Castander	fjc@ieec.uab.es		Rafael Rebolo Lopez	rrl@iac.es
	Georges Meylan	georges.meylan@epfl.ch		Jason Rhodes	jason.d.rhodes@jpl.nasa.gov
	Mark Cropper	msc@mssl.ucl.ac.uk		Bob Nichol	bob.nichol@port.ac.uk

The Organisational Units

OU-VIS - Visual imaging	
Henry McCracken	hjmcc@iap.fr
Catherine Grenet	grenet@iap.fr
Kevin Benson	kmb@mssl.ucl.ac.uk
OU-NIR - Near-IR imaging	
Andrea Grazian	grazian@oa-roma.inaf.it
Rychard Bouwens	bouwens@strw.leidenuniv.nl
OU-SIR - Near-IR spectroscopy	
Marco Scodeggio	marcos@lambrate.inaf.it
Yannick Copin	y.copin@ipnl.in2p3.fr
OU-SPE - Spectroscopic measurements	
Olivier Le Fèvre	Olivier.LeFevre@lam.fr
Christian Surace	christian.surace@lam.fr
OU-EXT - Data external to Euclid	
Gijs Verdoes-Kleijn	verdoes@astro.rug.nl
Joe Mohr	jmohr@usm.lmu.de

OU-SIM - Simulations of Euclid data	
Santiago Serrano	serrano@ieec.uab.es
Anne Ealet	ealet@cppm.in2p3.fr
OU-MER - Merging of external and Euclid data	
Adriano Fontana	adriano.fontana@oa-roma.inaf.it
Hervé Dole	Herve.Dole@ias.u-psud.fr
Martin Kuemmel	mkuemmel@usm.lmu.de
OU-LE3 - Level 3 data	
Jean-Luc Starck	jstarck@cea.fr
Enzo Branchini	branchini@fis.uniroma3.it
Filipe Abdalla	fba@star.ucl.ac.uk
OU-SHE - Shear measurements	
Andy Taylor	ant@roe.ac.uk
Fréderic Courbin	frederic.courbin@epfl.ch
Tim Schrabback	schrabba@astro.uni-bonn.de
OU-PHZ - Photometric redshifts	
Stephane Paltani	stephane.paltani@unige.ch
Francesco Castander	fjc@ieec.uab.es

The Science Working Groups

Weak lensing SWG	
Henk Hoekstra	hoekstra@strw.leidenuniv.nl
Tom Kitching	t.kitching@ucl.ac.uk
Martin Kilbinger (dpty)	martin.kilbinger@cea.fr
Galaxy clustering SWG	
Luigi Guzzo	luigi.guzzo@brera.inaf.it
Will Percival	will.percival@port.ac.uk
Yun Wang	wang@ipac.caltech.edu
Galaxy & AGN evolution SWG	
Andrea Cimatti	a.cimatti@unibo.it
David Elbaz	delbaz@cea.fr
Jarle Brinchmann	jarle@strw.leidenuniv.nl
Milky Way and Resolved Stellar Populations SWG	
Eline Tolstoy	etolstoy@astro.rug.nl
Annette Ferguson	ferguson@roe.ac.uk
Local Universe SWG	
Bianca Poggianti	bianca.poggianti@oapd.inaf.it

Chris Conselice	christopher.conselice@nottingham.ac.uk
Clusters of galaxies SWG	
Jochen Weller	jochen.weller@usm.uni-muenchen.de
Lauro Moscardini	lauro.moscardini@unibo.it
Jim Bartlett (dpty)	bartlett@apc.univ-paris7.fr
CMB Cross-correlations SWG	
Carlo Baccigalupi	bacci@sissa.it
Nabila Aghanim	nabila.aghanim@ias.u-psud.fr
Extrasolar planets SWG	
Jean-Philippe Beaulieu	beaulieu@iap.fr
Maria Zapatero-Osorio	mosorio@iac.es
Eamonn Kerins (dpty)	eamonn.kerins@manchester.ac.uk
SNe and Transients SWG	
Charling Tao	tao@cppm.in2p3.fr
Isobel Hook	ihook@lancaster.ac.uk
Enrico Cappellaro (dpty)	enrico.cappellaro@oapd.inaf.it

Cosmological Simulations SWG	
Pablo Fosalba	fosalba@ieec.uab.es
Romain Teyssier	romain.teyssier@gmail.com
Primeval Universe SWG	
Jean-Gabriel Cuby	jean-gabriel.cuby@lam.fr
Sune Toft	sune@dark-cosmology.dk

Strong lensing SWG	
Jean-Paul Kneib	jean-paul.kneib@epfl.ch
Massimo Meneghetti	massimo.meneghetti@oabo.inaf.it
Raphael Gavazzi (dpty)	gavazzi@iap.fr
Cosmological Theory SWG	
Luca Amendola	l.amendola@thphys.uni-heidelberg.de
Martin Kunz	Martin.Kunz@unige.ch
Matteo Viel (dpty)	viel@oats.inaf.it

THE SCIENCE DATA CENTRES

SDC Switzerland	
Pierre Dubath	Pierre.Dubath@unige.ch
SDC United Kingdom	
Keith Noddle	keith@keithnoddle.com
SDC Italy	
Marco Frailis	frailis@oats.inaf.it
SDC France	
Maurice Poncet	Maurice.Poncet@cnes.fr
SDC Netherlands	
Rees Williams	o.r.williams@rug.nl

SDC Spain	
Christian Neissner	neissner@pic.esu.de
SDC Germany	
Johannes Koppenhöfer	koppenh@mpe.mpg.de
SDC Finland	
Elina Keihanen	elina.keihanen@helsinki.fi
SDC US	
Harry Teplitz	hit@ipac.caltech.edu