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ESO

European Southern Observatory

Gabriel Marquette, ILO France





European Southern Observatory

- **ESO** - la **première** organisation intergouvernementale pour l'astronomie **en Europe** et l'observatoire astronomique **le plus productif** au monde.
- **Mission:** fournir des instruments à la pointe de la technologie aux astronomes et aux astrophysiciens, leur permettant de mener des recherches dans les meilleures conditions pour toujours repousser les limites de notre connaissance.
- **Pays Membres:** l'Allemagne, l'Autriche, la Belgique, le Brésil (non ratifié), le Danemark, l'Espagne, la Finlande, la France, l'Italie, les Pays-Bas, la Pologne, le Portugal, la République Tchèque, le Royaume-Uni, la Suède, la Suisse, le Chili (le pays hôte des installations de l'ESO) + l'Australie

Environ 200 millions € par an

700 personnes employées
(60% à Garching, 40% au Chili)

"An almost unique level of international cooperation is achieved at ESO, and everything is done by those who can do it best, irrespective of their country or institution. This spirit of excellence is an example for all Europe."

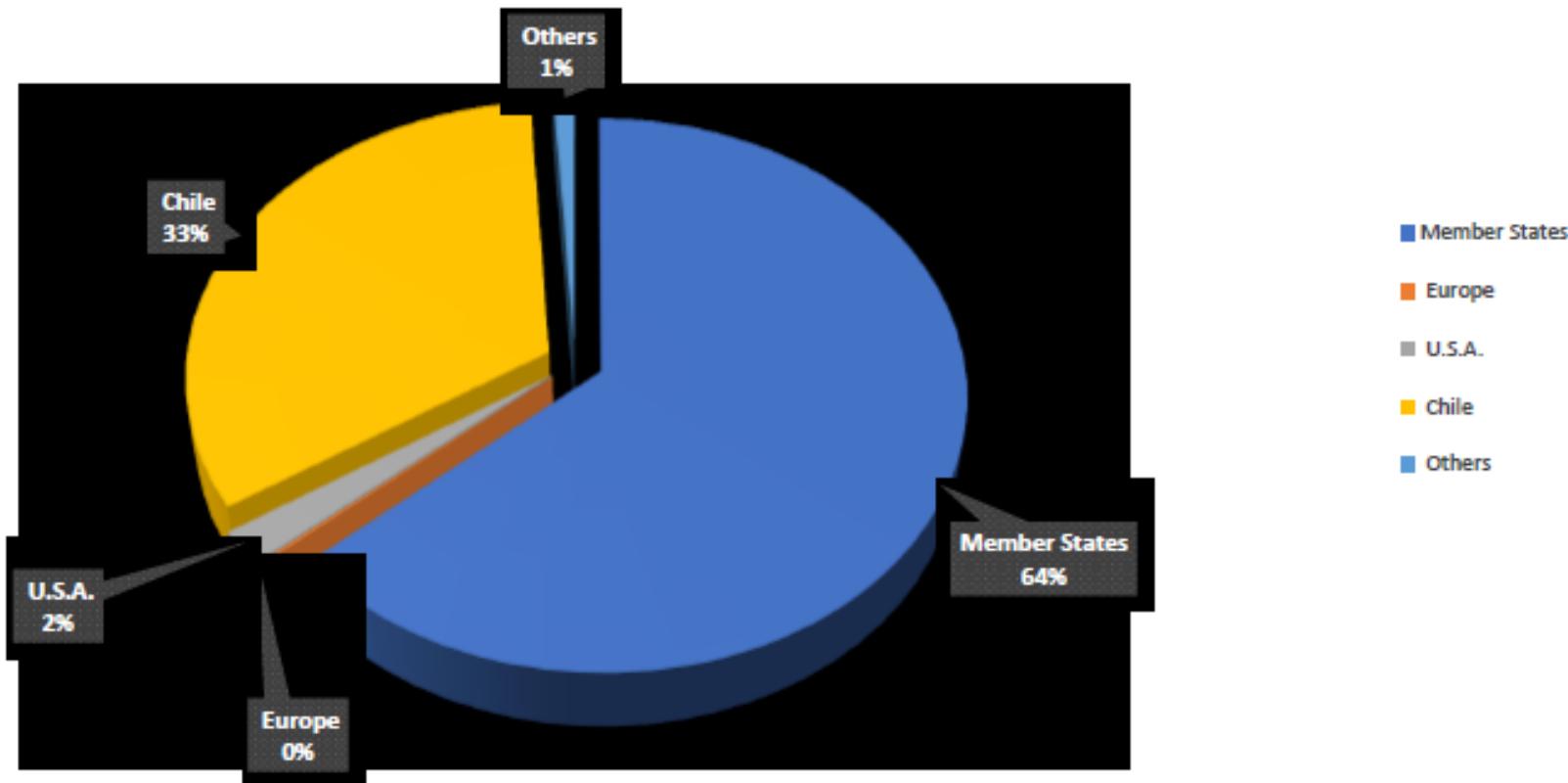
Mrs. Maria van der Hoeven, Minister of Education, Culture and Science, the Netherlands

Member States

- Annual contributions to the Organisation's budget based on the countries' net national income
- 2017 Scale of Contributions:
 - Germany 22%
 - United Kingdom 16%
 - France 16%
 - Italy 12%
 - Spain 8%
 - other Member States between 1% and 5%

Contracts awarded worldwide over the period 2007 - 2016

Cumulative values, country of origin



Total Contracts 10 years: 1.339 Million EUR

ESO programme

■ Visual/infrared light (ESO only)

- La Silla telescopes
- VLT, VLTI, VST, Vista
- ELT under construction



■ Submillimeter radio waves (partnership)

- APEX
- ALMA



ESO in Chile



ALMA and APEX
Height: 5100 m

VLT and E-ELT
Height 2635 m + 3046 m

La Silla:
Height: 2400 m

Santiago
(Offices)

Key-Technologies in Astronomy

ESO has contributed to the progress of several technologies applied to the modern astronomy to improve the image sharpness, among these:

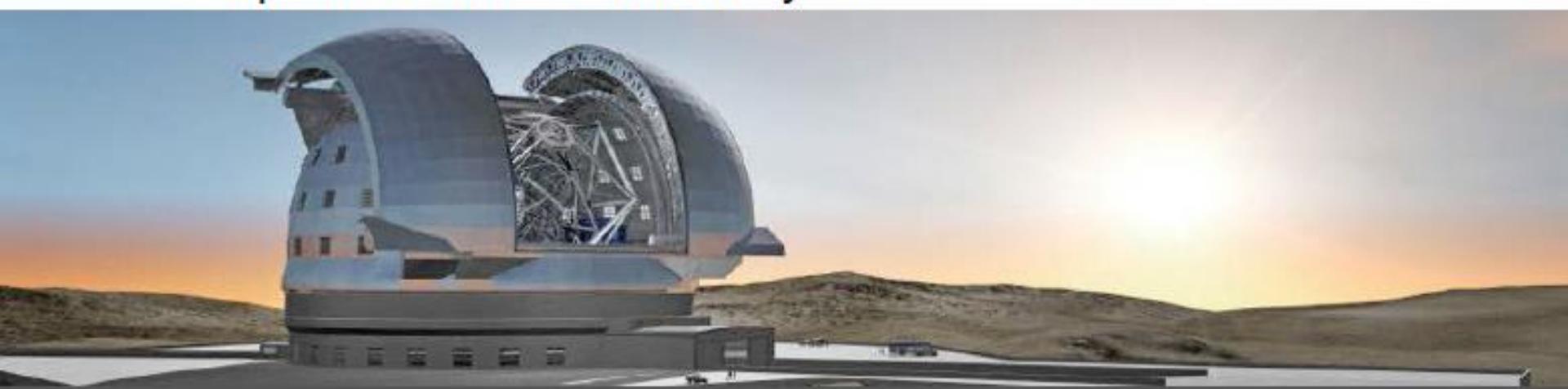
- ACTIVE OPTICS
 - Preserves optimal image quality by adjusting a “flexible” mirror’s shape with actuators during observations (i.e. corrects telescope flexure)
 - In use in most modern medium and large telescopes
- ADAPTIVE OPTICS
 - Technology to reduce distortions introduced by atmospheric turbulence
 - One of the principal reasons for launching the Hubble Space Telescope was to avoid this image smearing
- INTERFEROMETRY
 - The combination of the light collected by two or more telescopes boosts the angular resolution beyond that of a single telescope
 - ESO has been a pioneer in this field with the Very Large Telescope Interferometer (VLTI) at Paranal

■ Largest optical/infrared telescope in the world

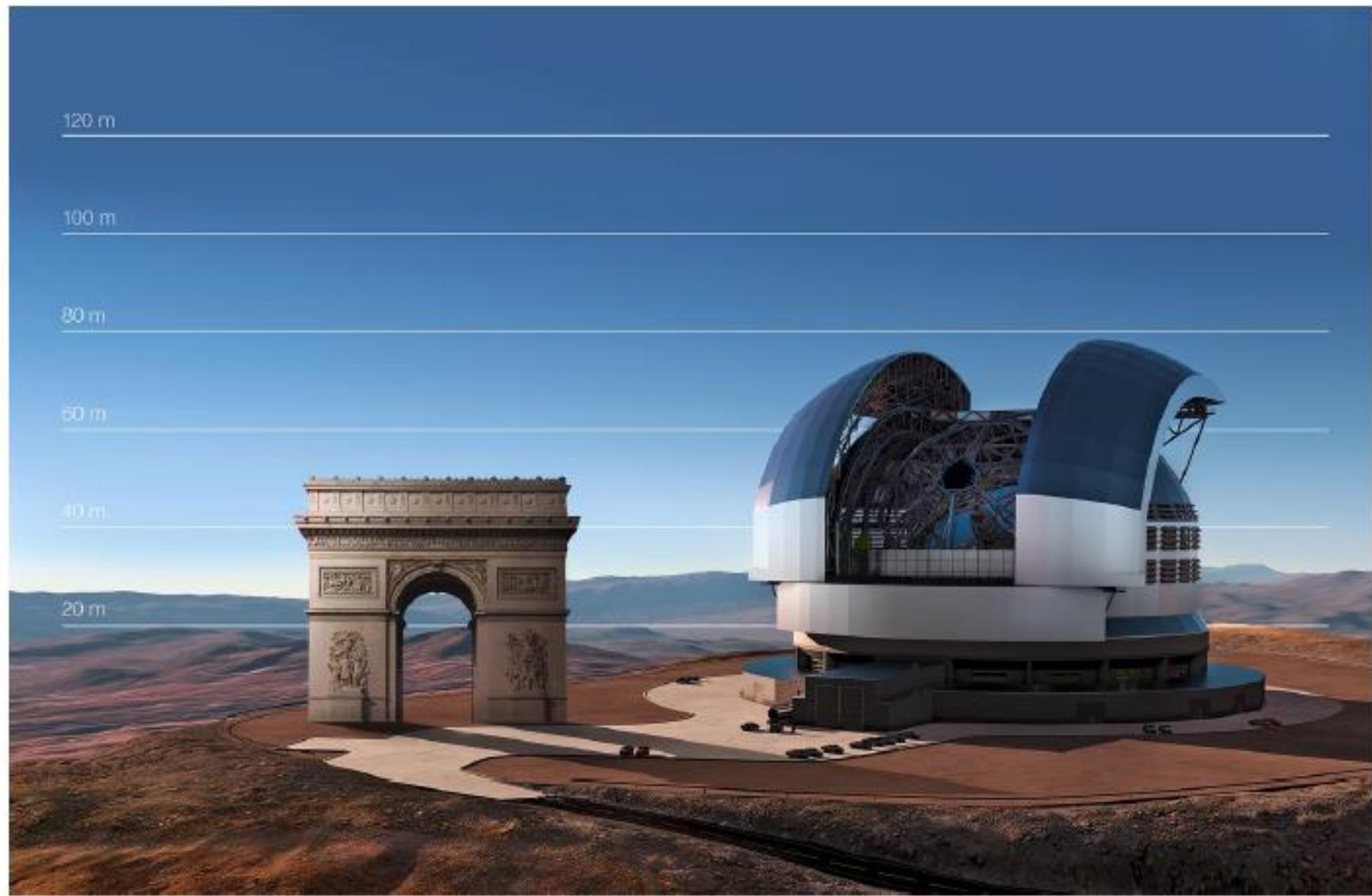
- 39m segmented primary mirror: transformational step
- Science: exoEarths, deep universe, resolved populations

■ Project

- Construction 2014-2024, on Cerro Armazones
 - As *integral part* of the Paranal Observatory ('one more telescope')
- ESO cost:
 - Total Capital cost (e.c. 2017): ~1157 MEUR incl. instr.s and contingency
 - Operation cost: ~50 MEUR / year



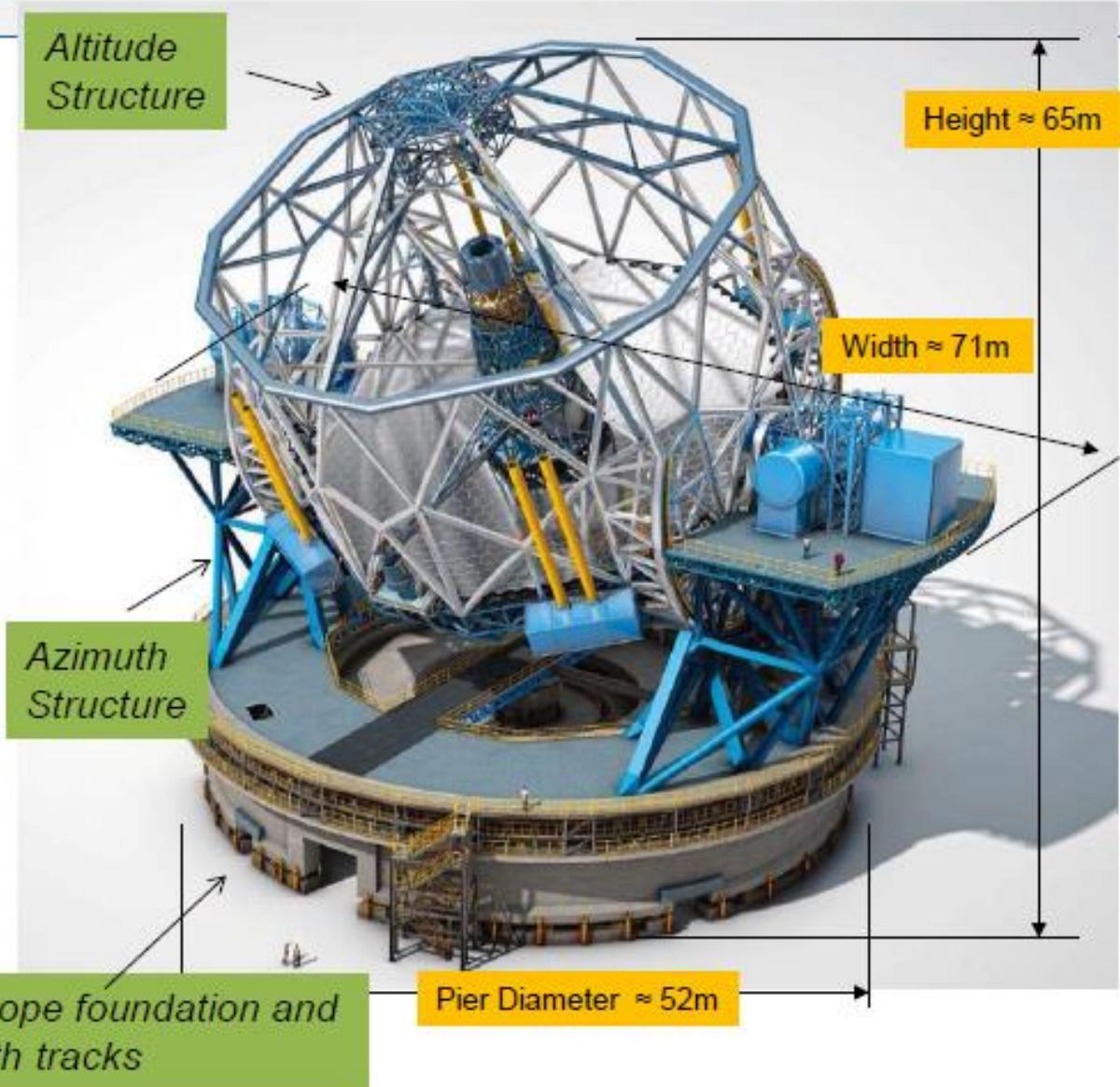
To put it in perspective...



E-ELT - Overview

Telescope design

- Altitude-Azimuth mount
- Main Structure about 3400 tons including 700 tons of opto-mechanics and electronics
- Hydrostatic bearings, driven by electrical direct drive motors
- Precision of 0.3 arcsec under the maximum wind disturbance.
- Two Nasmyth Platforms and one Coude Room for instruments
- Laser launch from M1 edges



Technologies for Adaptive Optics

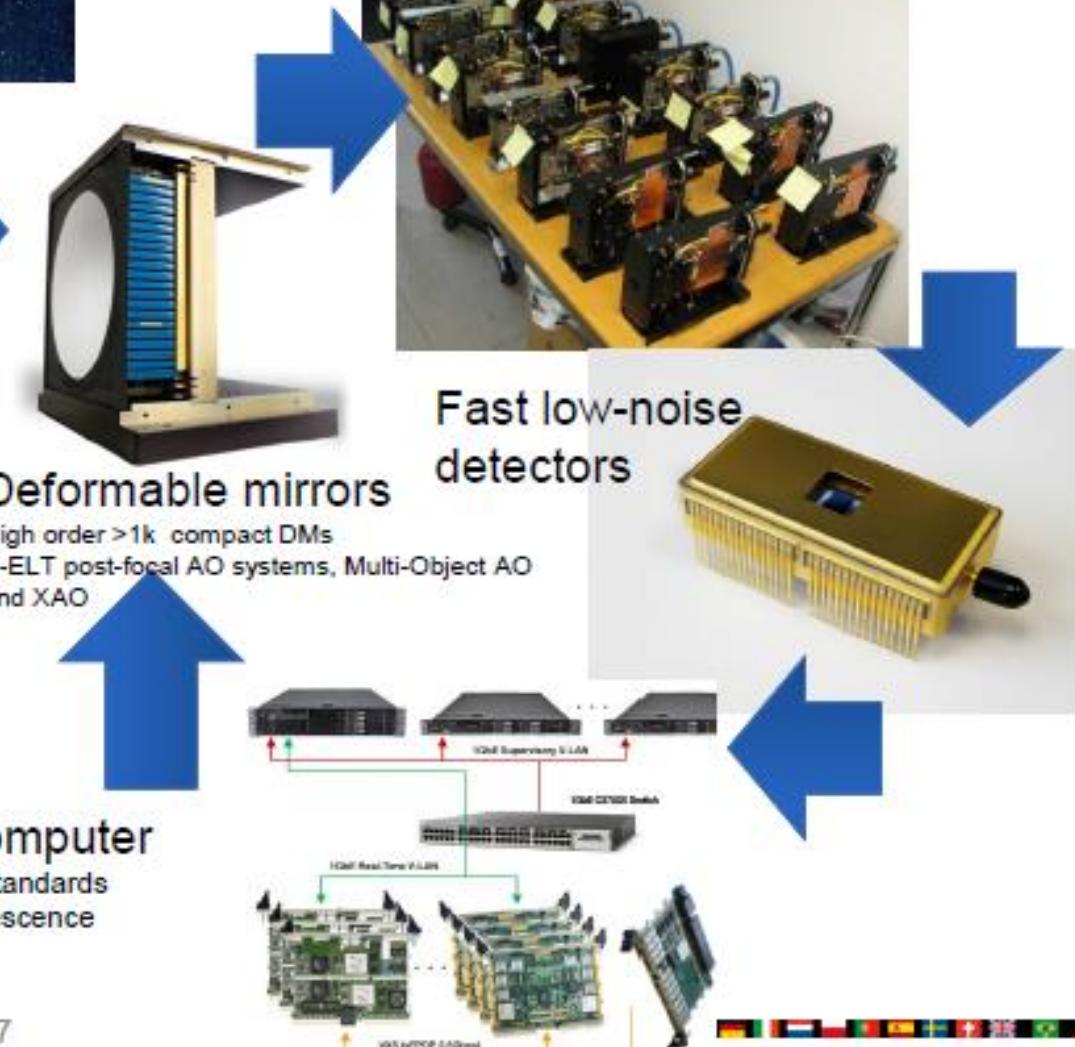


Laser Guide stars

Optimize and understand return flux
Effect of elongated laser spots
Strategy for direct tilt measurement
(without natural guide star)

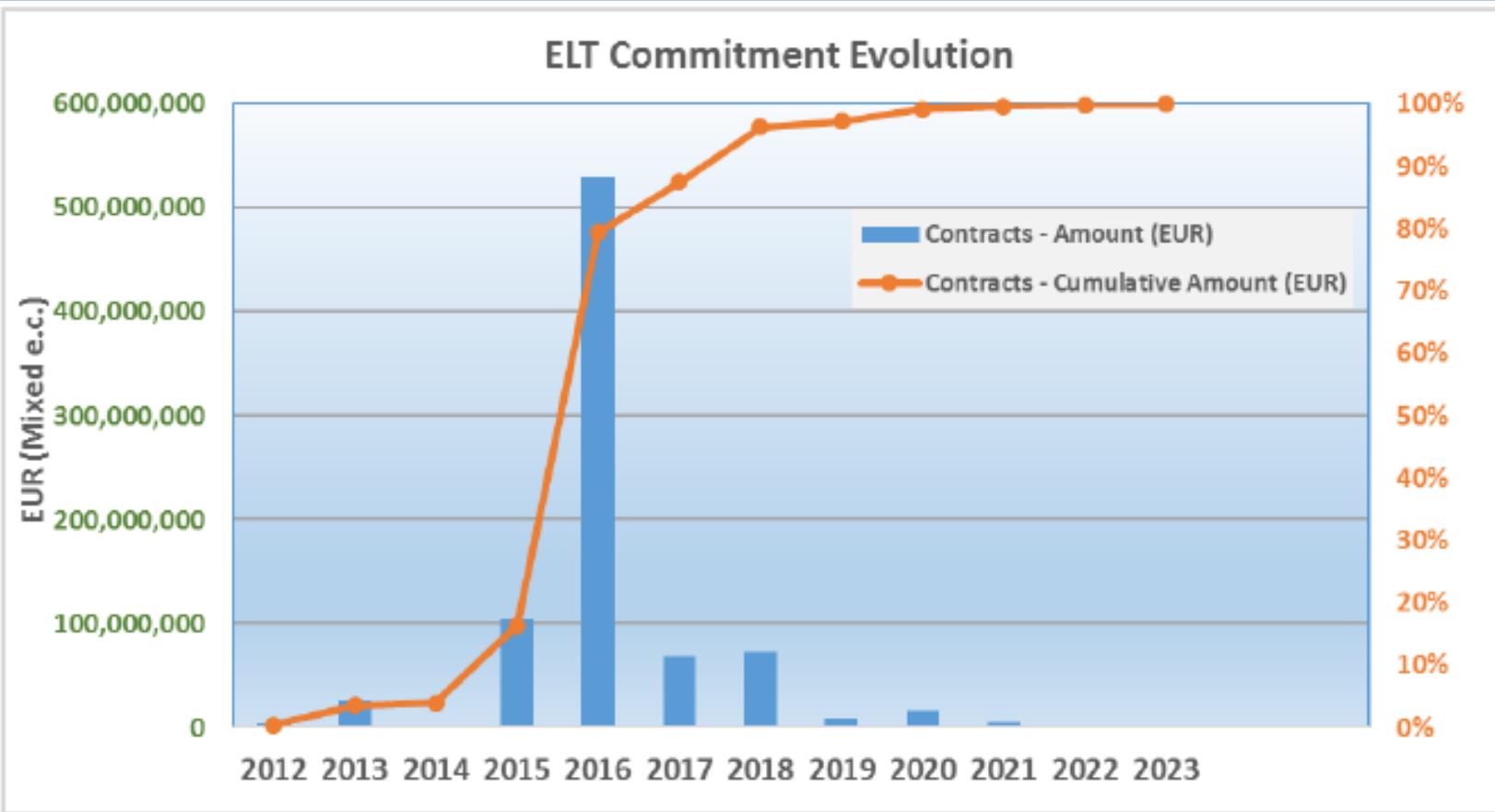
Deformable mirrors

High order >1k compact DMs
E-ELT post-focal AO systems, Multi-Object AO
and XAO



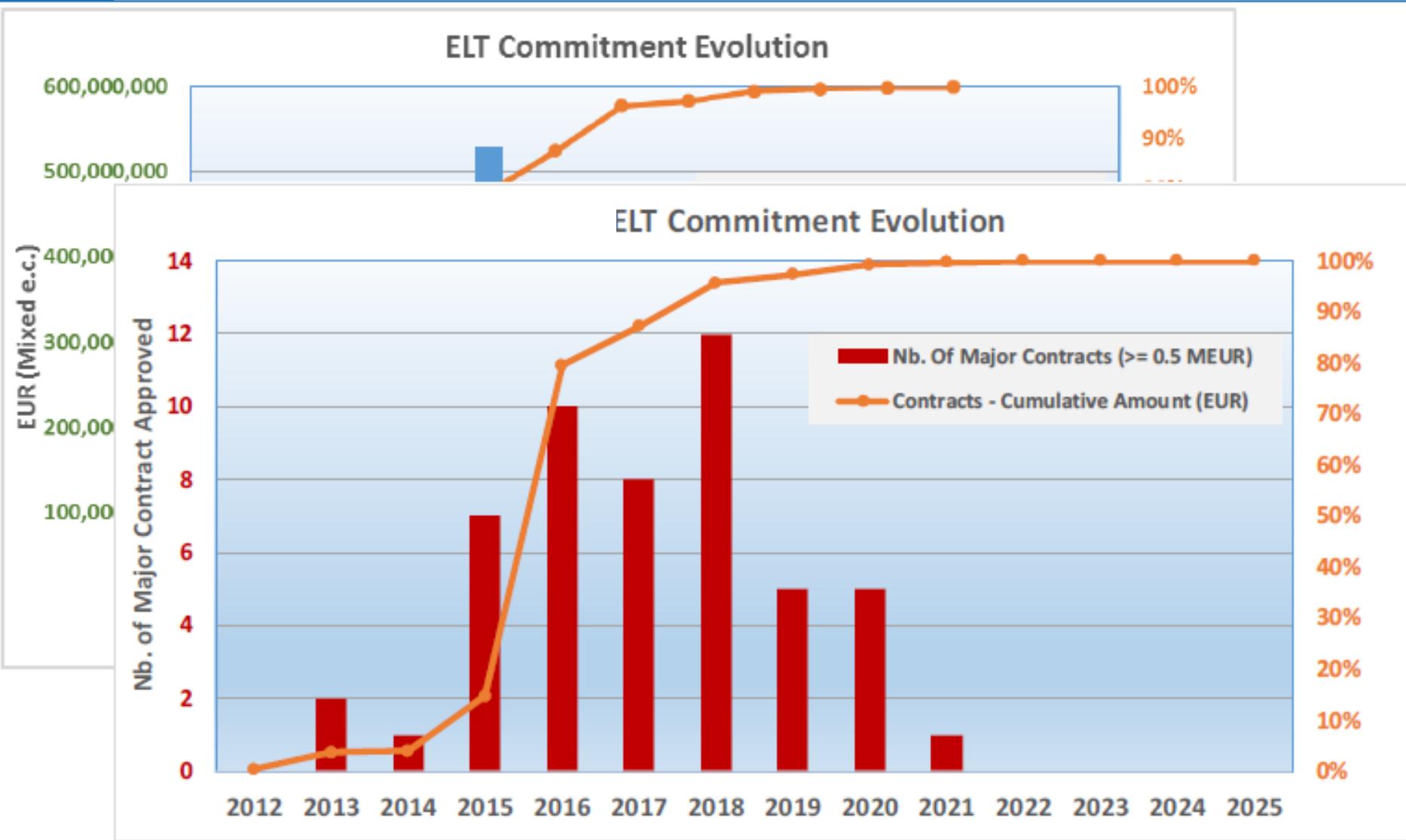
Executive Summary

Overall Status (Contracts)



Executive Summary

Overall Status (Contracts)





Executive Summary

Ongoing & Closed Major Contracts

Concluded/Ongoing Contracts	Description of Work	Contract Signature Date	Contractor	Forecast Completion Date (w/o Options)	Status
PJ42.01 Project Office	PA Consultancy Services ISVV Consultancy Services	Jan-16 Jan-16	ISQ Critical Software	Dec-18 Dec-18	On-going On-going
PJ42.02 DMS	Consultancy Support DM&S Design and Construction Contract	Jun-13 May-16	Ramboll ACe Consortium	May-18 May-23	On-going On-going
PJ42.03 Optomechanics	M4 Phase 1 Preliminary Design M4 Unit Final Design and Manufacturing M1 Segment supports - Qual. Units M1 Segment supports - Qual. Units M4 Mirror Shells Supply M2 Mirror and Auxiliary Equipment Supply M2 Blank Supply M3 Blank Supply M3 Mirror and Auxiliary Equipment Supply M2 and M3 Cell Design and Manufacturing M1 Edge Sensors Design and Manufacturing M1 Mirrors Polishing M1 Blanks Supply M1 Position Actuators	May-12 Jun-15 Jan-15 Feb-15 Jul-15 Jul-16 Jan-17 Jan-17 Feb-17 Jan-17 Jan-17 May-17 May-17 Jun-17	AdOptica AdOptica VDL CESA Safran Reosc Safran Reosc Schott Schott Safran Reosc Sener FAMES Safran Reosc Schott PI	Jan-15 Jan-23 Jul-17 Aug-17 Nov-23 Jul-24 Jan-19 Jul-19 Sep-23 Jul-22 May-22 Jun-23 Sep-22 Sep-22	Closed On-going On-going On-going On-going On-going On-going On-going On-going On-going On-going On-going On-going On-going
PJ42.05 Civil Infrastructure	Road and Platform	Dec-13	ICAFAL	Feb-17	Closed
PJ42.06 Support Infrastructure	Supply, and installation of ABC Power Substations (23kV + 0.4 kV)	Oct-16	SIEMENS	Jul-17	On-going
PJ18.10 Instrumentation	MICADO Construction HARMONI Construction METIS Construction MAORY Construction	Oct-15 Oct-15 Oct-15 Feb-16	MPE STFC NOVA INAF	Mar-25 Apr-26 Mar-26 Aug-25	On-going On-going On-going On-going



ESO – Gabriel Marquette ILO France

Le rôle de l' « Industrial Liaison Officer » (ILO):



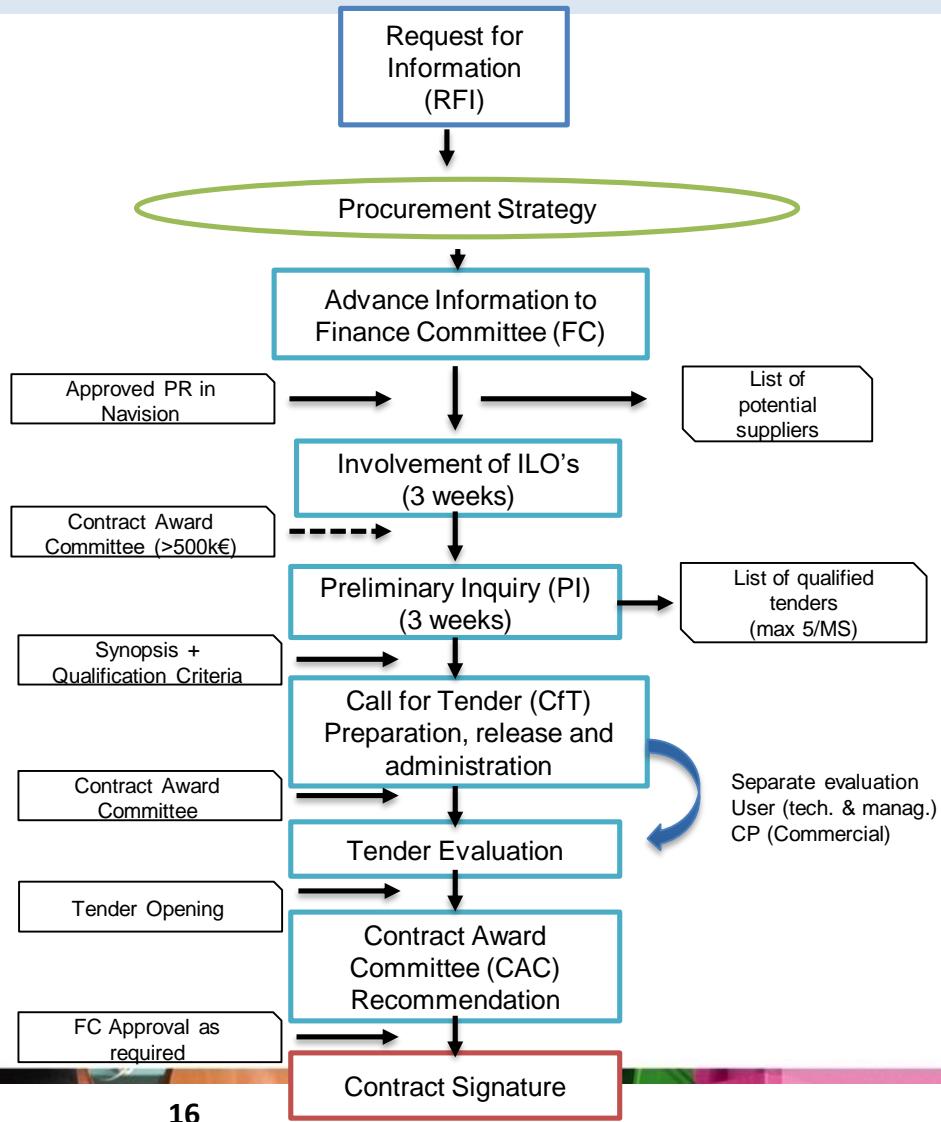
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” The role of the Industrial Liaison Officer is to establish contacts between ESO and (potential) suppliers and to support ESO in its search for the different suitable suppliers in their respective country in order to maximize the chance to distribute the ESO contracts as fairly as possible amongst suppliers in the different Member States”

ILO pour la France: Gabriel Marquette (Gabriel.MARQUETTE@cnrs-dir.fr)

ESO Procurement Process

Typically used for
Procurements
> 150k EUR



Procurement Policy (1/2)

- **Overall objective**: technical excellence at an affordable cost.
- In accordance with key principles for Public Procurement:
 - Non-discrimination
 - Transparency
 - Accountability
 - Fairness, economy and efficiency

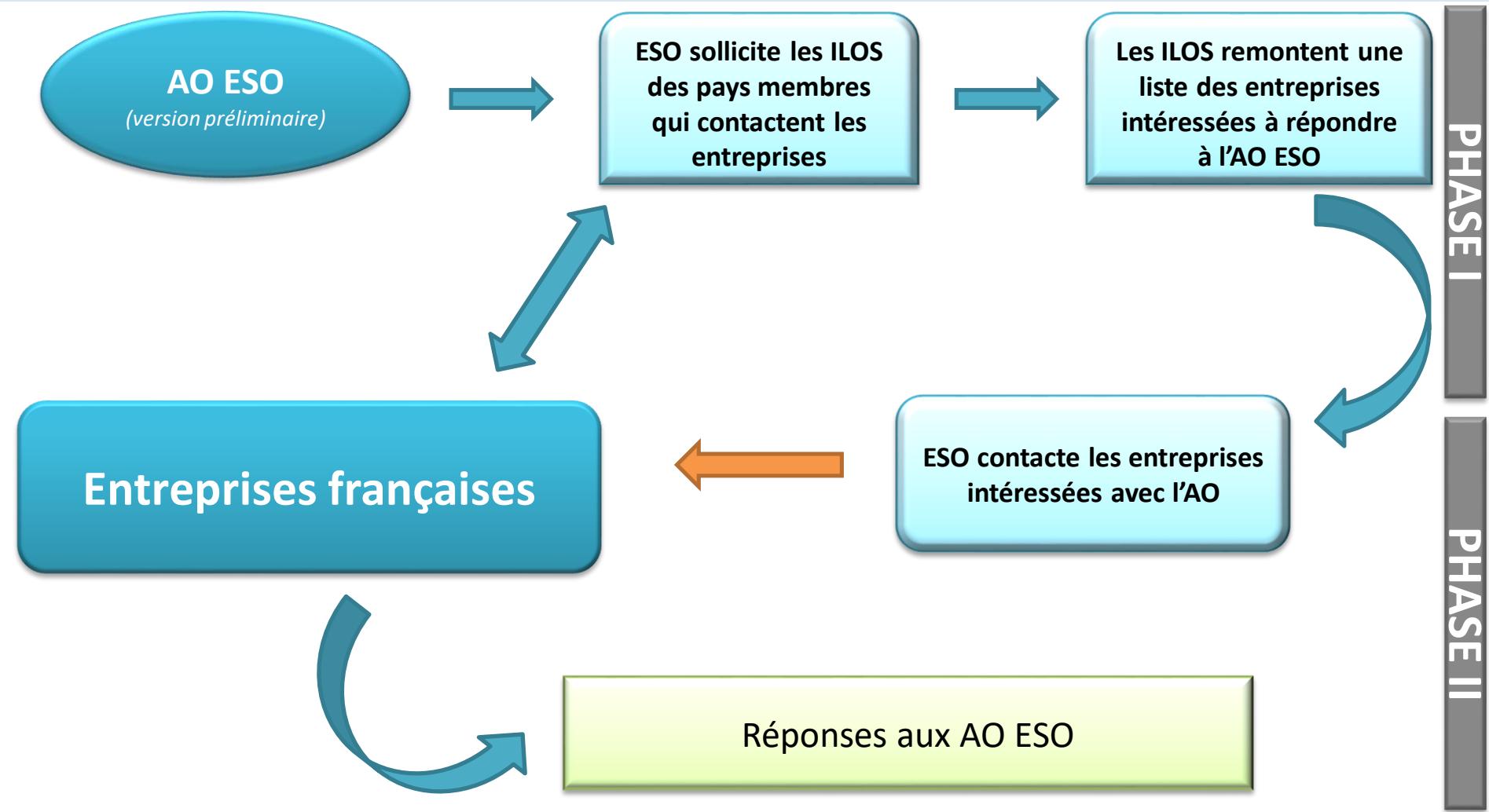
Procurement Policy (2/2)

- Requirements from ESO Financial Rules and Regulations:
 - Competitive Tendering;
 - Within ESO Member States;
 - Contracts awarded to the lowest priced technically and managerial compliant tender;
 - Fair distribution of the contracts among the ESO Member States.

- **Changements dans les règles de procurement:**
 - Best Value for Money
 - Prise en compte de la Performance et de l'Innovation
 - Internationalisation



AO ESO très ciblés





AO ESO préliminaires (exemples)



- ✓ Visible Detectors for the HARMONI Instrument of the ELT (RFI to be released approx. in June 2018)
- ✓ Design, Manufacture, and Certification of the ERIS System Handling Tool (3rd Qtr. 2018)
- ✓ Service Contract for the Supply of Cryogenic, Noble and Industrial Gases for the ALMA Observatory, near San Pedro de Atacama (2nd Qtr. 2018)
- ✓ Software Maintenance and Development Services for the Paranal Observatory Site (2nd Qtr. 2018)
- ✓ Design, Production, Verification and Delivery of the M1 Segment Assembly Manipulator and Design, Prototyping, Production, Verification of the M1 Local Optical Phasing Sensor of the ELT (2nd/3rd Qtr. 2018)
- ✓ Etc.

Consultables à tout moment sur le site de l'ESO:

<http://www.eso.org/public/industry/cp/docs/CFT-advance.html#Released>

Exemples de la contribution française dans ESO

ALMA

- **Alcatel Space Industries** : ALMA Prototype Antenna
- **CNRS**: Development of Software for ALMA
- **Derains & Gharavi**: Law firm for arbitration procedure
- **Observatoire de Bordeaux**: Tunable Filter Bank Card Production
- **SIVECO Group**: Computerised Maintenance Management System
- **The AEM Consortium (TAS, EIE, MT-Mechatronics)**: Antennas



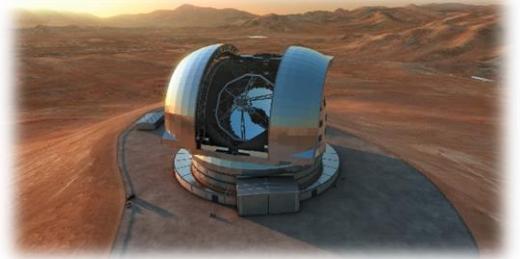
VLT

- **SODETEG**: Inflatable Shelter
- **AEROSPATIALE**: Feasibility Study for M2
- **ONERA**: Demo Prototype
- **G.I.E. TELAS**: ALU MIRROR BLANK
- **REOSC**: Polishing and coating of mirrors
- **CEN (Cegelec Groupe Energie Nucléaire)**: THERMAL CAMERA
- **SAGEM SA**: DSM Spare Thin Shell
- **CILAS S.A.** : High order deformable mirror

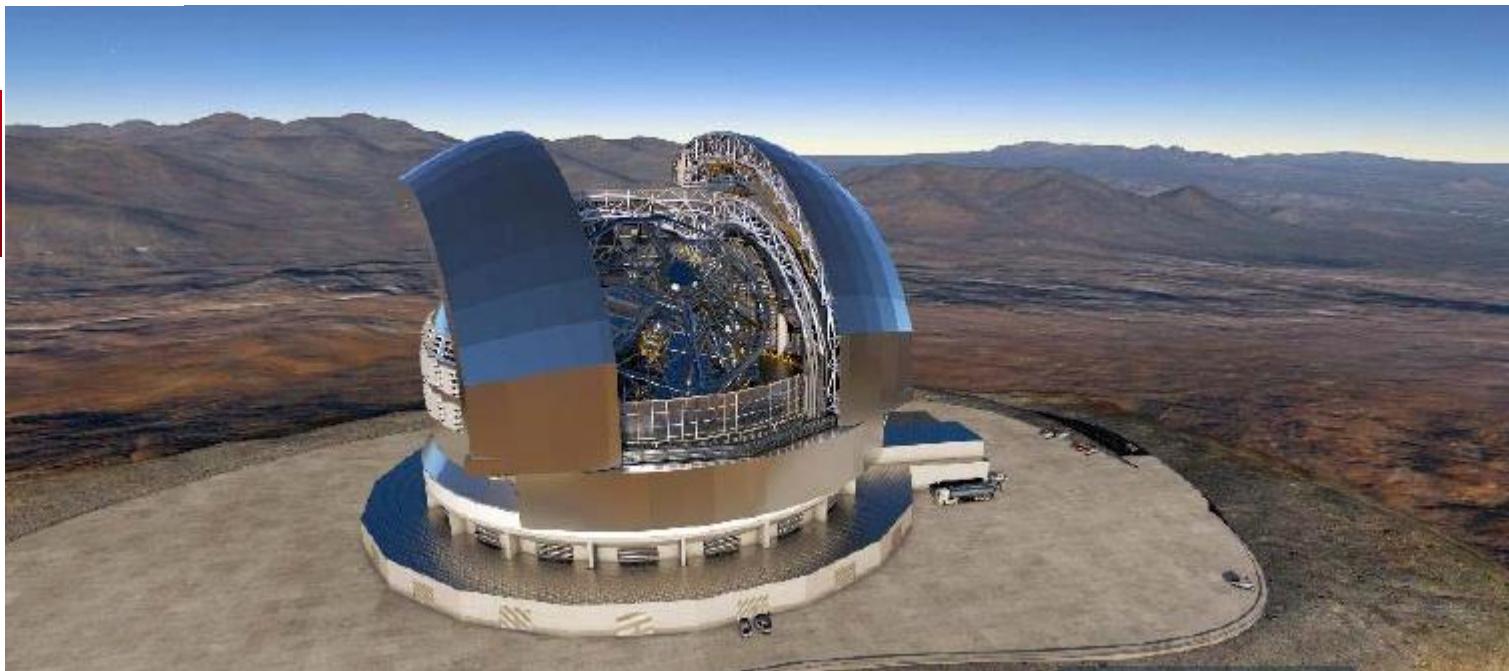


ELT

- **CILAS**: Design Study for M4 Adaptive Unit for ELT
- **SAGEM SA**: Procurement of 7 ELT primary mirror segment prototypes
- **ONERA**: ELT Laser tomographic module design study
- **SAFRAN REOSC**: M1, M2, M3, M4, ...



ESO French Industry Day



ESO French Industry Day



La première édition française de l'ESO Industry Day a eu lieu le 20 juin 2017 à l'Institut d'astrophysique de Paris



Les participants à la première journée ESO France 2017



Session plénière dans l'amphithéâtre de l'IAP.



Les "one-to-one meetings" entre les participants et les représentants de l'ESO

Base de données : Industriels



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Objectifs: avoir une base de données à jour recensant le plus grand nombre d'entreprises françaises et leurs compétences afin de mieux cibler les AO ESO et augmenter la participation française (= nombre de contrats).

66 entreprises françaises recensées

Divisées en 8 catégories:

- Optiques
- Equipements
- Cryo
- Métrologie
- Fabrication
- Matériaux
- Computing
- Imagerie



Pour apparaître dans la base de données,
contacter: Kristiana Stoitseva
(Kristiana.STOITSEVA@cnrs-dir.fr)



Prochaines étapes



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✓ **ILO ESO:**

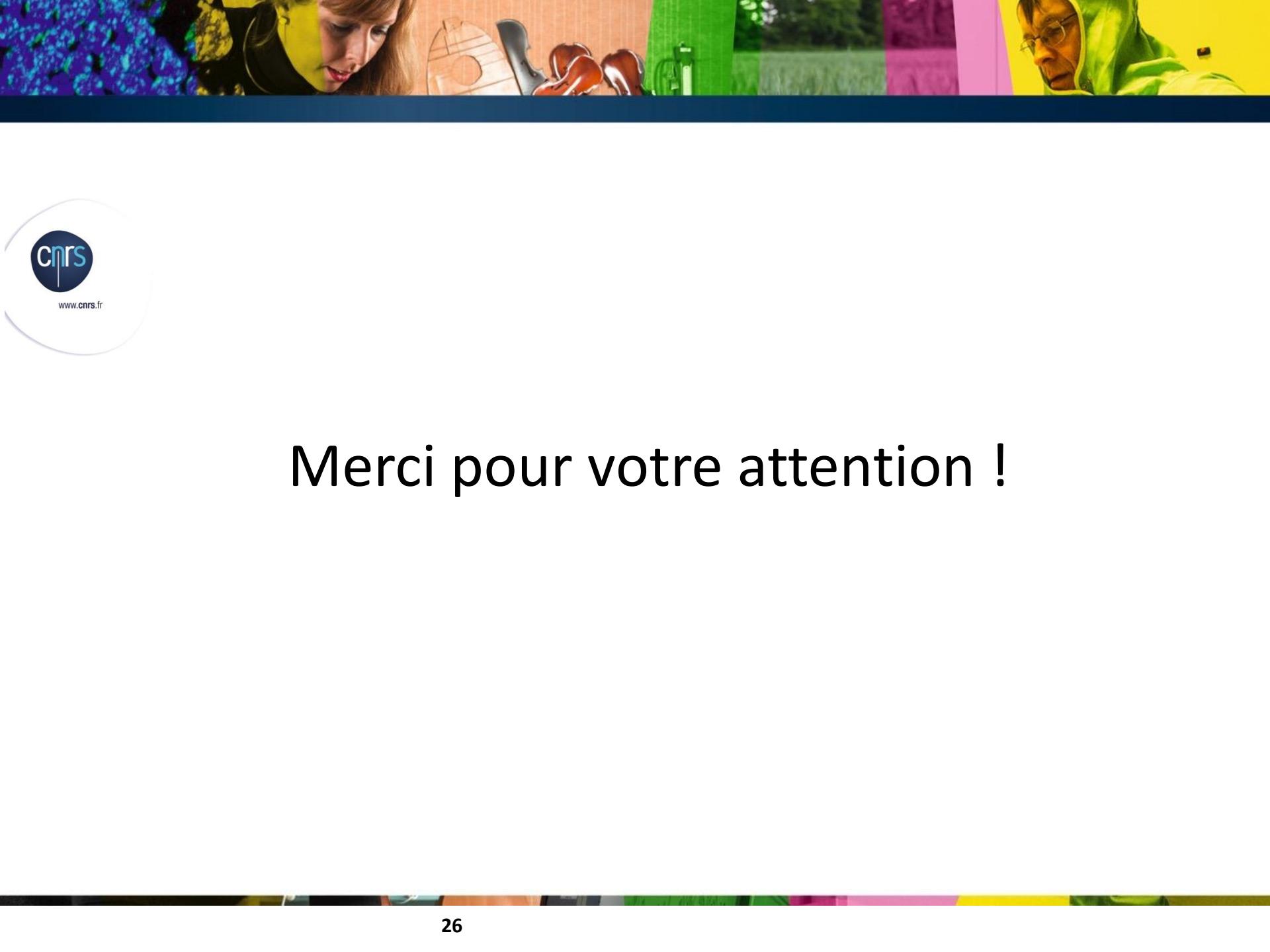
- ✓ Cartographie industrie française ESO
- ✓ Faire connaitre et reconnaître les compétences/expertises françaises
- ✓ Préparer les entreprises aux réponses des futurs AO: R&D, partenariats

✓ **Un réseau d'ILOs France:**

- ✓ Partage des bases de données
- ✓ Partage des meilleures pratiques
- ✓ Faire évoluer les règles de Procurement
- ✓ Faire évoluer les règles sur la PI et sur les droits d'exploitation

✓ **Big Science Business en France:**

- ✓ Etude du marché Big Science pour la France
- ✓ Intégration des entreprises dans le processus dès la maturation des TGIR
- ✓ Contribution forte au prochain BSBF



Merci pour votre attention !



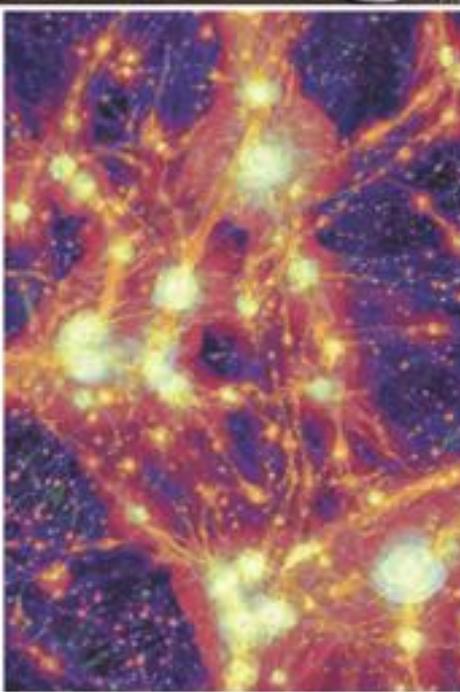
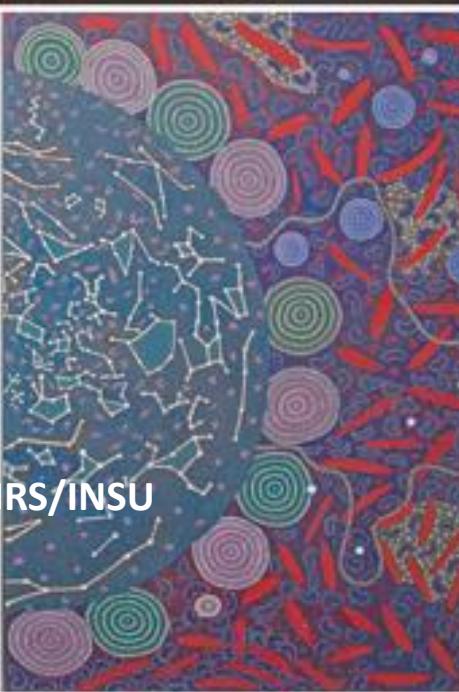
Square Kilometre Array

un radiotélescope pour observer l'Univers au cours de toute son histoire et un business model innovant pour les TGIR



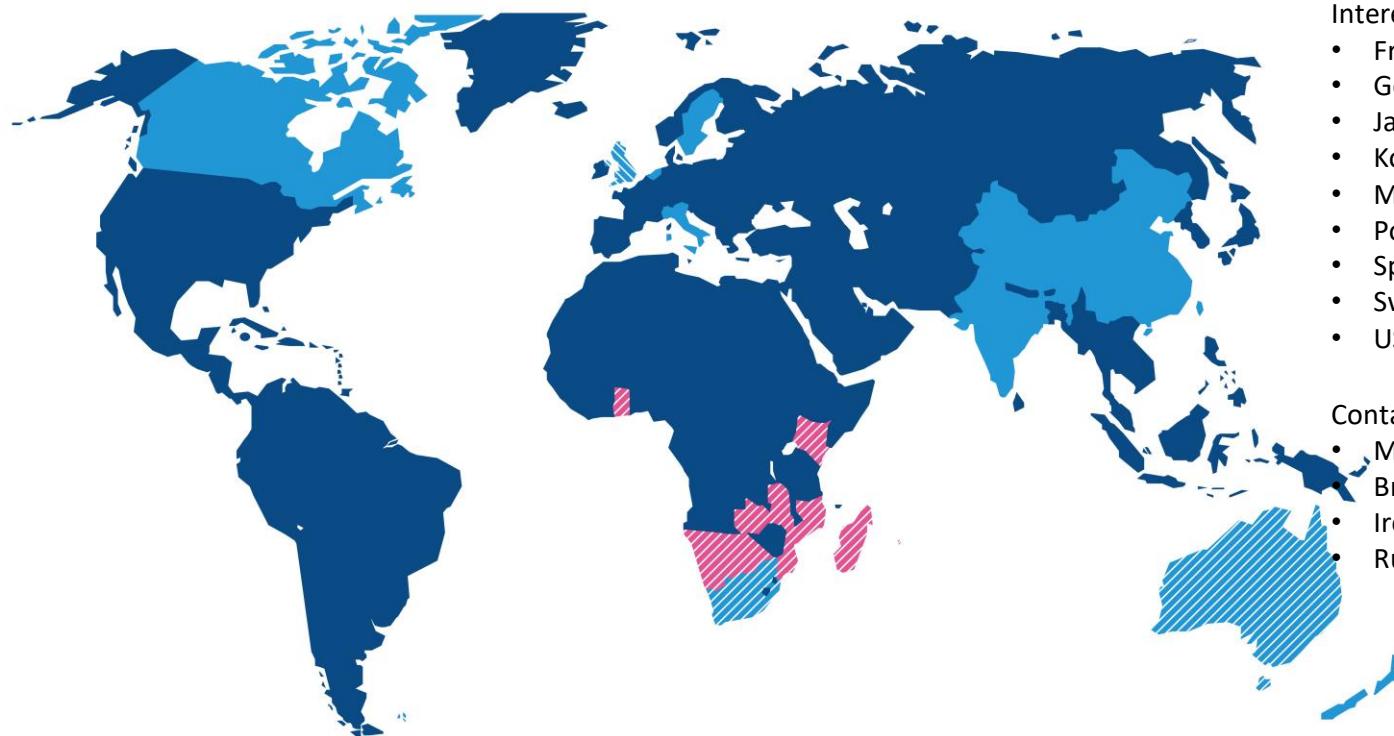
Gabriel Marquette

Relations Industrielles CNRS/INSU
French ILO for SKA
Member of SKA PSOW



SKA Organisation: 10 countries, more to join

Australia (Dol&S)
Canada (NRC-HIA)
China (MOST)
India (DAE)
Italy (INAF)
Netherlands (NWO)
New Zealand (MED)
South Africa (DST)
Sweden (Chalmers)
UK (STFC)



- Full members
- SKA Headquarters host country
- SKA Phase 1 and Phase 2 host countries



- African partner countries
(non-member SKA Phase 2 host countries)

This map is intended for reference only and is not meant to represent legal borders

Interested Countries:

- France
- Germany
- Japan
- Korea
- Malta
- Portugal
- Spain
- Switzerland
- USA

Contacts:

- Mexico
- Brazil
- Ireland
- Russia

L'objectif scientifique clé de SKA: l'histoire de l'Univers



Aube du cosmos
(premières étoiles et galaxies)

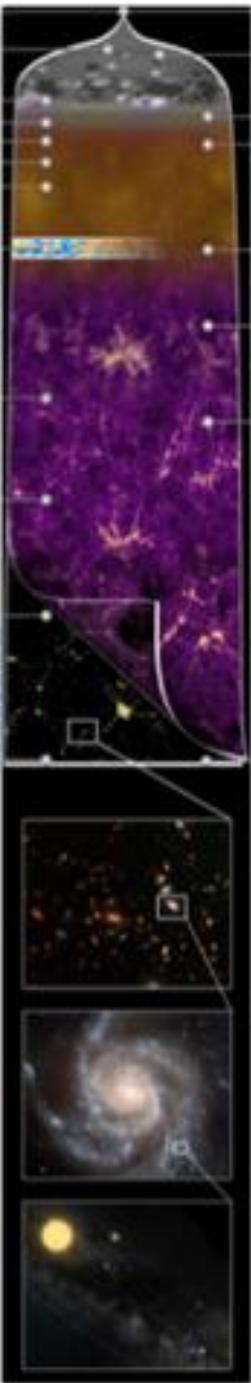
Cosmologie
(énergie sombre et structure à
grande échelle)

Evolution des galaxies
(contenu en gaz et formation de
nouvelle étoiles)

Magnétisme cosmique
(origine et évolution)

Physique fondamentale (objets
compacts)

Berceau de la vie
(planètes, molécules, SETI)



Technological challenges

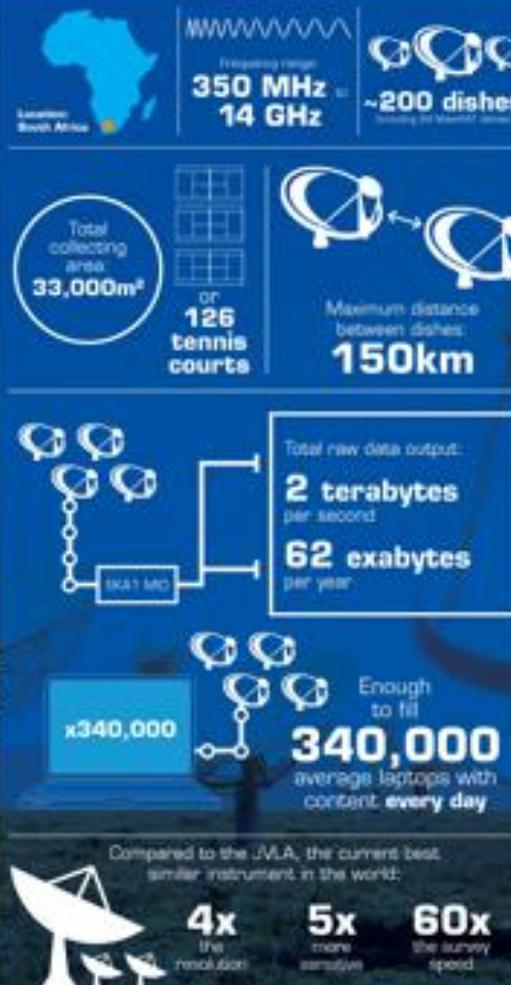
SKA1 LOW - the SKA's low-frequency instrument

The Square Kilometre Array (SKA) will be the world's largest radio telescope, revolutionising our understanding of the Universe. The SKA will be built in two phases - SKA1 and SKA2 - starting in 2019, with SKA1 representing a fraction of the full SKA. SKA1 will include two instruments - SKA1 MID and SKA1 LOW - observing the Universe at different frequencies.



SKA1 MID - the SKA's mid-frequency instrument

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Perspectives industrielles



SKA1-MID



SKA1-LOW

8,8 Tb/s



7,2 Tb/s

~2 Pb/s



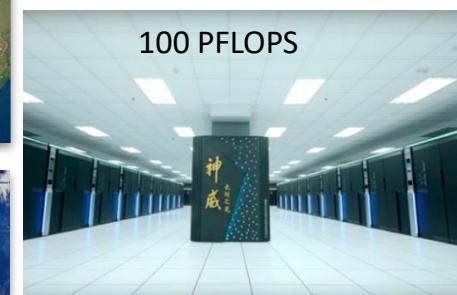
50 PFLOPS



5 Tb/s



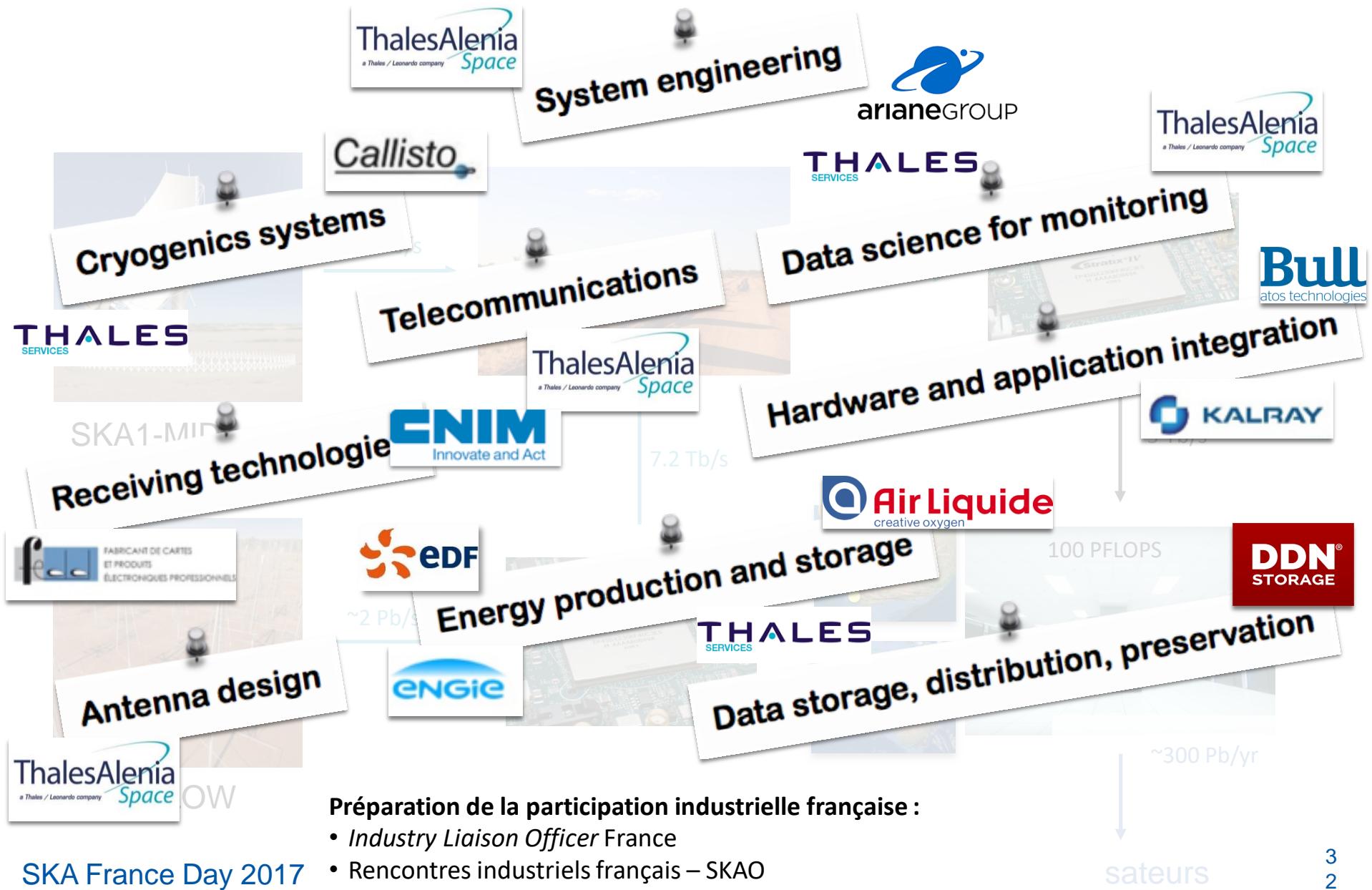
100 PFLOPS



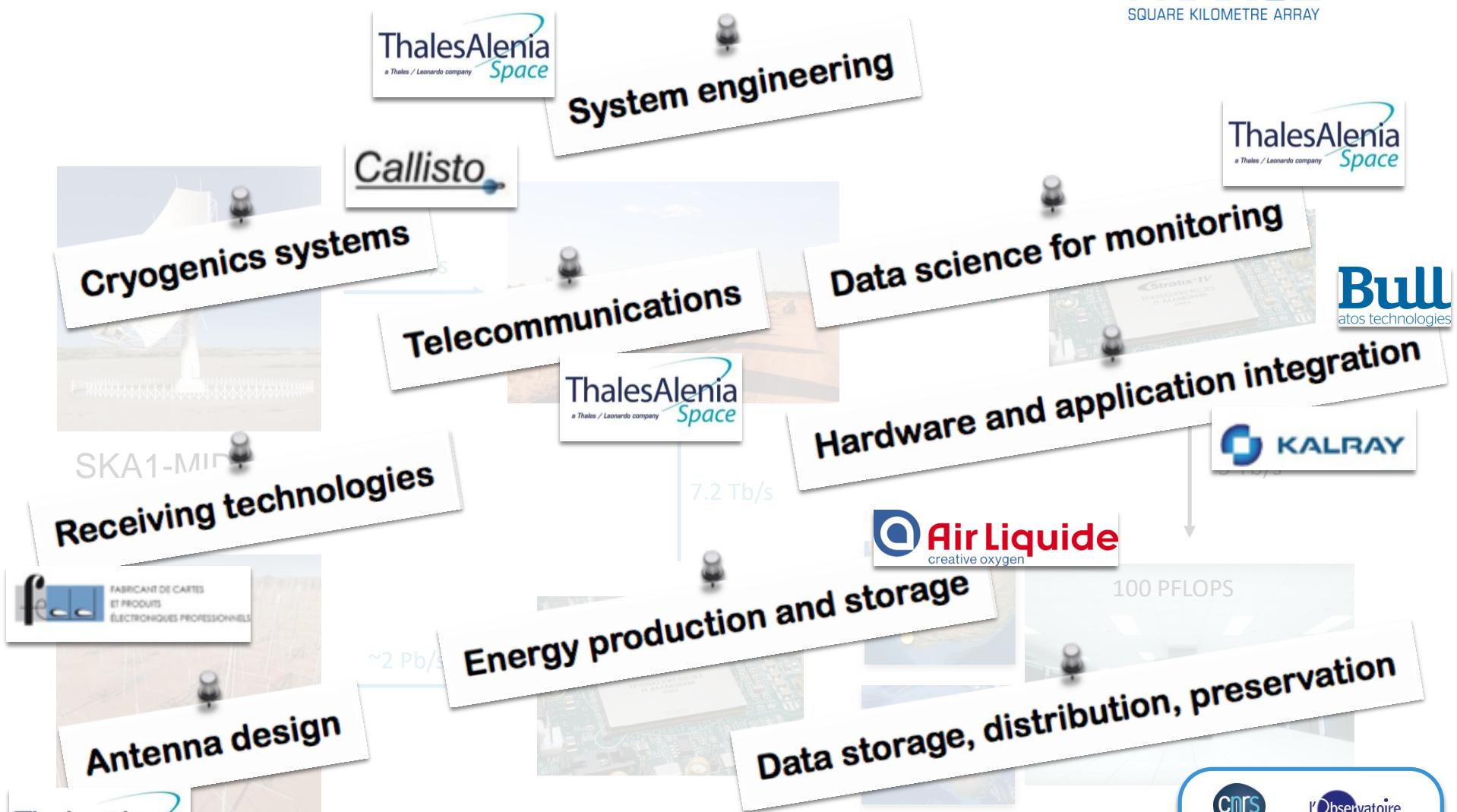
~300 Pb/an

Utilisateurs

Perspectives industrielles



Maison SKA-France



- Protocole d'accord signé entre 11 partenaires (CNRS = chef de file)
 - + 4 autres partenaires en discussion
- Montants des contributions : > 250 k€/an + investissements sur fonds propres (R&D, études)



Tableau de bord des *Critical Design Reviews*

Element	RRN Submission	CDR Submission	CDR Meeting	CDR Close
Telescope Management	Thalès Services 1 January 2018	28 February 2018	17-20 April 2018	29 June 2018
Signal & Data Transport	17 January 2018	28 February 2018	15-18 May 2018	13 June 2018
Infrastructure Australia	Engie, EDF, CNIM Air Liquide	30 April 2018	27-29 June 2018	31 July 2018
Infrastructure South Africa	19 March 2018	30 April 2018	2-4 July 2018	31 July 2018
Central Signal Processing	Kalray, Bull (includes PSS, LMC, CDR and CDR sub-elements)	30 June 2018 (includes LMC sub-element)	25-28 September 2018	31 October 2018
Science Data Processing Pre-CDR	Bull, Thalès Services 17 September 2018	25 April 2018	20-22 June 2018	
Science Data Processing CDR	17 September 2018	31 October 2018	17-19 December 2018	28 February 2019
Low Frequency Aperture Array	Thalès Alenia Space	11 October 2018	17-19 December 2018	28 February 2019
Dish Array Pre-CDR	FED, Calisto, CNIM, AirLiquide	28 September 2018	8 November 2018	TBD
Dish Array CDR	17 September 2019	July 2019	TBD	TBD
Assembly, Integration & Verification	17 September 2018	October 2018	December 2018	February 2019
System CDR			30 March 2019	31 July 2019

Vert : phase passée avec succès

Orange : conclusion attendue



Rouge : potentielle évolution du calendrier

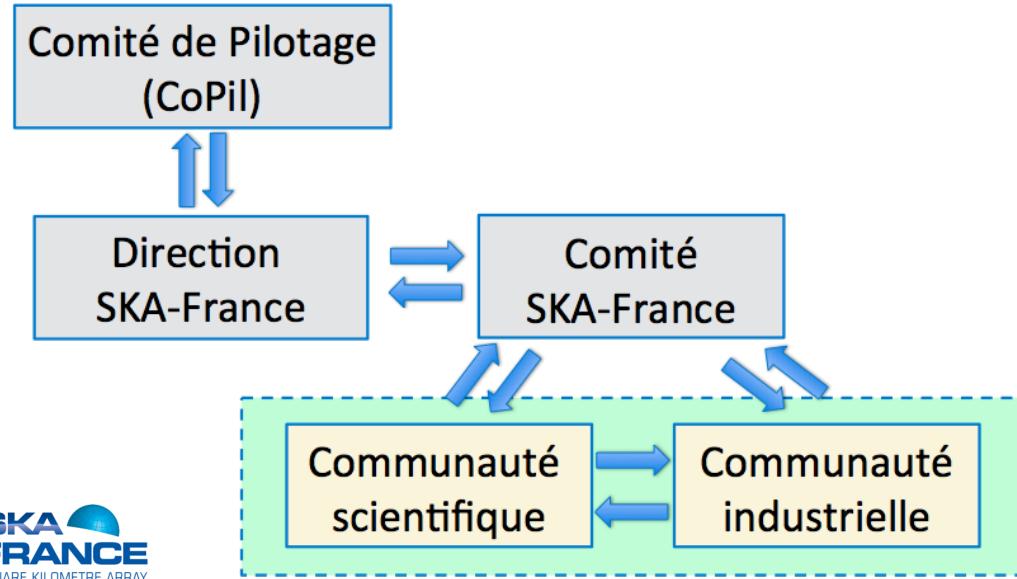
Approche intégrative et Impact socio-économique

- **Intégration de l'ensemble des coûts, de la phase recherche jusqu'à l'industrialisation**
- **Développement d'un nouveau relationnel avec le monde économique en associant les partenaires industriels dès la phase d'étude du TGIR:**
 - Optimisation des coûts de R&D
 - Meilleur positionnement pour la réponse aux AO
- **Mise en place d'un modèle d'affaires innovant permettant l'engagement des investissements sur le long terme**
 - Minimisation des pertes liées aux échecs aux AO
 - Calcul du ROI en prenant en compte les aspects marketing, impact, image, marché(s), contrats longue durée, etc.
 - Financement public-privé du TGIR possible !
- **Partage des cultures et des contraintes avec les donneurs d'ordre (ministères, TGIR):**
 - Règles de procurement, réalité des coûts complets, stratégie d'entreprise

Maison SKA France



- * A MoU, strong real equilibrated PPP, between research organisations and their industry partners
- * A science and technology roadmap
- * A forum to develop fundamental research and R&D projects
- * A precursor of a new business model for Large Research Infrastructures



Merci !

