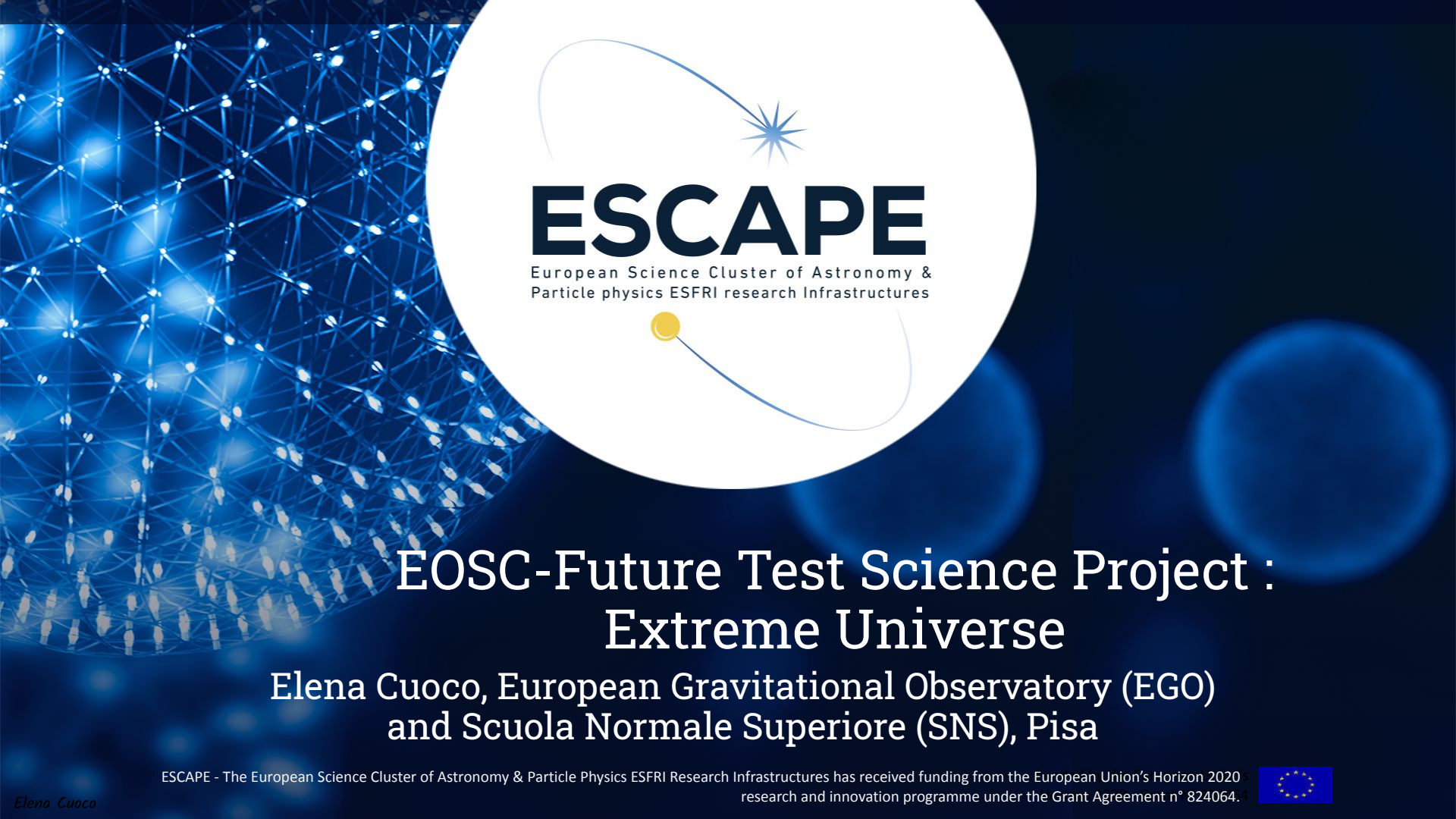

EOSC-Future Test Science Project : Extreme Universe

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ESCAPE - The European Science Cluster of Astronomy & Particle Physics ESFRI Research Infrastructures has received funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement n° 824064.

Goals of the Extreme universe Test science project

- ➔ Exploit Astrophysical extreme phenomena through the gravitational waves, GRB, FRB, neutrino messengers.
- ➔ Understand extreme matter and particle processes in strongly curved space-time and compact objects
- ➔ Building convincing science cases proto-EOSC for MMA and Extreme Universe studies

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Pilot projects

Main Research Area	Objects/sources	Messengers	ESF/RI involved	ESCAPE services EOSC-Future integrations	Data Analysis tools (AI,ML)	Pilot project(s)	Computing resources required	Partner PM involved
Compact objects	*Pulsars,..*	*radio, GW,...*	*LOFAR...*	*Multimessenger platform/Software catalogue,...*	*Machine Learning*	*1) Radio astronomy: FRB*		*42 PM Astron,...*
High energy Astrophysics	*GRBs, jets, AGN, BNS, CCSN*	*neutrinos, gamma-ray, radio,X-ray, GW,...*	*CTA, Virgo, KM3NET, SKA,LSST*	*Multimessenger platform/Software catalogue,...*	*Model comparison, Machine Learning*	*1)GRB/neutrino/GW analysis, 2) Blazar MWL/neutrino*	*GPU cluster Jupyter hub*	*12 PM UVa, 6 PM FAU. CNRS, 12 PM SNS*
Fundamental physics	*Dark matter, GR, Primordial Universe*	*GW,*	*Virgo, Einstein Telescope*	*Template banks, generation software,...*	*Machine learning approach*	*1) DM template bank and ML analysis pipeline 2) GW Stochastic background*	*GPU cluster Jupyter hub*	*10 PM INFN,12 PM UvA, 12 PM SNS, 2 PM FAU ...*

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Plan of the work

We will continue with the project already started in ESCAPE, focusing on the realizations of **End to End workflow**

1. **Select the scientific goal: (<6 months)** ✓
   a. **See table**
2. Evaluation of database, data, census of software already in place in the different participating ESFRI and assessment of interoperability (< 6months),
3. Organization of datasets for the Data analysis experiment (< 6months)
4. Development, implementation (18 months)
5. Publication, prototype release on EOSC portal (30 months)

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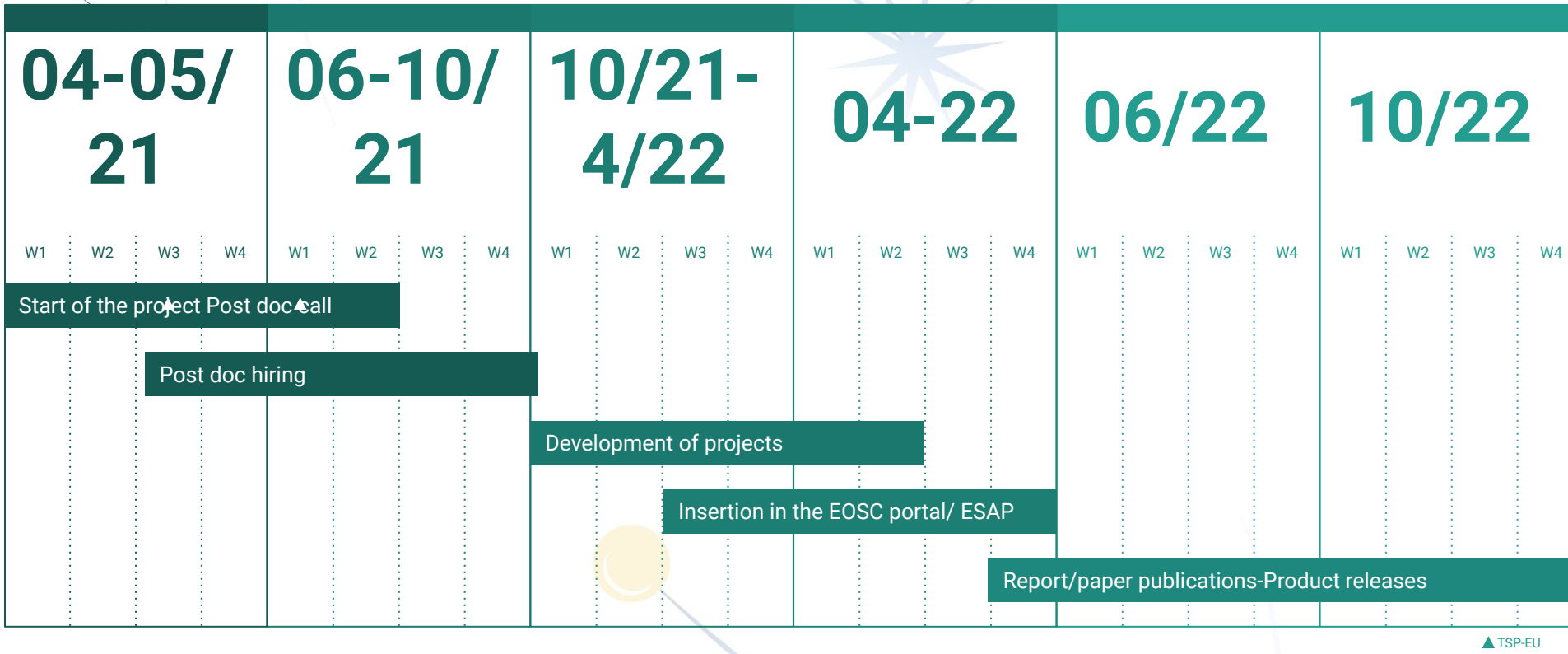
TSP- EU timeline



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ESCAPE services

Which kind of ESCAPE service are we going to use?

- AAI authentication service
- Data lake
- Data analysis platform (ESAP)
- Software catalogue
- Virtual Observatory
- Citizen science links
- ...

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Detailed project: *Compact objects, pilot1*

Team/Lab/ESFRI involved: Vedantham, Hessels, Swinbank, van Haarlem, Meyer / ASTRON / LOFAR (42 PM)

- Classify sources in LoTSS.
- Radio as probe of particle acceleration.

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Detailed project: *High Energy Astrophysics, pilot1*

Team/Lab/ESFRI involved: INFN 1O PM , SNS 12 PM ,FAU 6PM, LAPP 6PM

- GW, Neutrino, GRB multimessenger analysis
- Real time ML platform

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Detailed project: *High Energy Astrophysics, pilot2*

Team/Lab/ESFRI involved: UVA 12PM, FAU 6PM, LAPP 6PM?

- Developing capabilities for joint modeling of MWL observations from radio though X-rays with very-high-energy (VHE) gamma-rays from CTA and VHE neutrinos from KM3NET.

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Detailed project: *Fundamental Physycs, pilot1*

Team/Lab/ESFRI involved: UVA 12PM, SNS 12PM,...

- Exotic GW waveform template and ML application
  - Waveform template generation and database inclusion
  - ML application for the detection

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Detailed project: *Fundamental Physycs, pilot2*

Team/Lab/ESFRI involved: 10 PM INFN, SNS...

Modeling, detection and parameter estimation for non-Gaussian stochastic backgrounds of gravitational waves.

The two key ingredients are:

- *A Markov chain Monte Carlo procedure which generate segments of data for a network of detectors with the correct statistics,*
- *A fast superposed waveform generator, which will be optimized by using machine learning techniques.*

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Additional requests

- MoU for data sharing. Easy access and templates for the teams
- Policy for publications?
- In kind/ external participation. Do we need to formalize?

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Open the call

- Some partners are ready to launch the call
- Need to have the GA in place at least
- Ian already prepare the general header, we need only to specify the call for the single project/lab

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