XV ET Symposium SCB Summary

The New SCB Structure





Expected Deliverables for Site Selection (see ET-PP)

Report on 3D geology, hydrology, etc. model with localisation of the ET infrastructure (Exp. in Feb26)

Complete quantification of all the aspects impacting the ET performance for each site (Exp. in July26)

Updated cost and schedule estimates of the excavations, including, if necessary: instrumentation for Newtonian Noise cancellation; costs of debris removal; costs of land acquisition, permitting, etc. (Exp. in July26)



SCB Duties

Set a common framework Risks

- Activities already on going
- Managed directly by site Host Teams
 - different organizational strategies, constrained by the national and regional fundings conditions
 - different timelines
- Site selection criteria and the optimal geometrical configuration still to be set

Steer the process to evaluate the detector performance

Risks

- ET Collaboration is still working on the definition of detector specification
- Still on-going: standard modelling and interpretation



Highlights from Sardinia

Einstein Telescope

Status Update of Sardinia Activities	Davide Rozza 🥝
Room 409 at INAF-OAS	09:10 - 09:30
Ground Motion Analysis for the Einstein Telescope: ShakeMap, Seismic Hazard, and Case Studies	Licia Faenza 🥝
Room 409 at INAF-OAS	12:10 - 12:30
Seismic array analysis in the Italian candidate site for ET	Giovanni Diaferia 🦉
Room 409 at INAF-OAS	12:30 - 12:50
Infrasonic Noise Analysis at Sos Ennatos	Wathela Alhassan 🥝
Room 409 at INAF-OAS	14:30 - 14:50
Integrated Analysis Approach for Territorial Data at the Einstein Telescope Site in Sardinia (Italy)	Monica Marzario 🥝
Room 409 at INAF-OAS	15:10 - 15:30
Geological exploration and new configuration selection for the candidate Einstein Telescope site in Sardinia (Italy) Ø Dr Giovanni Luca Cardello O	
Terrestrial and airborne gravimetry in the Sardinia (Italy) candidate area for the Einstein Telescope (ET) Filippo Greco
Room 409 at INAF-OAS	09:00 - 09:20
The impact of local noise recorded at the ET candidate sites on the signal to noise ratio of CBC gravitational wave sign. <i>Matteo Di Giovanni</i>	

8 contributions ranging from the study of site seismicity to different noise measurements, from geology, geophysics and geotechnical investigations to the estimation of ET site dependent performance





Davide Rozza on behalf of the Sardinian site characterization team

Two Geometrical Options: Δ vs 2L



Bitti 🏹

Legal Framework and authorization

Socio-economic impact

Geological studies

Site monitoring

Noise impact Evaluation









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Engineering studies

From the geological and physical point of view, Sardinia is an optimal candidate to host the Einstein Telescope, either in Δ or in L (\rightarrow 2 sites) configuration!

Ground Motion Analysis for the Einstein Telescope: ShakeMap, Seismic Hazard, and Case Studies: Take-Home Message L. FAENZA et al.

L. Faenza et al.

- Sos Enattos is one of the most seismically stable locations in Europe
 - PGA < 0.03 g for standard design events (probability of exceedance of 10% in 50 years)
 - Even under extreme scenarios (probability of exceedance for 2% in 50 years), shaking remains far below critical thresholds

->Even if the operational lifespan of the infrastructure is limited, evaluating very low exceedance probability scenarios (e.g., 10^{-4} annual probability) is essential, as the facility is critical and must be designed to withstand rare but potentially catastrophic seismic events

- Deep geological knowledge and stability
 - Rock conditions at tunnel depth confirmed
 - Attenuation of ground motion from surface to depth validated using borehole-based models
- Rich seismic data heritage
 - Centuries of historical documentation
 - Updated analysis of past events and improved instrumental monitoring
- Robust methodology, international benchmarks
 - PSHA using ESHM20 and MPS19 models
 - Scenario-based ShakeMap simulations using GMMs calibrated to real data
- Why it matters
 - Guarantees low seismic noise for gravitational wave detection
 - Supports long-term resilience and scientific excellence of the Einstein Telescope project

Seismic array analysis in the Italian candidate site for ET

G. Diaferia, C. Giunchi, I. Molinari, M. Olivieri & Sardinia Characterization Team from UniSS, UniCA, INFN





- Reliable characterization of seismic noise sources distribution in the 10-20 Hz range.
- · Wider arrays are necessary for investigating the 1-10 Hz interval.
- Beamforming shows an azimuthally homogenous source of noise at P3, propagating as surface waves in the 10-20 Hz. Both arrays in P2 show no noise coming from SE.
- The inversion of Rayleigh wave dispersion curves and analysis of HVSR spectra confirms a high-velocity, rather homogenous subsurface with no shallow resonant layer.

GEOLOGICAL EXPLORATION AND NEW CONFIGURATION





The impact of local noise recorded at the ET candidate sites on the signal to noise ratio of CBC

ET sensitivity (blue)

gravitational wave signals for the ET triangle configuration (M. Di Giovanni et al.)

- Depending on the local seismic levels, ambient noise has an impact on the ET-LF sensitivity curve;
- The higher noise level at the EMR site translate into a degradation of the ET-LF sensitivity;
- Sardinia is compliant with the ET requirements, showing only a marginal impact on ET-LF sensitivity even at the 90th percentile;
- This study is needed for the site selection process for ET may help in the design of noise suppression systems.





Highlights from EMR

Most Likely Triangle – based on current knowledge

MLT location and depth convergence based on:

- Structural geology model (16 boreholes)
- Improved definition of Bose Val-Dieu block
- Geomechanical core evaluation
- Available seismic and ERT data
- Noise evaluation upcoming

2nd borehole campaign:

- Confirm vertices/depth
 (~ 5 new boreholes ●)
- Use recently completed seismic campaign data
- Refine hydro-geological model
- Investigate L (pending approval)



Integrating subsurface data into holistic 3D model

Presentations: Yannick Forth, Michael Kiehn, Daniel Drimmer

- Borehole logging and coring results
- Hydrogeological analysis
- Seismic lines
- Electric Resistivity (ERT)
- Gravimetrics



Hydrogeological characterization







3D Inversion of Deep ERT survey in Val Dieu. This 7.5 km line was acquired using 26 receiver station and performing 300 injections.



Top view on the Deep ERT line from Val Dieu. Lateral information can be found and verified with the existing geologic maps.



Seismic line running through borehole location Hombourg, providing excellent extrapolation to other areas (e.g. Triangle Legs)



Einstein

Felescope







Noise measurements and Newtonian Noise modeling

Presentations: Stan Bentvelsen, Sacha Peters, Hadrien Michel

- We have no approved model of NN for complex geological settings
- Complex geology provides (additional) opportunity for NN mitigation
 - Team set up to develop adequate model work with SCB & ISB
- Testing validity of using neural networks for NN subtraction as mitigation option
- 10 Boreholes being equipped with downhole seismic sensors, expecting first results in Q3
- Surface noise measurements continuing around scan lines from boreholes



Ambient noise measurements layout with sensors for 1-10Hz,



Coherence measurement of seismic signals of windturbines



Evaluating deep neural networks for Newtonian noise subtraction



Stan Bentvelsen on behalf of the EMR Noise Modeling Working Group (ULiège, RWTH, Maastricht, Nikhef, Ghent, Hamburg, KULeuven)



Highlights from Lusatia

Updated gelogical map and preliminary 3D model



Based on re-evaluation of hundreds of borelogs

Sedimentary cover striped (model by Körschner, Freiberg)



Presentation by Achtziger-Zupancic, Fraunhofer



Ambient noise network in Lusatia

Spatial pattern of noise peak in Lusatia. Borehole is located in blue area

Presentation by Lindner, DZA

Full 3D seismic simulations → NN modelling

Comparisons between surface and buried stations



Poster by Yao, KIT

Sedimentary cover

How to proceed?

>NN modeling and evaluation

- □ ETC task force involving OSB-ISB-SCB-Local Teams coordinated by SCB
- □share code and recipes
- Optimization of existing tools or development of new ones should be approved by relevant ETC bodies (i.e. NN code should be approved by NN WP of ISB-ANM division)

>Geotechnical evaluation => Bid book

- □Common Table between ETO Local Teams already exists
- Lusatia should be included
- Do we also need a task force?

