ET Activities at CIEMAT and Plans

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Current GW activity at CIEMAT

LVK:

- Virgo engineering, computing, experimental GW pipelines with and without ML.
- Mechanical and system engineering team unfortunately reduced to less than 50% of a single engineer in the last years, with no technicians.
  - Direct impact: limiting the capacity of the group to commit to hardware contributions.

Einstein Telescope:

- Active participation of PIC in the E-Infrastructure Board (EIB).
- Computing & data-model.

Staffing - new hires planned (2027)

- Permanent researcher.
  - Tomislav Andric, co-lead of the new AI-for-ET transversal division
  - Experience in Reinforcement Learning control and Neural Network modelling for GW instrumentation.
- One PhD student
- The engineering team is slowly growing, unfortunately with temporary contracts and involvement not guaranteed in GW.
  - So far we have not been successful in securing funding for GW engineering (AEI PN 2023 ~100k€ direct costs for 3 years)
  - We will try again with the new request to AEI PN 2026.

Strategy - main ideas

- Sustain ongoing computing operations and initiatives.
- Drive a software-led instrumentation program centered around the new permanent research hire to advance his current work.
- Pursue hardware exploration strictly when adequate personnel resources become available.

Lines of action in ET: Work Packages

- **WP1 ET Computing & Data Model** (baseline, active)
  - Direct continuation of current PIC and CIEMAT infrastructure activities.
  - Distributed computing architecture, workflow orchestration, and data modeling for ET.
- **WP2 Intelligent Control & Simulation** (planned 2027)
  - Enabled by permanent researcher hire and new PhD student.
  - Reinforcement Learning control systems and Neural Network modelling for instrumentation.
- **WP3 Environmental Noise & Data Analysis** (planned 2027)

Risks, mitigations and safeguards

- **Funding & Budget Risks:** Potential for underfunding or delayed financial support.
- **Cost-Effective Strategy:** Focus planned activities on software development, keeping costs manageable by using permanent research staff.
- **Simulation-centric ML/RL:** Restrict ML and RL developments strictly to simulations for the time being, avoiding hardware implementation.
- **Resource Leveraging:** Capitalize on the existing ML expertise within the CIEMAT group.
- **Hardware Postponement:** Delay any commitment to hardware-related work until a robust engineering team is fully re-established.