WP5 - Data analysis and computing

FLASH Kick Off Meeting

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Summary (from Proposal)
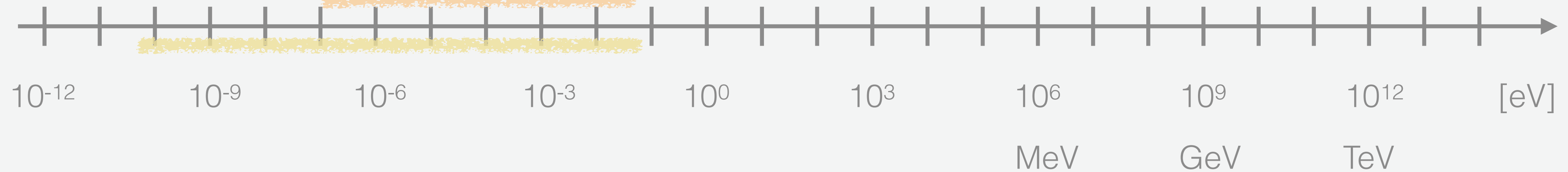
- Task 5.1: Searching for Axion Like Particles
  - Baseline analysis
  - More modern approach of the data analysis (ML)

- Task 5.2: Searching for High Frequency Gravitational Waves
  - Sort out model dependencies
  - Time domain analysis, new development
  - Combination of data streams from participating sites

- Task 5.3: Computing Infrastructure
  - Computing model of QUAX experiment will be used
  - Data Handling

- Task 5.4: Run Automation
  - Design and requirements for run automation, including calibration and tuning

- **Axions**:
  - Monochromatic signals, infinite duration
  - Integration in **frequency domain**
  - New analysis concepts: noise supression

- **HFGW**:
  - Transient signals, µs - ms duration
    - For PBH mergers
  - Analysis in **time domain**
  - Challenges:
  - Signal / Noise discrimination
  - Combination of various frequencies / location
    - In contrast to radio astronomy not a clear signal in each detector

- Both signal sources need dedicated analysis strategies
  - Potentially same data could be used

- Need to store time series data
  - Dictates needed storage / computing resources

Ongoing efforts at Mainz and Bonn

- **Axions @ Mainz**:
  - **Standard analysis** currently ongoing
    - Frequency sweep in measured data
    - Integration and noise reduction in **frequency domain**
    - **Statistical analysis** in frequency domain
    - No ML in base - analysis

- **HFGW @ Bonn**:
  - Initial studies of possible analysis strategies
  - **ML classifiers** identifying signal like time series
    - Generation of training data in progress
    - **DNN** and **transformer** networks being studied

- **HFGW @ Mainz**:
  - Simple analysis (no ML)
    - Short (10 ms) chunks of time-series data analysed in frequency domain to find power excess
    - Used for sensitivity estimates

- Current person power:
  - Mainz:
    - 1 PhD student + 0.25 PostDoc

  - Bonn:
    - 1 Master + 1 PhD student

- Expected to increase next year

Future Goals

- **Explore novel analysis techniques**
- Usage of **ML algorithms**

  - Frequency Domain: Noise suppression
    - Auto Encoders, Classifiers

  - Time Domain: Signal vs. Noise classification
    - Classifiers (optimal network type?)
    - Anomaly detection ….

- **Some questions to think about for TDR:**
  - Data storage and handling
    - Storage sites -> INFN & Bonn foreseen
    - Needed capacity?

  - Computing model
    - Data formats
    - Resources needed
      - Distributed computing
    - Common analysis frameworks?

WP5 Organisation

- Groups in volved from proposal:
  - Bonn, LMF, Mainz, Pisa

More analysers welcome!
Who is interested to join?

- Suggesting concise bi-weekly meeting to keep all involved groups in touch

- Dedicated mailing list would be nice. Could be hosted at Bonn, at CERN or elsewhere?