

# Polish Virgo activities

**Main topics: CW & Detchar ; development of ML techniques**

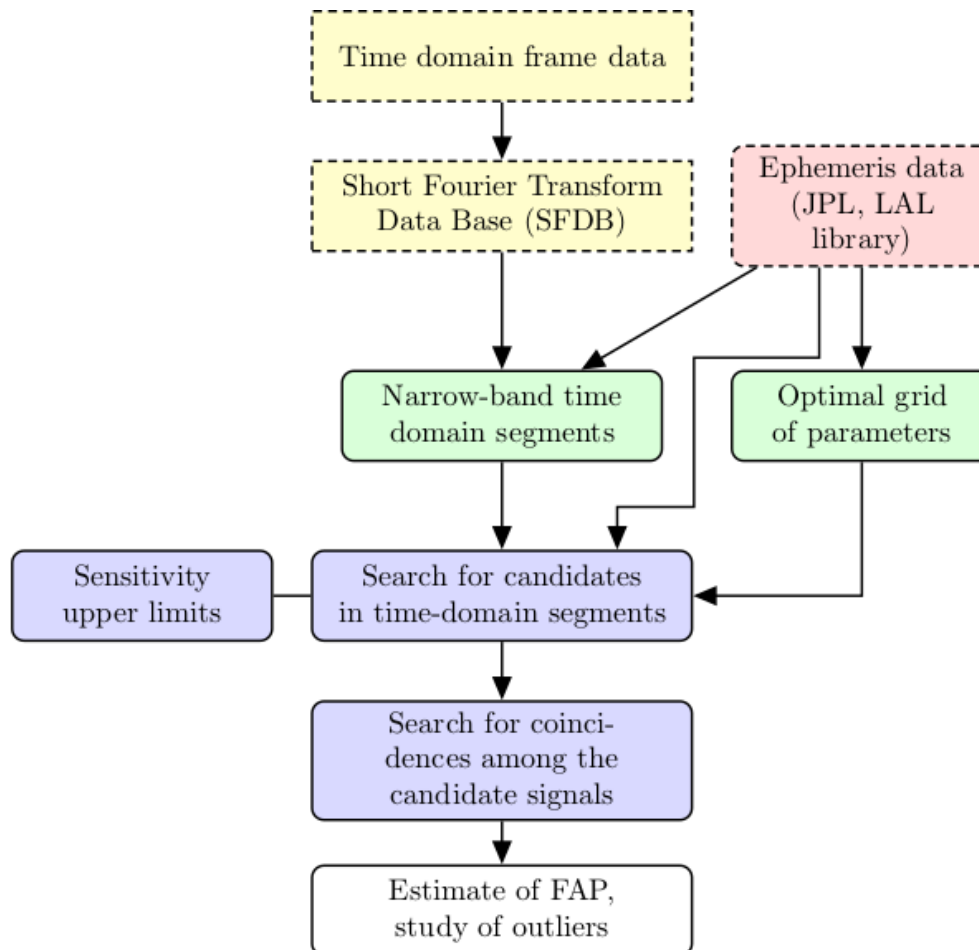
## **Groups involved in computing:**

- CAMK: **M. Bejger**, P. Ciecieląg, M. Cieślar, F. Morawski, M. Sieniawska
- AstroCENT@CAMK International Research Agenda (**T. Bulik** et al.)
- IMPAN (**A. Królak**)
- NCBJ (O. Dorosh)
- UW (**T. Bulik** et al.)

# Polish Virgo activities

## Major computational projects

- CW Time Domain F-statistic all-sky pipeline (25 mln CPU hours for O2 from PL-Grid)



# Polish Virgo activities

## Major computational projects

- Classification and clusterization (unsupervised learning) of GW signal candidates from the Time-Domain F-Statistic continuous gravitational-wave signal search
- CW directed (selected directions) & targeted (known pulsars) searches
- transient-CW directed searches - long-lasting but not strictly continuous signals, with more complicated morphology than just simple CW signal with  $\dot{f}$  (possible astrophysical scenarios: r-modes, magneto-elastic instabilities, accretion and thermal gradients in binary systems)

# Polish Virgo activities

## Specific projects we are working on related to raw data:

- ML analysis of transient-CW “tracks” in  $f\text{-}\dot{f}$ -(amplitude, other parameters) parameter space - identification of signals @CAMK,
- Denoising and removal of signals from the data (to study the residuals - testing gravity theories) and glitches (data cleaning, outlier/anomaly detection), using main and selected auxiliary channels. Multi-channel information needed for ML training @CAMK,
- Detchar & env studies/dev @UW,
- Inter-channel causality inference: prediction and characterization of influence of auxiliary channels on the main GW channel (glitch/anomaly detection, also to signal detection?) @CAMK
- Glitch/anomaly classification using Convolutional Neural Networks, Recurrent NN, Long Short Term Memory Networks and Generative Adversarial Networks. We are also exploring unsupervised ways of classification (t-Stochastic Neighbor Embedding, HDBSCAN). @CAMK

# Polish Virgo activities

- The AstroCENT is planning to design and deploy seismic sensors on the Virgo site, and analyze the data. Currently they have 38 seismometers at the North End building. It will be increased to 150 units (inside and outside of the buildings). The expected data stream from those sensors is 1.5 TB/day. This data stream will need to be analyzed to find correlations and coherence value with the gravitational wave channel at Virgo as well as with other auxiliary channels.