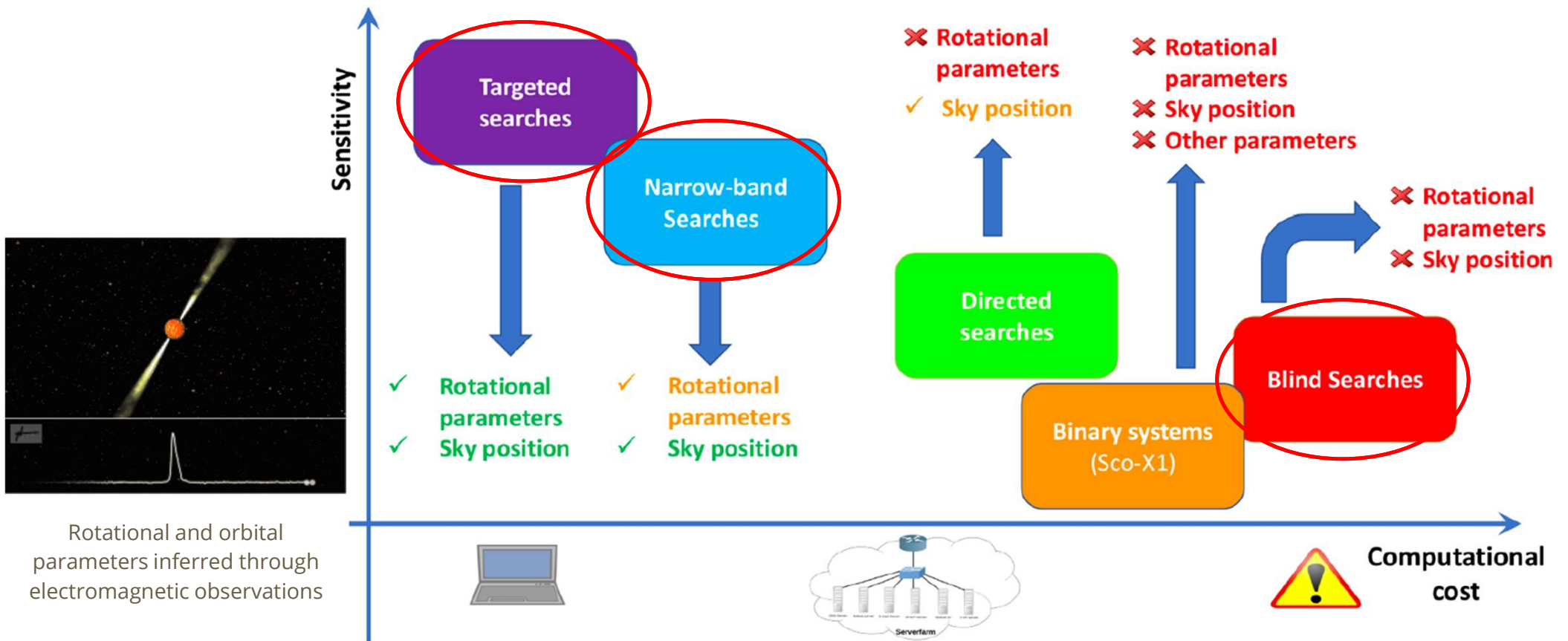

Virgo a Cagliari

— ET kickoff meeting 24/06/2024 —

Chi e cosa

- Staff:
 - P. Bortignon, D. Brundu, A. Contu, A. De Falco, A. Riggio, A. Sanna
 - + Claudia Lazzaro (1 / 7 / 2024)
- Post-doc, PhD, Laureandi
 - E. Codazzo, S. Cotza, L. Mirasola, R. Panai, Zhihua Liang
- Attività:
 - Onde continue (CW)
 - Machine Learning per la ricerca di GW
 - Presa dati in O4

Continuous Wave searches

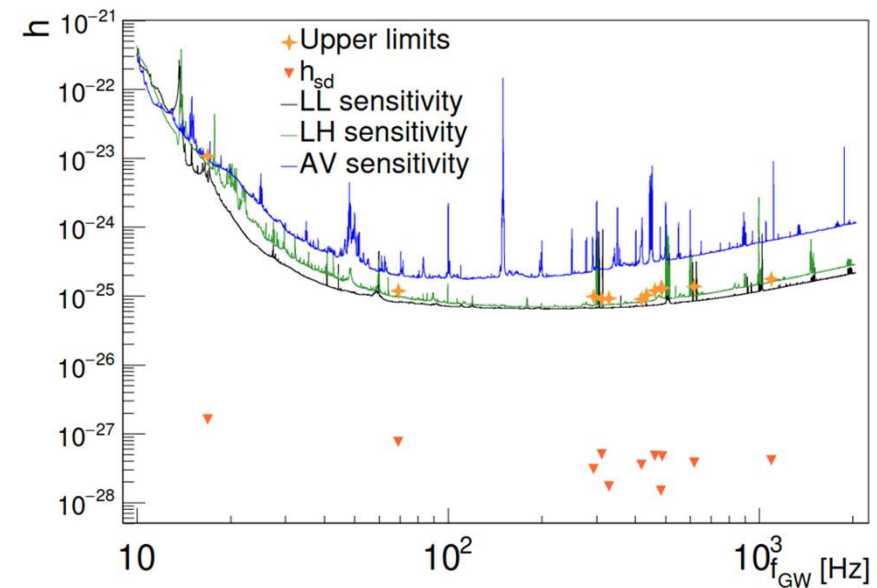
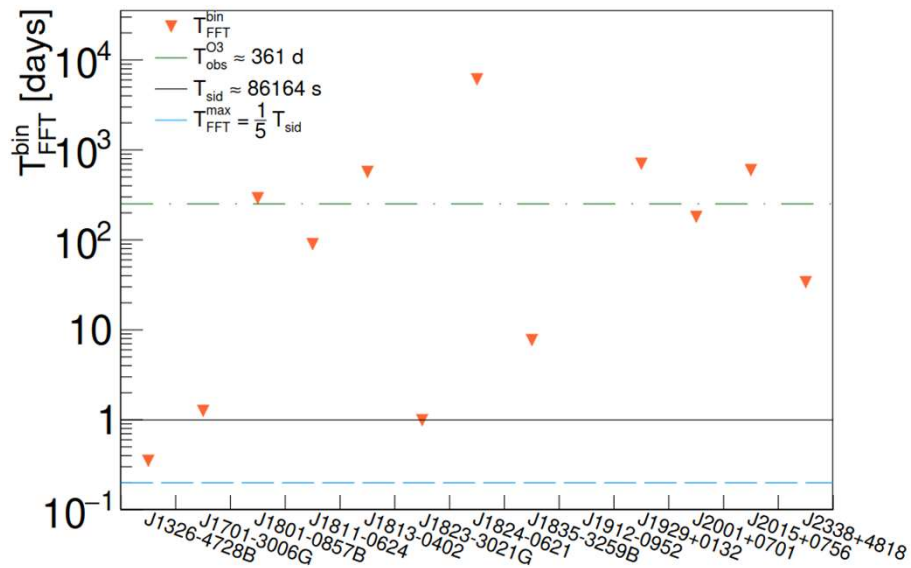


New targeted search

Developed a new fast method to detect
CWs from stars in binary system



Applied to 13 targets from ATNF catalogue
without detecting any CW



Paper sent to PRD and currently under review
[arXiv:2404.03721](https://arxiv.org/abs/2404.03721)

Narrowband search

LM chair of analysis and paper team for LVK collaboration

Neutron stars equation of state is still missing

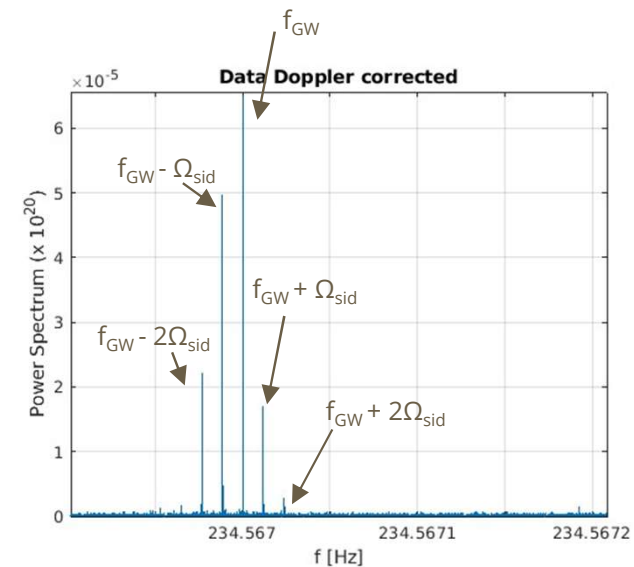


Its structure still uncertain

- is the outer crust rigid?
- is the hole star rigid?



Search for CW emission slightly mismatched from an electromagnetic counterpart



Search based on CW modulation due to Earth rotation

All-sky search

Cagliari group deeply involved in the follow-up procedure

Master thesis ongoing to study the systematics of Frequency-Hough pipeline



Testing a new pipeline on faint signals
Short author list paper foreseen

During 6 months at Universitat Illes Balears L. Mirasola and R. Tenorio [pushed an article](#) to tune a Monte Carlo Markov Chain follow-up pipeline

Involved in AI studies to discern isolated CW emitters from ones in binary systems using the Frequency-Hough pipeline

Search for CW without preknowledge of any parameter



need to probe all the parameter's combinations

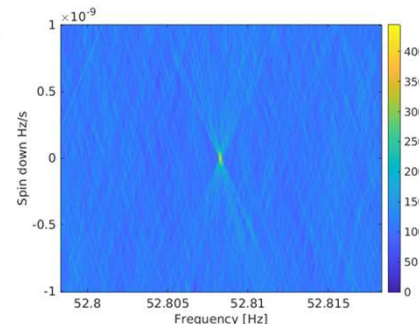
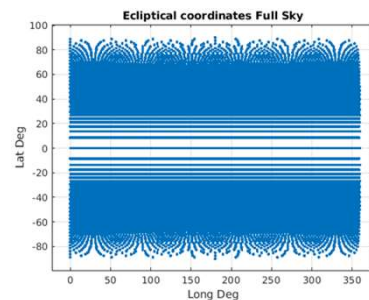


Impressive computational cost



Hierarchical approach where interesting candidates are followed up

sky position (2 angles)
frequency
frequency time derivative



Artificial Intelligence and GW research

- Development of a normalizing flow model (NVP architecture) for modelling the distribution of galaxies in the Universe and inferring gravitational waves
- Development of machine learning models to extract parameters from gravitational waves
- NF: machine learning model that transforms a complex distribution into a simpler one through invertible transformations
- Our parameters: 256 hidden layers, for the moment 3 input parameters (a.r., dec, redshift), 128 affine transformations
- **Goal:** find a $p(a.r, dec, z, L^a)$ to facilitate the search for host galaxies of GW
- Now the neural network is trained on over 200 millions of galaxies.