

Search for R-Modes GWs from PSR J0537-6910



Alessio Zicoschi

for the Rome Virgo Group

University of Rome "La Sapienza"



AMALDI
RESEARCH CENTER



Reasons for this search:

- First EM triggered search of continuous GW signals (CWs) produced from r-modes excitation in pulsar J0537-6910, which is known for its frequent glitches.
- “NICER” telescope timing model reported 3 glitches during LIGO-Virgo O3 run [1].

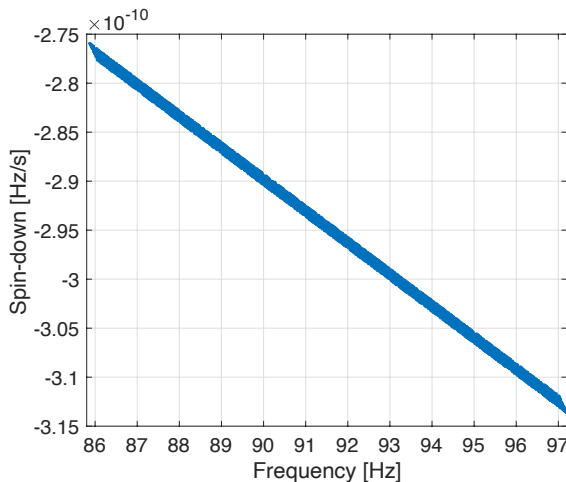
LIGO-VIRGO O3



R-Modes Emission Model:

- R-modes GW are dominated by quadrupole current emissions.
- $$f = Av - B \left(\frac{v}{v_k}\right)^2 v \quad f' = Av' - 3B \left(\frac{v}{v_k}\right)^2 v'$$
- A and B are physical parameters depending on the pulsar Equation of State and they define the parameters space [2].

$$1.39 \leq A \leq 1.57 \quad 0 \leq B \leq 0.195$$



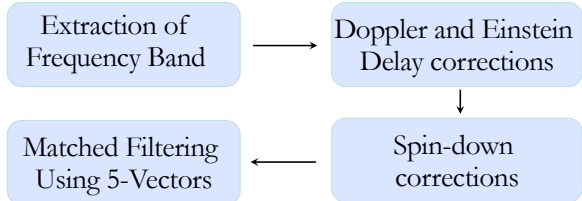
How are we performing this search?

- A coherent search is performed on each intra-glitch period.
- Results are then incoherently combined.

Coherent Part:

The Narrow-Band 5-Vector Pipeline

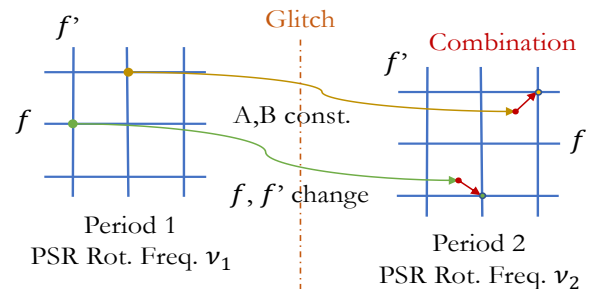
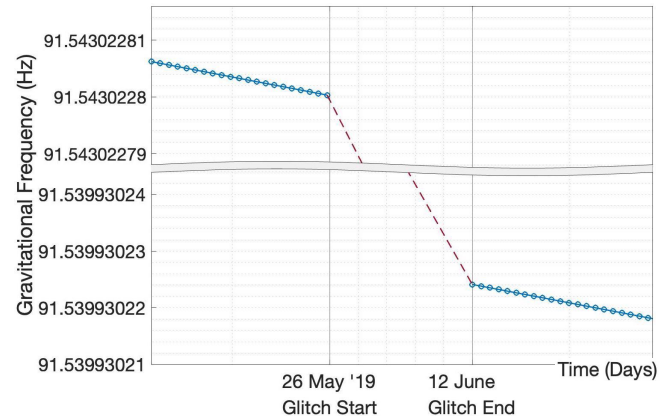
This pipeline is widely used for NB CWs searches [3][4].



Incoherent Part:

The Combination Algorithm

GW signals change frequency on different periods, while the parameters A and B are constants. The aim is to track the evolution of signals along the run.



Conclusions

We are currently applying this procedure to LIGO O3 data, but it is sufficiently general to be used also in future searches.

Bibliography

- [1] Ho, W. C. G., Espinoza, C. M., Arzoumanian, Z., et al. 2020, MNRAS, 498, 4605, doi: 10.1093/mnras/staa2640
- [2] Caride, S., Inta, R., Owen, B. J., & Rajbhandari, B. 2019, Phys. Rev. D, 100, 064013, doi: 10.1103/PhysRevD.100.064013
- [3] Astone, P., Colla, A., D'Antonio, S., et al. 2014, Phys. Rev. D, 89, 062008, doi: 10.1103/PhysRevD.89.062008
- [4] Mastrogiovanni, S., Astone, P., D'Antonio, S., et al. 2017, Class. Quant. Grav., 34, 135007, doi: 10.1088/1361-6382/aa744f