University of Warsaw
Burst projects

Marek Szczepańczyk
Alejandro Casallas Lagos

POLGRAW general meeting,
Kraków, 15-16.09.2026

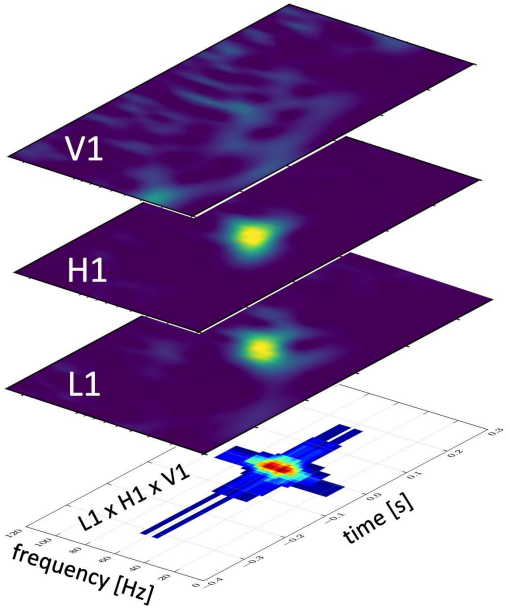
Group introduction

- Current group:
  - Marek Szczepańczyk (homepage)
    - Faculty at the University and Polish Return grant
    - PhD and Postdoc (10 years in LIGO)
  - Alejandro Casallas-Lagos, postdoc
  - Bachelor/Master students: Dorota Jeż, Łukasz Sobczak, Serena Fink
- LVK contributions: low-latency search, GWTC catalogs, SN searches, other burst searches
- GW Astrophysics course: winter 2026 and spring 2027 (Marek and Alejandro)
- Summer 2026:
  - Summer internship (NSF IREU): Emily Troutman, Quinn Kukk
  - Graduated, Bachelor: Filip Baciak
  - Workshop on burst searches: link
- 2026 papers:
  - Casallas-Lagos et al (MS): https://arxiv.org/abs/2607.21924 (supernova)
  - Casallas-Lagos et al (MS): https://arxiv.org/abs/2607.21925 (supernova)
  - Kumar et al (MS): https://arxiv.org/abs/2607.13275 (BBH quasi-normal modes)
  - Wils et al (MS): https://arxiv.org/abs/2607.17439 (broadband signal calibration)
  - Sierra et al (MS): https://arxiv.org/abs/2604.15500 (supernova)

Main theme:

detectable GW sources

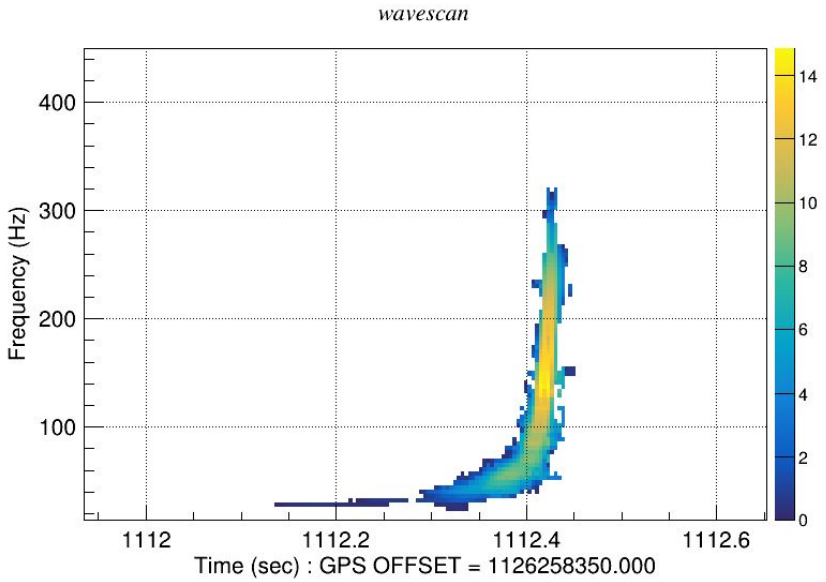
Burst methods (excess power)



x(t) —Wavelet Transform→

- Time-Frequency Decomposition
- Cluster Selection
- Constrained Likelihood

—Inverse Transform→ h(t)



GW150914

Discovered by burst methods

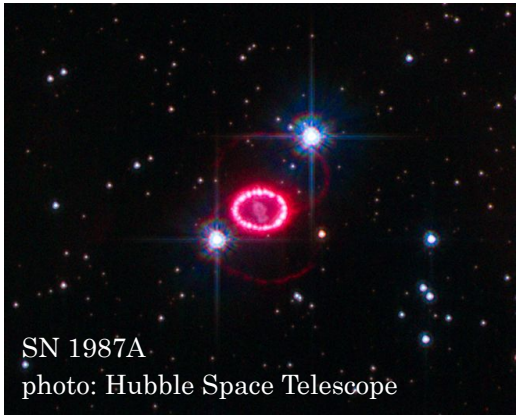
2026/2027 Projects

- Low-latency burst searches
- Core-collapse supernova physical inference: proceedings and a follow-up of IGWN Symposium SN2025gw
- **GW lensing with burst methods** (our main development, with Marek Biesiada and Sreekanth Harikumar)
- Neutron star glitches (6 week visit in Australia)
- Eccentric binaries (with Syed Naqvi and Iwona Kotko)

SN2025gw (July 2025 in Warsaw)

SN2027gw

24 - 28 May 2027, Knoxville, US



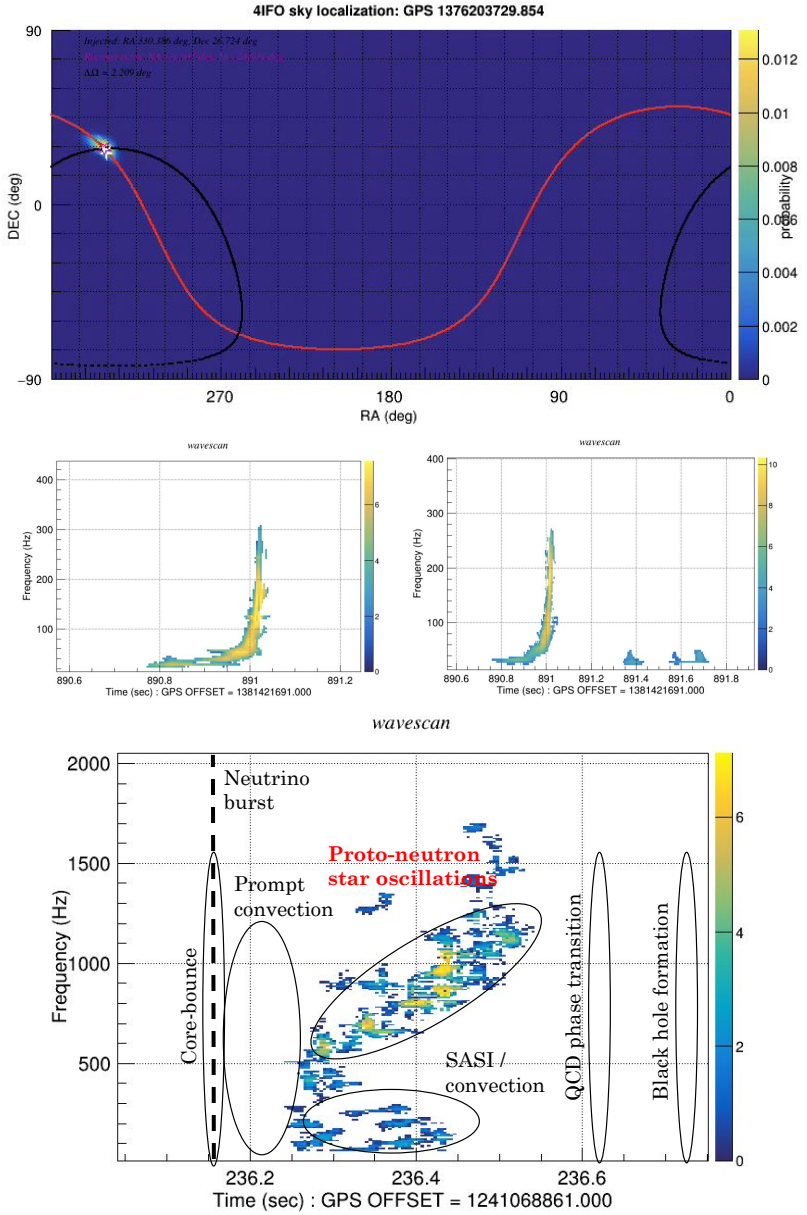
Projects

GW lensing with burst searches

1. Sky localization algorithm for GW lensing events.
2. Angular error distribution and sky localization area studies.
3. Injections for BBH's catalog covering mass bins, randomizations, population, and reproducibility.
4. Differentiating BKG from injections.
5. Paper writing

CCSN GW High frequency feature estimation

1. cWB plugin development for HHF curvature estimation.
2. Validation of cWB reconstructed events for physical interpretation.
3. Astrophysical interpretation.
4. Paper writing



Projects

Eccentric binaries

- Eccentric binary black holes: binary black holes with elliptical orbits.
- Eccentricity: e = 0 (circular orbits) → e = 1 (head on collision)
- The detection of eccentric BBHs would provide a compelling signature of dynamical formation.

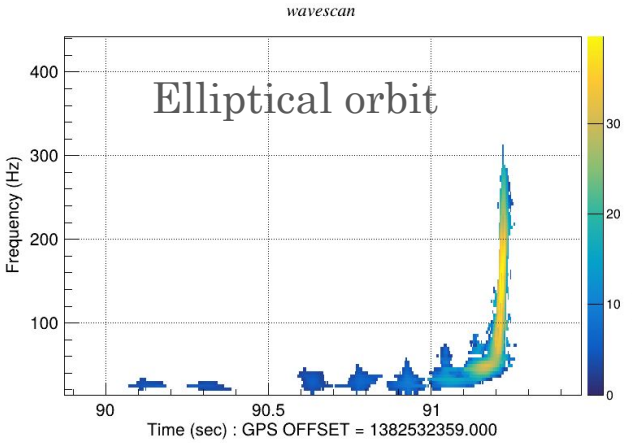
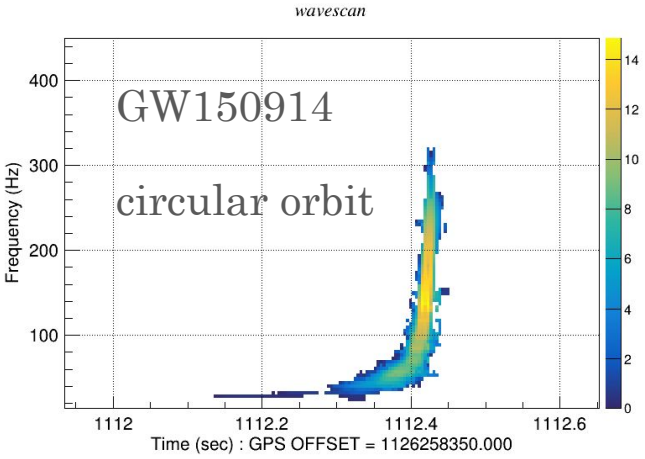
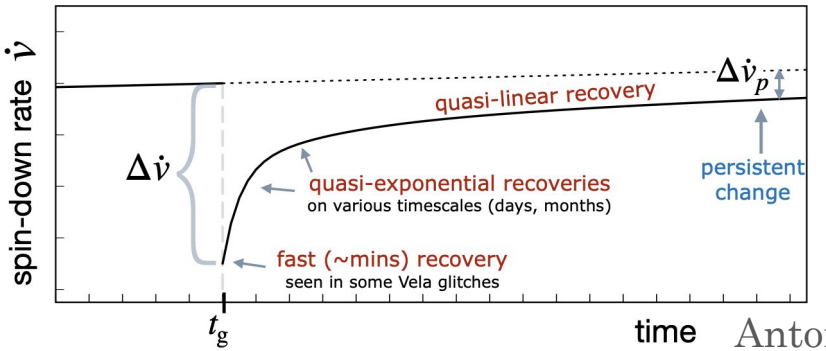


Image: Bhaumik

Neutron star glitches

- Sudden spin up of a pulsar/neutron star
- Potential GW source
- Is it worth searching for glitches in low latency?





Antonopoulou et al 2022

Summary

What's next unique GW source that we may discover?

lensed BBH

core-collapse supernova

eccentric binary

pulsar glitch

Questions I'm happy to discuss with POLGRAW

- CW and CCSN: What will happen with CW searches if a CCSN happen?
- CW and pulsars: How do the pulsar glitches impact CW searches?
- eBBH: What's the impact of detecting an eccentric binary on studying isolated and dynamically formation channels?
- Lensed BBH: What's an impact of detecting lensing on cosmology?
- Low-frequency noise: Realistically, how well can we improve low-frequency detector sensitivity?