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Continuous gravitational waves from Galactic neutron stars: demography, detectability and prospects.

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Surveying the sky in search of continuous gravitational waves (CWs) emitted by unknown neutron stars (NSs) is by now a well established practise. The elusiveness of such signals pushes the involved academic community to refine its search techniques and strategies as well as to review the assumptions made on an astrophysical basis.

We discuss both points and study the prospects for detection of CWs from Galactic NSs making use of a synthetic population, generated by evolving stellar remnants in time according to different models, making this the first "ab-initio" approach devoted to the topic.
We consider the most recent constraints set by all-sky searches for CWs and use them for our detectability criteria.
We track the parameter space occupied by our synthetic signals so as to understand how to invest the limited computational resources in order to maximise the chances of detection.
We discuss prospects in view of 3rd-generation detectors and briefly treat the case of recycled NSs.

Our results show that NSs whose ellipticity is solely caused by magnetic deformations cannot produce any detectable signal, not even by 3rd-generation detectors.
Currently detectable sources show a strong correlation between magnetic field and ellipticity. We find that if low magnetic field isolated neutron stars are very rare, then the highest possible ellipticity values must be realised in nature in order to have a detectable source.
Computational cost might be saved in all-sky surveys by restricting the searches to $\pm 15^\circ$ of the galactic plane and by limiting the frequency derivative range as a function of frequency, generally below 600 Hz.
According to our models, 3rd-generation detectors as Einstein Telescope and Cosmic Explorer constitute an enhancement of possible detectable sources of a factor up to ≈ 250.
CWs from recycled NSs will likely remain elusive to detection by current detectors but should be detectable with the next generation of detectors.

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