CAMK annual meeting

Marek Lewicki

AstroCeNT and University of Warsaw

CAMK, 5 II 2025

Publications

1. *Impact of cosmic expansion on gravitational wave spectra from strongly supercooled first-order phase transitions*, ML and Ville Vaskonen, arxive: 2511.15687
2. *Reconstructing early universe evolution with gravitational waves from supercooled phase transitions*, Adam Gonstal, ML, Bogumiła Świeżewska, JHEP 08 (2025) 039
3. *Black holes and gravitational waves from phase transitions in realistic models*, ML, Piotr Toczek, Ville Vaskonen, Phys.Dark Univ. 50 (2025) 102075
4. *Steady-state bubbles beyond local thermal equilibrium*, Tomasz Krajewski, ML, Ignacy Nałęcz, Mateusz Zych, JHEP 06 (2025) 118
5. *Thermalization effects on the dynamics of growing vacuum bubbles*, Tomasz Krajewski et al. JHEP 03 (2025) 178
6. *Gravitational waves from cosmic strings in LISA: reconstruction pipeline and physics interpretation*, LISA Cosmology Working Group, JCAP 05 (2025) 006

Presentations

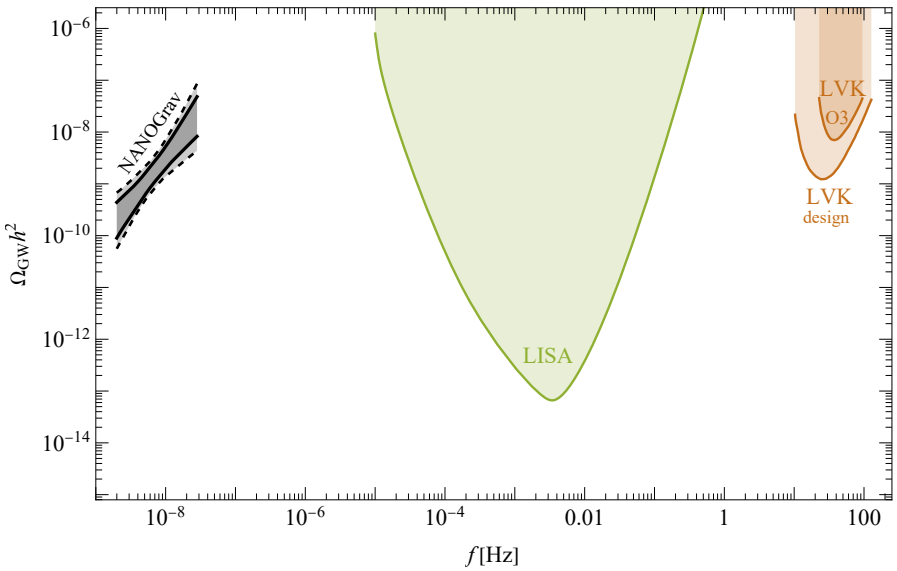
- KCETA Colloquium, *Search for cosmological phase transitions through their gravitational wave signals*, KIT, Karlsrhue, Germany 16 I 2025
- Numerical Simulations of Early Universe Sources of Gravitational Waves, *Supercooled cosmological phase transitions and their gravitational wave signals*, NORDITA, Stockholm, Sweden 28 VII-15 VIII 2025
- Advancing gravitational wave predictions from cosmological first-order phase transitions, *Strong cosmological phase transitions and their gravitational wave signals*, CERN, Geneva, Switzerland 25-29 VIII 2025

Organisation

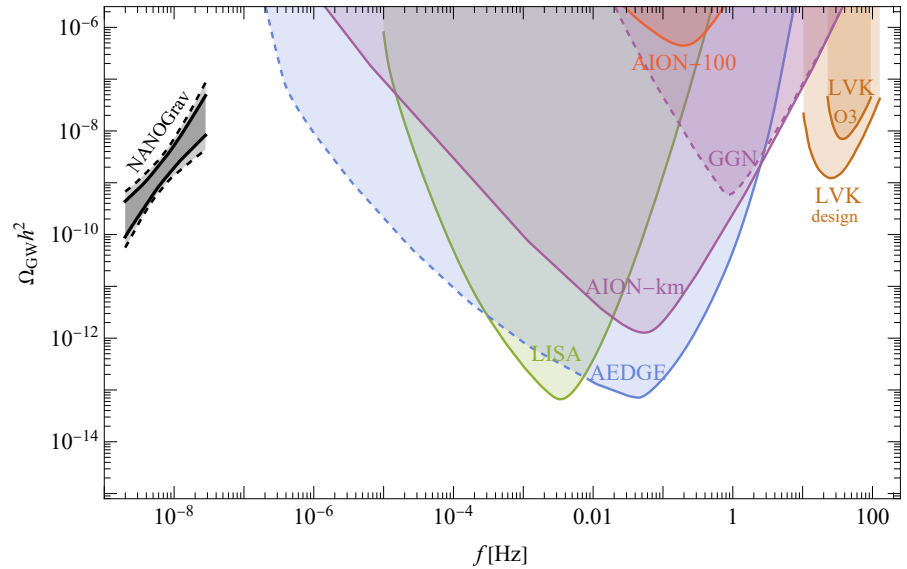
- 12th LISA Cosmology Working Group Workshop, Estonian Academy of Sciences, 2-5 VI 2025
- Gravitational Wave Probes of Physics Beyond Standard Model 4, University of Warsaw, 23-27 VI 2025
- Scalars 2025, University of Warsaw, 22-25 IX 2025

Involvement in experimental efforts

1. LISA: co-Chair of the LISA cosmology working group (2024-2027)

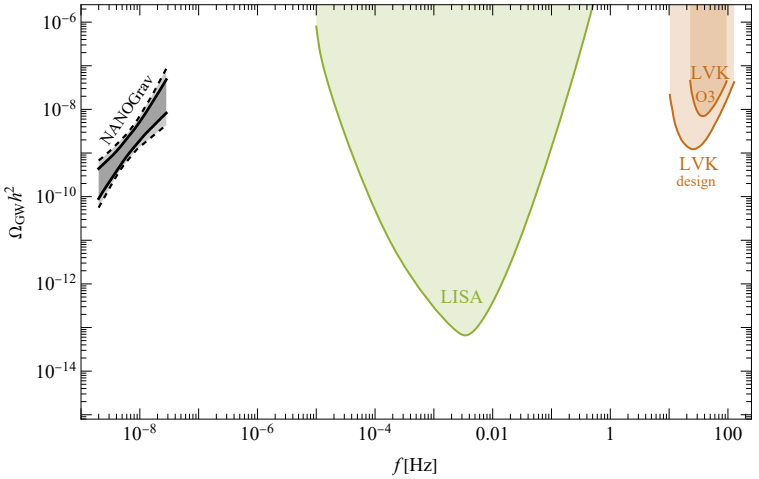


2. TVLBAI: Representative of UW in the proto-collaboration (formerly a part of AION and AEDGE collaborations)



LISA Cosmology WG

The goal of the CosWG is to investigate the scientific return of LISA related to cosmology. The CosWG also studies the science that can be analysed by cross-correlating LISA measurements with cosmological observables or robust, cosmological theories.

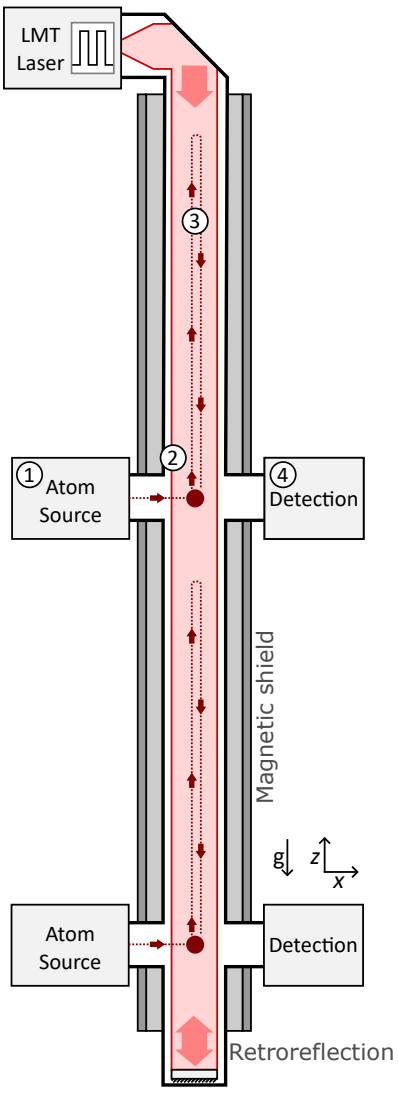


Examples of past (or ongoing) CosWG projects:

- Measurments of the Hubble parameter and its red-shift depence by means of standard sirens in LISA data
- Constraints on theories of modified GR by means of standard sirens in LISA data
- LISA potential to test cosmic strings
- LISA potential to test particle physics models predicting first-order phase transitions
- LISA potential to test inflationary models
- LISA sensitivity to stochastic backgrounds not fully homogeneneous or isotropic
- Reconstruction of the stochastic background frequency shape in LISA

https://directory.lisamission.org/register

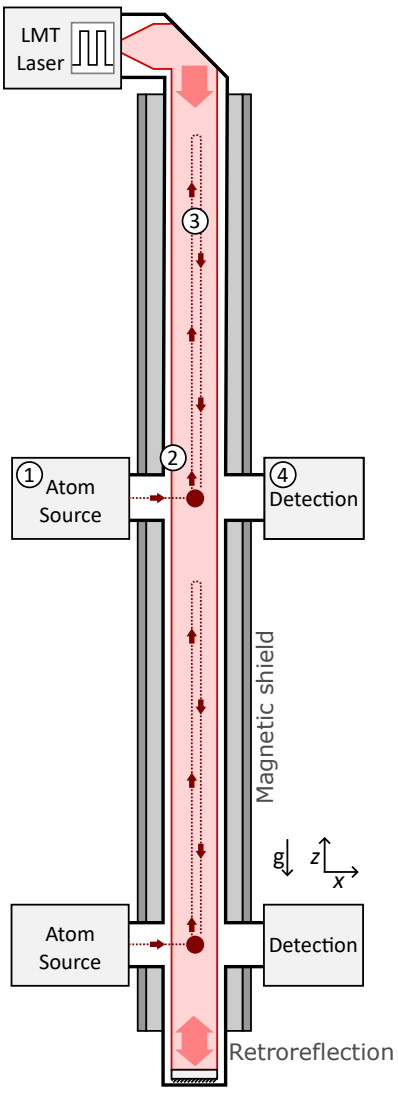
AION and AEDGE



- The presence of a gravitational wave modulates the separation distance L, giving rise to time variations in phase shift between the interferometers.

Sensitivity Scenario	L [m]	T [sec]	$\delta\phi_{\rm noise}$ $[1/\sqrt{\rm Hz}]$	LMT [number n]
AION-10	10	1.4	10^{-4}	1000
AION-100	100	1.4	10^{-5}	40000
AION-km	2000	5	0.3×10^{-5}	40000

AION and AEDGE



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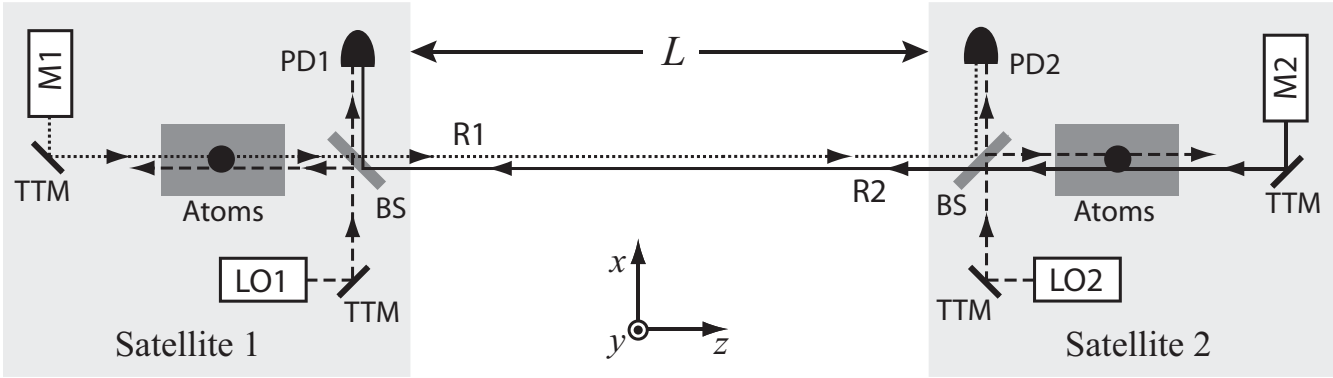
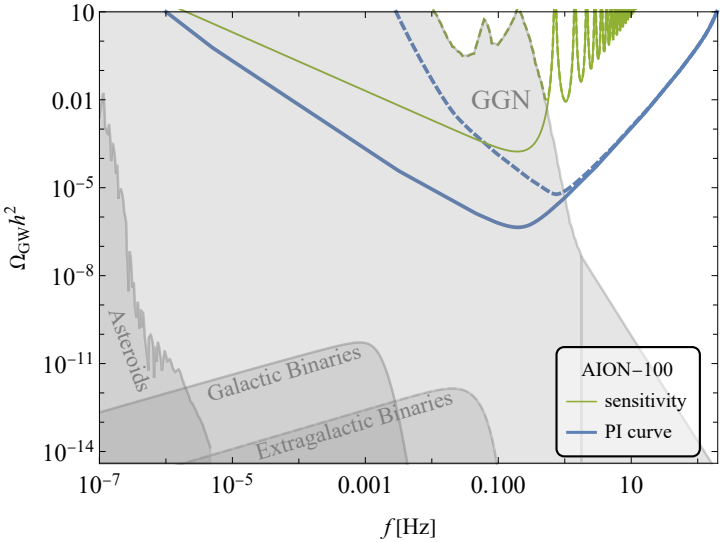
AEDGE	4.4×10^{7}	300	10^{-5}	1000

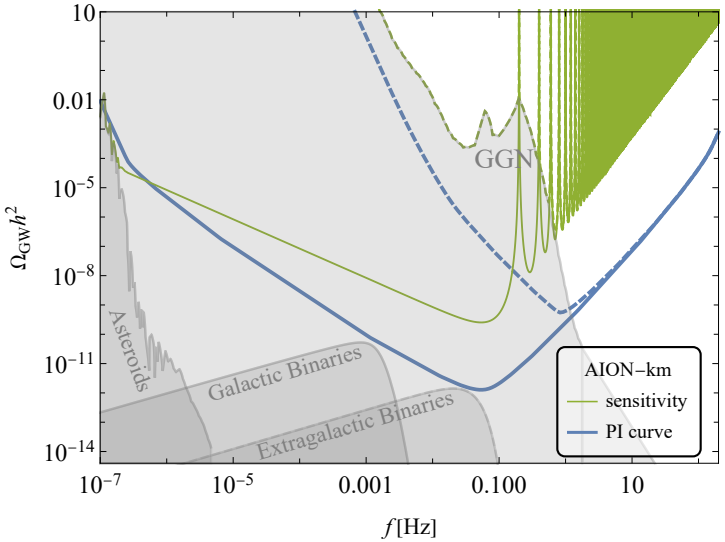


Badurina et. al. arxiv: 1911.11755, AEDGE Collaboration arxiv: 1908.00802

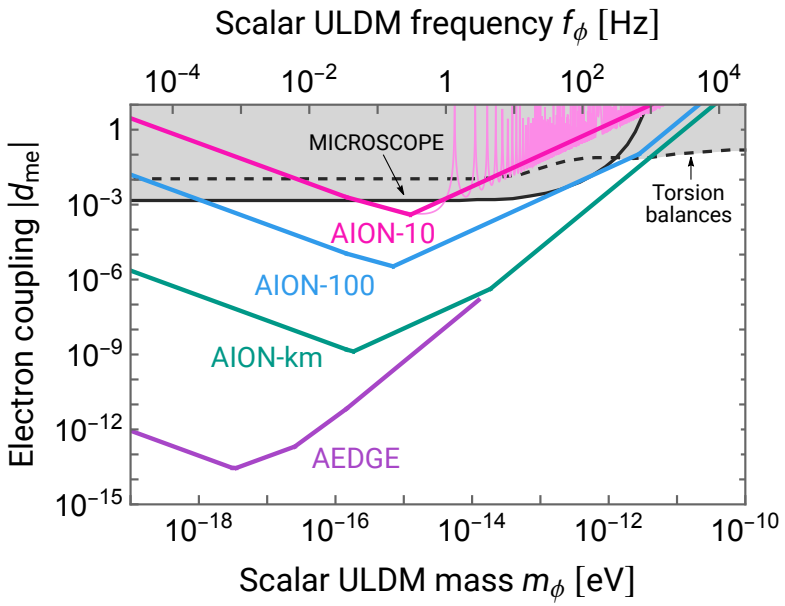
AION sensitivity

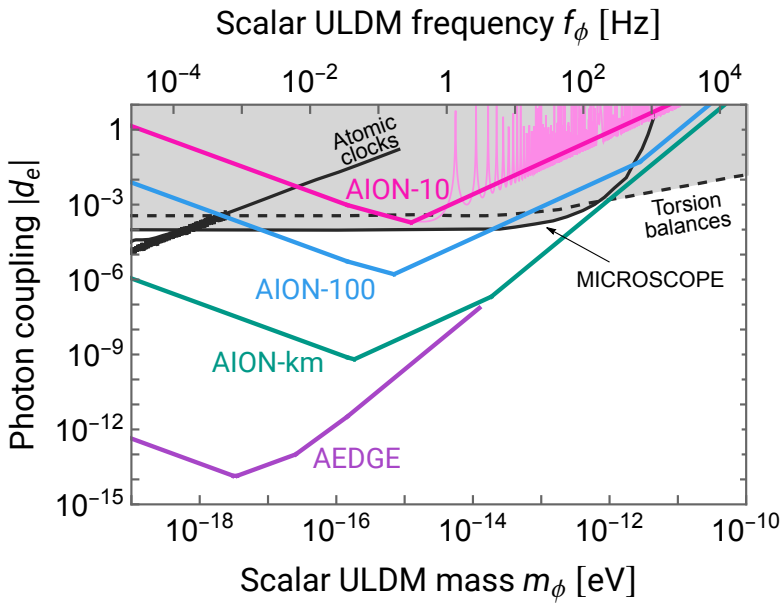
- Key issue: seismic noise





- Probe of ultra light dark matter models





Leonardo Badurina et al., arxiv: 2108.02468