Lab Seminar

August 8, 2025

GR24 & Amaldi 16 Report

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Photo taken at Kelvingrove Art Gallery and Museum

Overview

- July 14-18, 2025
- Scottish Exhibition Centre, Glasgow
- 24th International Conference on General Relativity and Gravitation (GR24)
- 16th Edoardo Amaldi Conference on Gravitational Waves (Amaldi16)

https://iop.eventsair.com/gr24-amaldi16/

History of GR and Amaldi

- **GR0**: Bern, 11-16 July 1955

http://www.isgrg.org/pastconfs.php

- **GR1**: Chapel Hill, 18-23 January 1957
  - Known as Chapel Hill Conference
  - Theoretical acceptance of gravitational waves

…

- **Amaldi1**: Frascati, Rome, 14-17 June 1994

…

- **Amaldi9**: Cardiff, 10-15 July 2011
  - My first Amaldi. Poster on ASC for LCGT.
  - Bus from London. Late check in. Seagull. Banquet in museum (↑).
- **GR22/Amaldi13**: Valencia, 7-12 July 2019
  - Presented KAGRA upgrade plans.
  - Paella.
- **Amaldi15**: Online, 17-21 July 2023
  - Presented ultralight DM searches
  - First international conference attended from Caltech
- 2024年9月、2025年5月 Bramにいじられる
- **GR24/Amaldi16**: Glasgow, 14-18 July 2025

By Numbers

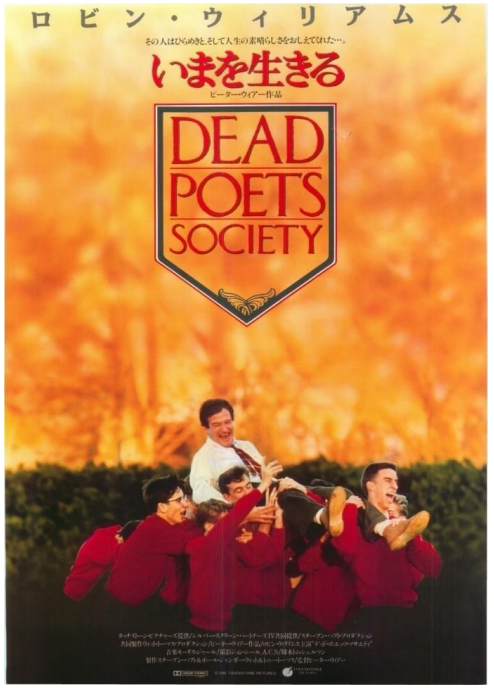
- 800+ participants (do not start on time…)
- 604 talks
  - 18 plenary
  - 12 parallel session rooms
- 159 posters

Too much rain

GR24 Amaldi16 Conference Monday, 14 July 2025

	Clyde Auditorium	Alsh 1	Alsh 2	Boisdale 1	Boisdale 2	Carron 1	Carron 2	Dochart 1	Dochart 2	Forth	Gala 1	Gala 2
8:55am–9:00am	Civic Welcome on behalf of the Lord Provost, Bailie Hanif Raja											
9:00am–9:05am	Welcome from the University of Glasgow, Vice Chancellor, Professor Sir Anton Muscatelli FRSE AcSS											
9:05am–10:15am	Plenary Talks (Clyde Auditorium) – Elena Giorgi & Lia Medeiros											
10:15am–10:45am	Morning Coffee Break (Halls 1 and 2)											
10:45am–12:00pm	Plenary Talks Part 2 (Clyde Auditorium) – Yuta Michimura & Amanda Farah											
12:00pm–1:30pm	Networking Lunch (Clyde Auditorium) + ISGRG Committee meeting (Etive Room) (Closed Meeting)											
1:30pm–3:15pm	C2 Gravitational wave astronomy: searches, data analysis, parameter estimation and multi-messenger astronomy	A2 Classical GR: Mathematical developments	D4 Quantum fields in curved space-time, semiclassical gravity, quantum gravity phenomenology, and analog models	B3 Approximations, perturbation theory, and their applications	C4 Concept and research towards next-generation detectors	C1 Pulsar timing arrays	C5 LISA and other space-based detectors	A1 Classical GR: Theoretical developments	B1 Relativistic astrophysics	C6 Gravitational waves: Relativity and fundamental physics	C9 Experimental gravitation	C10 Experimental tests of the nature of compact objects
3:15pm–3:45pm	Afternoon Coffee Break (Halls 1 and 2)											
3:45pm–5:30pm	C2 Gravitational wave astronomy: searches, data analysis, parameter estimation and multi-messenger astronomy	A2 Classical GR: Mathematical developments	D4 Quantum fields in curved space-time, semiclassical gravity, quantum gravity phenomenology, and analog models	B3 Approximations, perturbation theory, and their applications	C4 Concept and research towards next-generation detectors	C1 Pulsar timing arrays	C5 LISA and other space-based detectors	A1 Classical GR: Theoretical developments	B1 Relativistic astrophysics	C6 Gravitational waves: Relativity and fundamental physics	C9 Experimental gravitation	C10 Experimental tests of the nature of compact objects
6:00pm–8:00pm	Civic Reception (Glasgow Science Centre, 50 Pacific Quay, Glasgow G51 1EA)											

My Talk on LVK+3G Instrument



- On time 😎
- No question from audience 😢
- Questions from the chair
  - Why 50 K instead of 22 K?

    → Frosting. (I should have also mentioned that the issue is being addressed to have more future prospects.)
  - Don't we need to wait for O5 for 5 detector detection, considering current KAGRA sensitivity?

    → Yes. Chance in O4 is low. (I assumed that he meant 4 detector detection. I should have said that "detection" in the network is not well defined. Also, Mpc is not the metric for sky localization.)

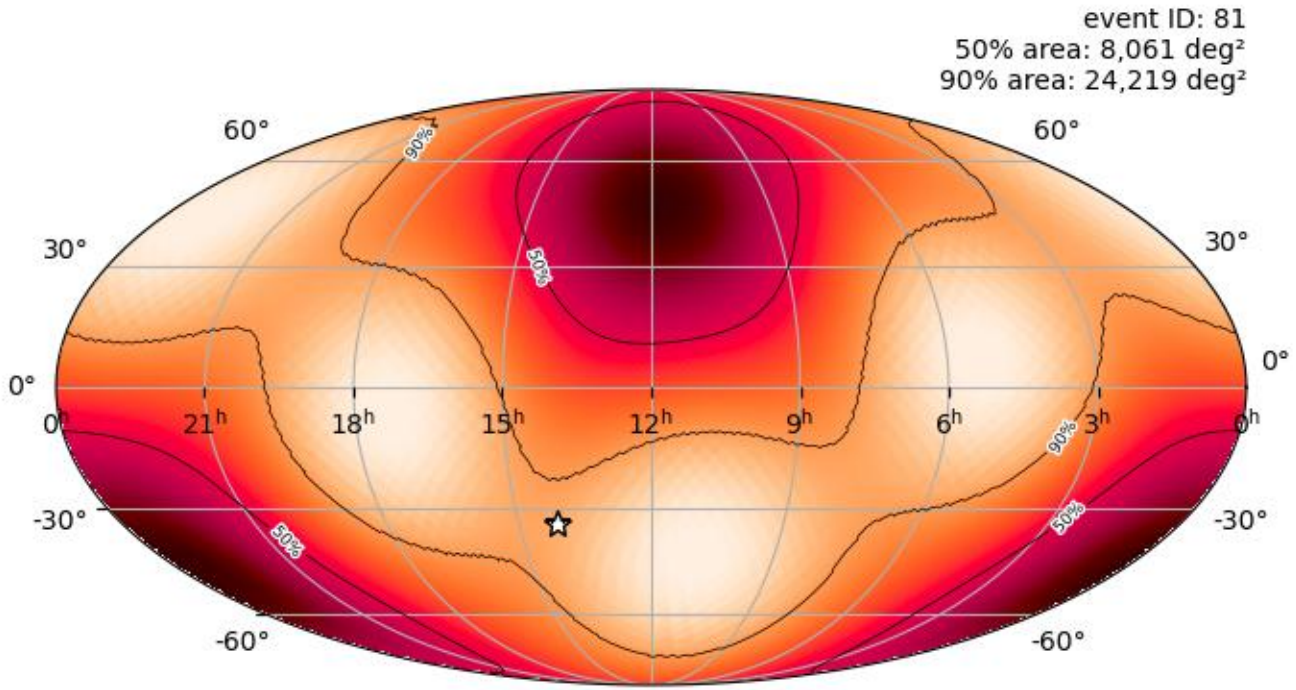
Lord Kelvin

- 1824 Born in Belfast, Ireland
- 1834 Studied at U of Glasgow
- 1846 Professor at U of Glasgow
- 1904 Chancellor of U of Glasgow

University of Glasgow

O4 Sky Localization Simulation

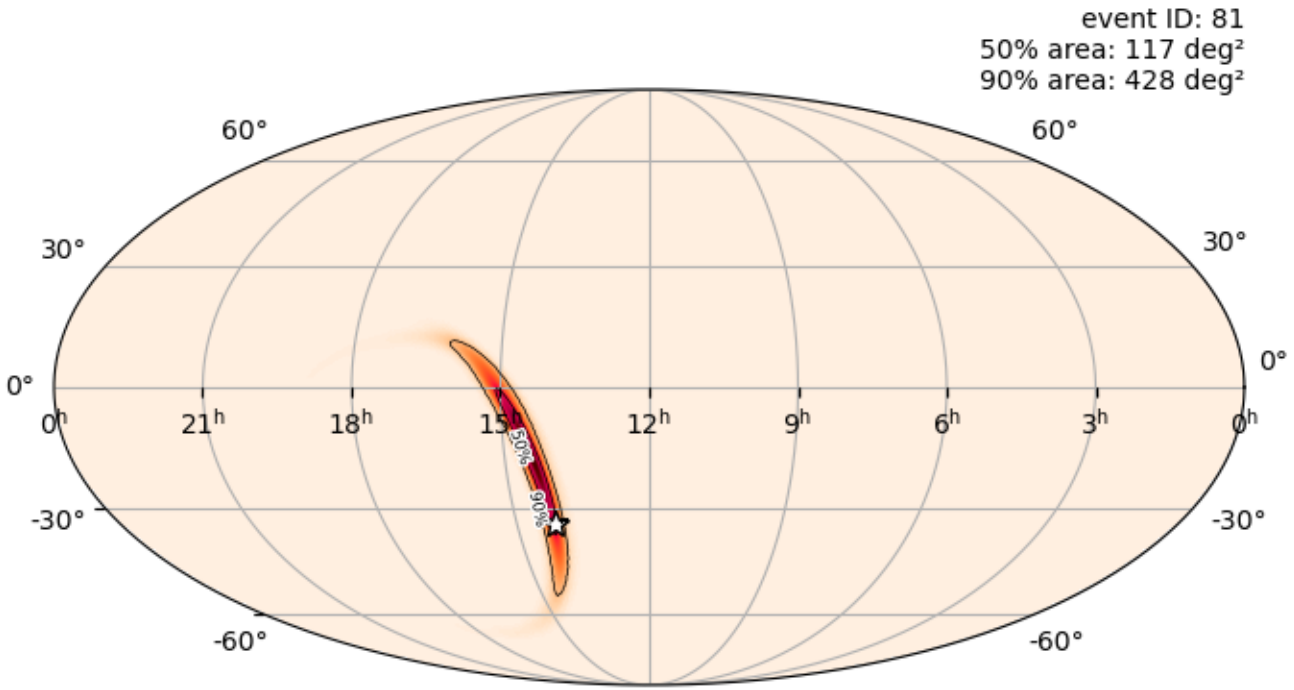
- O4 H only



For 1.4-1.4 BNS at 80 Mpc, calculation by Peony Lai and Alvin Li

O4 Sky Localization Simulation

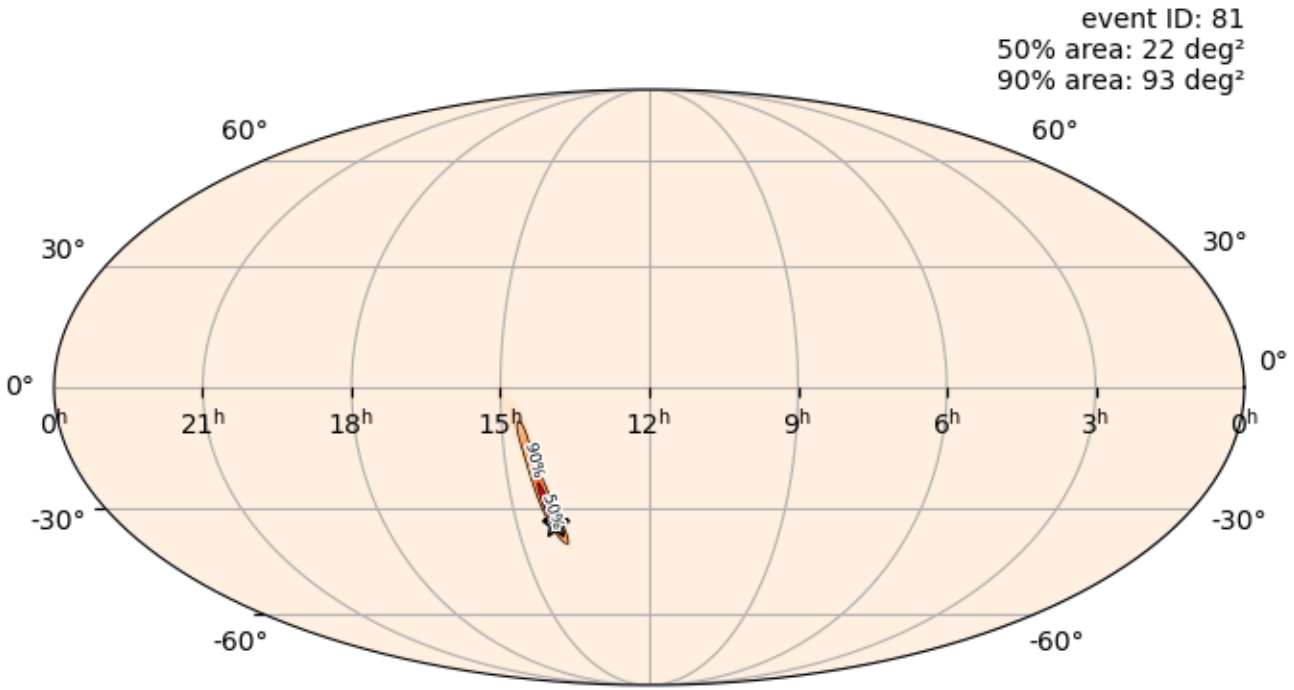
- O4 H + L



For 1.4-1.4 BNS at 80 Mpc, calculation by Peony Lai and Alvin Li

O4 Sky Localization Simulation

- O4 H + L + V

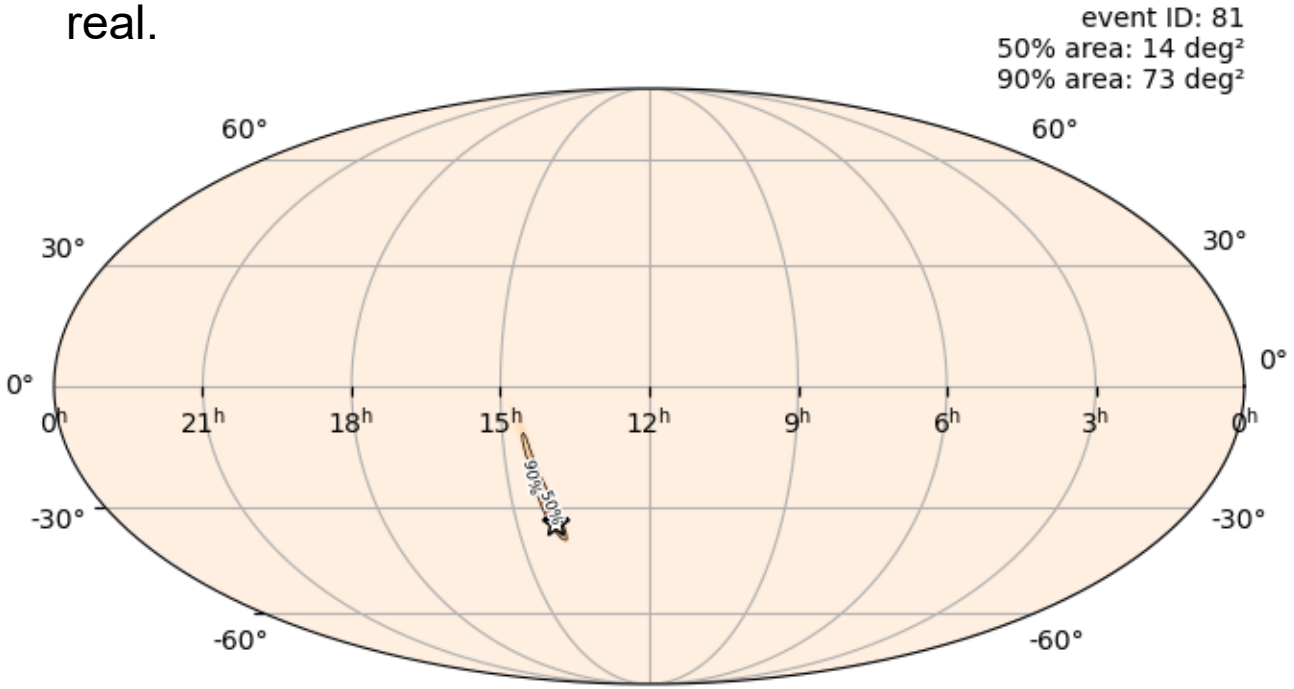


For 1.4-1.4 BNS at 80 Mpc, calculation by Peony Lai and Alvin Li

O4 Sky Localization Simulation

- O4 H + L + V + K(10 Mpc, SNR=2.9)

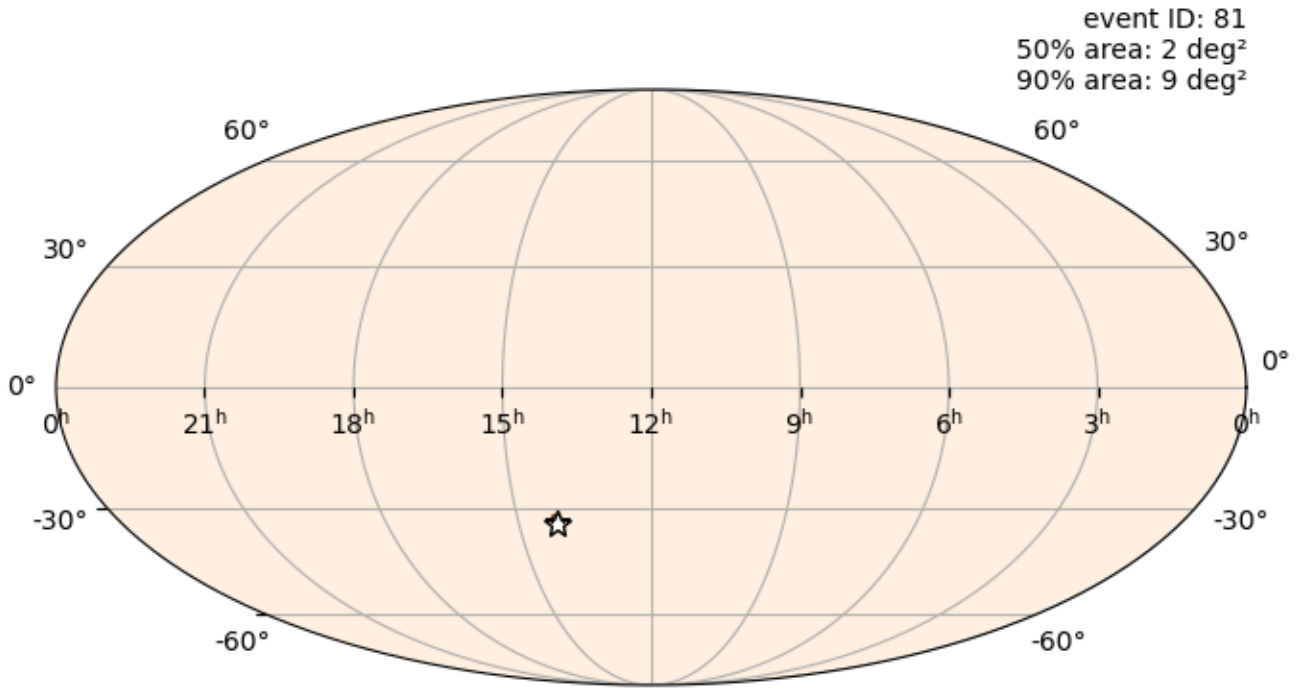
  SNR of this level can happen from noise fluctuations, according to Kato-kun's study JGW-G2516672. So, it is hard to claim detection by K, but sky localization is better than HLV. Need further study to say that this improvement is statistically real.



For 1.4-1.4 BNS at 80 Mpc, calculation by Peony Lai and Alvin Li

O4 Sky Localization Simulation

- O4 H + L + V + K(25 Mpc, SNR=5.3)



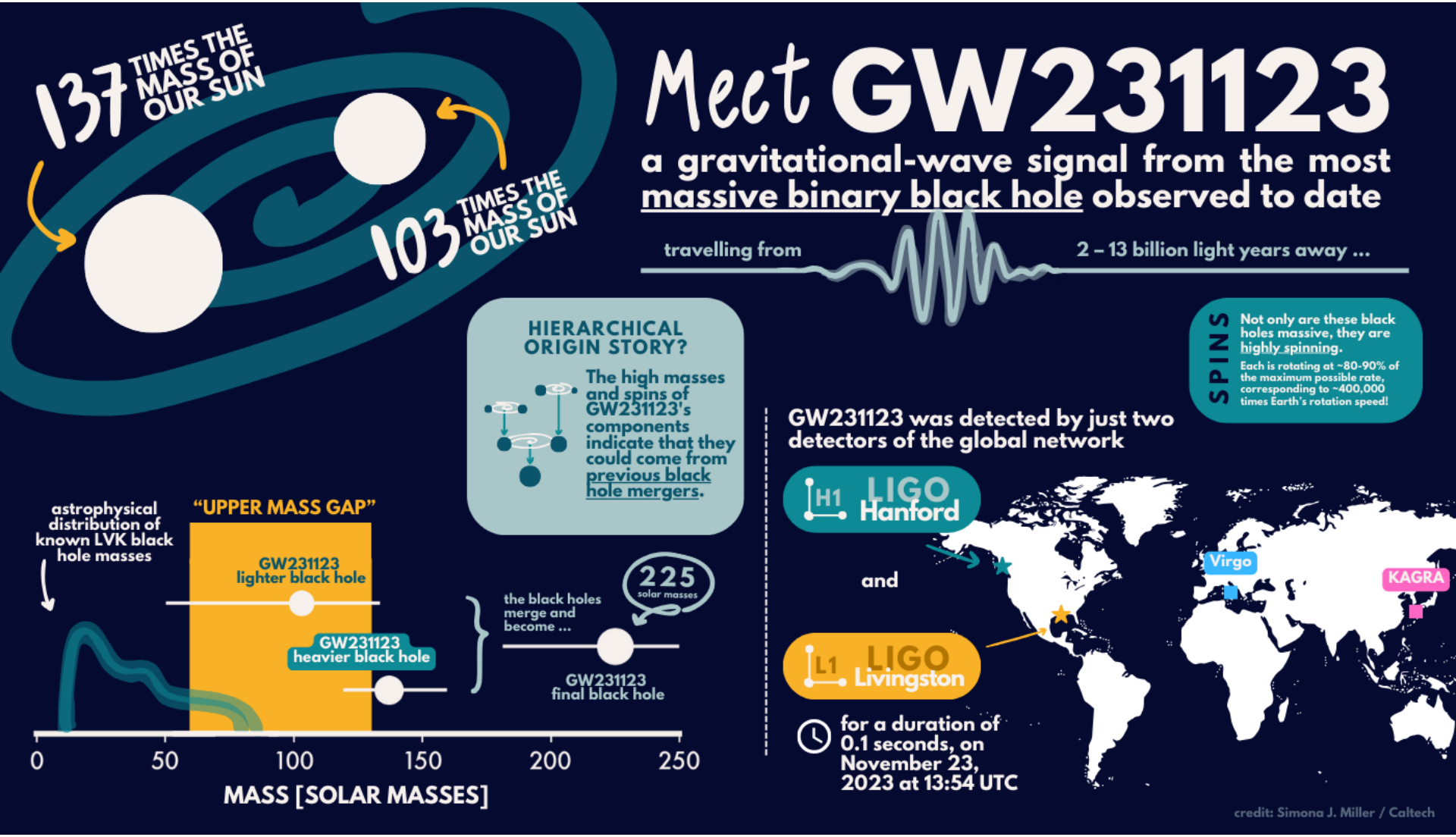
For 1.4-1.4 BNS at 80 Mpc, calculation by Peony Lai and Alvin Li

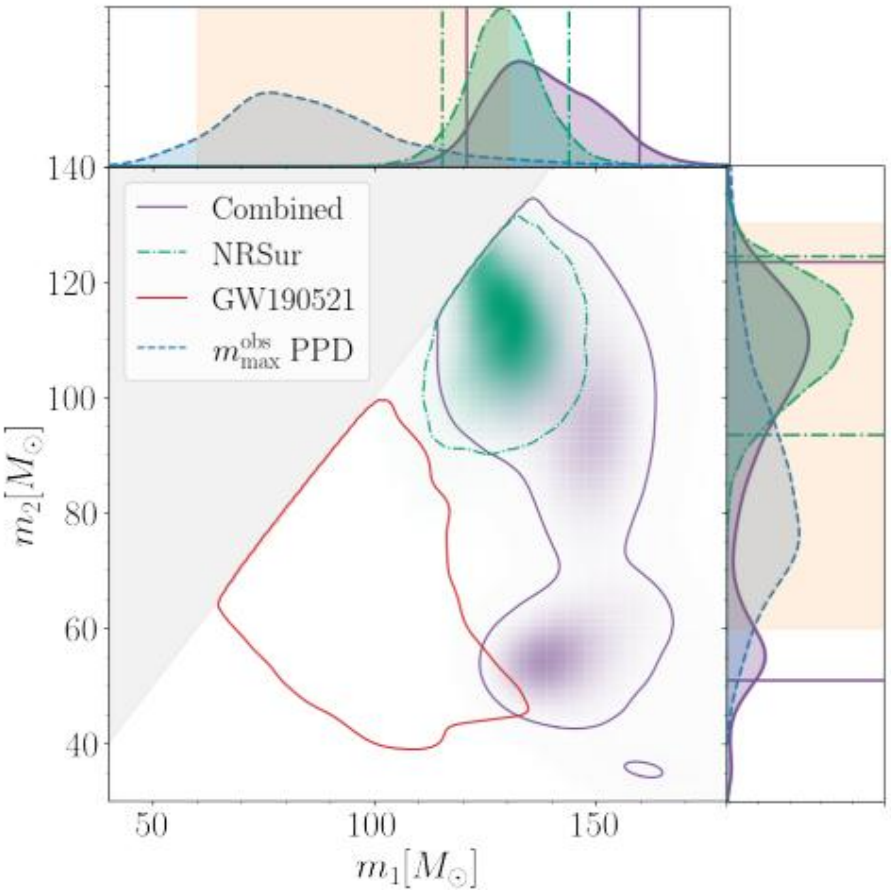
Reception at Glasgow Science Centre

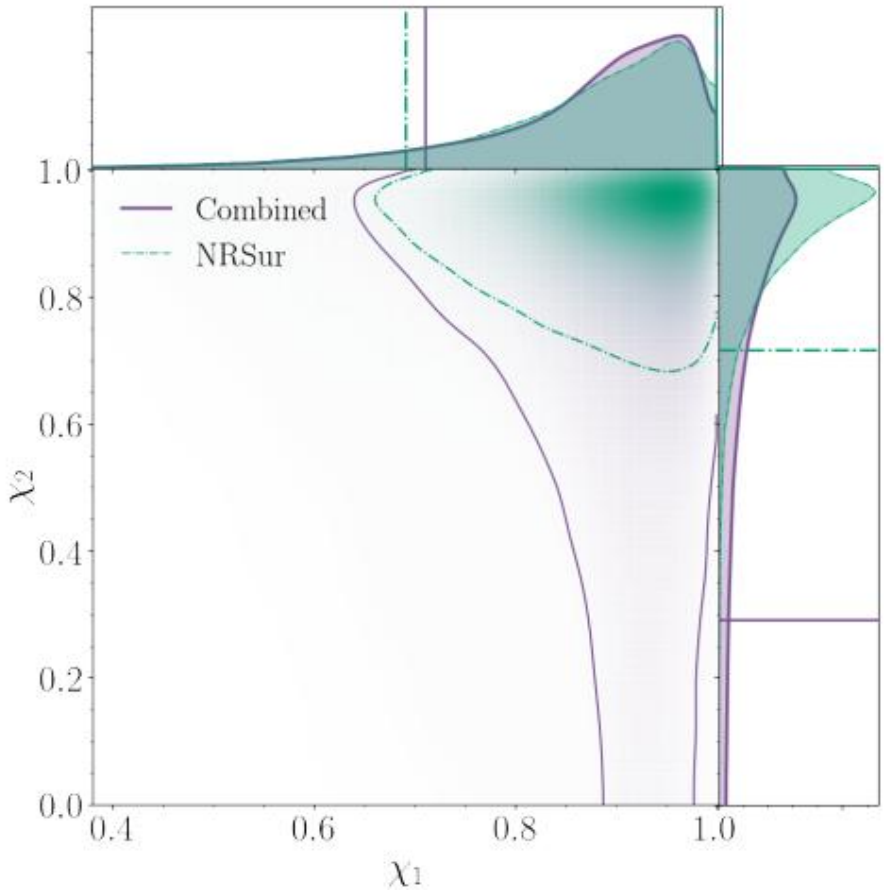
Physicists having a hard time passing by irresistibly interesting exhibits.

My Notes (1/4)

- Amanda Farah (plenary)
  - GW231123, high spin, GR consistency check violation?
  - Hierarchical merger?
- Warren Bristol, Laurence Datrier
  - CE site study, including habitability, DEI etc.
- Victoria Graham
  - Cryogenic suspension thermal noise tests with Glasgow 10 m
  - 10 m is used as a reference cavity
- Dana Jones
  - CW from vector boson cloud search using GW231123 remnant
  - Signal duration is higher for vector than scalar
- Ruiqi Liu
  - Latest G measurement at HUST targeting 5ppm uncertainty
  - Resonant frequency shift of torsion pendulum with silicon sphere
- Carlos Frajuca
  - Speed of gravity using sapphire rods
  - Astronomische Nachrichten 345, e230177 (2024)


137 TIMES THE MASS OF OUR SUN
103 TIMES THE MASS OF OUR SUN
Meet GW231123
a gravitational-wave signal from the most massive binary black hole observed to date
travelling from
2 – 13 billion light years away ...
HIERARCHICAL ORIGIN STORY?
The high masses and spins of GW231123's components indicate that they could come from previous black hole mergers.
SPINS
Not only are these black holes massive, they are highly spinning.
Each is rotating at ~80-90% of the maximum possible rate, corresponding to ~400,000 times Earth's rotation speed!
astrophysical distribution of known LVK black hole masses
"UPPER MASS GAP"
GW231123 lighter black hole
GW231123 heavier black hole
the black holes merge and become ...
225 solar masses
GW231123 final black hole
0
50
100
150
200
250
MASS [SOLAR MASSES]
GW231123 was detected by just two detectors of the global network
H1 LIGO Hanford
and
L1 LIGO Livingston
Virgo
KAGRA
for a duration of 0.1 seconds, on November 23, 2023 at 13:54 UTC
credit: Simona J. Miller / Caltech





https://arxiv.org/abs/2507.08219

My Notes (2/4)

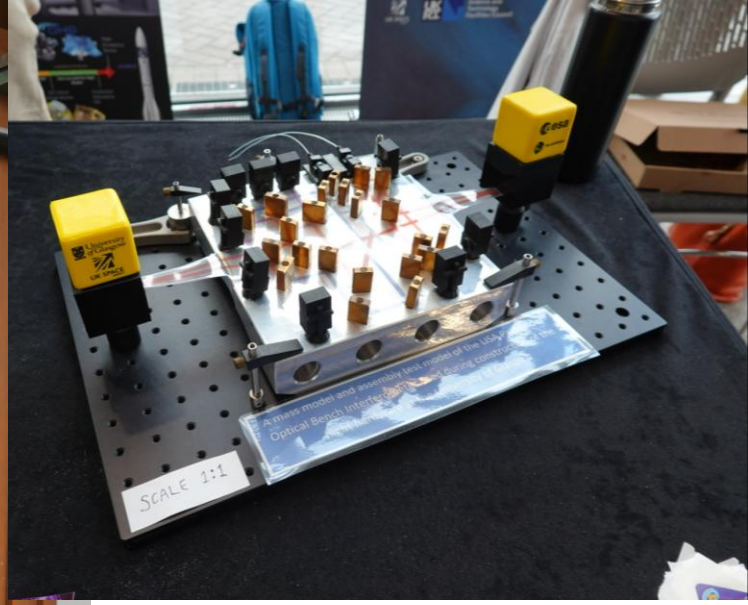
- Riccardo Della Monica
  - PyGRO, A&A 698, A193 (2025)
  - Pulsar timing around Sgr A* to measure the mass of Sgr A*
  - More precise by 4 orders of magnitude proposed
  - No hair theorem can also be tested
- Gabriella Chiarini
  - Compact inertial sensor development at AEI 10 m
  - Various talks/posters on HoQI and COBRI other than this talk
- Firoz Khan
  - Blue glass is good in terms of BRDF and reflectivity
  - Scattered light noise calculation (based on arXiv:2412.11592) and baffle design for AEI 10 m
  - Simulation using FRED
- Matteo Carlassara
  - Tapered suspension thermal noise is not correct for GWINC
  - Reaching SQL broadband might not be possible with updated calculation

My Notes (3/4)

- Satoru Takano
  - BHD for AEI 10 m
- S. Ashutosh
  - Generation of non-local quantum entanglement through non-inertial motion (arXiv:2407.14276)
- Oliver Philcox (plenary)
  - 2025 conclusion: new physics seems unlikely for H0 and σ8 tension
  - DESI best-fit solutions for w0wa is theoretically strange
- Sylvia Biscoveanu (plenary)
  - NSBH constraints on EoS etc. MNRAS, 518, 5298 (2022)
  - Probability of NSBH being EM bright is improved to 18% from GW230529 (tidal deformation is larger for nearly equal mass NSBH)
- Gautam Satishchandran (plenary)
  - Interferometer experiments can be decohered by black holes
  - Int. J. Mod. Phys. D 31 (2022) 14, 2241003

My Notes (4/4)

- Gerhard Heinzel
  - LISA phasemeter test with hexagon test
  - Absolute length measurement to 1 m necessary for TDI
  - This is done using pseudo random noise
- Vittorio Chiavegato
  - LPF low frequency noise is not understood by a factor of 2
  - PRD 110, 042004 (2024), PRD 109, 102009 (2024)
- Marcel Beck
  - TAPSI, picometer stable interferometer
  - CQG 42, 135001 (2025)
- Wanda Vossius
  - MONET (Mechanical Oscillations in Non-Equilibrium Thermodynamics)
  - Under temperature gradient, for ET
  - Helmut Schmidt University + Hamburg University


SCALE 1:1


GR24
Amalfi16