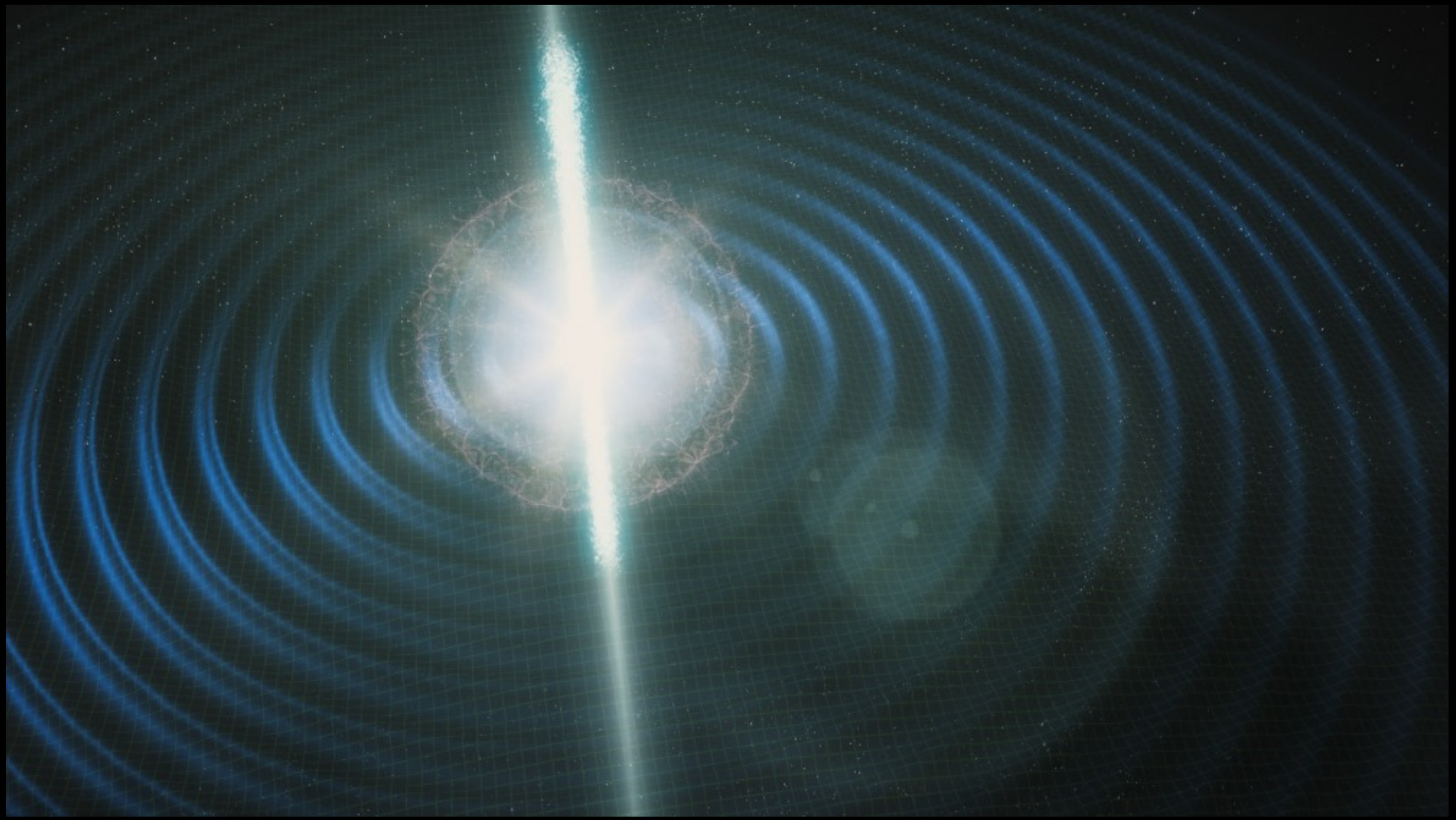
Standard sirens update, 10 October 2024



Where do we fit within OzGrav?

From the OzGrav-2 proposal, we have a **Cosmos Key Program (KP5)** which aims to:

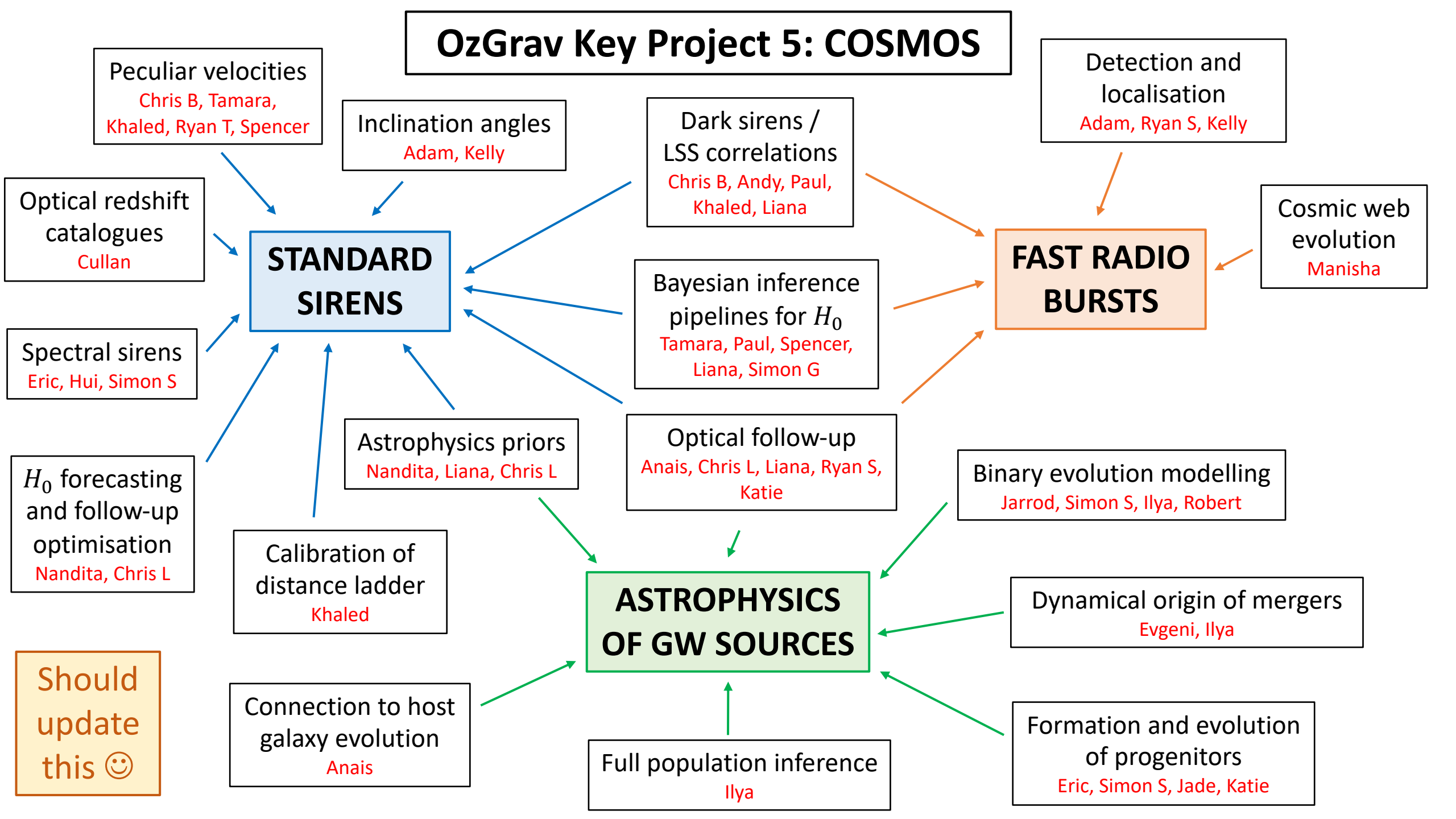
"Determine fundamental properties of the Universe"

The three themes of the Cosmos Key Program are:

Cosmology with Standard Sirens

Astrophysics of Gravitational Wave sources

Cosmology with Fast Radio Bursts


OzGrav Key Project 5: COSMOS
Peculiar velocities
Chris B, Tamara, Khaled, Ryan T, Spencer
Inclination angles
Adam, Kelly
Dark sirens / LSS correlations
Chris B, Andy, Paul, Khaled, Liana
Detection and localisation
Adam, Ryan S, Kelly
Optical redshift catalogues
Cullan
STANDARD SIRENS
Bayesian inference pipelines for H_0
Tamara, Paul, Spencer, Liana, Simon G
FAST RADIO BURSTS
Cosmic web evolution
Manisha
Spectral sirens
Eric, Hui, Simon S
Astrophysics priors
Nandita, Liana, Chris L
Optical follow-up
Anais, Chris L, Liana, Ryan S, Katie
H_0 forecasting and follow-up optimisation
Nandita, Chris L
Calibration of distance ladder
Khaled
Binary evolution modelling
Jarrod, Simon S, Ilya, Robert
ASTROPHYSICS OF GW SOURCES
Dynamical origin of mergers
Evgeni, Ilya
Should update this ☺
Connection to host galaxy evolution
Anais
Full population inference
Ilya
Formation and evolution of progenitors
Eric, Simon S, Jade, Katie

Your CIs and Program Scientists for KP5

Chris Blake
(CI)

Ilya Mandel
(CI)

Nandita Khetan
(Standard Sirens PS)

Manisha Caleb
(FRBs PS)

Robert Song
(Astrophysics PS)

Please get in touch with any of us if you have questions about our Key Program or would like to discuss where your work fits in!

Standard sirens topic – organization

- We use #h0-project channel on the OzGrav Slack
- We maintain a **standard sirens project list** linked from #h0-project
- Our goals of sharing this project list:
  - Increase awareness and sharing of information across the team
  - In this way, identify collaborative opportunities and/or research overlaps
  - Help with organising updates at telecons
  - Assist with reporting our activities and outcomes to OzGrav and the ARC
- We hold monthly standard siren videocons (thanks Nandita!) including project updates, short talks, journal clubs, etc. – **second Thursday in the month at 2pm AEST**
- All are welcome to join our team!

Standard sirens topic – science

Effect of galaxy peculiar velocities

Improved redshift catalogues for dark sirens

Simulation-based population studies

Improving inclination angles

Developing the spectral siren method

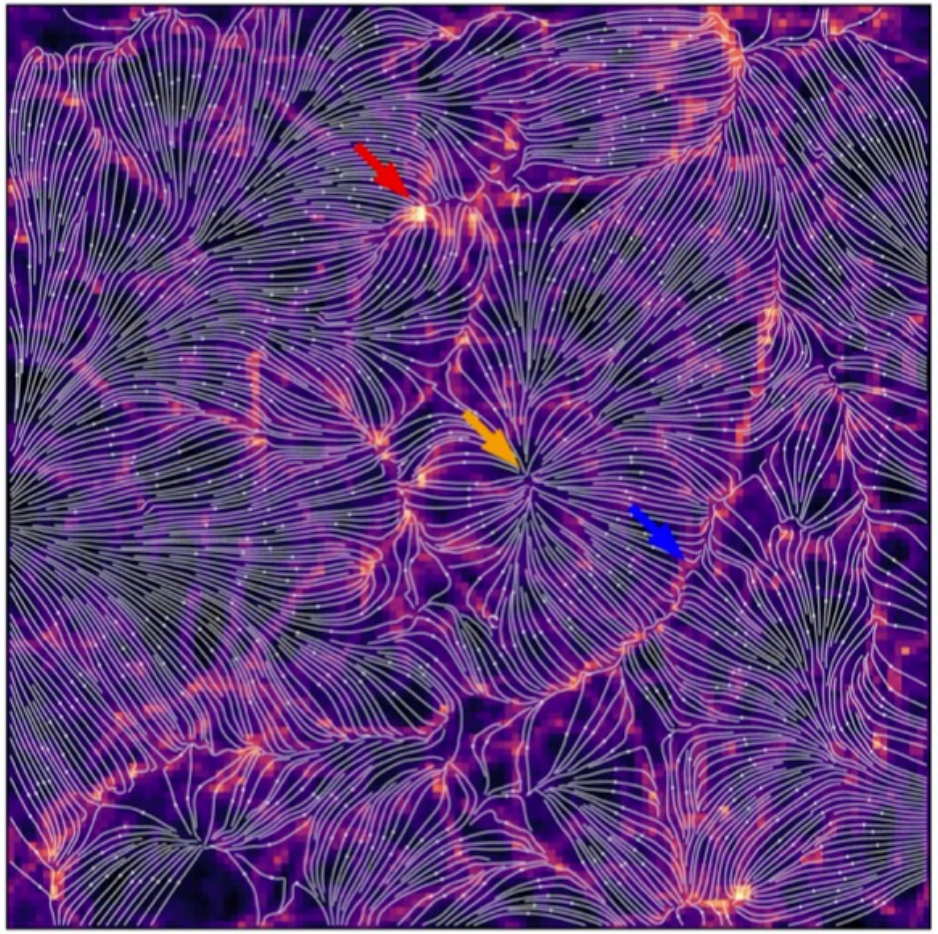
Joint inference of neutron star equation of state

Role of peculiar velocities

See work by: Ryan Turner, Khaled Said, Simon Goode, Chris Blake

Talks given at July standard sirens meeting – slides on Slack

- Peculiar velocities change the redshifts of standard sirens and hence affect determinations of H_0
- Relative effects are largest at low redshift and are correlated between different objects by "bulk flows"
- Goal 1: propagate PV errors into H_0 analysis
- Goal 2: improve current velocity reconstruction maps of the local Universe

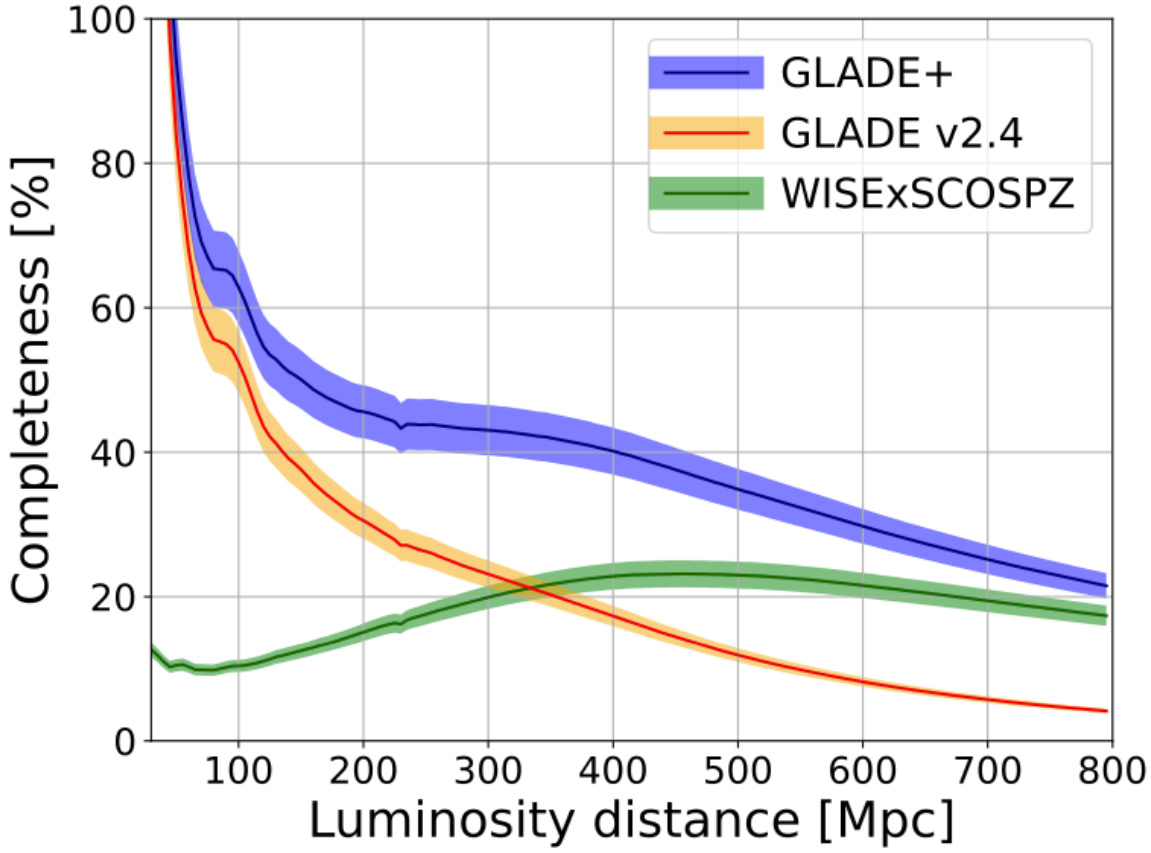


Improved optical redshift catalogues for dark sirens

See work by: Cullan Howlett

Talk given at June standard sirens meeting – slides on Slack

- Dark siren analyses rely on catalogues of potential host galaxies for probabilistic analysis and cosmological inference
- The current GLADE+ catalogue can be updated in the light of new observational surveys (DES, DESI, 4MOST, LSST, etc.)
- Goal: data curation, characterisation of completeness, value-added data products

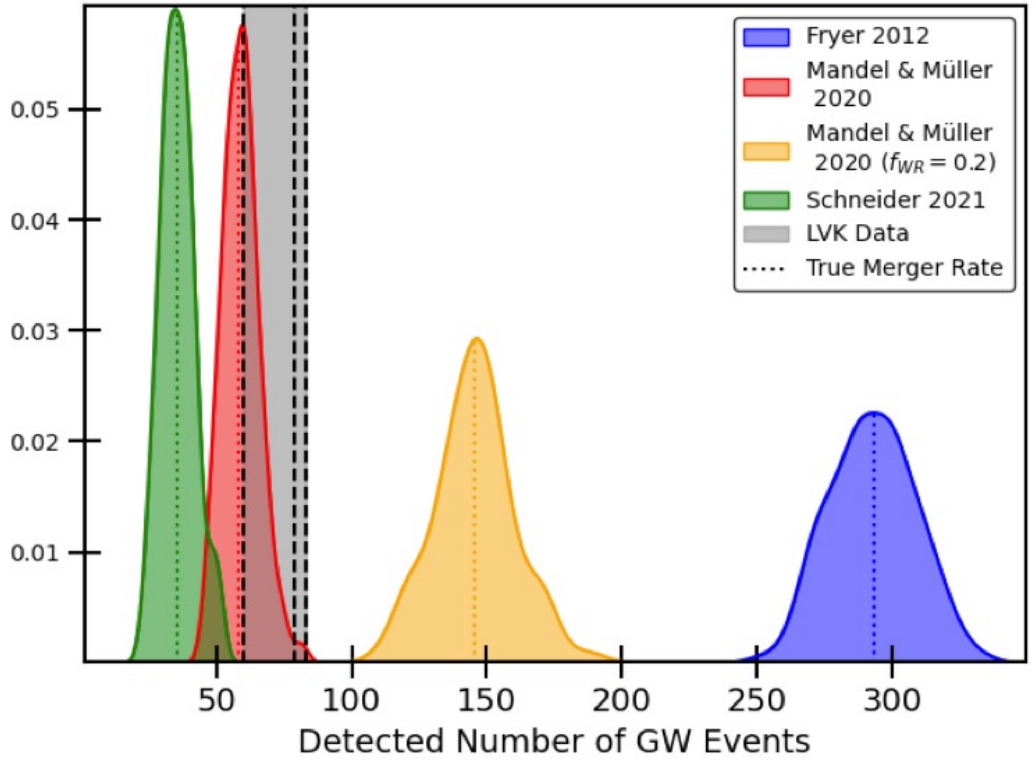


Simulation-based studies

See work by: Nandita Khetan, Liana Rauf, Cullan Howlett

Talk given by Liana at OzGrav videocon in July

- Map the link between GW mergers and host galaxies
- Goal: Integrate simulations, semi-analytical and population models
- Goal: optimise weights for dark sirens and implication for H_0 analysis
- Goal: Can dark siren analyses be undertaken with photometric redshifts?
- Goal: What is the optimal strategy for wide-field spectroscopic follow-up?

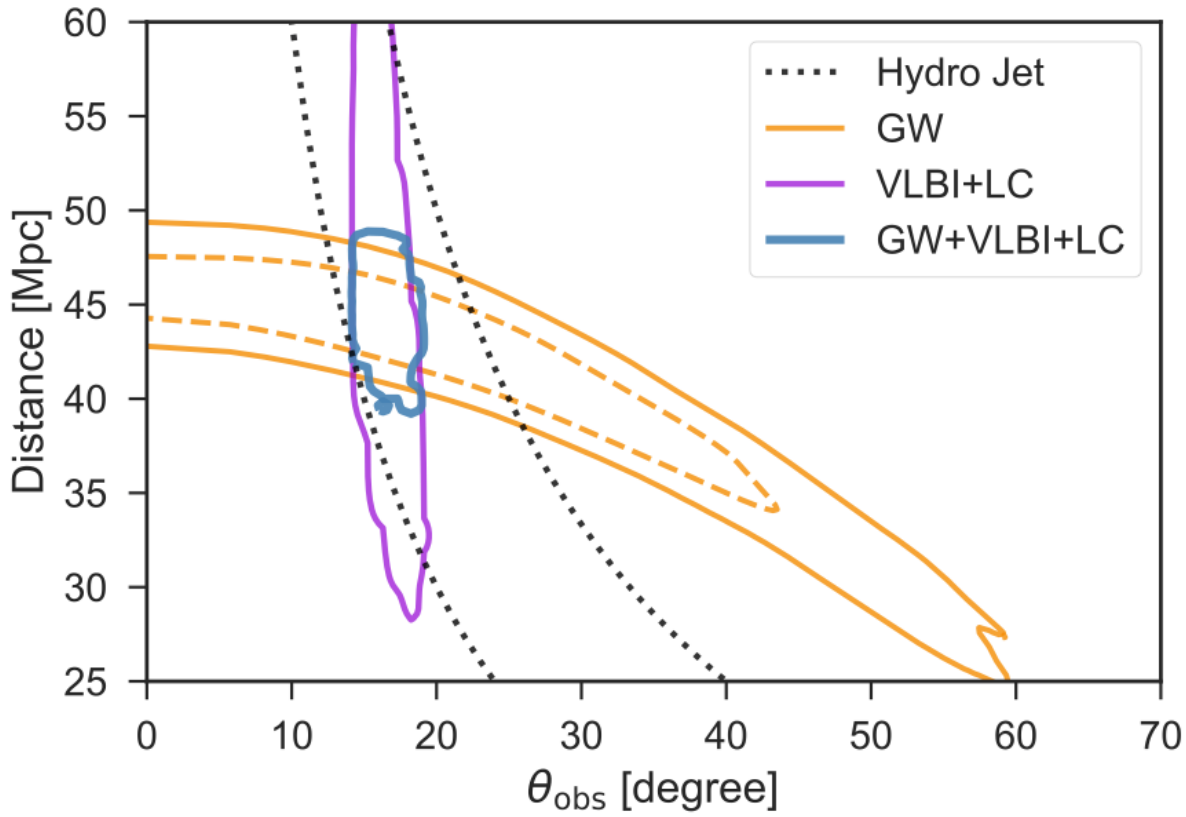


Improving bright siren inclinations

See work by: Kelly Gourdji, Adam Deller

Talk given by Kelly at June standard sirens meeting – slides on Slack

- Inclination angle is a significant source of error in standard siren luminosity distances
- High-resolution VLBI studies of GW mergers improve jet models hence constrain the GW source geometry
- Goal: improved measurement of H_0 from GW170817

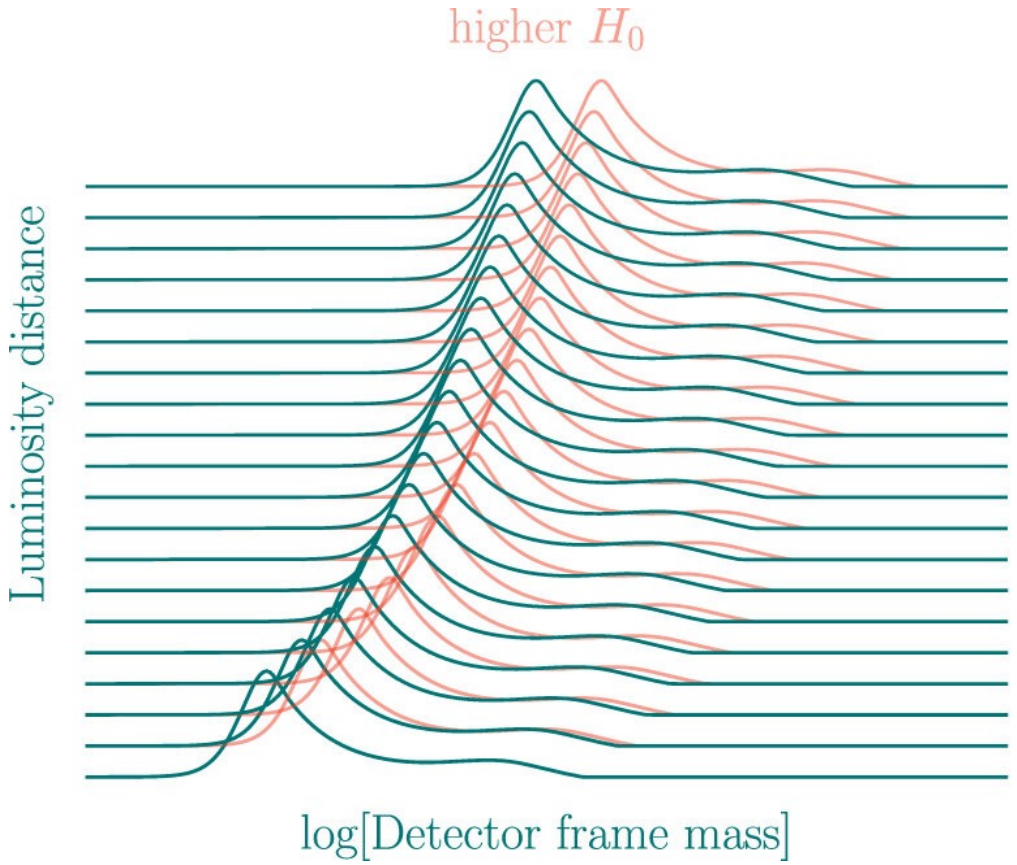


Spectral sirens

See work by: Hui Tong, Eric Thrane

- Can the information in the GW source population distributions (such as the mass) be used to improve cosmological fits?

- Goal: investigate the potential of the spectral siren method and any biases introduced by incomplete population models

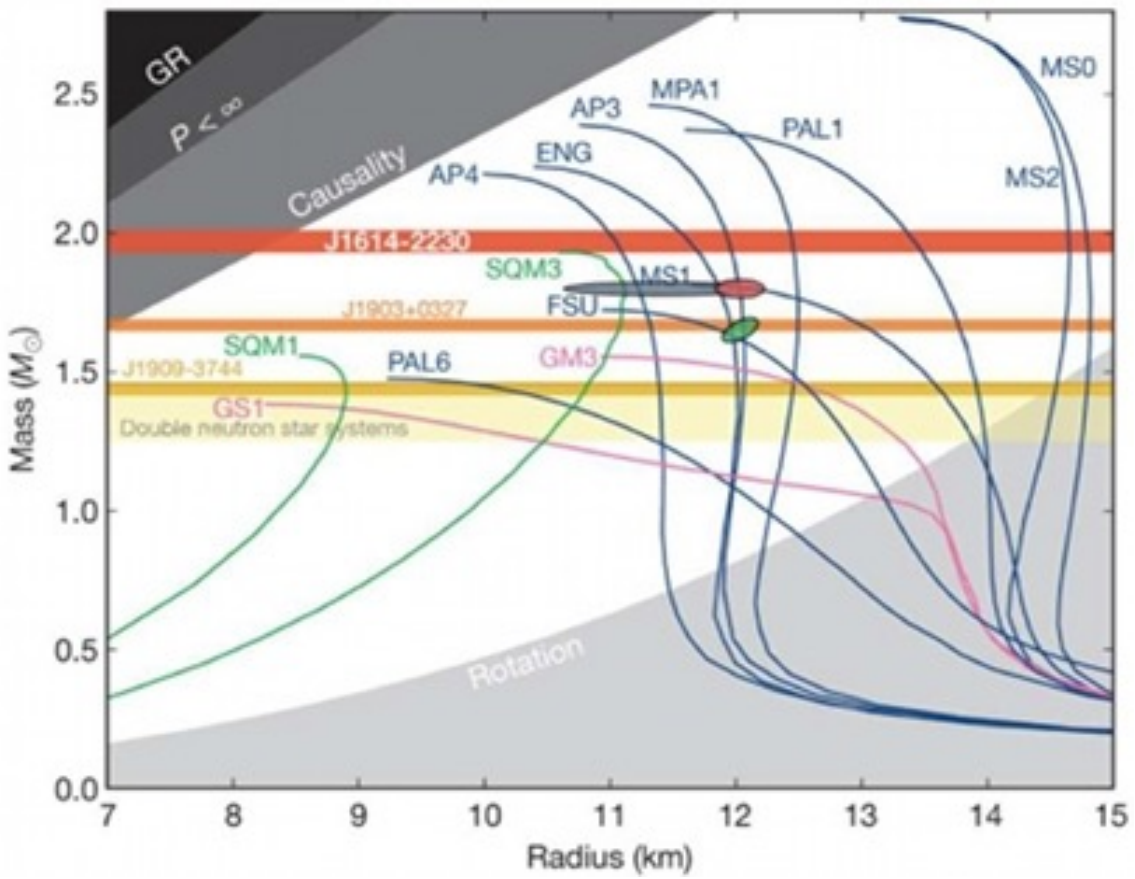


Neutron star equation of state

See work by: Spencer Magnall, Paul Lasky

Talk given by Spencer at OzGrav videocon in September

- Develop infrastructure for joint inference of H_0 and the neutron star equation of state from the GW signal
- Goal: what joint constraints are possible from future GW detectors?



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