SUPA IAC Meeting – 7th June 2018

Theme: Astronomy & Space Physics

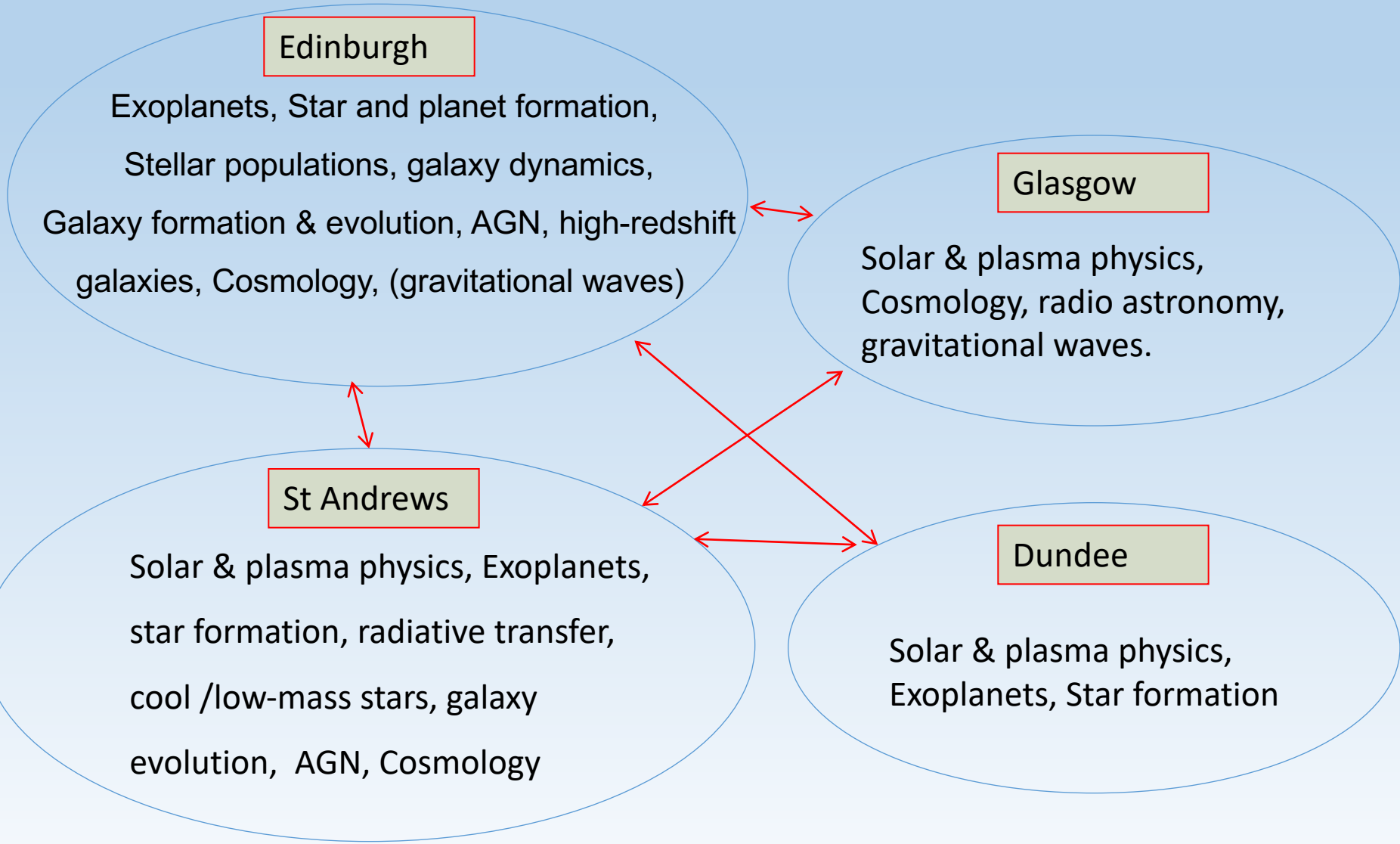
Theme Leader/speaker: Ken Rice (Edinburgh, Institute for Astronomy))

Edinburgh (IfA + UKATC)
St Andrews (Astronomy + Solar Physics)
Glasgow (IGR + Astronomy & Astrophysics Group)
Dundee (Astronomy + Solar Physics)

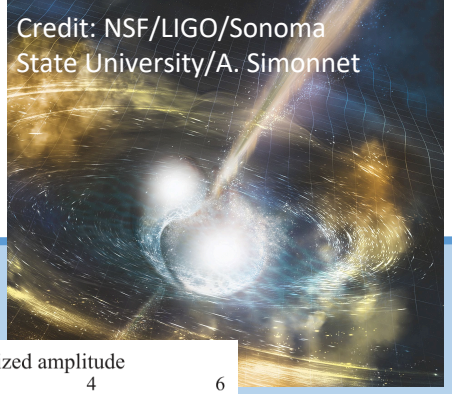
~ 50 Academic staff
> 60 PDRAs and Research Fellows
~ 100 PhD students

Funding: Mainly STFC, but a lot of ERC success, some Leverhulme.

Current Scope of Theme

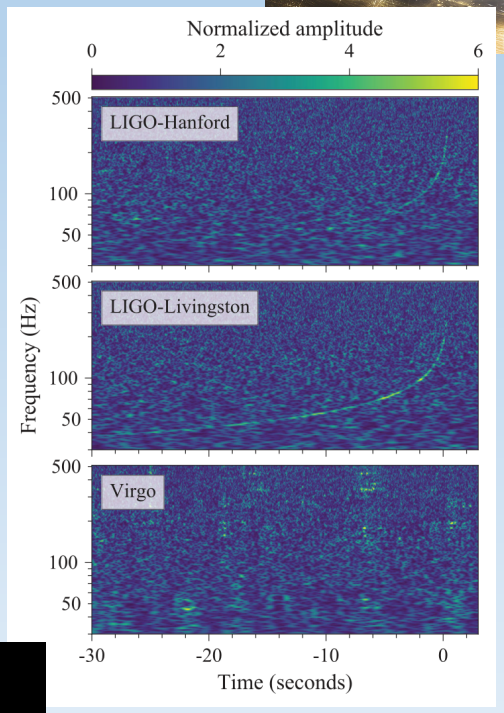


GW170817



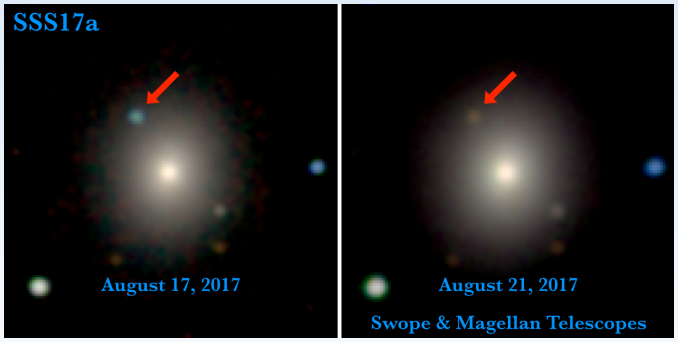
Gravitational wave event observed on 17 August 2017

- Seen in both LIGO detectors, but not in Virgo – helped to constrain location.
- Electromagnetic follow-up (including Edinburgh)
  - Neutron-neutron star merger.
  - Sets limit on difference between speed of light and speed of gravity (constrains modified gravity theories)
  - Stellar nucleosynthesis – neutron star mergers may contribute significantly to formation of r-process elements (e.g., gold/platinum)
- Significant parts of the GW analysis and publications led by Glasgow.
- E.g., Standard siren measurement of the Hubble Constant.
  - Doesn't require any form of cosmic distance ladder.

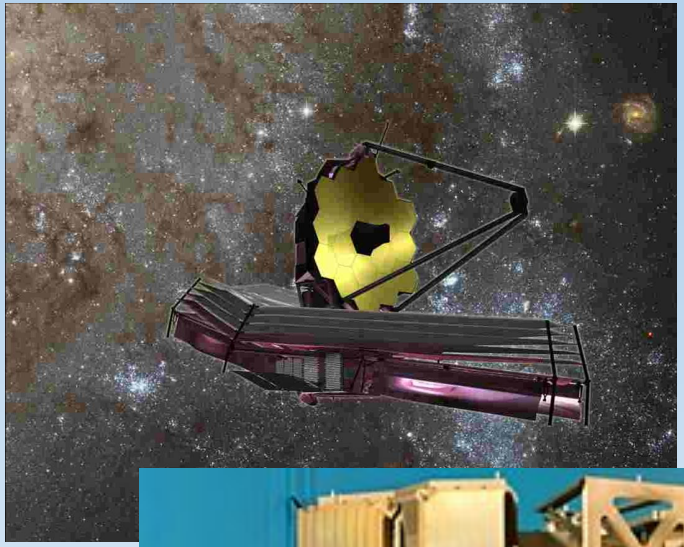


LIGO Scientific Collaboration and Virgo Collaboration

Credit: LIGO/Virgo/NASA/Le



JWST and MIRI



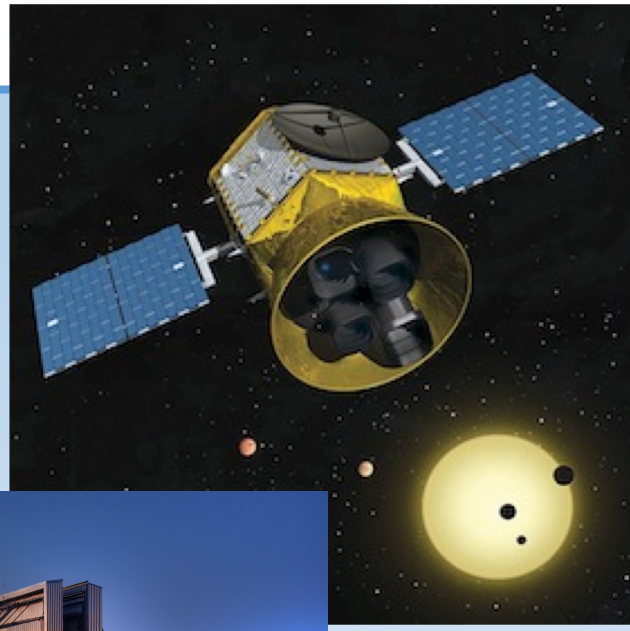
James Webb Space Telescope (JWST)

✧Launch date – early 2020 (was 2019, recently delayed to 2020).
✧6.2 m primary mirror, going to L2.
✧Primarily observing in the infra-red.

Mid-Infrared Instrument (MIRI)
✧Gillian Wright (UKATC) – European PI,
Alistair Glasse (UKATC) – project scientist
✧Already have PhD students working on simulating MIRI observation.

- Will play a key role in characterising planetary atmospheres and high-redshift galaxies.
- UKATC has access to Guaranteed Time.
- Beth Biller: Co-PI of an Early Release Science project.

TESS and HARPS-N

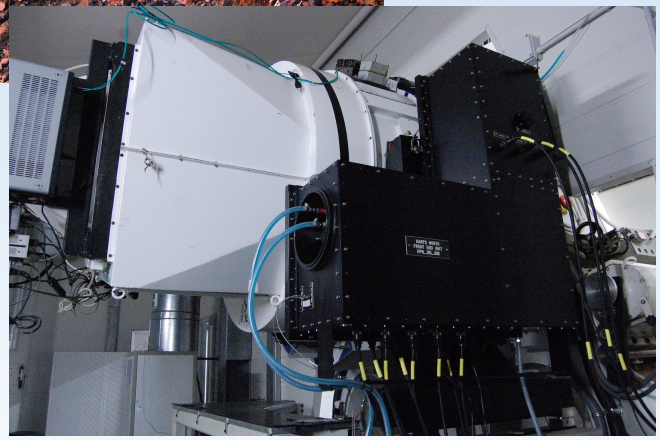


NASA's Transitting Exoplanet Survey Satellite (TESS)

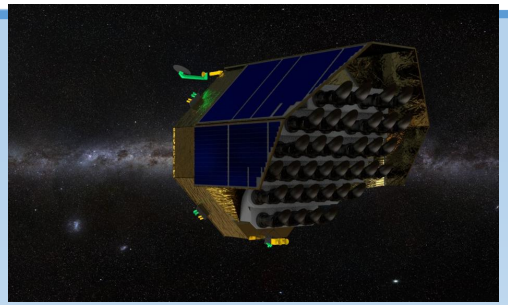
- ✧Launched 18 April 2018
- ✧Highly elliptical orbit with period of 13.7 days.
- ✧Will survey ~200000 stars for transiting exoplanets
  - ❖ Transits give planet radius.
- ✧Expected to detect hundreds of planets with radii < 2 Earth radii around bright stars.

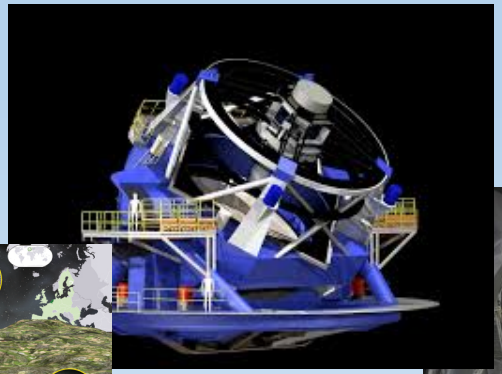
High-Accuracy Radial velocity Planet Searcher – North (HARPS-N)

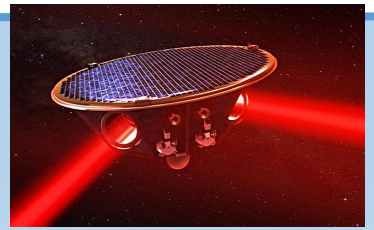
- ✧Collaboration including Edinburgh and St Andrews, part built by UKATC.
- ✧Located on 3.6m TNG – La Palma.
- ✧Currently, the most accurate radial velocity spectrometer (~1 m/s)
- ✧Will play a key role in following-up TESS planets
  - ❖ Radial velocity measurements give mass – mass + radius -> composition.
  - ❖ Can characterise small, rocky planets.
- ✧Centre for Exoplanet Science (Edinburgh, St Andrews, Dundee).

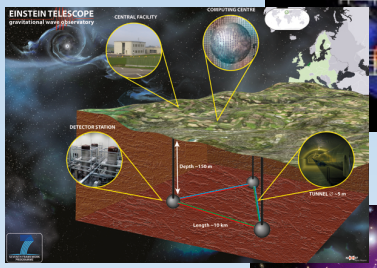


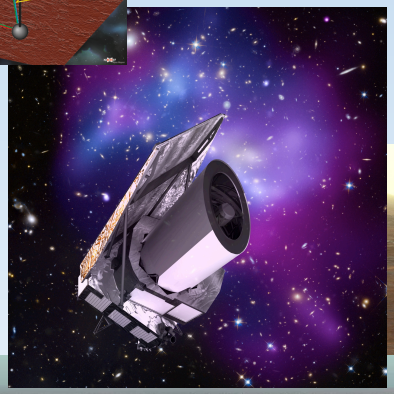
The medium/long-term future

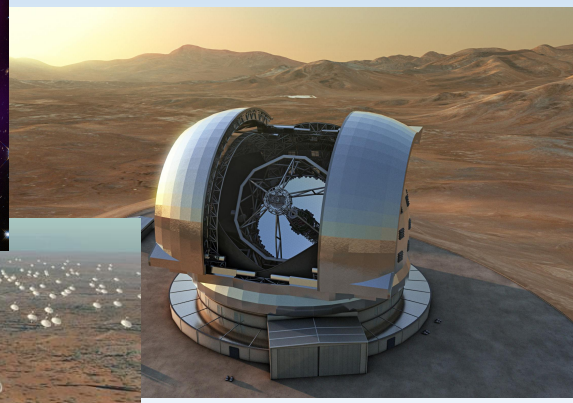


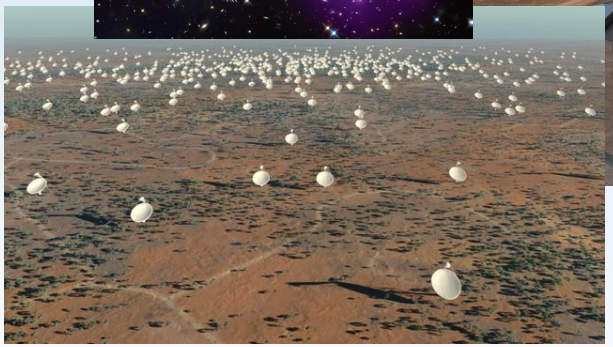












- eLISA, Einstein telescope
- PLATO (ESA)
- Daniel K. Inouye Solar Telescope
- EUCLID (ESA)
- Large Synoptic Survey Telescope (LSST)
- Wide Field Astronomy Unit (WFAU) will be involved in data management for EUCLID and LSST.
- UKATC
  - SKA (operations)
  - MOONS, ERIS (VLT).
  - HARMONI, METIS (E-ELT).

Impacts & spin offs

Blackford analysis

- Blackford Analysis: located at ROE, and growing.
- Centre for Doctoral Training in Data Intensive Science (ScotDist)
  - Includes Astronomy and Space Sciences and Particle and Nuclear Physics.
  - Edinburgh, St Andrews, Glasgow
  - 16 students started in September 2017, 9 students starting in September 2018.
  - Training courses + 6 month industrial placements.
  - Link with Alan Turing institute (one studentship)
    - Machine learning

Higgs Centre for Innovation
Science & Technology Facilities Council

2017

2018

- **Opened 25 May 2018.**
- **Start-up incubator to house 12 small companies (two already in place).**
- **Clean room, Shaker table, Cryo-vacuum testing, Optical & IR benches.**
- **3 x Nano-sat functional testing kit, Optical simulation for Earth-obs, RF Comm testing**

Concluding Remarks

- Vibrant, active community engaged in many exciting and world-leading research programmes/projects
- Already active in many of the future major astronomy and space science projects
  - Scientifically (JWST, EUCLID, LSST, TESS, LISA, EINSTEIN TELESCOPE,….)
  - Data management (EUCLID, LSST, ….)
  - Instrumentation development (VLT, E-ELT, JWST, LISA, EINSTEIN TELESCOPE,….)
- Considerable impact and spin-off opportunities
  - Blackford Analysis, Higgs Centre for Innovation, gravitational wave detector technology, Centre for Doctoral Training in Data Intensive Science, ….

Things to continue thinking about:

- Funding for International/EU PhD students and Research funding post-Brexit?
- Environment
  - **Maintaining** critical mass in key areas and providing the right environment to prosper.