WALLABY early science: Imaging a nearby spiral galaxy

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Australian Square Kilometre Array Pathfinder (ASKAP)

- SKA pathfinder
- 36 x 12 m antennas

- Revolutionary receivers – Phased Array Feed (PAF)
  - Gives an instantaneous 30 deg$^2$ FOV
  - Unprecedented survey speed
  - New techniques for observation and data reduction
Widefield ASKAP L-band Legacy All-sky Blind surveY (WALLABY)

- High resolution neutral hydrogen (HI) maps
  - Covering 75% of the entire sky (-90 < dec < 30)
  - Velocity range of -2,000 < v < 78,000 km/s
  - Angular resolution of ~30 arcsec
  - Spectral resolution of 4 km/s channel
  - Sensitivity of ~1.7 mJy
- Should detect 500,000+ gas-rich galaxies (Duffy et al. 2012)
- Largest, most homogenous sample of HI galaxies yet
- Study the properties and environments of galaxies
  - E.g. HI mass function, evolution of cool gas, missing satellite problem, star formation etc...
✧ Sub array of 10 – 16 antennas
✧ 48 – 240 MHz bandwidth
✧ Enough observations to reach WALLABY sensitivity
✧ Do ‘WALLABY’ science!
✧ Played a huge role in commissioning, esp. ASKAPsoft
✧ Papers coming out soon!

Image credit: Karen Lee-Waddell
Observing Strategy
M83 & Dorado Fields

Red: M83 subgroup
Blue: HIPASS detections
Brown: New dwarf galaxies

M83

ES field 3: M83 (For, B. + 2018, in prep)

Peak flux density map of M83

M83

NGC 1566 (Elagali, A. + 2018c, in prep)

Right ascension (J2000)
Declination (J2000)

Grand design spiral with warped rings of HI

NGC 1566

Elagali et al. in prep

For et al. in prep
**My Galaxy – IC 5201**

✧ Nearby spiral galaxy in the NGC 7232 field:
  ✧ Brightest HI source -> easily detected in 1 night
  ✧ Isolated and nearby (v = 900 km/s)
  ✧ Combining data is not trivial -> Ideal (simple?) test case
  ✧ In reality, very difficult to image
  ✧ Limited (12 MHz) bandwidth
  ✧ Limited beams (2 per footprint)

✧ 12 months ago -> Combined 6 nights in 1 beam

✧ Now:
  ✧ Reduced 2 beams in each footprint per observation
  ✧ Mosaicked image of 16 (~150 hrs) nights
  ✧ Extensive image testing
  ✧ Reached full WALLBY sensitivity, 1.7 mJy per 4 km/s channel

Kleiner et al. in prep
IC 5201 Results

✧ Well resolved, extended HI disk
✧ **10** additional extragalactic HI detections
✧ **7 new** HI detections
✧ **3** of these are satellites of IC 5201
✧ **2 new** velocity \((cz)\) measurements
✧ **2 possible** HI detections with no counterparts
✧ No HI bridges or tails between IC 5201 and its satellites
✧ 1 Satellite is very irregular \(\rightarrow\) possible past interaction?

Kleiner et al. in prep
Detected: See Lee-Waddell

Kleiner et al. in prep
Summary

✧ WALLABY early science is producing exciting results!
✧ The HI images have reached full WALLABY depth
✧ Imaged the extended HI disc of IC 5201
✧ Techniques applicable to the ~4000 nearby HI rich galaxies
✧ **11** HI detections in the image:
  ✧ **7 new** HI detections
  ✧ **3** of these are satellites of IC 5201
  ✧ **2 new** velocity (cz) measurements
  ✧ **2 possible** HI detections with no counterparts
Thank you!

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