Scientific Activities Related to SKA in Taiwan

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1. Radio Research Activities in Taiwan

SMA

ALMA

AMiBA

Future

GLT

SKA?
Possible SKA-Related Activities

(1) Cosmology and galaxy evolution
   - H I emission/absorption statistics
   - Radio-FIR relation of galaxies

(2) AGNs
   - Collimation of jets
   - Search for diffuse radio emission around AGNs

(3) Star formation
   - Monitoring of young stellar objects

(4) Instrument Development
   - Extension of ALMA Band 1
   - GBT multi-beam receiver
   - AMiBA future plan
Cosmology and galaxy evolution

H I Absorption Statistics

Damped Lyman α clouds (DLAs): $N_H > 2 \times 10^{20} \text{ cm}^{-2}$

Statistics of 21 cm absorption optical depth to be compared with a future large SKA sample
Radio Continuum as a SF Indicator

Hirashita (2013)

Radio–FIR relation in nearby dwarf galaxies (BCDs: 1/10–1 Zsun)

With SKA, we can extend the sample to high-z metal-poor (primeval) galaxies.
Cross-correlating GBT HI & WiggleZ optical galaxies at $z \sim 0.6-1$

- 200 hours, 41 deg$^2$ survey at the GBT
- Measuring the WiggleZ fields at 800 MHz band, $0.5 < z < 1.1$
- Foreground subtraction using SVD in freq-freq covariance matrices, and correcting for frequency dependent beam
- Foreground subtraction down to factor of $>100$

- HI brightness temperature on these scales at $z=0.8$:

$$\Omega_{\text{HI}} r b = (4.3 \pm 1.1) \times 10^{-4}$$

Masui+, GBT-HIM team, 2012
CO intensity mapping with AMiBA-DACOTA

- 1.2 m dish, 6 m baseline, currently operate at 83-102 GHz
- At 30-32 GHz, probes 6.19 < z < 6.67 for CO[2-1], 2.59 < z < 2.83 CO[1-0]
- At 31 GHz, resolution=6.7’, FoV =28’, probes >10 Mpc scales
- AMiBA team (ASIAA): Paul Ho, Kai-Yang Lin, Ming-Tang Chen, Homin Jiang+
- DACOTA team (Berkeley/Arizona): Geoff Bower, Dave Deboer, Dan Marrone+

DACOTA is a scientific and technical pathfinder in the search for the CO intensity mapping signal and this proposal is part of a larger roadmap to understand and characterize molecular gas in the early Universe. The design of DACOTA has been optimized to reach sensitivity in the power spectrum commensurate with the signal level predicted for the EOR in self-shielded models for CO abundances at $z_w$. We predict a $>\sigma$ detection with a kilo-hour integration at $z_w$. Given the much higher signal level of the $z_w$ signal, we will make a $>\sigma$ detection at that lower redshift. While sensitivity and control of instrumental systematics are central to our design, astronomical foregrounds, atmospheric effects, and interference are unlikely to be significant hindrances which is a strength of this technique. Through separate resources, the DACOTA team is developing a low $J_{W} \rightarrow i$ band that will be matched to the $J_{W} \rightarrow k$ band of this proposal to disambiguate the redshifted signals. The success of DACOTA in detecting the $z_w$ and $z_w-q$ signals will give us substantial insight into how to detect fainter signals with greater significance. Ultimately, as in the case of HI EOR measurement, a larger-scale mapping instrument based on the technologies developed in this ATI can provide a detailed view of the EOR. DACOTA results will provide an important complement to targeted galaxy observations obtained with EVLA, ALMA, JWST, and other facilities.
AGNs

Imaging Re-collimation Process of the M87 jet

Dynamic Range of current our EVN image is $\sim 2500$

- SKA will improve it $> 1,000,000$

Is the M87 jet re-collimated to form HST-1?
Detection of the counter-jets is very important;
- Constraining a proper viewing angle
- Jet acceleration dynamics
- SED analysis for core emission profile
- Modeling the accretion disk and BH shadow
Diffuse emission around FR II radio galaxies: episodic activity

\[ \alpha_{\text{inj}}^{\text{inn}} \sim \alpha_{\text{inj}}^{\text{out}} : \text{similar jet power} \]

(Konar & Hardcastle, 2013)

Newly discovered diffuse halo (Sirothia+, 2013)

Hope to discover many such radio haloes with the SKA
Monitoring of Young Stellar Objects

JVL A 8–10 GHz for ~ 200 days

Liu et al. (2013)

The current sensitivity of JVL A for full-night integration: ~ µJy.

“Solar flares” at the distance of these YSOs: nJy – µJy.

By SKA, we can target more normal stellar flares.
ALMA Band-1 Project Overview

- Led by ALMA-EA (ASIAA)
- Cooperation with HIA (Canada), NRAO (USA) and U Chile.
- Freq.: 35-52 GHz in SSB operation
- Receiver Noise Temp.: 25-32 K (expected) @ 15K
- PDR in July 2013
- CDR in 2014
- End of project: Summer 2019

Development of SKA instruments is our natural extension.
GBT-HIM Project (P.I. T.-C. Chang): Building a 7-beam receiver at 700-945 MHz for redshifted HI survey at 0.5< z < 1 for BAO measurements.
- Use Short-backfire Antenna (SBA) with a edge-tapered reflector; with a cryogenic tube connecting to the dipole to reduce Tsys.
- Prototype for installation on GBT summer 2013; ASIAA+NRAO+GBT-HIM team
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