FAST Proposal Coverpage

Last updated: 01/10/2019

Project Name:
(A 1-line title for your project)

Connecting the Circumgalactic Medium and the HI content of the redshift ~ 0.2 galaxies: A pilot study

Project Summary:
(A 1 paragraph summary of your project, including its scientific goals and how you will address them. This information will be potentially public.)

The Circumgalactic Medium (CGM) plays an vital role in regulating galaxy formation and evolution. However, the connection between the far away CGM and the galaxy central activities remains a puzzle. The COS-Halos survey revealed the occurrence of highly ionized CGM for 44 galaxies by O VI absorption lines and found a strong correlation between the CGM and Star formation. **To further explore this correlation and address the question of how central galactic activities can impact the CGM hundreds of kpc away in the distant halo, we propose to a pilot program to study the HI content of galaxies selected from the COS-halo survey.** HI as the raw material for star formation provides a fundamental quantity to address such correlation. We plan to do a pilot observation of HI emission lines for several galaxies at redshift z∼0.2 from COS-Halos survey sample. Meanwhile, we also expect to take this opportunity to explore the feasibility of detecting HI emission from relatively high redshift galaxies for FAST.

PI and Observer Contact Details:
(Contact details which other FAST observers can use to contact you about your project)
Name, Email, Cell number/Wechat account name

Taotao **Fang, fangt@xmu.edu.cn, 18250899620**
Qingzheng Yu, yuqingzheng@stu.xmu.edu.cn, 17689216873
Liyuan Lu, luliyuan@stu.xmu.edu.cn, 15567687695

Project Type:
(tick all that apply)

☑Spectral Line: pointing
- ❑ Spectral Line: Imaging
- ❑ Pulsar (fold/timing mode)
- ❑ Pulsar (search mode)
- ❑ Pulsar (single pulse)
- ❑ Continuum
- ❑ Other (please specify)
  - ❑ _____

Observing Mode:
- ❑ Remote Observing
- ☑ Travelling to FAST to observe

Project Members

(just list the names here. A full table is required on later pages.)

Taotao Fang, Qingzheng Yu, Liyuan Lu, Jessica Werk, Ming Zhu, Bo Zhang

Requested Contact Person/Collaborator from the FAST Project

(If none specified, one will be assigned to the project)

Ming Zhu, Bo Zhang

Project Justification

(This should be at most two single-column pages long in a font of size no smaller than 11pts. Note that the source table should be in separate pages. the following sections are required.)

1. **Motivation**（Science background, related existing observations, state-of-art results and current references）

The COS-Halos survey revealed the occurrence of highly ionized CGM for 44 galaxies by O VI absorption lines and found a strong correlation between the CGM and Star formation (Werk et al. 2016, Tumlinson et al. 2011). **To further explore this correlation and address the question of how central galactic activities can impact the CGM hundreds of kpc away in the distant halo, we propose to a pilot program to study the HI content of galaxies selected from the COS-halo survey (Werk et al. 2012).** HI as the raw material for star formation provides a fundamental quantity to address such correlation. We plan to do a pilot observation of HI emission lines for several galaxies at redshift z∼0.2 from COS-Halos survey sample (Werk et al. 2013). In the previous COS-Halos survey, Werk et al. observed 44 galaxies with HST/COS and Keck/HIRES, and they presented the equivalent width and column density measurements for ion species at low and intermediate ionization states of the CGM (Werk et al. 2013).

2.Why FAST now？ (What is the unique advantage of using FAST? Can the proposed science be carried out in at Parkes, GBT, and/or Arecibo? Are the required capabilities available now in the commissioning phase or will have to wait for the normal operation?)

Observing HI 21 cm emission from galaxies at cosmological distances (z>0.1) is difficult due to the weak flux of the line and the limitation of sensitivity of existing facilities (Lah et al. 2009). For example, the ALFALFA sky survey limited their redshift to z~0.06, and HIPASS survey limited it to z~0.04. So far, WSRT and VLA have detected some HI galaxies in Abell clusters with long integrations (Verheijen et al. 2007). In addition, Arecibo also did a pilot survey on 10 field galaxies at z~0.2 (Catinella et al. 2008). The high sensitivity of FAST is a unique advantage for detecting HI from galaxies at z~0.2. According to the operational specifics we know about FAST, the required capabilities are available now.

3.Expected results (Justify the integration time and required observations here. Specify the quality of data required for a publication. A publication plan.)

Based on the 10 targets which had star formation activity and Hα emission of Arecibo's pilot survey (Catinella et al. 2008), we selected 5 sources from COS- Halos survey (Werk

et al. 2013) with relatively high SFR in our pilot survey. Considering the high sensitivity, 2 hours total integration time for every source is needed. To estimate the HI mass of our targets, we need make sure the signal to noise ratio of HI line is higher than 5, which needs ~0.2mJy for sensitivity. After we achieved our results, we plan to publish the HI detection results first, and then we plan to do the complete survey of COS-Halos galaxy sample (Werk et al. 2013) for the publication of study on the correlation between HI content of these galaxies and the CGM.

References:

Werk, J. K., Prochaska, J. X., Cantalupo, S., et al. 2016, apj, 833, 54.
Tumlinson, J., Thom, C., Werk, J. K., et al. 2011, Science, 334, 948
Werk, J. K., Prochaska, J. X., Thom, C., et al. 2013, apjs, 204, 17.
Werk, J. K., Prochaska, J. X., Thom, C., et al. 2012, apjs, 198, 3.
Catinella, B., Haynes, M. P., Giovanelli, R.et al., 2008, apjl, 685, L13.
Verheijen, M., van Gorkom, J. H., Szomoru, A., et al. 2007, apjl, 668, L9.
Lah, P., Pracy, M. B., Chengalur, J. N., et al. 2009, mnras, 399, 1447.
Fang, T., Buote, D., Bullock, J., et al. 2015, apjs, 217, 21.
Fang, T., Bullock, J., & Boylan-Kolchin, M. 2013, apj, 762, 20.
Fang, T., Danforth, C. W., Buote, D. A., et al. 2014, apj, 795, 57.
Luo, Y., Fang, T., & Ma, R. 2018, apjs, 235, 28.

Technical Requirements:

*(Please fill out **all** fields)*

Receivers:

- ❑ 19-beam (all)
- ☑19-beam (central)
- ❑ Other (please specify)
  - ❑ _____

Backends:

- ☑19-beam ROACH
- ❑ CRANE
- ❑ Other (please specify)
  - ❑ _____

Observing mode:

(Please refer to your earlier selection on Page 1 in order to complete the correct section)

- ❑ Pulsar (fold)
  - De-dispersion (coherent/incoherent):
  - Number of channels:
  - Bandwidth (MHz):
  - Number of profile bins:
  - Length of sub-integrations (s)

- ❑ Pulsar (search)
  - Number of channels:
  - Bandwidth (MHz):
  - Sampling time (μs):

- ☑Spectral line / Continuum
  - Frequencies of interest 1100~1300MHz(HI, depend on sources)
  - Observing mode (pointed, drift, m/x, mapping): pointed
    - Details of observing mode
      Position switching
  - Dump time (i.e., how often should a spectrum be written to disk) (seconds): 10s

2. Other Comments:

(Please feel free to provide additional comments here regarding the technical setup of your observations

Full list of Project Members:

(The Principal Investigator (PI) should be listed on the first (shaded) row. Additional rows can be added as needed. Please identify the observer(s) with an asterisks beside his/her name(s).)

Name	Email	Institution	FAST Observing Experience (Y/N)
Taotao Fang	fangt@xmu.edu.cn	Xiamen University	N
Qingzheng Yu*	yuqingzheng@stu.xmu.edu.cn	Xiamen University	N
Liyuan Lu*	luliyuan@stu.xmu.edu.cn	Xiamen University	N
Ming zhu	mz@bao.ac.cn	NAOC	Y
Bo zhang	zhangbo@nao.cas.cn	NAOC	Y

Source List & Observing Time Requirements:

(Please complete the table below for all sources which you plan to observe. Be sure to include the required integration time of each source, and the number of times you plan to observe it (repeats). ***In addition, you can also optionally attach your proposed observing schedule to your proposal)***

Name	RA	Dec	LST Rise	LST Set	Integration time (s)	Repeats
J0910+1014_34_46	09:10:31.50	+10:14:51.1	15:55:43	18:55:55	600	12
J0943+0531_106_3	09:43:33.78	+05:31:22.2	16:47:55	19:09:33	600	12
J1112+3539_236_14	11:12:38.16	+35:39:20.4	17:33:33	21:21:41	600	12
J1419+4207_132_30	14:19:12.21	+42:07:26.5	20:52:52	00:13:57	600	12
J1435+3604_68_12	14:35:12.41	+36:04:41.5	20:55:54	00:42:55	600	12

Total Integration Time:

(For each source, calculate "Repeats x Integration time", then add together.)

10hr = 36000s

Estimated Overhead Time:

(The total time taken to setup the telescope, move between sources, calibrate, etc. Note that the source changing time of FAST is 10minutes..)

2hr = 7200s

Total Time Request:

(Total Integration Time + Estimated Overhead Time)

12hr =43200s

Final Time Allocation:

(DO NOT FILL IN THIS SECTION. This will be completed after your submitted proposal has been reviewed.)