

Observing Proposals

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Topics

- **Telescope Access Program (TAP)**
 - M31 as distance anchor 2015B, 2016B
 - Fundamental Properties of Very Low Mass Stars (VLMS) 2017A
- **Bohyunsan Optical Astronomy Observatory (BOAO)**
 - Comprehensively Spectroscopic Study of Be Stars in Open Clusters 2017A
- **Lulin (LOT)**
 - Some star clusters observation 2015B
 - Confirming the Be Stars in Open Clusters 2016C
- **Nishi-Harima Astronomical Observatory (NHAO)**
 - Comprehensively Spectroscopic Study of Be Stars in Open Clusters 2017A
- **Xinglong, Lijiang (CAS?)**
 - Comprehensively Spectroscopic Study of Be Stars in Open Clusters 2017A

Facilities

- **Telescope Access Program (TAP)**
 - CFHT (3.6m), Palomar Hale (5.1m), Magellan (2 x 6.5m), and Steward Observatory Small Telescopes (Bok 2.3m, VATT 1.8m, etc), **MMT (6.5m) spectral**
- **Bohyunsan Optical Astronomy Observatory (BOAO)**
 - 1.8m spectral
- **Lulin (LOT)**
 - 1m spectral
- **Nishi-Harima Astronomical Observatory (NHAO)**
 - 2m spectral
- **Xinglong, Lijiang (CAS?)**
 - 2.16m, 2.4m spectral

Deadlines

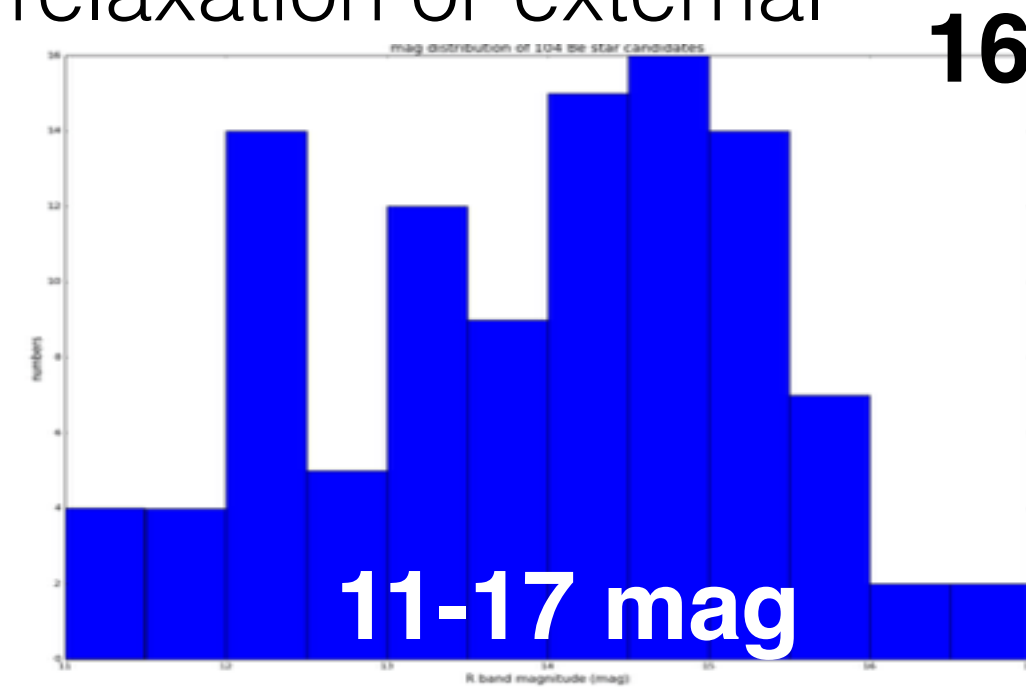
- **Telescope Access Program (TAP)**
 - March and September every year
- **Bohyunsan Optical Astronomy Observatory (BOAO)**
 - May and October every year
- **Lulin (LOT)**
 - Every season
- **Nishi-Harima Astronomical Observatory (NHAO)**
 - Privately contact
- **Xinglong+Lijiang (CAS?)**
 - July and November every year (?)

Scientific Justifications I

- **Comprehensively Spectroscopic Study of Be Stars in Open Clusters**
 - The formation of rapid rotation is still controversial.
 - stellar age to probe a possible scenario for the formation of the rapid rotation —> star clusters
 - Sample of Be stars in open cluster is incomplete
 - image survey time consuming
 - spectroscopic survey limited to bright stars
 - PTF (narrow-band + H α -band)
 - 139 open cluster sample with age (1 Myr-1 Gyr), distance (1.5-2.5 kpc)
 - 104 Be stars are found in 29 open clusters

Scientific Justifications II

- **Comprehensively Spectroscopic Study of Be Stars in Open Clusters**
 - Our main scientific goal is to confirm and classify the Be candidates on the basis of the H α emission line, HeI λ 4026, HeI λ 4387, HeI λ 4471, and Mg II λ 4481 absorption lines (Yu et al., 2016) by using CAS 2-m telescopes.
 - disk fraction EW[H α] vs cluster age/environments
 - spatial distribution in clusters \rightarrow relaxation or external perturbation
 - subtype classification
 - long-term variability \rightarrow outburst
 - Be in old open cluster (10^9)



Research plans and its feasibility

B. Research plan and its feasibility:

Using Taiwan Lulin 1-m and USA Lick 3-m telescopes, several Be candidates have successfully confirmed the Be star spectroscopically from a couple clusters including a young cluster NGC 663 and an old cluster NGC 6830 (Yu et al., 2016). Our preliminary work showed that our method and criteria are feasible. We plan to finish data reduction and analysis within 3 months after observations. Furthermore, we also have extensive experience of spectroscopic observations and data reduction/analysis, including USA KPNO Mayall 4m (Yu), Lick Shane 3m (Yu), Korea BOAO 1.8m (Yu), China NAOC 2.16m (Hsia, Lin & Lee), and Taiwan 1m (You) telescopes. Our funding is sufficient to support observation trips, data reduction, and publication charges. Backup observation plans of different scientific topics will be prepared in case the requesting instruments are not available, including RR-Lyrae stars (Ngeow), PNe (Hsia), and asteroids (Kinoshita and Chang).

Necessity and Expectation

C. Necessity of using the CAS 2-meter-class telescopes:

Spectroscopic survey of Be stars in clusters is very time consuming. This project will be the most comprehensive spectroscopic survey of Be stars in open clusters. To accomplish the project, CAS 2-meter-class telescopes play the most important role because the brightness distribution of our candidates are suitable to use 2-meter-class telescopes for spectroscopic confirming and investigation.

D. Expected result and scientific output:

We plan to obtain spectra of 63 candidates brighter than 14.5 mag during this semester, and we expected to have scientific output of Be star knowledge, including:

- (a) Reporting newly discovered Be stars in clusters.
 - (b) Relation between Be stars and cluster environments.
 - (c) Study variability of Be stars with different subtypes.
- At least one paper will be accomplished and submitted.

Technical Justifications

3 long-slit exposures (SNR>50) x 600 sec/exposure x 27 Be candidates brighter than 13 mag
+
3 long-slit exposures (SNR>50) x 900 sec/exposure x 21 Be candidates brighter than 14 mag
+
3 long-slit exposures (SNR>50) x 2000 sec/exposure x 15 Be candidates brighter than 14.5 mag
= 44.3 hrs ~ 4 nights

Since our Be candidates distribute from R.A. = 00h to R.A. = 07h, we request to observe our targets during Nov and Dec 2016. To avoid contamination of the moon, we request to observe at grey/dark nights.

For 2.16 m telescope:

We request BFORC with medium dispersion instruments G7 grating.

Slit width: 1.8arcsec

Moon phase: dark or grey nights.

For 2.4 m telescope:

We request YFORC with G3 grating.

Slit width: 1.8arcsec

Moon phase: dark or grey nights.

Results

- **Telescope Access Program (TAP)**
 - M31 as distance anchor 2015B, 2016B (x)
 - Fundamental Properties of Very Low Mass Stars (VLMS) 2017A (?)
- **Bohyunsan Optical Astronomy Observatory (BOAO)**
 - Comprehensively Spectroscopic Study of Be Stars in Open Clusters 2017A (7 nights)
- **Lulin (LOT)**
 - Some star clusters observation 2015B (3 nights)
 - Confirming the Be Stars in Open Clusters 2016C (13 nights)
- **Nishi-Harima Astronomical Observatory (NHAO)**
 - Comprehensively Spectroscopic Study of Be Stars in Open Clusters 2017A (5 nights)
- **Xinglong, Lijiang (CAS 2-m)**
 - Comprehensively Spectroscopic Study of Be Stars in Open Clusters 2017A (3+3 nights)