Why TAP?

Science

• Compensates China’s lack of medium- & large-aperture multi-purpose optical telescopes (> 2.4 m) and cutting-edge infrared instrumentation
• Facilitates international collaboration and competitiveness
• Allows complementary observation facilities to ongoing large projects
• Yields China-based high impact research results

Education

• Builds the base of experienced observers in China to propose, execute, and lead observational investigations
• Provides student training on large telescopes for China’s next generation astronomers in observation and instrumentation (41)
Canada-France-Hawaii Telescope (CFHT) 3.6m Mauna Kea ~15 nights/year

Hale 5.1m Mt. Palomar (Caltech) ~45 nights/year

MMT 6.5m Mt. Hopkins Steward Obs.) 12 nights/year

Magellan 2x6.5m Las Campanas (Chile) (Steward Obs.) 4 nights/year

2020 (Feb~Jul)
CFHT: 4-8 nights

Palomar: ~ 22-23 nights

LCOGT: ~450 hours (Apr-Aug)
Milestones of Telescope Access Program (TAP)

- 2008/11: Initial evaluation
- 2009/12: China-TMT Science Meeting
- 2010/09: TAP created
- 2011/03: First TAP proposal deadline
- 2014/01: TAP++ Advisory committee
- 2014/07: TAP/Pilot B Key Projects
- 2017B: Last semester for Steward MOU
- 2017/10: Renewal of Palomar MOU +6
- 2018/01: New Advisory Board
- 2018/10: Confirmed partnership of XMU
- 2018/11: Renewal of CFHT MOU +4
- 2018/11: Initiation of committee board
- 2019/02: 1st Board Meeting, THU, PKU, USTC confirmed membership
- 2019/08: 2nd Board Meeting, NJU, YNU confirm membership
- 2019/12: TAP Workshop at XMU

With the rapid development of astronomy in China, including many future projects that will benefit from a broad base of experienced optical-IR astronomers, we initiated the Telescope Access Program (TAP). China-based astronomers have previously accessed international telescopes either through collaboration, going abroad for a time, or applying for small amounts of open time on a few facilities. Although these efforts should and will continue, TAP is a different kind of program. TAP will, for the first time, give all China-based astronomers direct access to optical-infrared facilities with apertures of 3.6m+5.5m. This time is not predetermined for specific projects, but is allocated through an open and competitive basis.
TAP Structure

Starting 2019B, TAP employed a new committee board system:

• Updated time allocation policy (~80% GT + ~20% OT)
• Potential Funding expansion (more nights & more telescopes)
• Committee board structure
• Semi-annual meeting (e.g. coordinate with China’s next generation optical-IR telescopes: 12m, TMT, EAO, …)

CAMS: Center for Astronomical Mega-Science, CAS
Incl. NAOC, PMO, SHAO, XAO, YNAO, ….
The TAP TAC proposal review process is one of TAP’s strengths

TAC is broadly representative of astronomy in China (7-8)

66 unique individuals, many serving multiple times, over 15 TACs

- NAOC (31), SHAO (12), PMO (11), YNAO (2), USTC (6), PKU (16), NJU (10), XMU (6), SJTU (3), BNU (1), SDU (2), THU (2), TJNU (1), SYSU (1), International (13)

Every proposal gets an international external review

TAC ranking is purely based on science merit and quality of the proposal

TAP-VO platform starts for 2019A semester
TAP Publications

Observations started in 2011B. As of Nov, 2019:

- 133 refereed publications
  (http://info.bao.ac.cn/tap/?q=publications)
- total: 1200 citations
- 14 papers with 20 or more citations

TAP Publications by Telescope:
- Palomar (52)
- CFHT (32)
- MMT (25)
- Magellan (17)
- LCOGT (14)
TAP Publications
What sciences can be done with TAP?

Discovery of Quasars at high-z

Optical spectra for the $z \sim 6.3$ quasar
Wu et al. (2015), Nature;
See Also
Wang et al. (2017, 2016), Jiang et al. (2016) …

Discovery of inflows fueling SMBH accretion disks

Fast gaseous inflow traced by a redshifted broad-absorption-line (H I & He I) (Zhou et al. 2019, Nature)
See Also
Schulze et al. (2018), Shi et al. (2016a,b) …

~ 1/3 on AGN related topics!
Galaxy Formation and Evolution

- Mass-Metallicity Relation
  * Metal poor star-forming galaxies via BASS (Gao et al. 2018, below)

- Lyman Alpha Emitters
  * Confirmation of z~7 LAE in the large area narrowband survey Lyman-Alpha Galaxies at the End of Reionization (LAGER) survey (Hu et al. 2017, 845, 16)
  * Damped Lyman alpha system (e.g. Xie et al. 2018, ApJ, 858, 32)

- Mass-Size Relation
  * in red galaxies (Favole et al. 2018)

Galaxy properties
- Dwarf Galaxies (e.g. Liu et al. 2017, 837, 109)
- Low surface brightness galaxies (e.g. Du et al. 2017, 837, 152)
- Emission Line galaxies via BASS (e.g. Lan et al. 2018, 866, 36; An et al. 2014, 784, 152)
**TAP Science Highlights**

**Luminous Supernova**

- The **most luminous Supernova** (ASASSN-15lh), Dong et al. (2016), Science, TAP-Magellan/LCO/Palomar
- Supernova catalog & follow-ups, Boss et al. (2018), Holoien et al. (2017), Godoy-Rivera et al. (2017), TAP-LCO
- Extragalactic tidal disruption events with TAP-MMT (Yang et al., 2013)

**Stars, Planets, and other subjects**

- **Resonant feature** in the Perseus arm of the Milky Way discovered with TAP-MMT (Liu, C. et al. 2012)
- **Super metal-poor** stars with LAMOST & TAP-Magellan (Li, H. et al., 2015)
- Extragalactic tidal disruption events (TDE) with TAP-MMT (Yang et al., 2013)
Telescope Access Program (TAP Optical-IR)
Key Programs - Adding Value to Domestic Programs

Chemical tagging of outlying populations of the Milky Way detected by the LAMOST survey

- PI: Gang Zhao (NAOC)
- High resolution spectroscopic follow-up of interesting LAMOST stars
- Extremely metal-poor stars, Carbon-enhanced metal-poor stars
- High-[alpha/Fe] metal-rich stars, Li-rich stars

Systematic characterization of exoplanetary atmosphere

Canada-France-Hawaii Telescope (CFHT) 3.6m Mauna Kea
15 nights

Automated Planet Finder (2.4m) Mt. Hamilton (UCO/Lick Obs.)
~30 nights

Wang et al. (2013), exoplanets

High-throughput, high-resolution spectroscopy (R~100,000)

- PI: Wei Wang (NAOC)
- Infrared transit photometry
- Uses Mauna Kea’s high altitude to observe CO band at 2.3um.
Telescope Access Program (TAP Optical-IR)
Key Programs - Joining International Surveys

Beijing-Arizona Sky Survey (BASS)

- PIs: Xu Zhou (NAOC), Xiaohui Fan (Arizona)
- Following the successful model of SCUSS (PI: Xu Zhou)
- An imaging survey of the North Galactic Cap; pre-imaging for the Dark Energy Spectroscopic Instrument (DESI)
- DESI will be a leading dark energy experiment
- 5 Chinese team members will be full DESI members, total value is USD $1m

Data Release 2 in Zou et al. 2018
Telescope Access Program (TAP Optical-IR)
Large programs: access to International Collaborations

CLAUDS: CFHT Large Area U-band Deep Survey

- Jiasheng Huang (NAOC), Yipeng Jing (SJTU), Chengze Liu (SJTU), collaboration with Canada, France, Japan (2014B-2016B)
- \(u^*\)-band imaging to 27 mag of 27 deg\(^2\) of HSC Deep fields
- Chinese team gains access to HSC deep fields, a Subaru Strategic Program
- Galaxy evolution at intermediate and high redshift

Largest LBG samples at \(z\sim3\) (million), Liu et al. in prep
TAP - Training the next generation of observers

- ~45 student PIs of TAP proposals
- Opportunities for students and postdocs to observe at the TAP telescopes
- China’s next generation of observers
- Training: 2016- now, PhD × 10, PhD Candidates × 22, M.S. × 1, M.S. in progress × 6
TAP - What have we learned?

TAP Successes

• High demand for telescope time
• High quality science programs
• Student training
• add value to domestic programs
• gain access to international teams and surveys via TAP
• lead high-value follow-up programs to large surveys via TAP

TAP + Palomar + CFHT +??

• Proposal process and evaluation makes for better science.
• International observatories want consistent, regular partners.
• China needs a portfolio of medium- to large-aperture optical-IR telescopes now.

Tap has made great contribution to the Chinese astronomy community, and we look forward to more future success, within China and with EA collaborations