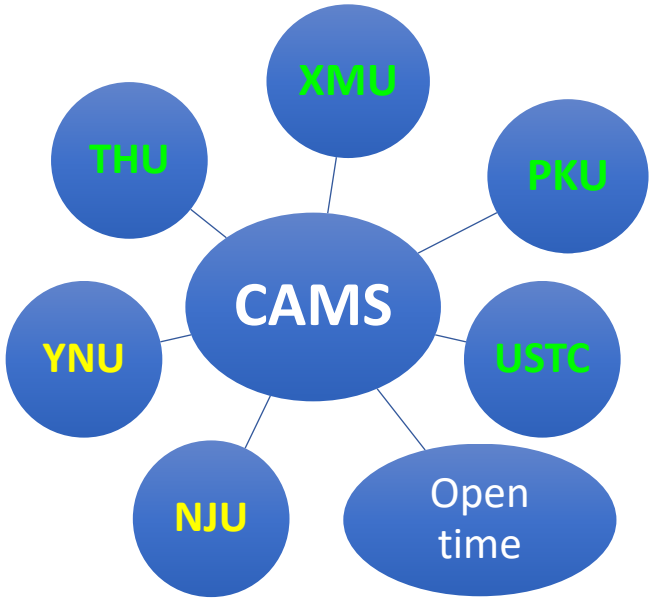
China's Telescope Access Program (TAP)



Y.Sophia Dai (戴昱)
NAOC

CAMS: Center for Astronomical Mega-Science, CAS
中国科学院天文大科学中心

JCMT 2019 User Meeting, Nov 7, 2019

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)

TAP Telescopes at a glance

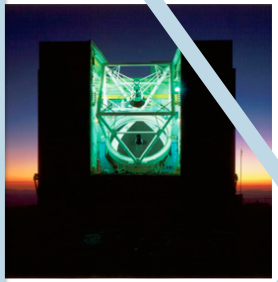
Canada-France-Hawaii Telescope (CFHT) 3.6m
Mauna Kea
~15 nights/year

- Wide-field imaging (optical, IR) – MegaCam, WIRCam
- High-res spectropolarimeter - EsPaDons, SPIRou
- Optical Imager spectroscopy (FTS)-- SITELLE
- Queue Service Observation

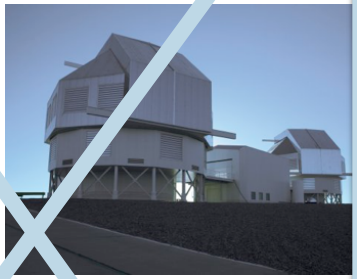
Hale 5.1m
Mt. Palomar
(Caltech)
~45 nights/year

- Optical, IR, long-slit spectrographs (DBSP, TriSpec)
- Imaging (WaSP/LFC, WIRC)
- High-throughput IFU/S (CWI*)
- High-res IR imager (PHARO)

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



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



- Wide field spectroscopy (Hectospec/chelle, IMACS, M2FS, Binospec)
- Long slit blue/red spectroscopy
- Echelette spectroscopy (MagE)
- MMIRS, FIRE
- AO

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

Palomar: ~ 22-23 nights

LCOGT: ~450 hours (Apr-Aug)

LCOGT.net Las Cumbres Observatory Global Telescope Network

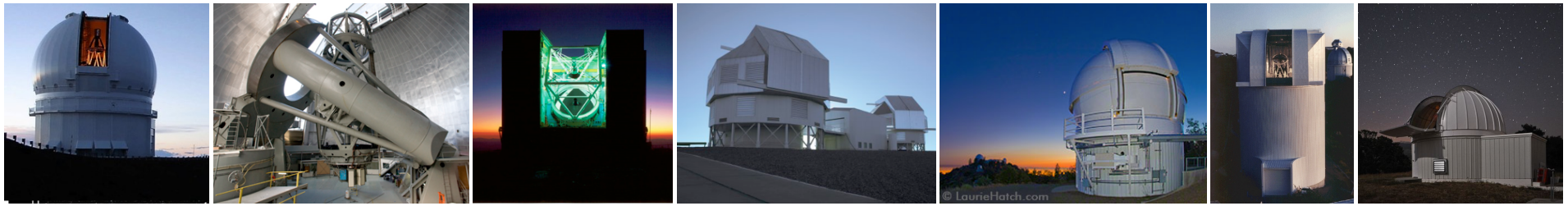
LCOGT 9x1m
450+ hours/year

- Time-domain imaging

Milestones of Telescope Access Program (TAP)

http://info.bao.ac.cn/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

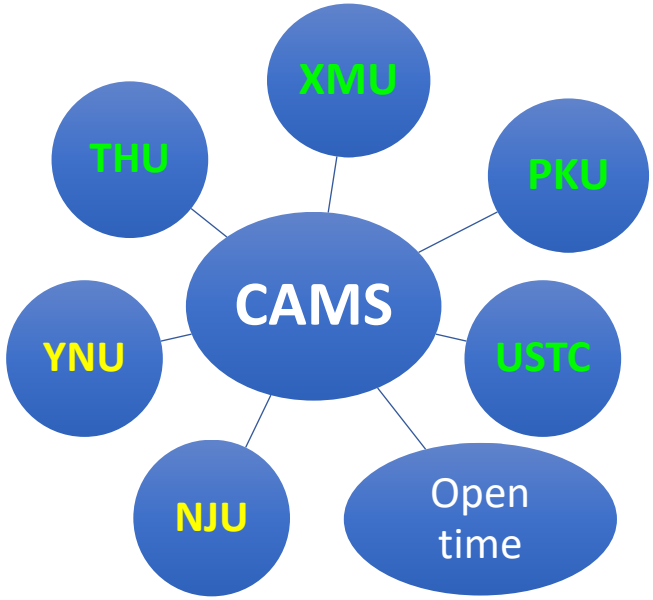


TAP Structure

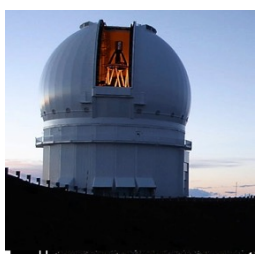
2019 User Meeting: Dec 16, 2019 @ XMU!

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

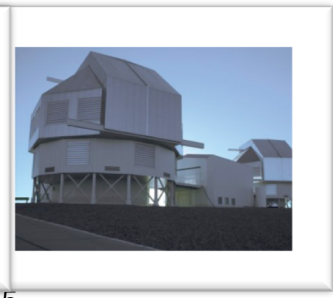
- Updated time allocation policy (~80% GT + ~20% OT)
- Potential Funding expansion (more nights & more telescopes)
- Committee board structure
- Semi-annual meeting (e.g. coordinate with China's next generation optical-IR telescopes: 12m, TMT, **EAO**, …)



CAMS: Center for Astronomical Mega-Science, CAS
Incl. NAOC, PMO, SHAO, XAO, YNAO….
中国科学院大科学中心





TAP Time Allocation Process

http://info.bao.ac.cn/tap/?q=node/14#TAC

2019B:

Cong Kevin Xu (NAOC, chair), Jianning Fu(BNU), Bo Ma(SYSU), Jianghui Ji(PMO), Jirong Mao(YNAO) Lulu Fan(SDU), Ling Zhu(SHAO), Weihao Bian(NJNU)

2019A:

Jianfeng Wu (XMU, co-chair), Cheng Li (THU, co-chair), Licai Deng (NAOC), Bin Luo (NJU), Li Ji (PMO), Yinghe Zhao (YNO), Hongxin Zhang (USTC), Lulu Fan (SDU)

2018B:

Cong Kevin Xu (NAOC, chair), Jianghui Ji (PMO), Keping Qiu(NJU), Junfeng Wang (XMU), Junzhi Wang (NJU), Xiaoyang Xia (TJNU), Yirong Yang (SYSU), Zhenya Zheng (SHAO),

2018A:

Greg Herczeg (KIAA-PKU, chair), Yu Sophia Dai (NAOC), Hongliang Yan (NAOC), Zhenya Zheng (SHAO), Martin Smith (SHAO), Li Ji (PMO), Yong Shi (NJU), Xu Kong (USTC), Jianfeng Wu (XMU)

2017B:

Taotao Fang (XMU, chair), Licai Deng (NAOC), Lulu Fan (SDU), Xi Kang (PMO), Guilin Liu (USTC), Maria Messineo (USTC), Yingjie Peng (KIAA-PKU), Shiyin Shen (SHAO), Jianrong Shi (NAOC), Stijn Wuyts (Bath)

2017A:

Cheng Li (THU, chair), Wiphu Rujopakarn (IPMU, co-chair), Jiasheng Huang (NAOC), Shiyin Shen (SHAO), Lulu Fan (SDU), Zhibo Jiang (PMO), Maria Messineo (USTC), Ran Wang (PKU)

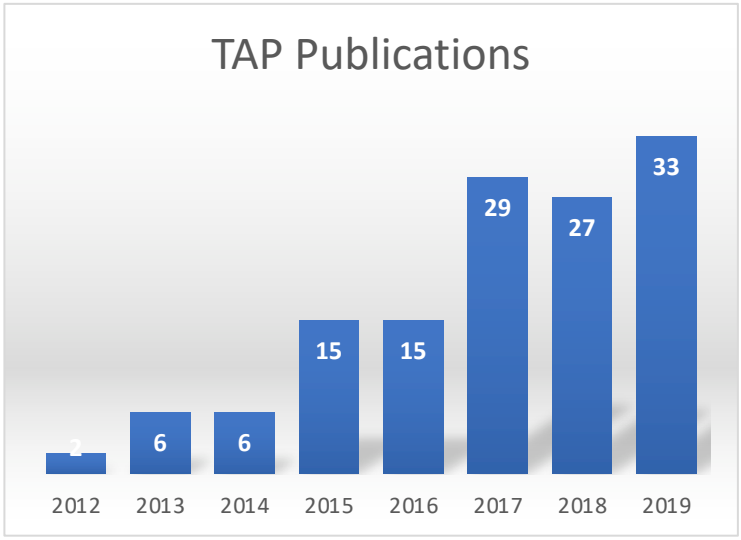
2016B:

Lei Hao (SHAO, chair), Taotao Fang (XMU, co-chair), Stijn Wuyts (Bath), Junfeng Wang (XMU), Ran Wang (PKU), Chao Liu (NAOC), Yanmei Chen (NJU), Hu Zou (NAOC), Li Ji (PMO)

- **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



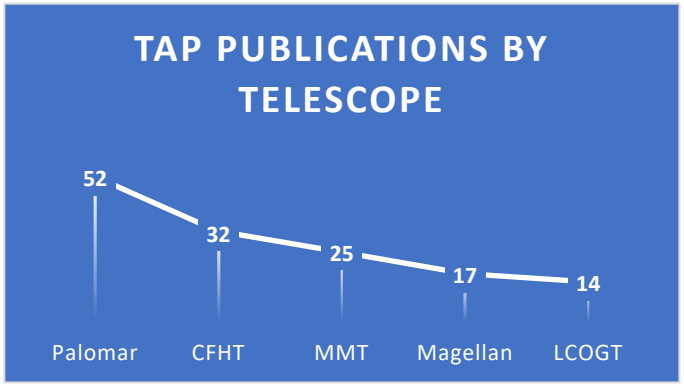
TAP begins 2011B

TAP expansion 2015A

Nov 2019

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
- 2 Nature, 1 Science, 61 ApJ, 5 ApJS, 2 ApJL, 9 MNRAS, 14 AJ, 4 PASP, 1 RAA, 3 on arXiv …

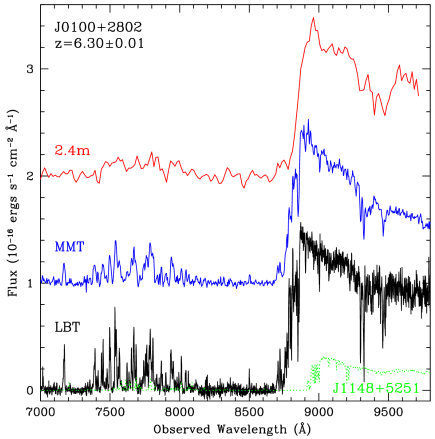


- Palomar (52)
- CFHT (32)
- MMT (25)
- Magellan (17)
- LCOGT (14)

TAP Publications

What sciences can be done with TAP?

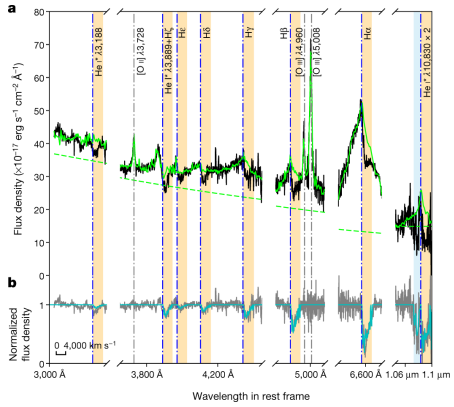
Discovery of Quasars at high-z



Optical spectra for the z~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!

Title	Author	Year	Journal	telescope
Fast inflows as the adjacent fuel of supermassive black hole accretion disks in quasars	Hongyan Zhou, Xiheng Shi, Weimin Yuan, Lei Hao, Xiangjun Chen, Jian Ge, Tuo Ji, Peng Jiang, Ge Li, Bifang Liu, Guilin Liu, Wenjuan Liu, Honglin Lu, Xiang Pan, Juntai Shen, Xinwen Shu, Luming Sun, Qiguo Tian, Huiyuan Wang, Tinggui Wang, Shengmiao Wu, Chenwei Yang, Shaohua Zhang & Zhong	2019	Nature	P200
Strongly Bipola Ejecta of the Norma Type IIP Supernova ASASSN-16at	h; Dong, Subo; ppee, B. J.; Stefano, Grupe, D.; K Prieto, J. L.; Cher Kuncarayakti, H.; Matti Seppo; Morales-Garoffolo, Antonia; Morrell, Nidia; Onori, F.; Reynolds, Thomas M.; Siviero, A.; Somero, Auni; Stanek, K. Z. Terreran, Giacomo; Thompson, Todd A.; Tomasella, L.; Ashall, C.; Gall, Christa; Gromadzki, M.; Holoien, T. W. -S.	2019	ApJL	LCO/Palomar
Galactic-scale Broad Absorption Line Outflow in the Quasar SDSS J144842.45+042403.1"	Tian, QiguoShi, XihengLu, HonglinLiu, WenjuanLiu, BoJiang, PengPan, XiangWang, TingguiZhang, ShaohuaZhou, Hongyan	2019	The Astrophysical Journal	P200
SDSS J153636.22+044127.0 and Its Analogs: Shocked Outflows, Not Active Binary Black Holes"	Zhang, ShaohuaZhou, HongyanShi, XihengJi, TuoJiang, PengPan, XiangSheng, ZhenfengSun, LumingZhong, Zhihao	2019	The Astrophysical Journal	P200
Broad Emission and Absorption Line Outflows in the Quasar SDSS J163345.22+512748.4"	Liu, BoZhou, HongyanShu, XinwenZhang, ShaohuaJi, TuoPan, XiangJiang, Peng	2019	The Astrophysical Journal	P200

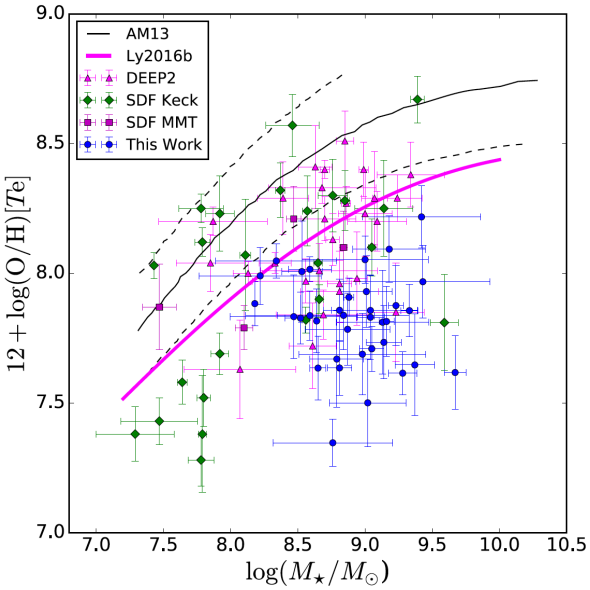
http://info.bao.ac.cn/tap/?q=publications

TAP Science Summary – other than AGNs

Galaxy Formation and Evolution

Mass-Metallicity Relation

* Metal poor star-forming galaxies via BASS (Gao et al. 2018, below)
* Blue compact dwarfs (Lian et al. 2016, ApJ, 819, 73)



Mass-Size Relation

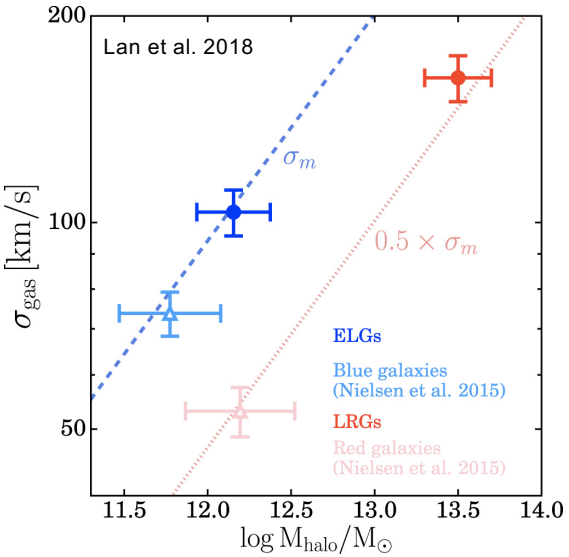
* in red galaxies (Favole et al. 2018)

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)
* LAE Survey (e.g. Hao et al. 2018, ApJ, 864, 145; Jiang et al. 2017, 846, 134)
* Damped Lyman alpha system (e.g. Xie et al. 2018, ApJ, 858, 32)

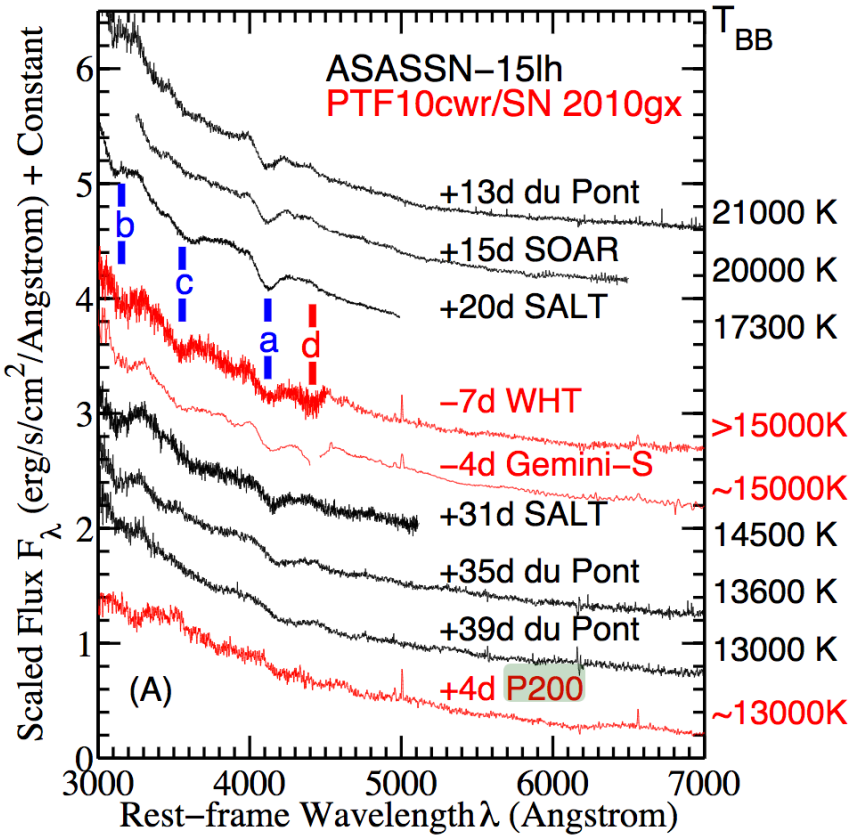
Galaxy properties

- 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)



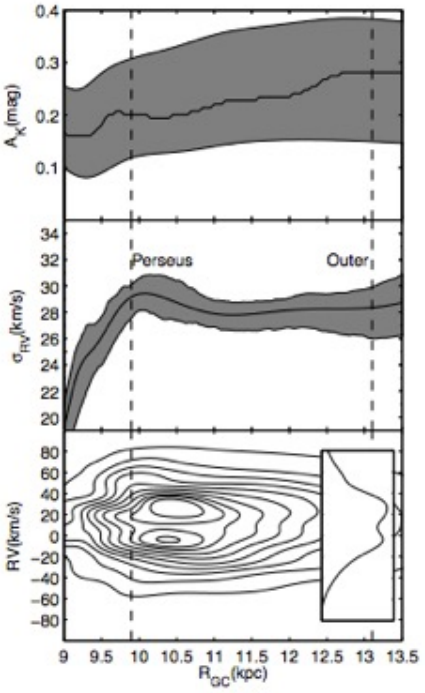
TAP Science Highlights

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

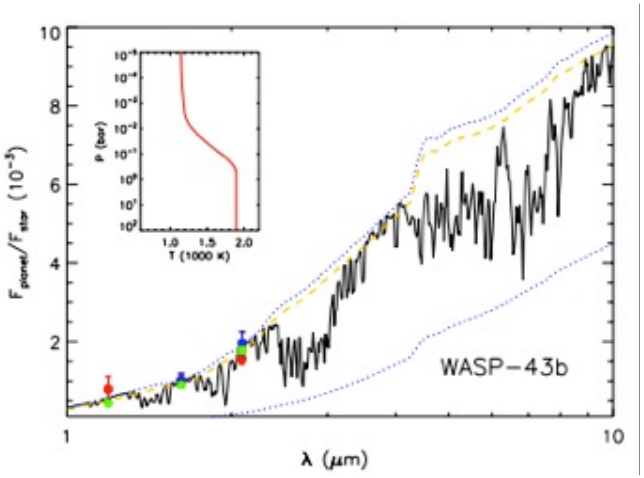
Automated Planet Finder (2.4m)
Mt. Hamilton
(UCO/Lick Obs.)
~30 nights

- 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

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

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



Wang et al. (2013), exoplanets

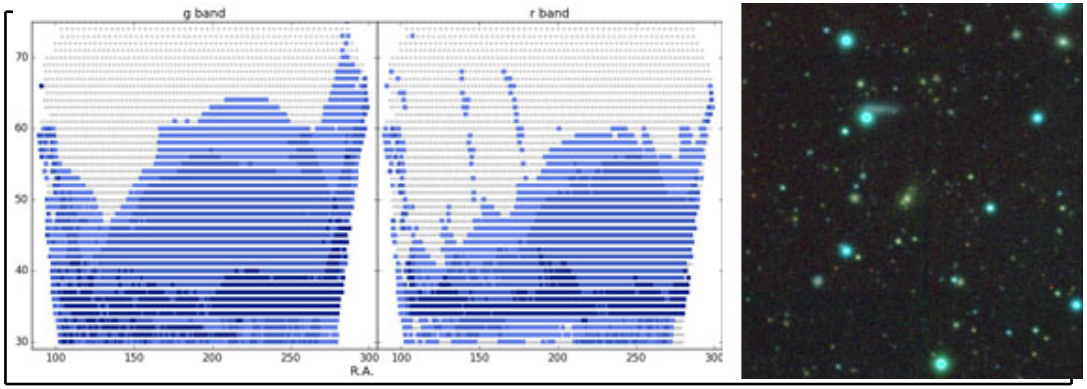
- PI: Wei Wang (NAOC)
- Infrared transit photometry
- Uses Mauna Kea's high altitude to observe CO band at 2.3um.

Telescope Access Program (TAP Optical-IR)
Key Programs - Joining International Surveys

Beijing-Arizona Sky Survey (BASS)

Bok Telescope (2.3m)
Kitt Peak
(U. Arizona/Steward Obs)
240 nights

- 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



90Prime - wide field broadband imaging

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

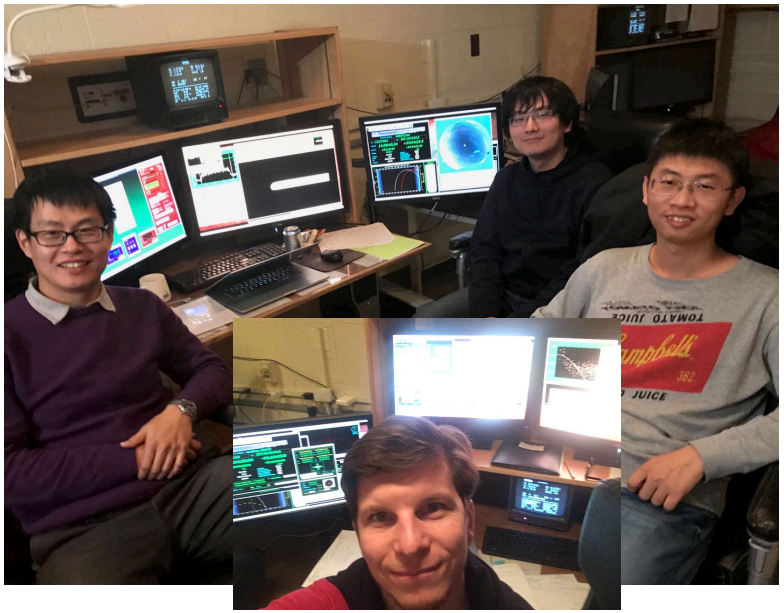
Canada-France-Hawaii Telescope (CFHT) 3.6m
Mauna Kea
17.5 nights

MegaCam: Wide-field imaging with u*-band sensitivity

Largest LBG samples at z~3 (million), Liu et al. in prep

TAP - Training the next generation of observers

NAOC grads doing remote observation at NAOC, 2019



NAOC staff/postdoc/grad observing at Palomar, Jan, 2018

- ~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