



中国科学院高能物理研究所
Institute of High Energy Physics
Chinese Academy of Sciences

Current Status of AliCPT-1 Experiment

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September 2019 @BNU



Outline



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- 1. Overview of the AliCPT-1**
- 2. Site construction**
- 3. Mount manufacture and testing**
- 4. Calibration plan**
- 5. Summary**

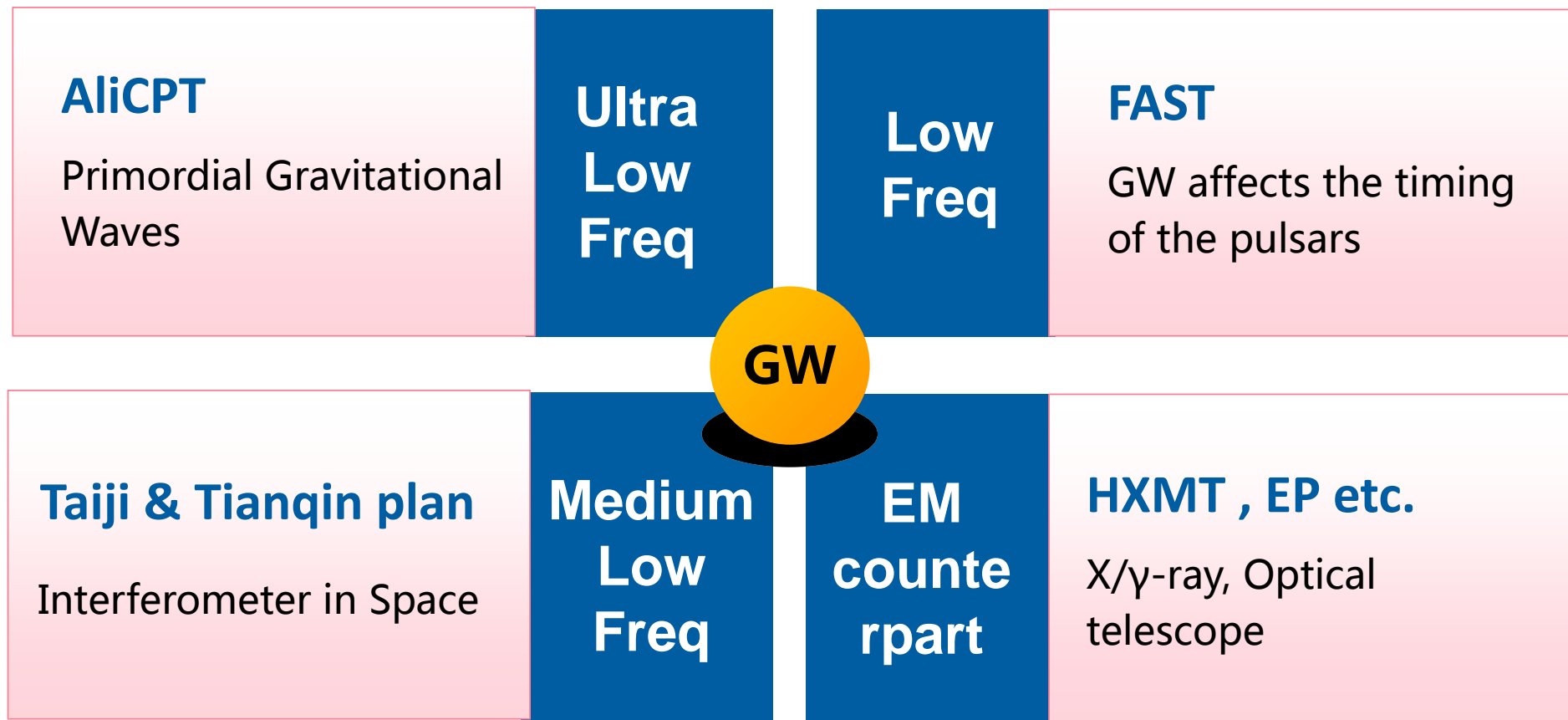


AliCPT (Ali CMB Polarization Telescope)



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AliCPT is one of the four gravitational waves projects in China (for the PGWs); The others being FAST, space probes TianQin & TaiJi (for the astrophysical GWs). After LIGO





AliCPT-1



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What a telescope do we need?

- The first CMB experiment in China
- Sited in the Northern Hemisphere
- High sensitivity, push r to ~ 0.01
- Small aperture, spatial scale \sim deg level
- Polarimetry

Science driven, translate to telescope design goal.

	AliCPT-1
Frequency	95GHz/150GHz
Optical Aperture	72cm
Beam width(deg)	0.3/0.2
FOV (deg)	20.8for 4-7 tiles (33.2 for 19 tiles)
Number of TES	~ 1700 per tile
$NET_{\text{per-detector}}$ ($\mu K_{\text{CMB}} * \text{Sqrt}(s)$)	~ 300

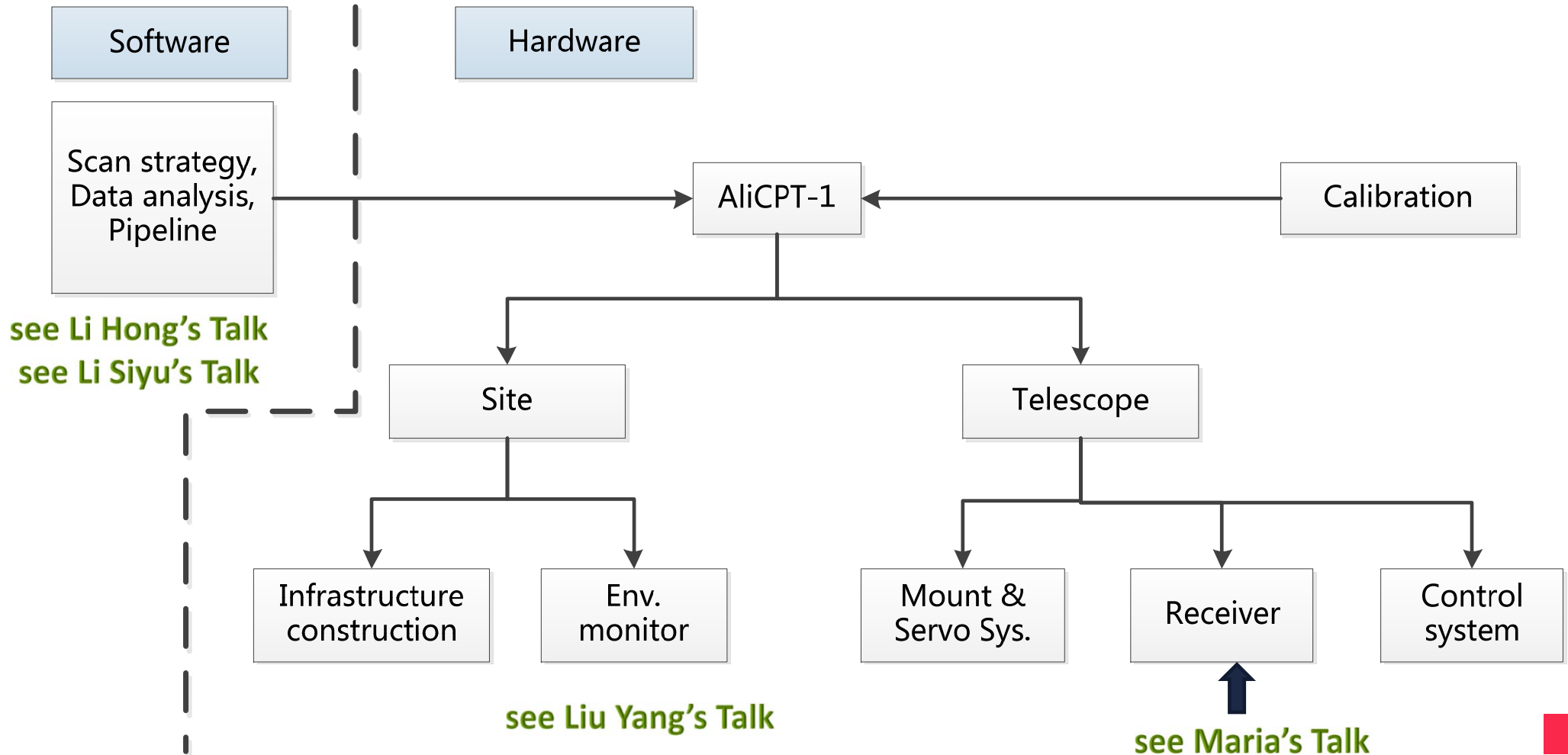
With the help of Stanford BICEP3 team
A two-lens refractive telescope



Task diagram



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Site status



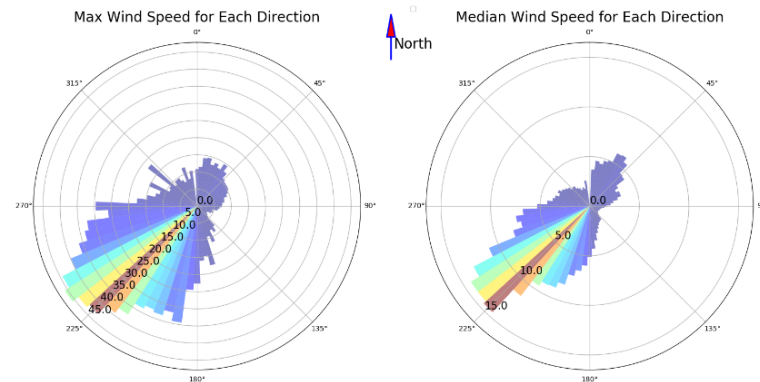
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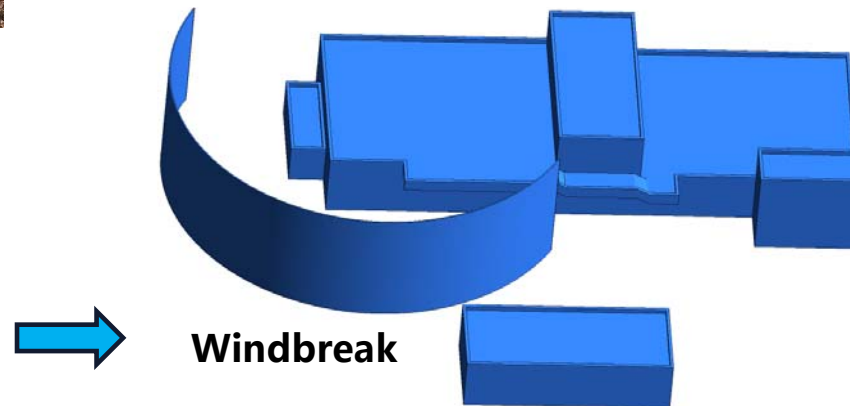
March, 2017



Dec., 2018



Windbreak:
10m high,
80% off.



Windbreak

It will be finished before this winter.



Site facilities



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➤ In the winter of 2018, the results from a weather station on B1-site show that:

- Temperature: $[-25.9^{\circ}, 2.2^{\circ}]$
- Atmospheric pressure: [520hPa, 546.6hPa]
- Wind speed: [0, 45.8m/s]

A severely hard working env.



making people on-site feel better:

1. Heating system

- Keep the telescope area $15-25^{\circ}$ / OK in Oct.

2. Oxygenator system /OK

3. Power system

- Main power from grid: 250kW / this year
- Backup power from generator: 160kW /OK

making data better:

1. Four weather stations / Ready on B1

- 3-d wind speed, pressure, temp., humidity

2. RPG and LN2 plant /Ready on B1

- Monitor PWV

3. RFI monitor /Shipping to B1 in Oct.

- 20MHz~14GHz

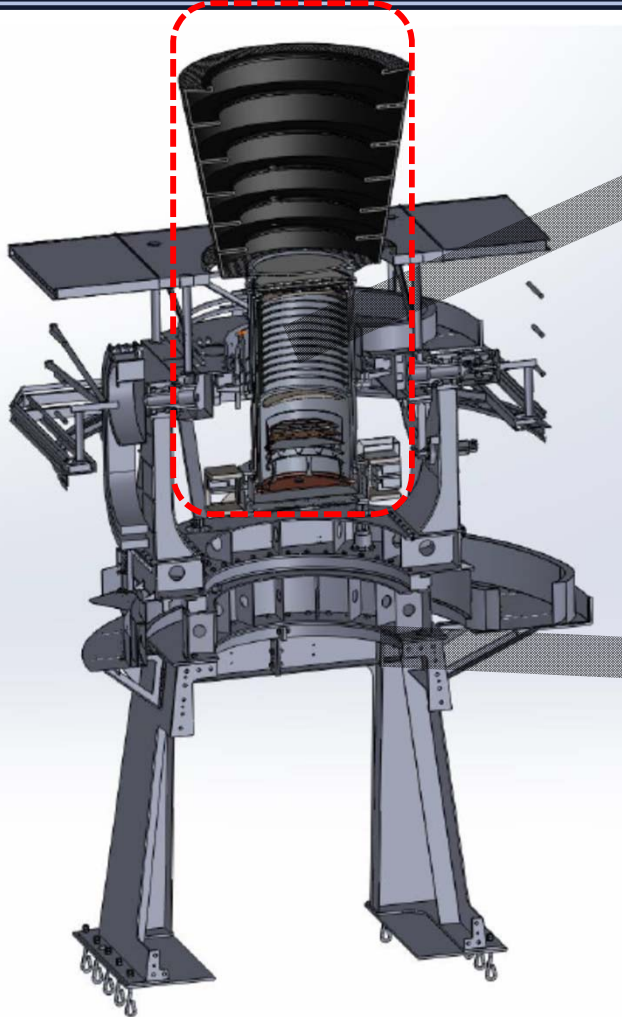
We expect the site construction and facilities are ready in this winter, waiting for receiver.



Mount status



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Receiver : see Maria' s talk.

optics : double refractor system

**Focal plane : TES array + uMux SQUID +
warm electronics**

cryostat : PT420+sorption, sub-K

Mount : Integrated and testing.

**Fully supports the receiver, including
everything attached to the cryostat.**

Cryostat CDR, Stanford team,2019



Mount status



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Sep., 2019

1. Bearing capacity

- max. 1.5tons



2. Driver spec. requirements

- AZ: range $\pm 270^\circ$. angular speed $> 5^\circ/\text{sec}$
- EL: range $45-135^\circ$. angular speed $> 1^\circ/\text{sec}$
- DK: range $0-181^\circ$. angular speed $> 2^\circ/\text{sec}$



3. Pointing accuracy

- better than $1'$ w/o correction
- Better than $10''$ w/ pointing model correction



Burn-in test now, and expect to ship to B1-site in this winter.



On-site calibration plan



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1. Detector and load characterization

- Calibrate parameters *w.r.t.* detector and optical system, especially optical efficiency
- Primary **calibrators: LN2 pool**

2. Spectral characterization

- To calibrate spectral response of detectors
- Primary **calibrators : FTS, thick grill filter**

3. Near field beam map (NFBM)

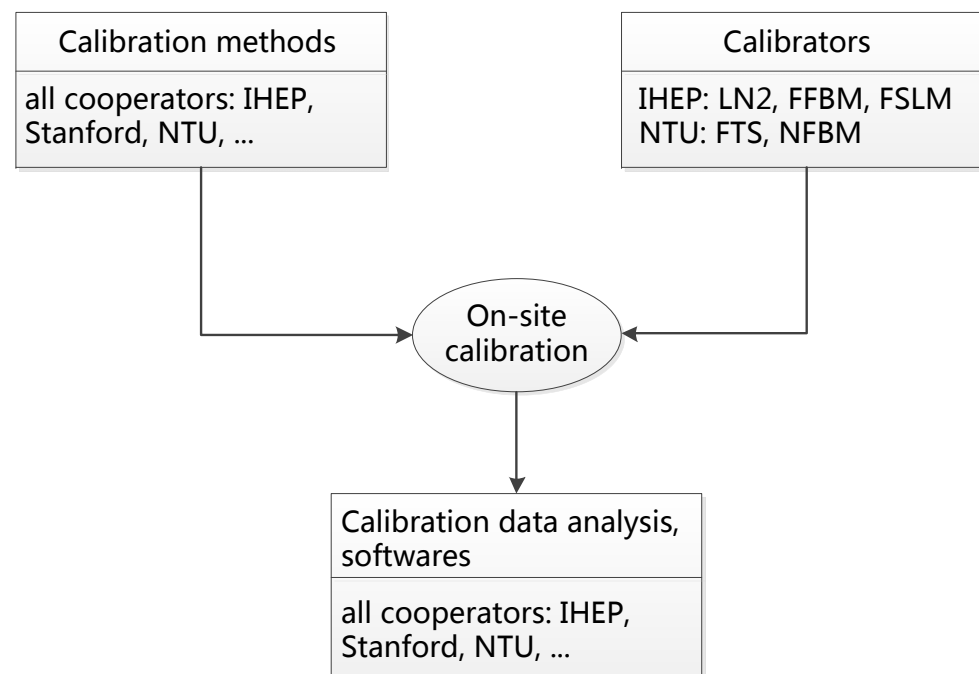
- Primary **calibrators : sources, X-Y moving platform**

4. Far field beam map (FFBM)

- Primary **calibrators : sources, mast**

5. Far sidelobe map (FSLM)

- Primary **calibration : sources, mast**



There is already a calibration group, but need more communications and discussions.

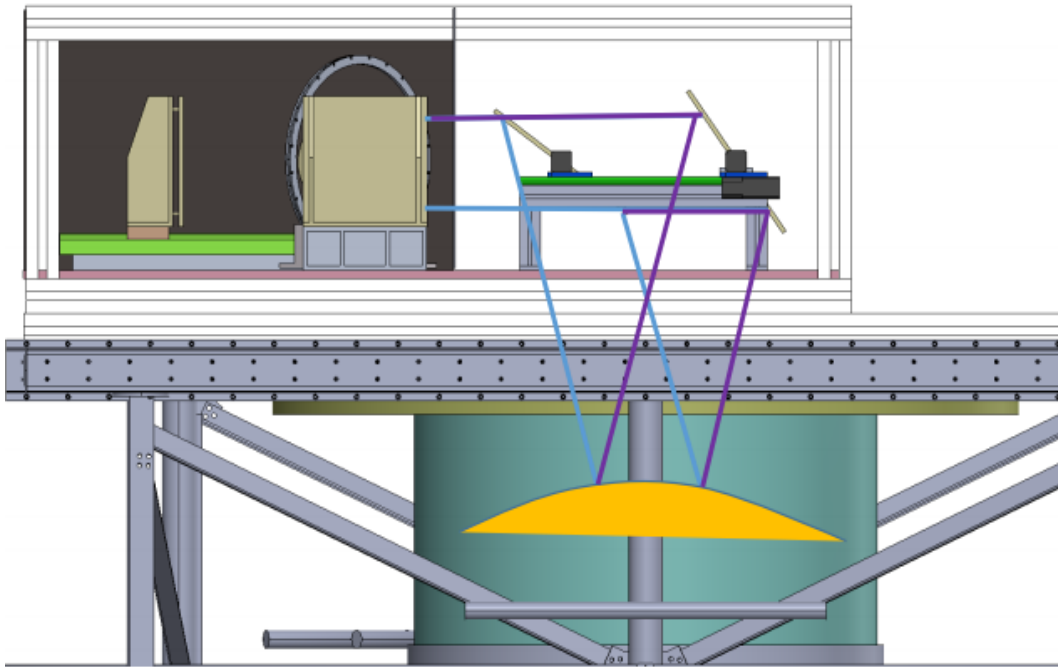


On-site calibration plan



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Usage illusion of FTS on top of receiver



From Chi-Ching Chen, NTU, 2019

1. Basic spec.

- Freq. range: 20-350GHz
- Freq. resolution: 1GHz
- Beam size: 25cm diameter
- Moveable mirror for scanning all detectors
- Weight: ~100kg.

Design finished, under manufacture.



On-site calibration plan

FFBM Site selection :

1. $d > 2D^2/\lambda$ (95GHz/150GHz: 328m / 518m)
2. clean background

No ground within 1°

Candidate-1, 1500m
27m mast

Candidate-2, 1250m
23m mast

Candidate-3, 620m
61m mast

	BICEP3	AliCPT
Aperture	52 cm ($A_g = 3.14 \cdot 0.26^2$)	72 cm
Optical efficiency	~ 20%	~ 17.2%
Information of source		
Distance	~ 210m	~ 1500m
Temperature	Chopped between ambient (~260K) and sky (~10K)	Same as BICEP3
Aperture	24' ' in diameter ($R = 30.48\text{cm}$)	R=1.7m at least

***Blackbody source is impossible!
RF source is the only choice***

Design finished, under manufacture.



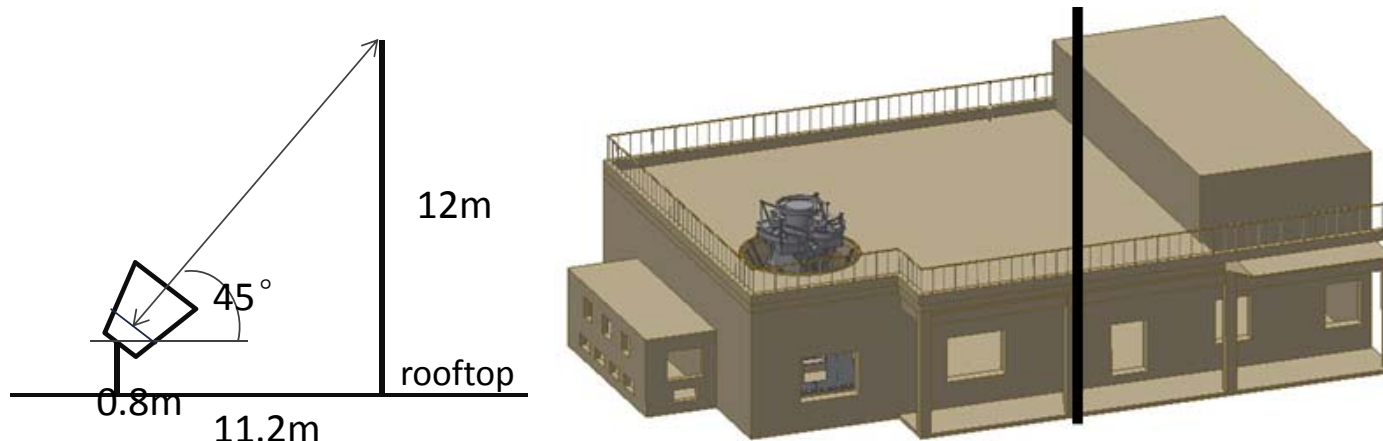
On-site calibration plan



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FSLM calibrator:

1. almost the same to FFBM, much closer to telescope.
2. Wider dynamic range than FFBM



Design finished, under manufacture.



Summary and ending words



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1. Expectations in this winter

- Site construction finished: windbreak, heating system.
- Mount commissioning on B1-site.

2. Expectations next year

- Calibrators finished.
- Receiver deployed on B1-site.

PI says, we need light. Then we try our best to do and expect seeing the first light in 2020!

**We observe the CMB sky in DARK(night),
we believe the CMB future in China is BRIGHT.**