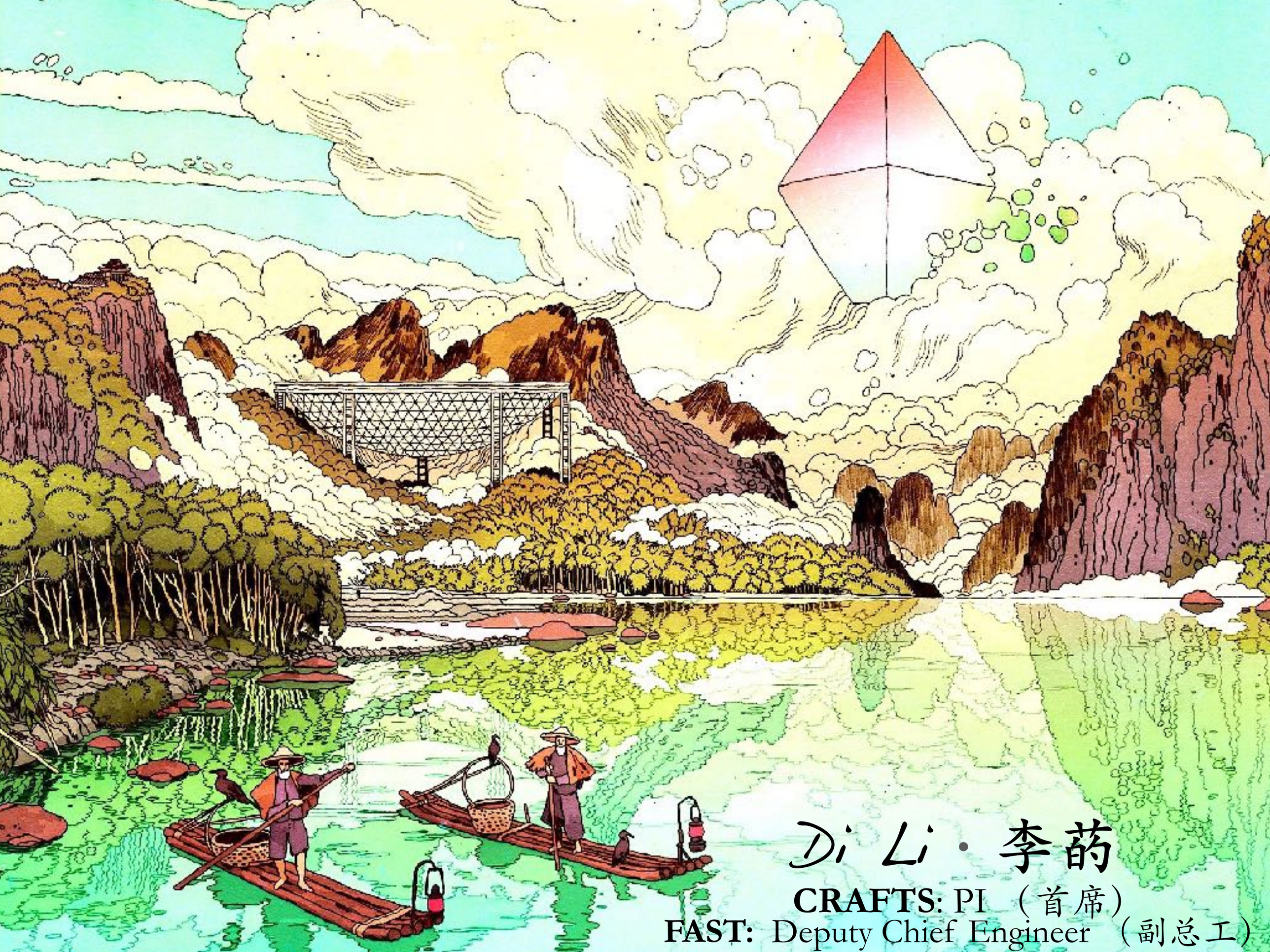

Di Li · 李荼

**CRAFTS**: PI （首席）

**FAST:** Deputy Chief Engineer （副总工）

# Timeline

- **Project Approval:**
  December, 2007
- **Construction Commence:** March, 2011 (¥1.15Billion)
- **Openning ceremony:** Sep. 25, 2016

- **Commissioning:** 2016 - ~2018

  **19 beam L-band array**: to be delivered in Nov., 2017

  **Backend upgrade (for commensal survey)**
  under development, to be expected in early 2018

- **Operation starts:** ~2019

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“中国天眼”

# Measurement

## (1) Anchor Grids

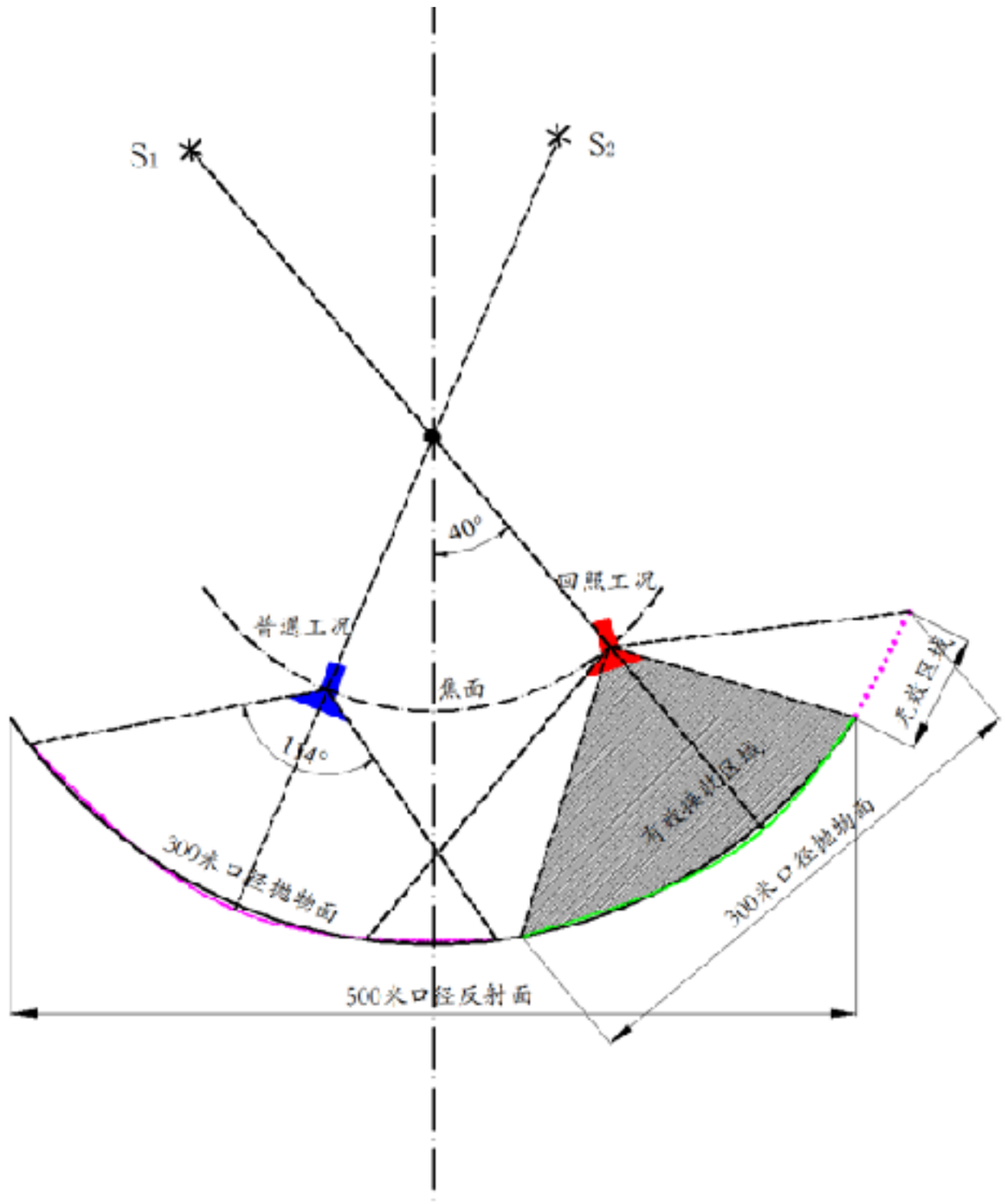
Anchor points: 5cm+0.5"
Baseline: 1mm
Time accuracy: 10ms

## (2) Feed Cabin

Supporting tower: 2cm
Cabin Initial Position: 2mm
Cabin dynamic measurement: 3mm
Cabin dynamic control: 10mm
Frequency: 5Hz

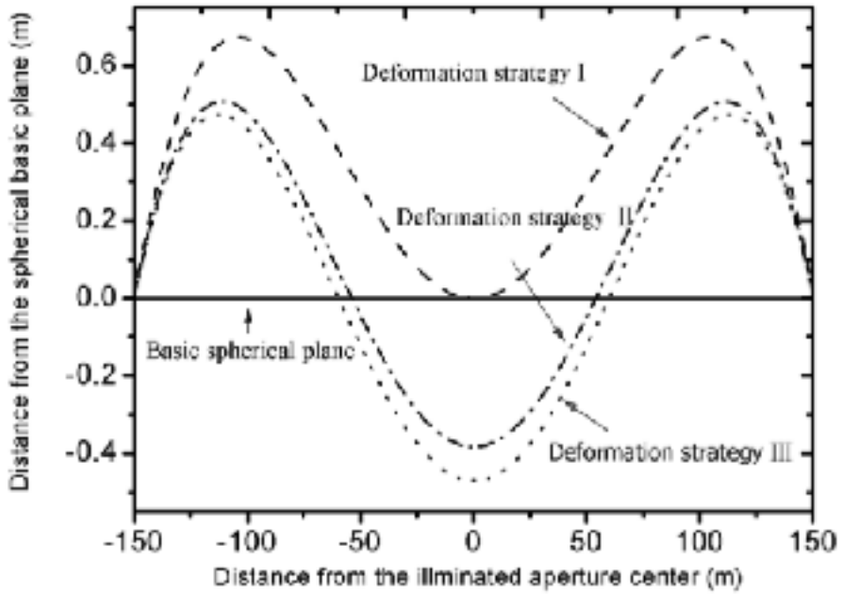
## (3) Primary Panels

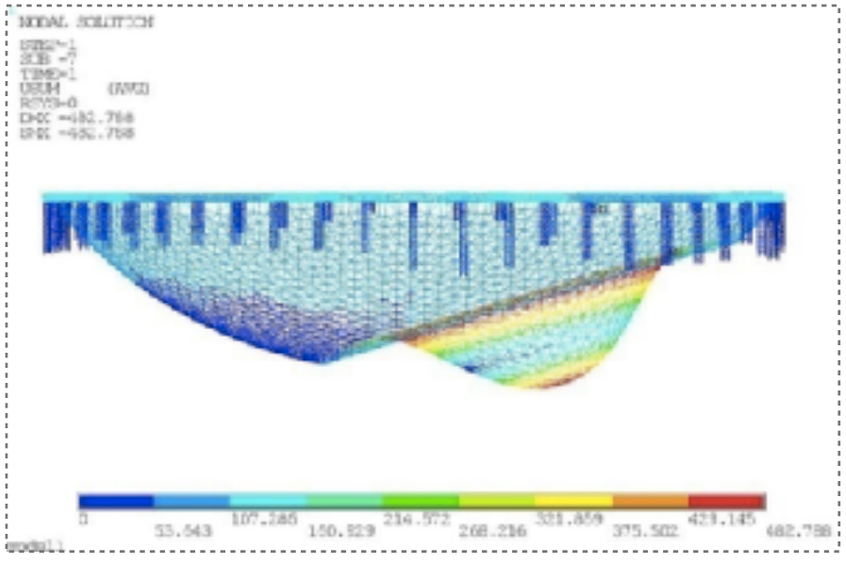
Actuator anchor point: 2cm
Cable mesh system anchor point: 2cm
Panel connecting nodes: 1.5mm
Nodes dynamic measure and control: 2mm
Frequency: 0.0017Hz



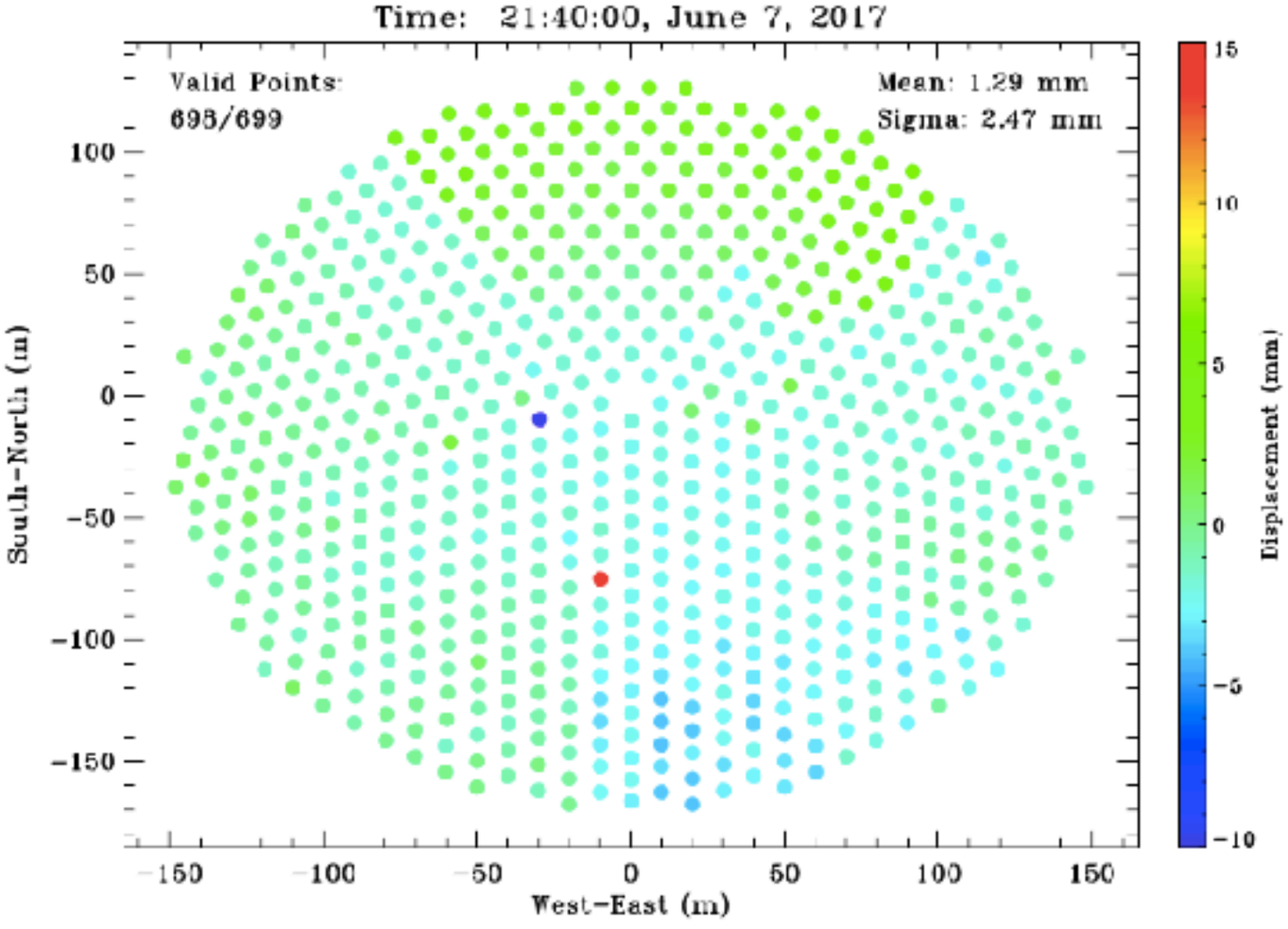

**FAST Optics**

# Surface Offsets




Jiang et al. 2015 *"Studying solutions for the fatigue of the FAST cable-net structure caused by the process of changing shape"*, Research in Astronomy and Astrophysics




June 2017
Measurements and Modeling

# Dynamic Fibers

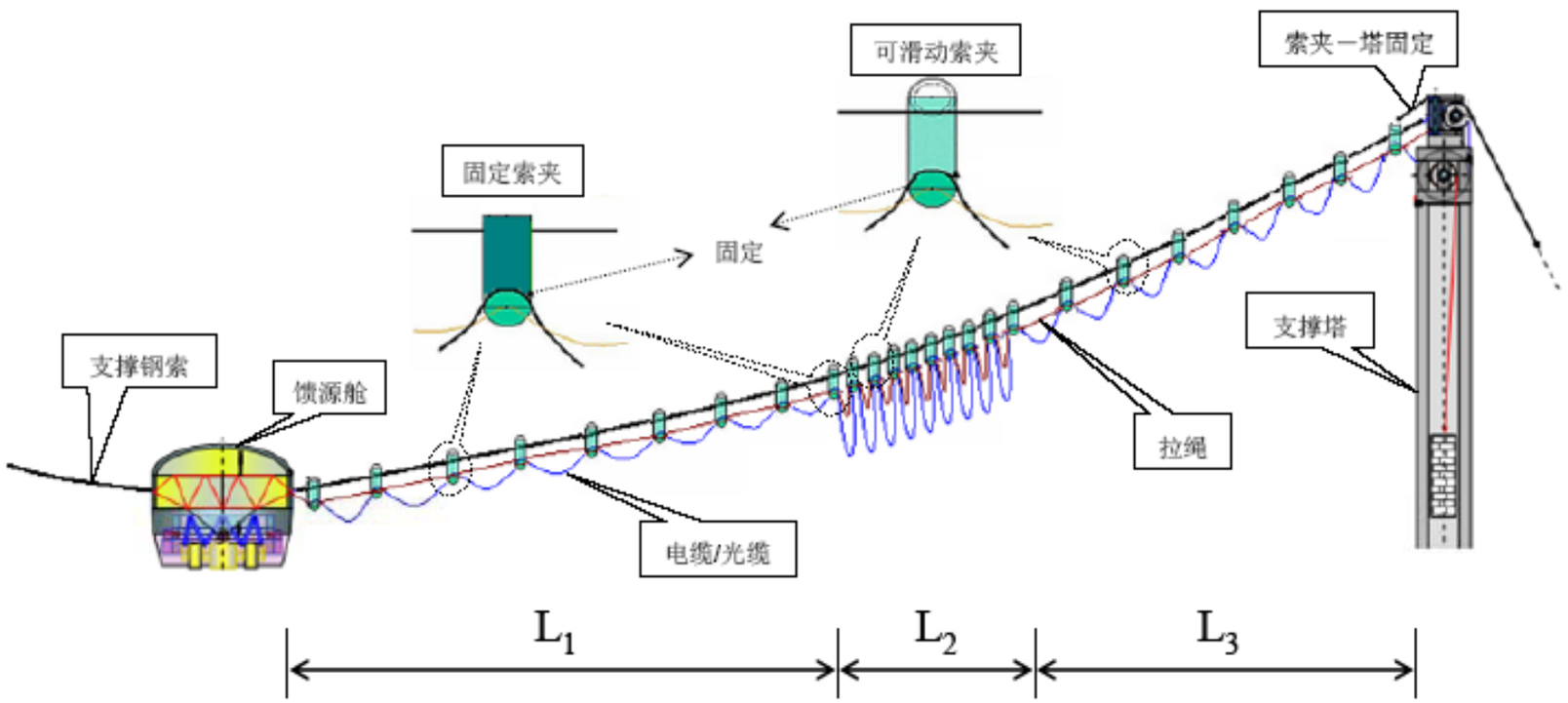



图 1 窗帘式缆线入舱方案示意图

# Dynamic Fibers

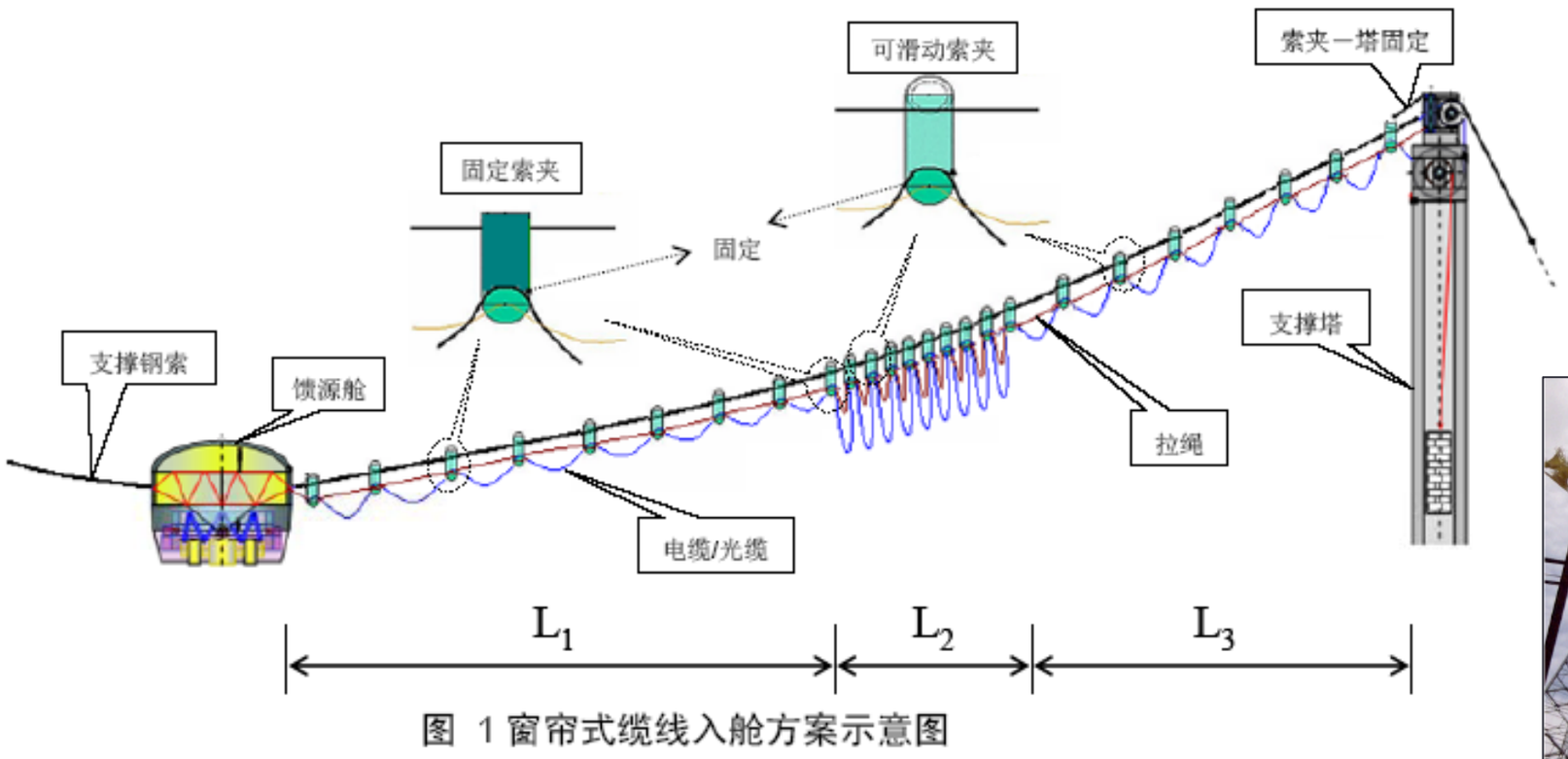



图 1 窗帘式缆线入舱方案示意图

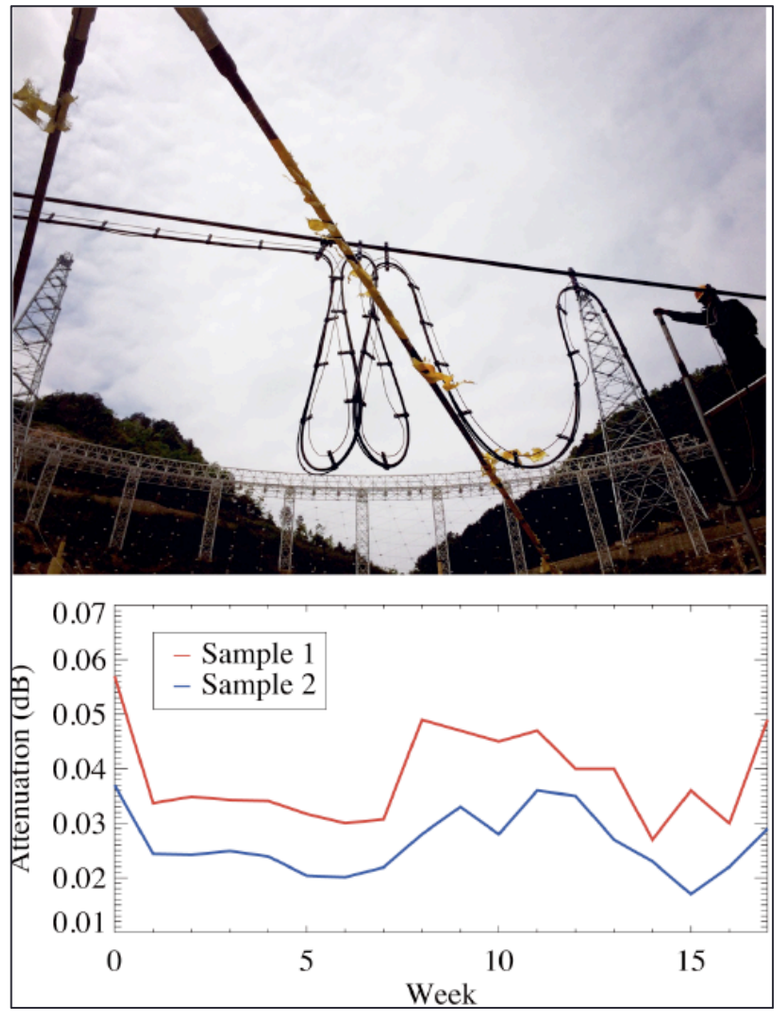



**Figure 3.** *Upper*: Installation of a suspension cable equipped with optical fiber and power cables. *Lower*: The attenuation of two optical fibers. Data are provided by Beijing BLADE Telecommunication Technical Development Co.

**Li** et al. 2015

# FAST对技术进步的贡献 之 索网结构

## 超强的疲劳性能

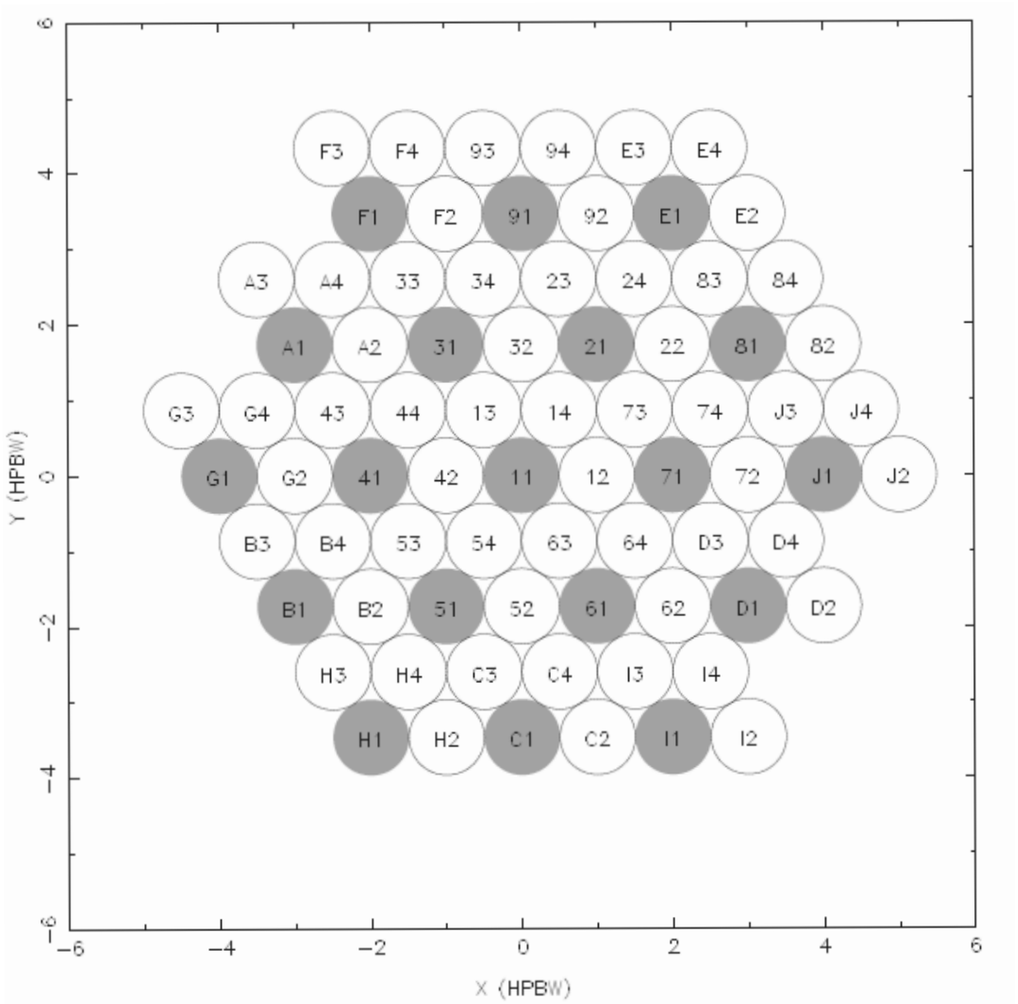
- ✓ 依托FAST 研制的高性能钢索结构，在200 万次循环加载条件下的疲劳强度可达500MPa，是目前相关标准规范的2.5倍，在国际范围内尚未见先例。
- ✓ 超高的疲劳性能使该种钢绞线在一些特种领域中有良好的应用前景，例如：摩天轮辐射索、体育场馆及航空母舰阻拦索等。

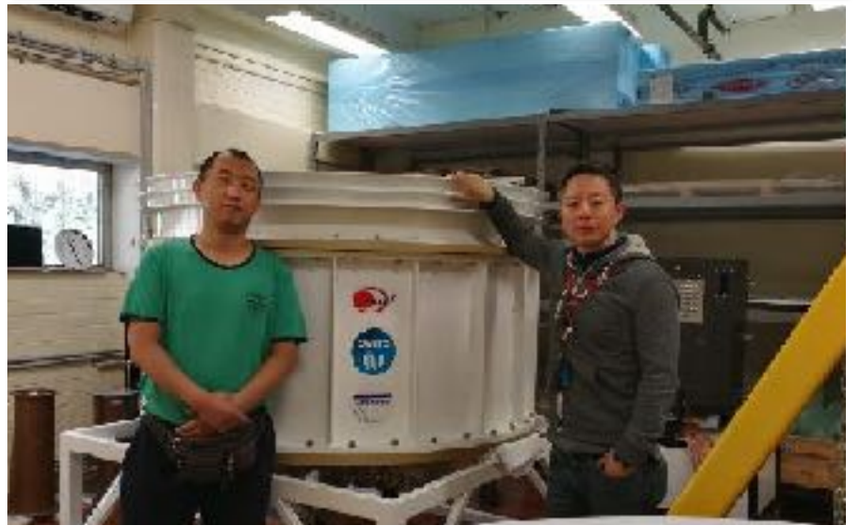
## 超高的精度要求

- ✓ 在FAST工程需求的牵引下，建立了高精度索结构生产体系，实现了我国索结构工业的精细化管理。目前精度为±1mm，标准规范为±15mm。
- ✓ 该生产体系已经在港珠澳大桥斜拉索等其它项目中得以应用，使我国的钢索结构生产制造水平得到巨大提升。

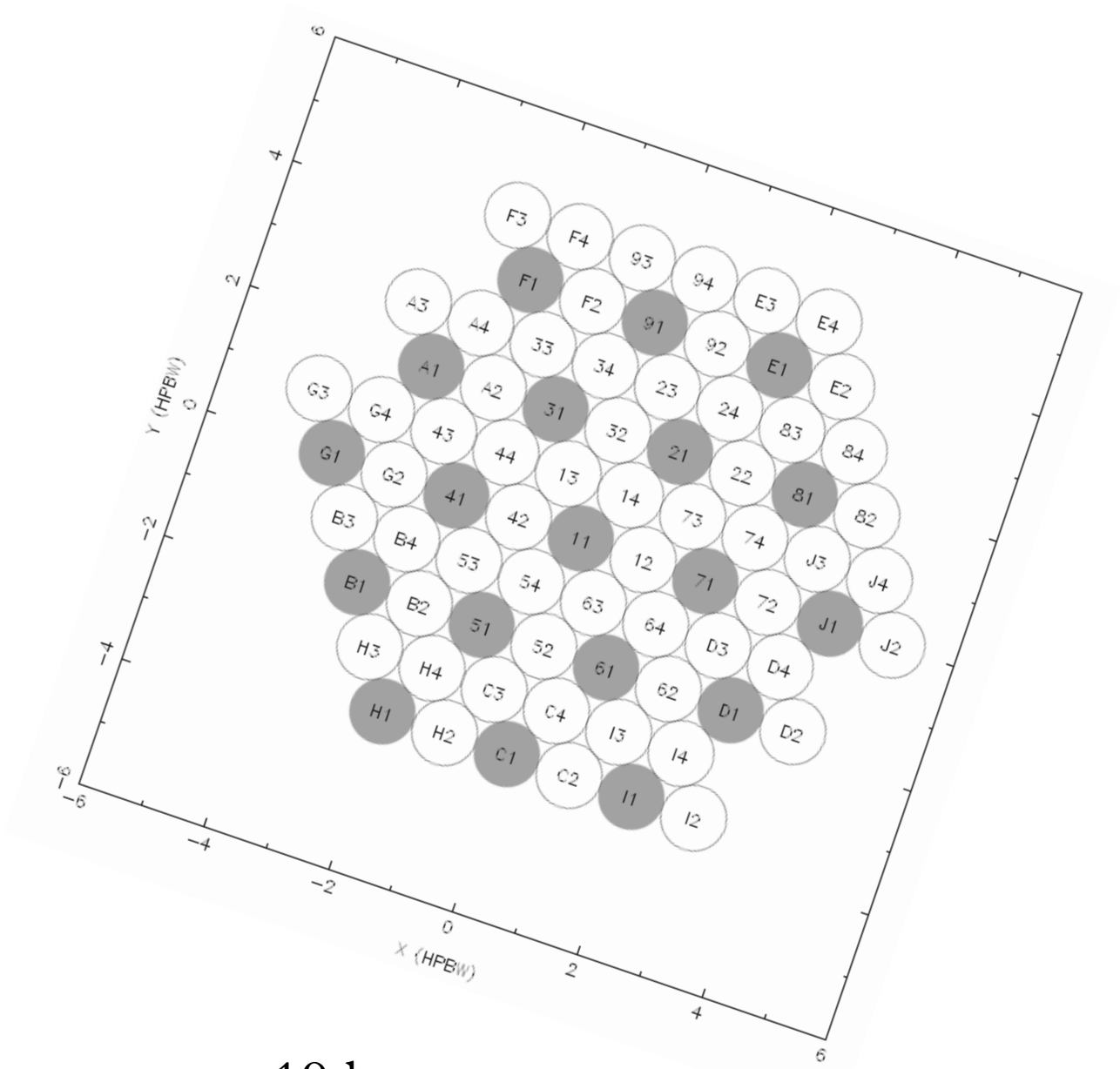
## 超大的索网跨度

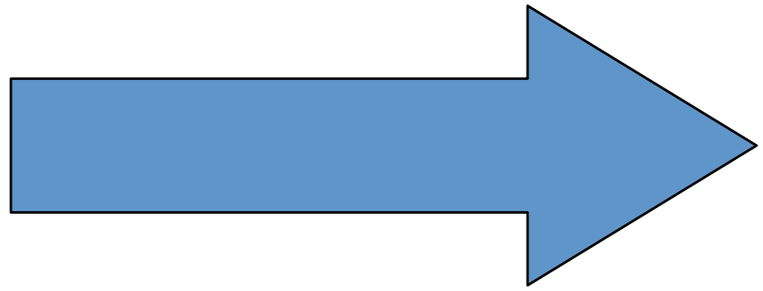

- ✓ 大跨度索膜结构安装技术：FAST工程索网结构有500米的跨度，这在世界范围内极为罕见，加之地处山区，场地限制极为苛刻。
- ✓ 在制造、安装过程中产生了大量具有我国自主知识产权的专利技术，也发表了10余篇文章。



- 19 beams
- 1.05 – 1.45 GHz, ~23K $T_{sys}$



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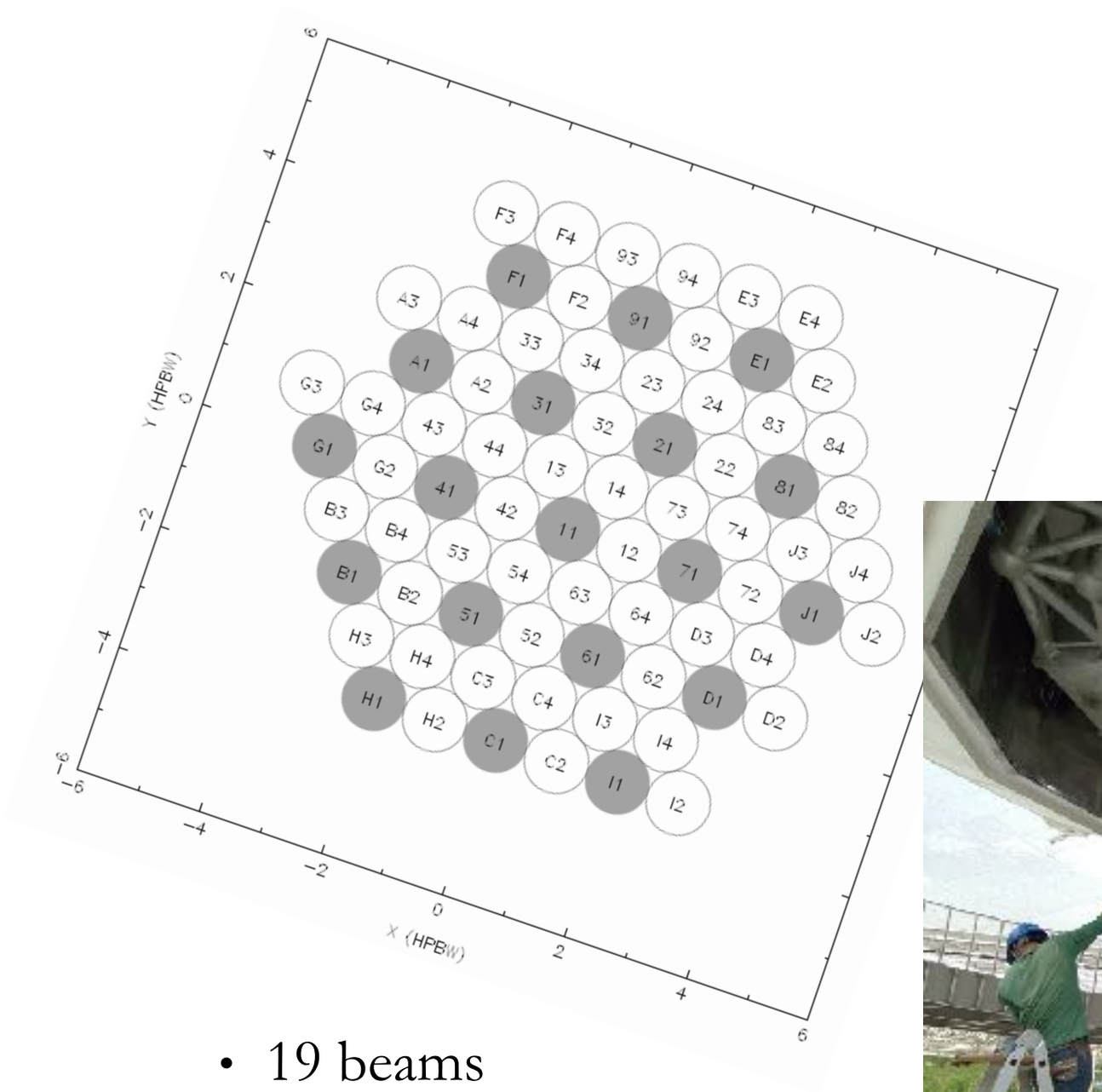
**Drift （sidereal)：** 漂移扫描

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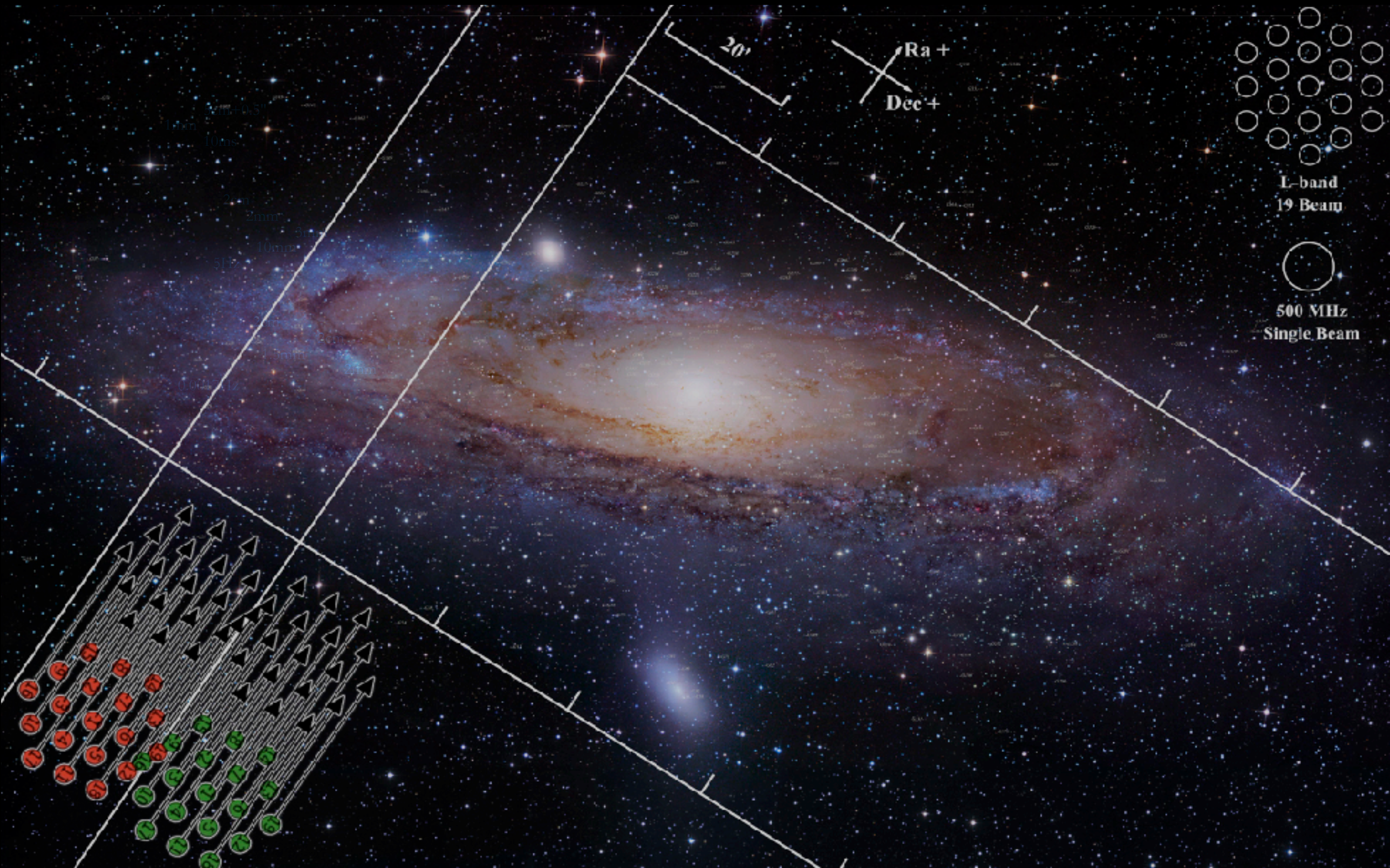
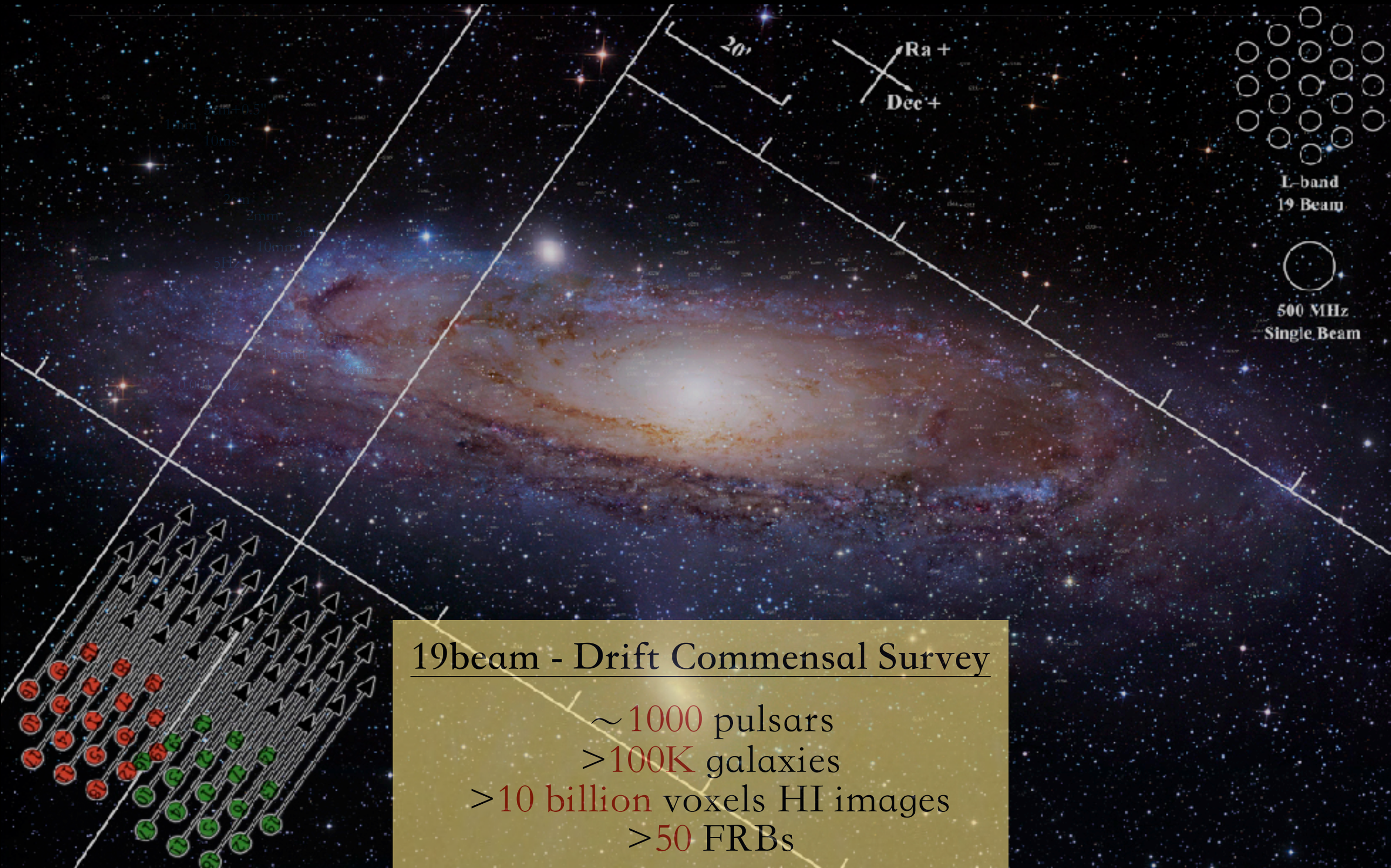
# Commensal Radio Astronomy FAST Survey



CRAFTS

# Commensal Radio Astronomy FAST Survey




## 19beam - Drift Commensal Survey

~1000 pulsars
>100K galaxies
>10 billion voxels HI images
>50 FRBs

CRAFTS

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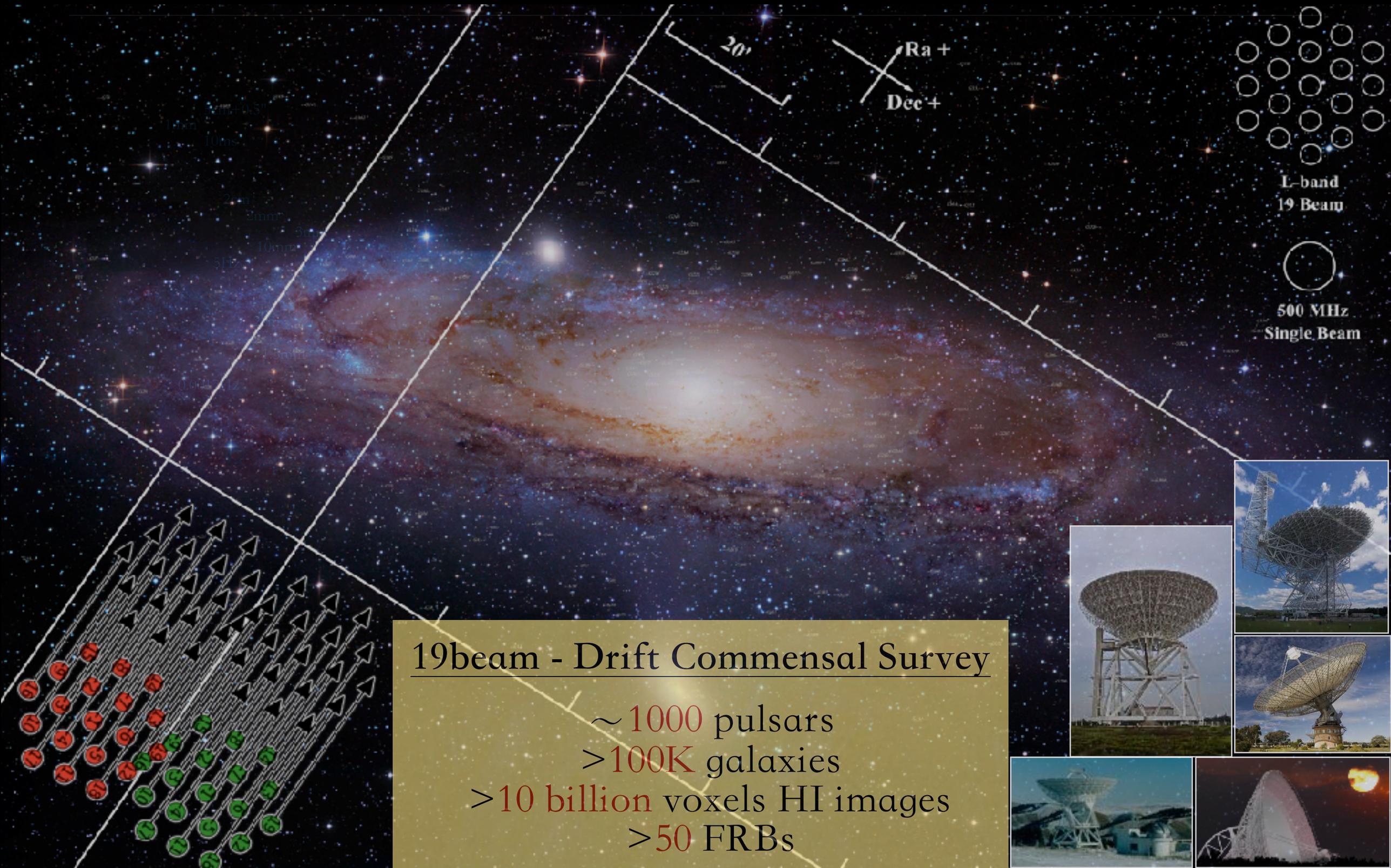


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~1000 pulsars
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# Commensal Radio Astronomy FAST Survey

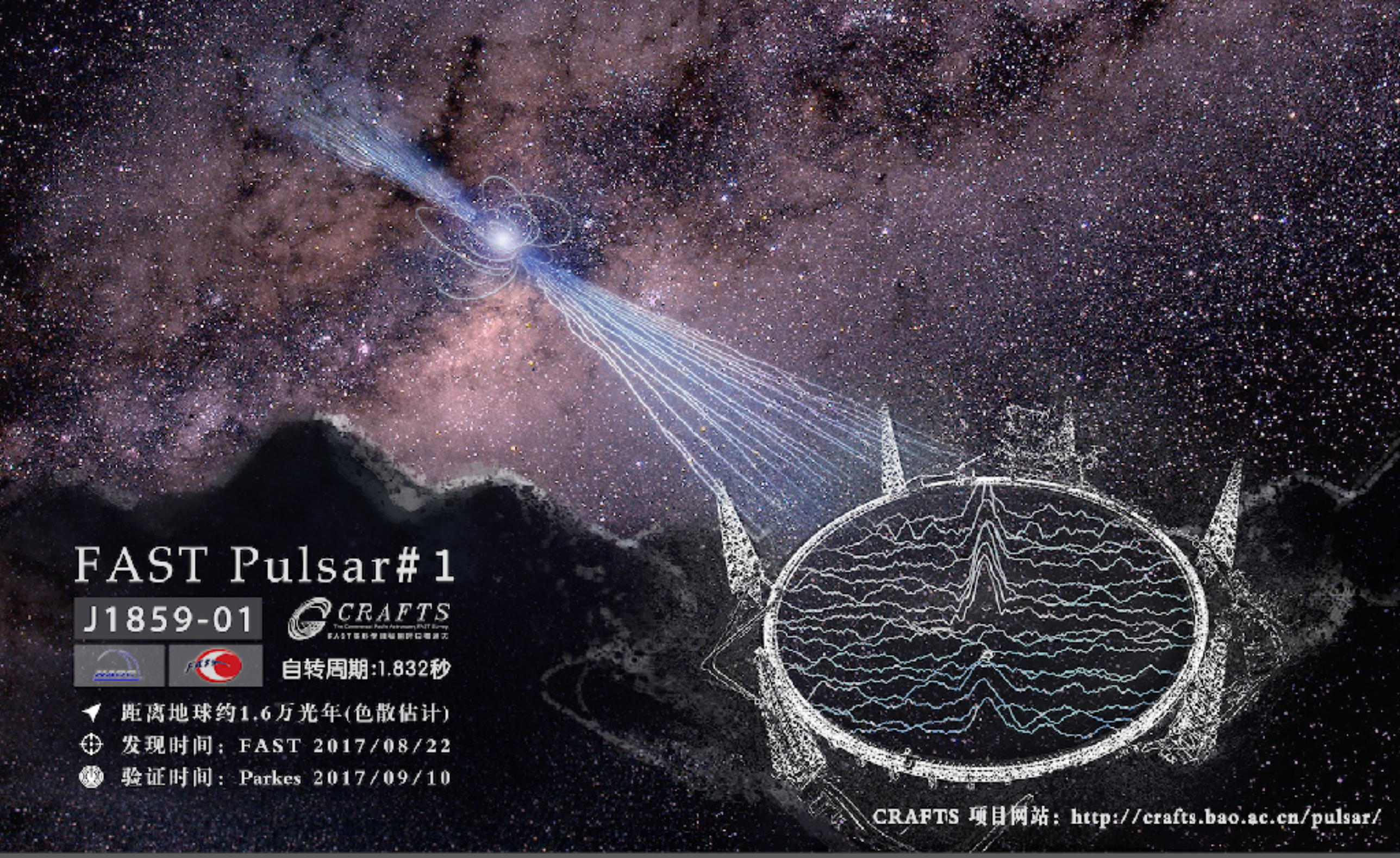
CRAFTS
The Commensal Radio Astronomy FAST Survey
FAST多科学目标同时扫描巡天

## CRAFTS

**u**nprecedented commensality:
pulsar, galaxy, imaging, and FRB

- Commissioning and survey demonstration
- Secured 1500 hours Parkes time for follow-up
- Negotiation with GBT underway
- Secured 100 hours Effelsberg for follow-up
- PI programs (11) with proposing lead from PKU, NJU, SHAO, XAO, BNU, etc.
- Secured Arecibo DDT, Effelsberg open time
- GBT, Arecibo, Chandra proposals etc. submitted
- Data facility (20PB+200 Tflop+100Gbs) contract signed


DL et al. 2018, Invited Review
IEEE Microwave, Vol 19, Issue 3




# FAST 首成果-

## 开启中国设备系统原创发现的时代

# FAST's First MSP

3FGL J0318.1+0252
FL8Y J0318.2+0254

- Fermi unidentified source
- GBT, Arecibo non-detection

**Wang et al. 2018, Atel # 10851**

*"FAST's Discovery of a New Millisecond Pulsar (MSP) toward the Fermi-LAT unassociated source 3FGL J0318.1+0252"*

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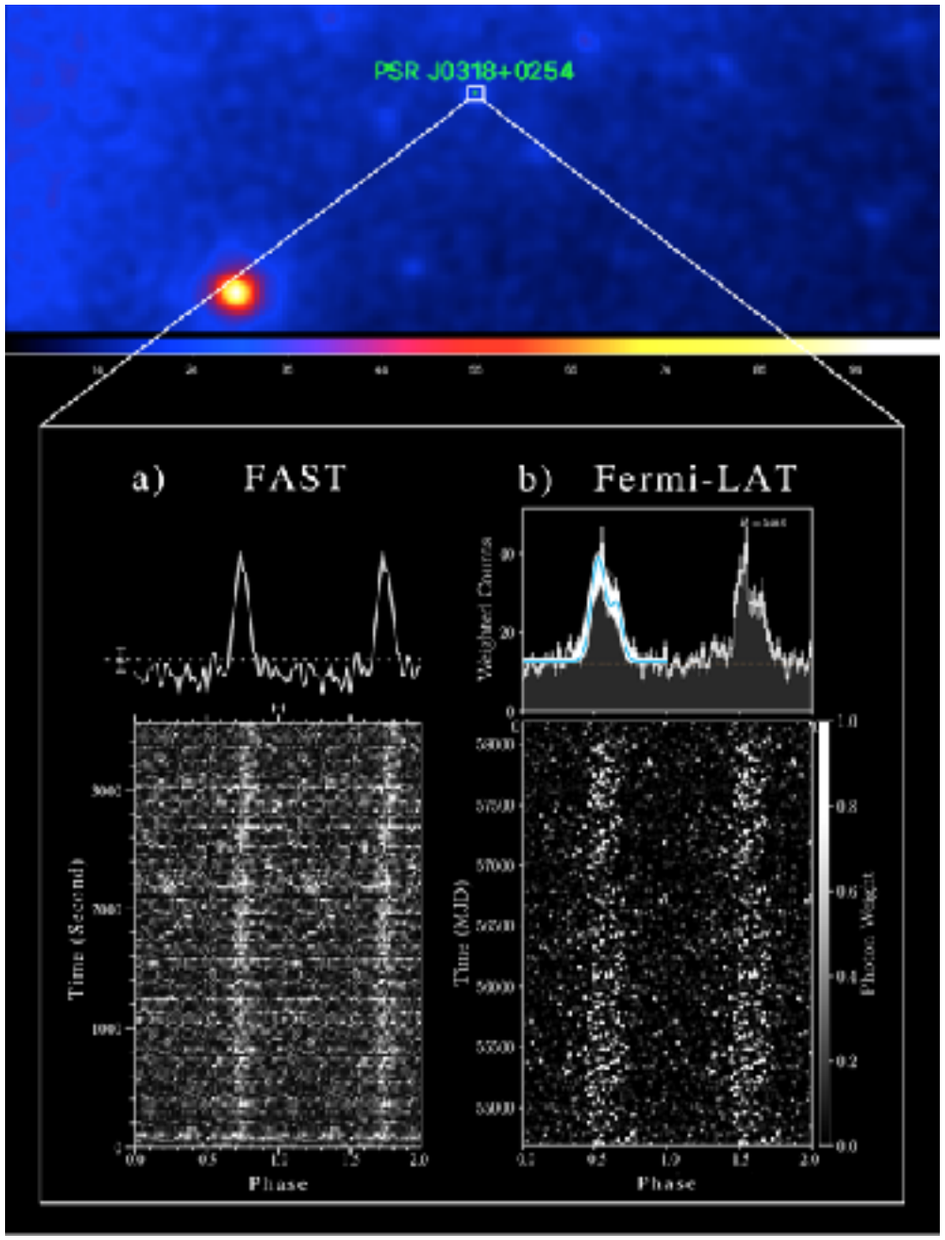
3FGL J0318.1+0252
FL8Y J0318.2+0254

- Fermi unidentified source
- GBT, Arecibo non-detection

## PSR J0318+0253

**p** 5.19 ms; **DM** 26 pc cm$^{-3}$

- **2018.2.27** FAST one hour tracking
- **2018.4.12** Wang Pei and GNU group discovered the candidate
- **2018.4.18** Colin Clark found the $\gamma$-counterpart
- **2018.4.23** Pablo confirm no X-ray, provide limits

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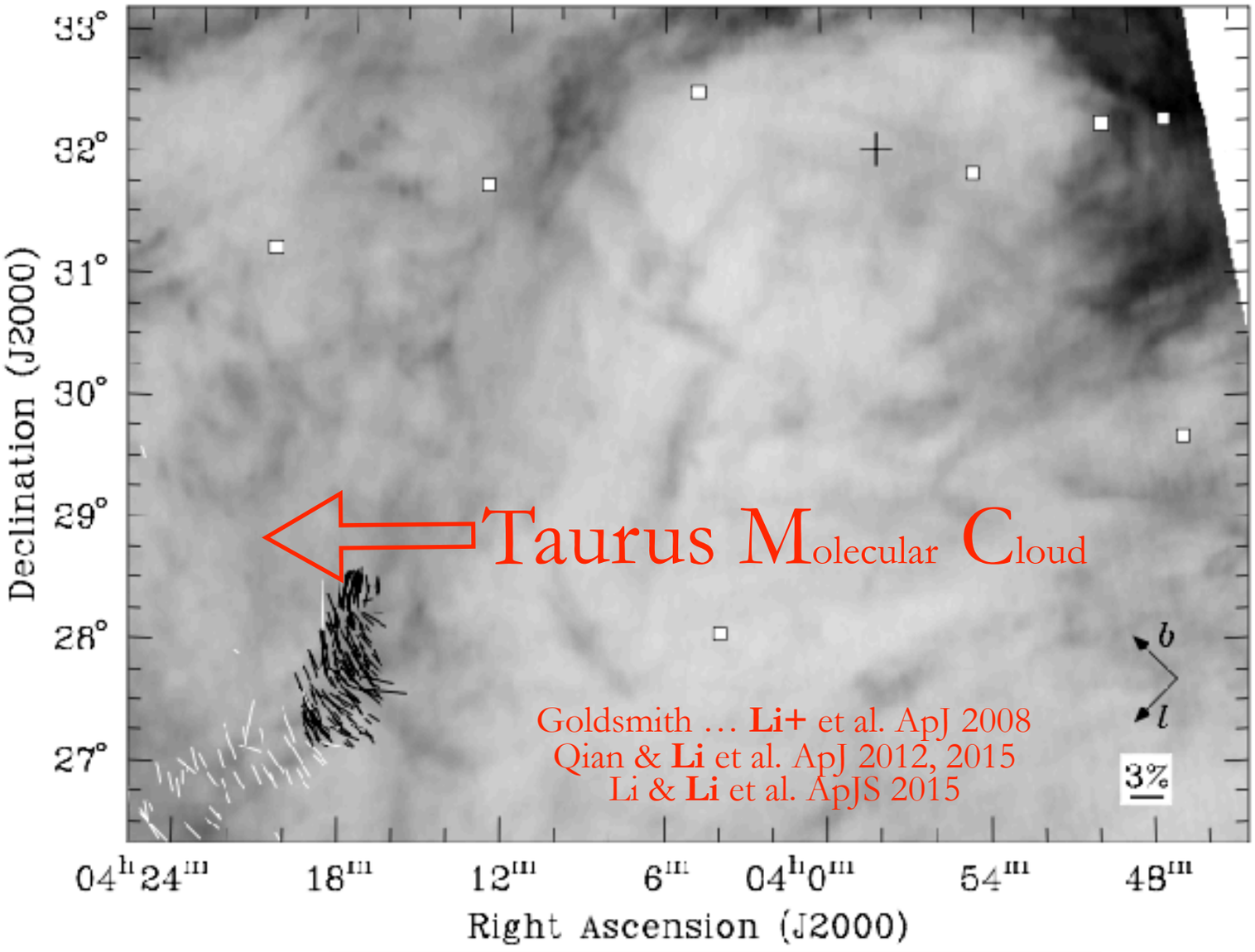
# FAST VLBI

- moving observatory coordinate
- ‘virtual’ phase reference point
- No down-conversion
- 38 synced digitization data stream
- reference antenna?
- A FAST ‘Core’ Array

Lost (maybe) to Carl in Sydney Harbor, on April 21st, 2018

# Closest SNR?
# FAST discovers radio pulses from J0357




Chapman … **Li+** et al. ApJ 2011

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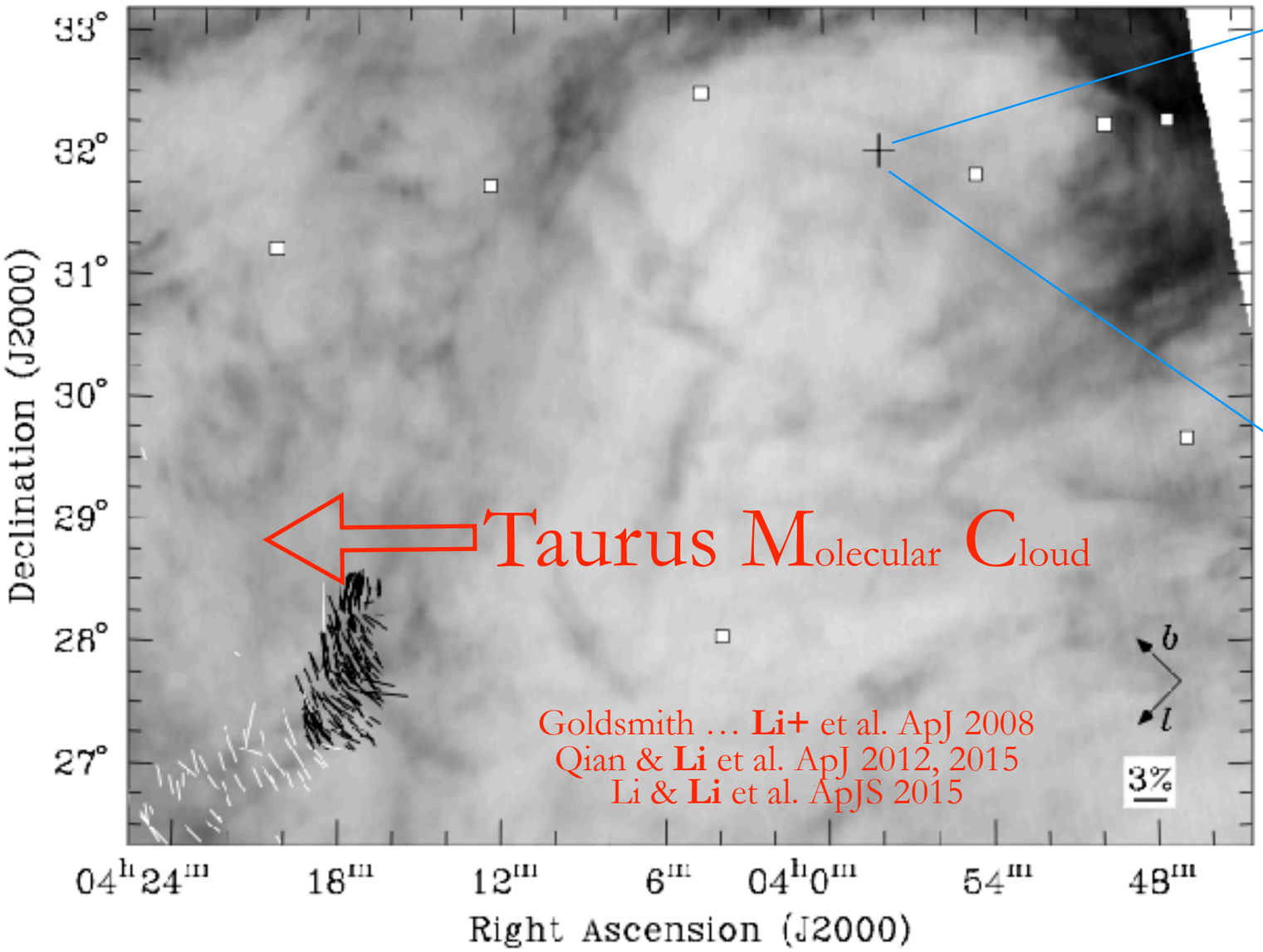


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Chandra X-ray Image
De Luca et al. 2011

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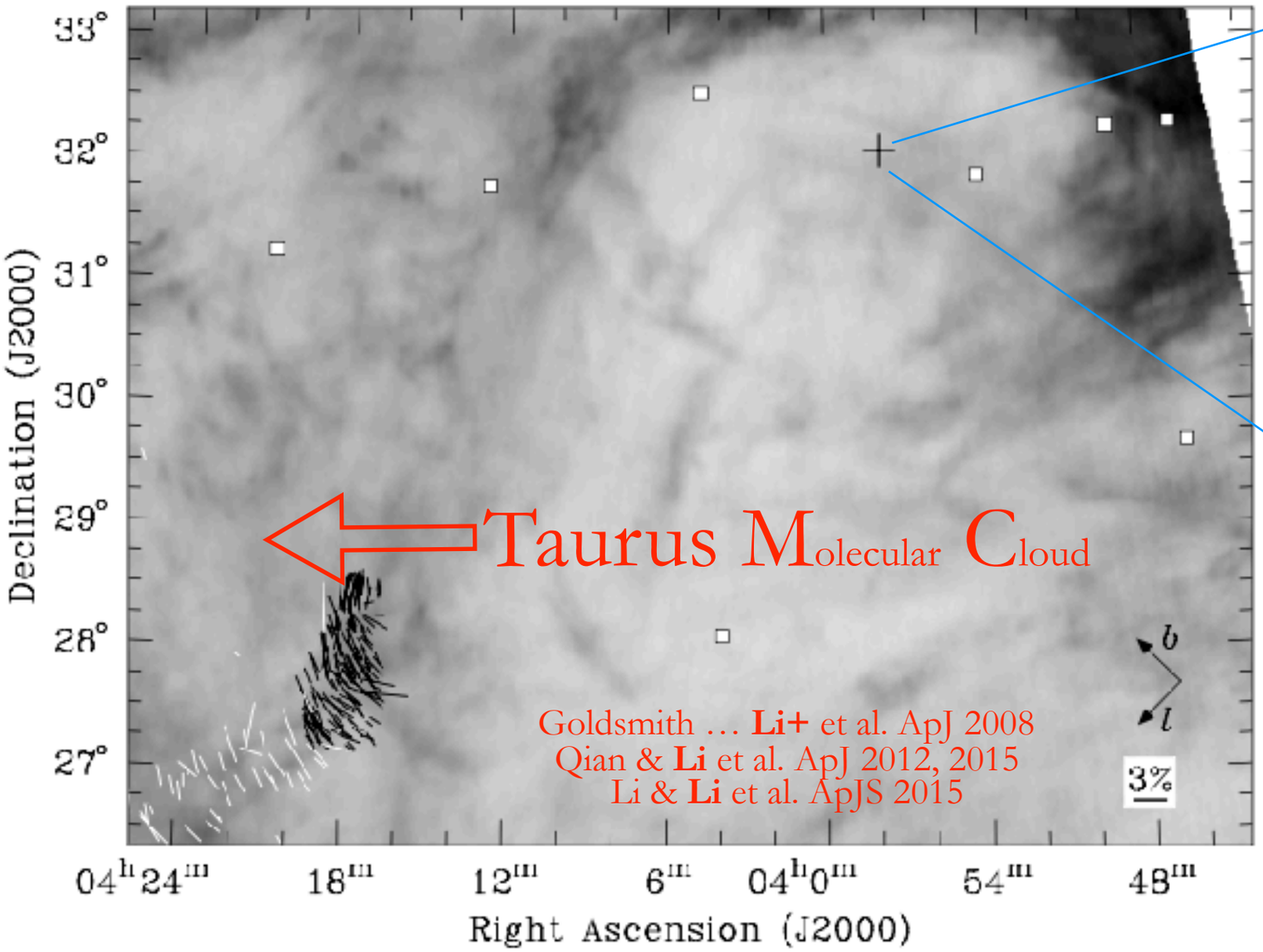
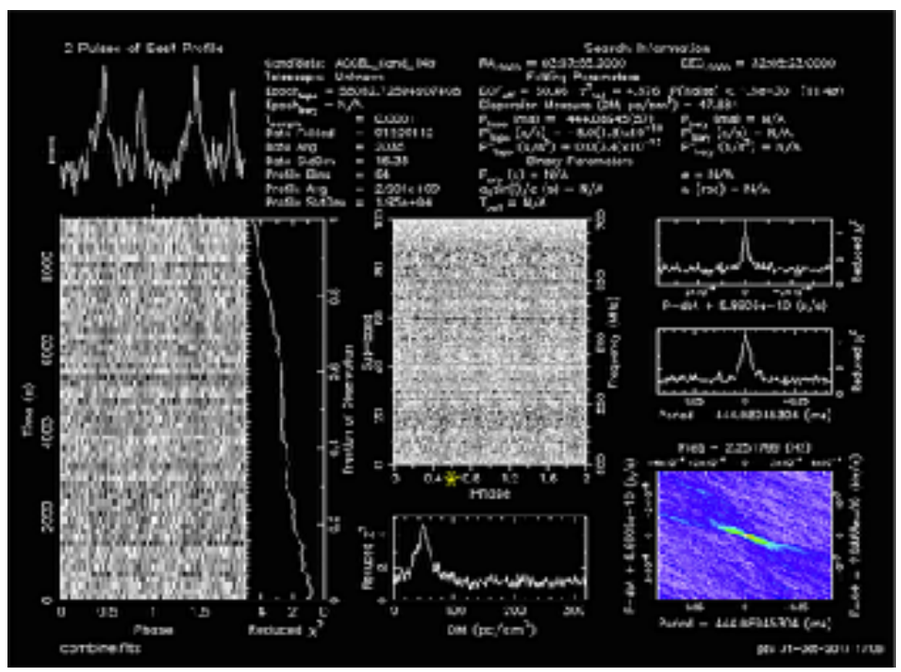



Chapman … **Li+** et al. ApJ 2011

**P= 0.444 s**
**DM=47.6**

GBT + Arecibo + HSA Follow-up


Chandra X-ray Image
De Luca et al. 2011



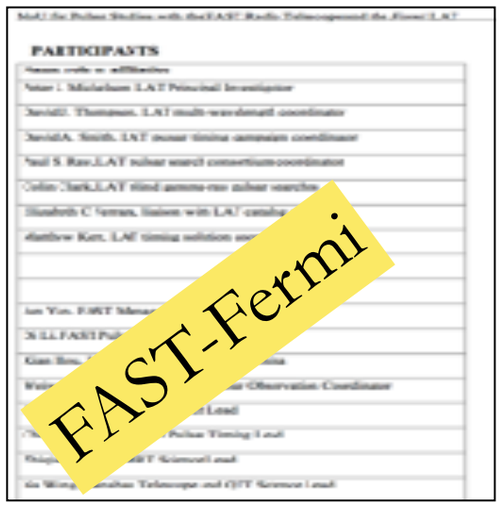
# Breakthrough Potentials

FAST + new tech. → New Parameters

post-FAST establishment:
current revolution in radio astronomy

- GW: LIGO
- 快速射电爆: FRB
- 相控阵技术: PAF
- Time Domain Astronomy
- AI/ML
- Multi-messenger





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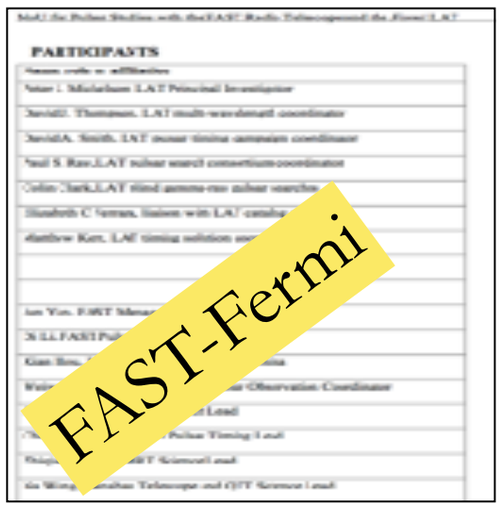


*Known Knowns; Known Unknowns, Unknown Unknows*