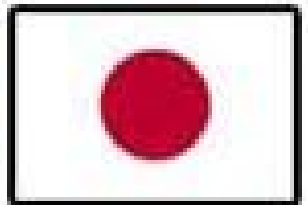
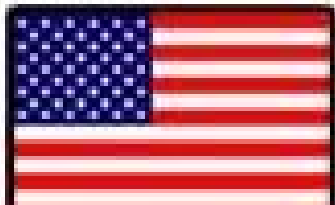




# 三十米望远镜

Thirty Meter Telescope

——几多惊喜几多愁



Great Paris Exhibition Telescope  
(lens at the same scale)  
Paris, France (1900)

Yerkes Observatory  
(40" refractor  
lens at the same scale)  
Williams Bay,  
Wisconsin (1893)

Hooker  
(100")  
Mt Wilson,  
California  
(1917)

(1979-1998)  
Multi Mirror Telescope  
Mount Hopkins, Arizona

(1999-)  
Hale (200")  
Mt Palomar,  
California  
(1948)

BTA-6 (Large  
Altazimuth Telescope)  
Zelenchuksky, Russia  
(1975)

Large Zenith Telescope  
British Columbia, Canada  
(2003)

Gaia  
Earth-Sun L2 point  
(2014)

James Webb  
Space Telescope  
Earth-Sun L2 point  
(planned 2018)



Tennis court at the same scale

Large Sky Area  
Multi-Object Fiber  
Spectroscopic  
Telescope  
Hebei, China  
(2009)

Hobby-Eberly  
Telescope  
Davis  
Mountains,  
Texas (1998)

(1998-2000)  
Very Large Telescope  
Cerro Paranal, Chile  
(1998-2000)

Large Binocular Telescope  
Mount Graham,  
Arizona (2005)

Magellan Telescopes  
Las Campanas,  
Chile (2000/2002)

Overwhelmingly Large Telescope  
(cancelled)

Arecibo radio telescope at the same scale

Gran Telescopio  
Canarias  
La Palma,  
Canary Islands,  
Spain (2007)

Southern African  
Large Telescope  
Sutherland,  
South Africa  
(2005)

Gemini North  
Mauna Kea,  
Hawaii (1999)

Gemini South  
Cerro Pachón,  
Chile (2000)

Large Synoptic  
Survey Telescope  
El Peñón, Chile  
(planned 2020)

Giant Magellan Telescope  
Las Campanas Observatory,  
Chile (planned 2020)

Kepler  
Earth-trailing  
solar orbit  
(2009)

Hubble Space  
Telescope  
Low Earth  
Orbit  
(1990)

Keck Telescope  
Mauna Kea, Hawaii  
(1993/1996)

Subaru Telescope  
Mauna Kea,  
Hawaii (1999)

European Extremely  
Large Telescope  
Cerro Armazones,  
Chile (planned 2022)

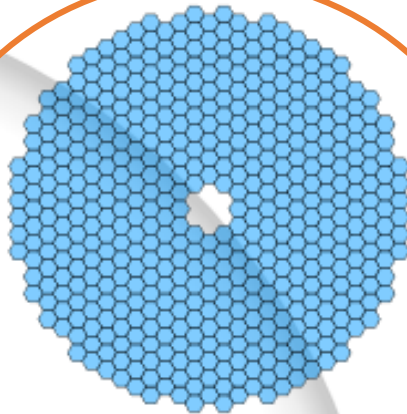
Thirty Meter Telescope  
Mauna Kea, Hawaii (planned 2022)

Human  
at the  
same scale

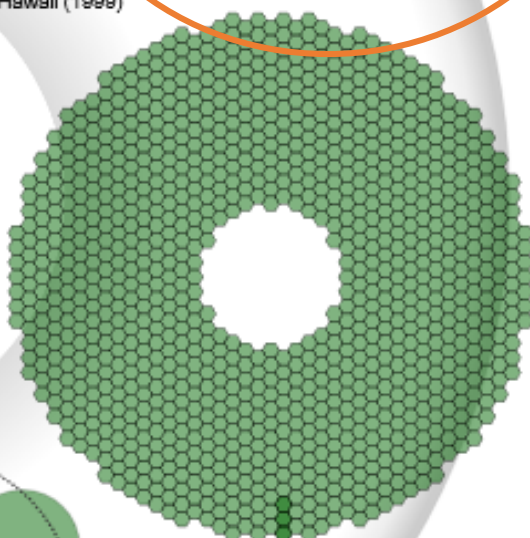
0 5 10 m  
0 10 20 30 ft



Basketball court at the same scale



Thirty Meter Telescope  
Mauna Kea, Hawaii (planned 2022)



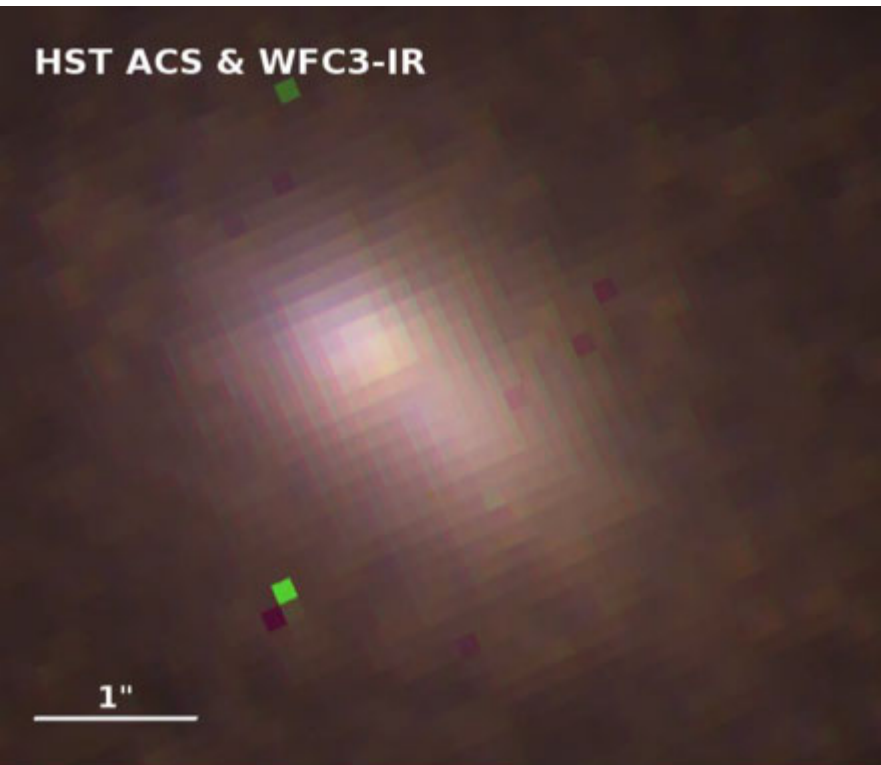
European Extremely  
Large Telescope  
Cerro Armazones,  
Chile (planned 2022)

Human  
at the  
same scale

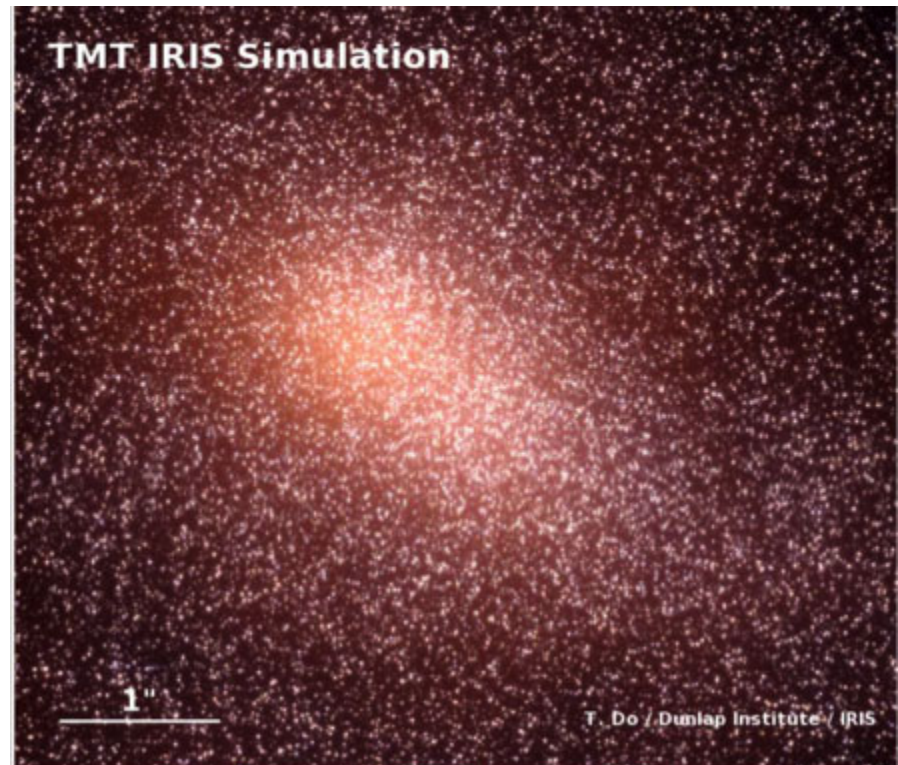
0 5 10 m  
0 10 20 30 ft



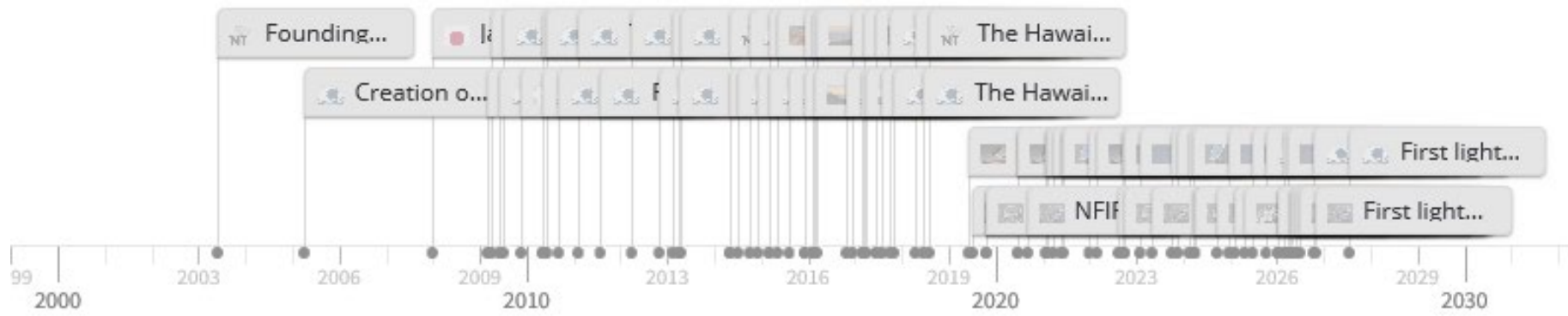
HST ACS & WFC3-IR



TMT IRIS Simulation



T. Do / Dunlap Institute / IRIS



- 科学目标
- 预期成果
- 光学设计
- 进展情况

# 科学目标 (9大类)

- 基础物理和宇宙学
- 早期宇宙、星系形成、星系间介质
- 超大质量黑洞
- 银河系和周边星系
- 恒星、恒星物理和恒星际介质
- 恒星及行星起源
- 探测系外行星
- 太阳系内科学
- 时域天文学



# 预期成果

## ——基础物理和宇宙学

- 强相互作用力和引力
  - 约束极端致密体的状态方程
  - 利用双中子星检验引力理论
- 对附近和远处物体的暗物质的精确研究。
  - 对矮星系的质量分布进行明确的限制
  - 在引力透镜系统中探测黑暗的子结构。
- 基本物理学常数随时间的变化
  - 精细结构常数
  - 质子-电子质量比

promises to set limits on the order of  $10^{-4}$  on the variation of  $\alpha$ , and of  $10^{-3}$  on the variation of the electron mass over the past 13 billion years.

# ISDT

## The TMT International Science Development Teams

- 帮助确定观测站的能力和运作，以最大限度地提高其科学产出。
- 鼓励科学家积极参与TMT项目，包括观测者、理论物理学家、高能物理学家。
- 与参与者建立科学合作。
- 在跨越仪器边界的关键科学领域展示TMT的全部潜力。
- 通过制作白皮书和组织研讨会来提高TMT科学的知名度。

International Science Development Team	Conveners
<a href="#">Fundamental physics and cosmology</a>	Ian Dell'Antonio Tommaso Treu
<a href="#">Early universe, galaxy formation and the intergalactic medium</a>	Mark Dickinson Tadayuki Kodama
<a href="#">Supermassive black holes</a>	Yue Shen Matt Malkan
<a href="#">Milky Way and nearby galaxies</a>	Alan McConnachie Eric Peng
<a href="#">Stars, Stellar Physics and the Interstellar Medium</a>	T. Sivarani Richard de Grijs
<a href="#">Formation of stars and planets</a>	Gregory Herczeg Jessica Lu
<a href="#">Exoplanets</a>	Christian Marois Norio Narita
<a href="#">Our solar system</a>	Tian Feng Tomohiko Sekiguchi
<a href="#">Time domain science</a>	G.C. Anupama Masaomi Tanaka

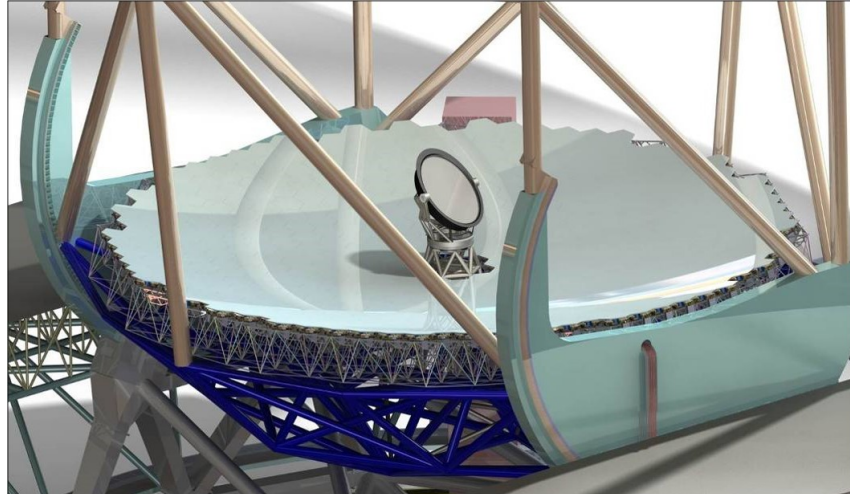
# 光学设计





# 光学系统

- 地平式
- Ritchey-Chrétien System

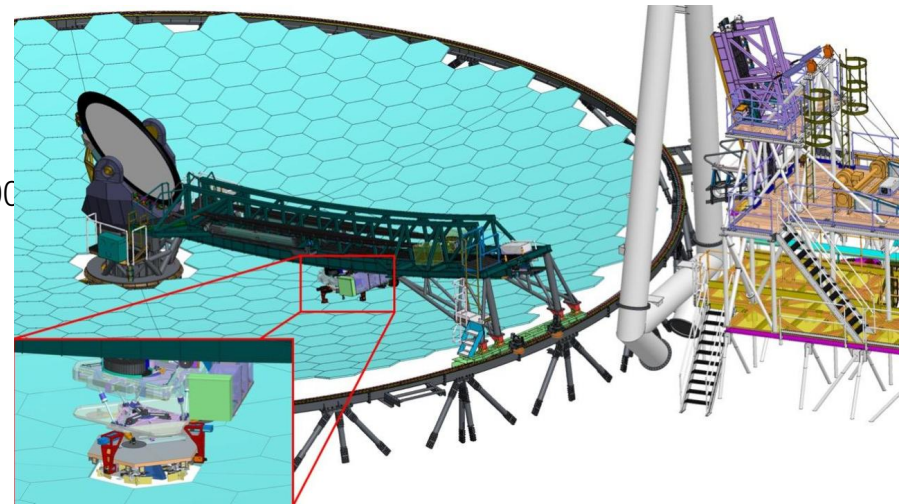


- 三面镜子 {
  - 第一镜：双曲面
  - 第二镜：双曲面
  - 平面镜：平面镜
- 两个耐氏平台 → 八个终端设备

# Primary Mirror

Parameter	Value
Aperture, m 口径	30
Number of segments 分镜个数	492
Focal Ratio 焦比	f/1
Paraxial Radius, m 近轴半径	60
Conic 圆锥曲线类型	-1.000
Segment thickness, mm 分镜厚度	45
Mass, metric tons 重量	121
Segment gaps, mm 分镜间隔	2.5

**Clearceram®**



Infrared Multi-Object Spectrometer  
红外多目标光谱仪

IRMS  
(NFIRAOS top port)

NIRES-B  
(NFIRAOS side port)

InfraRed Imaging Spectrometer  
红外成像光谱仪

IRIS  
(NFIRAOS bottom port)

Wide Field Optical Imaging Spectrometer  
大视场光学成像光谱仪

HROS  
(not shown)

WFOS

IRMOS  
(not shown)

Near-InfraRed, Multi-Object  
Spectrometer  
近红外多目标光谱仪

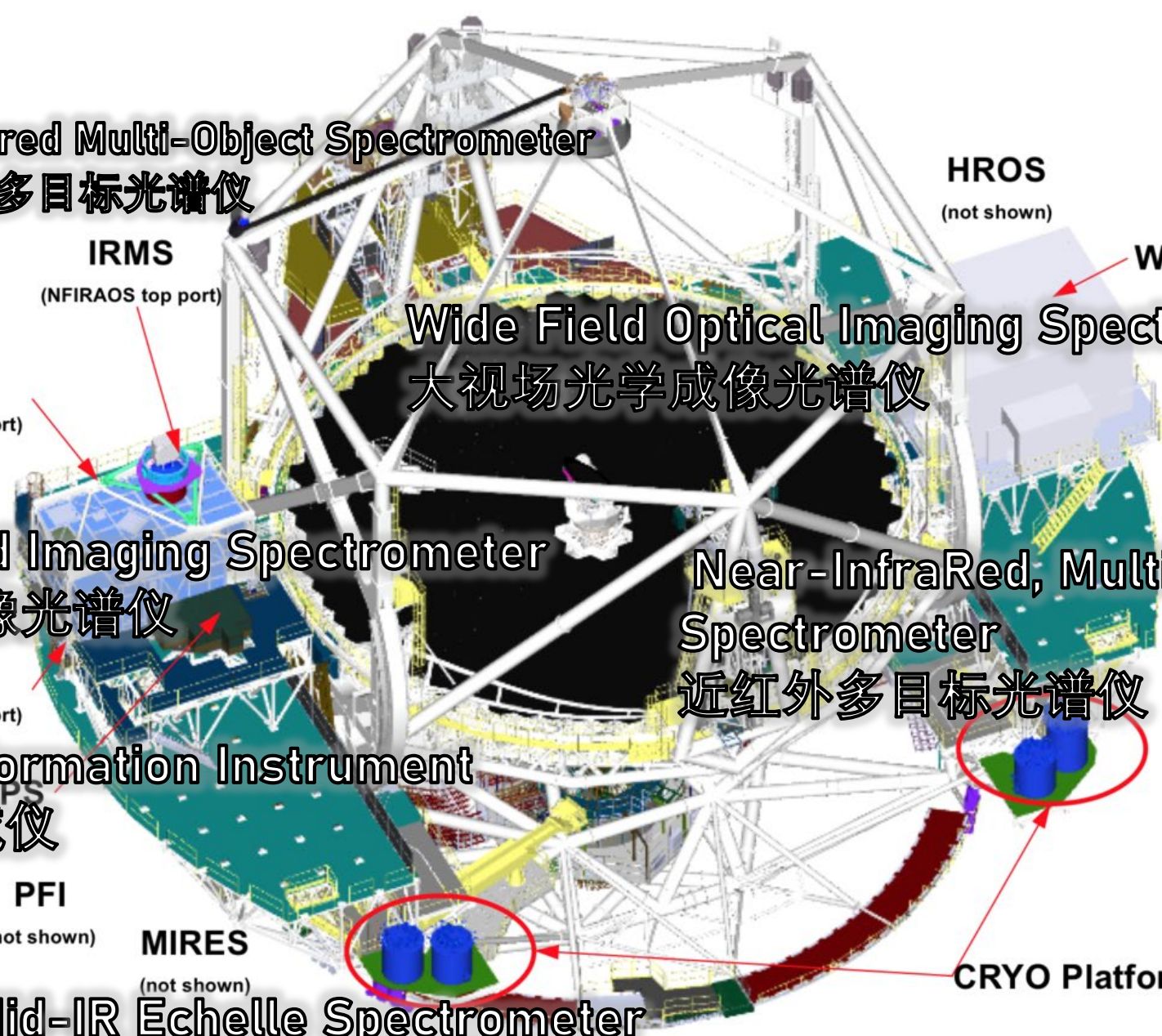
Planet Formation Instrument  
行星形成仪

PFI  
(not shown)

MIRES  
(not shown)

Mid-IR Echelle Spectrometer  
中红外阶梯光谱仪

CRYO Platforms



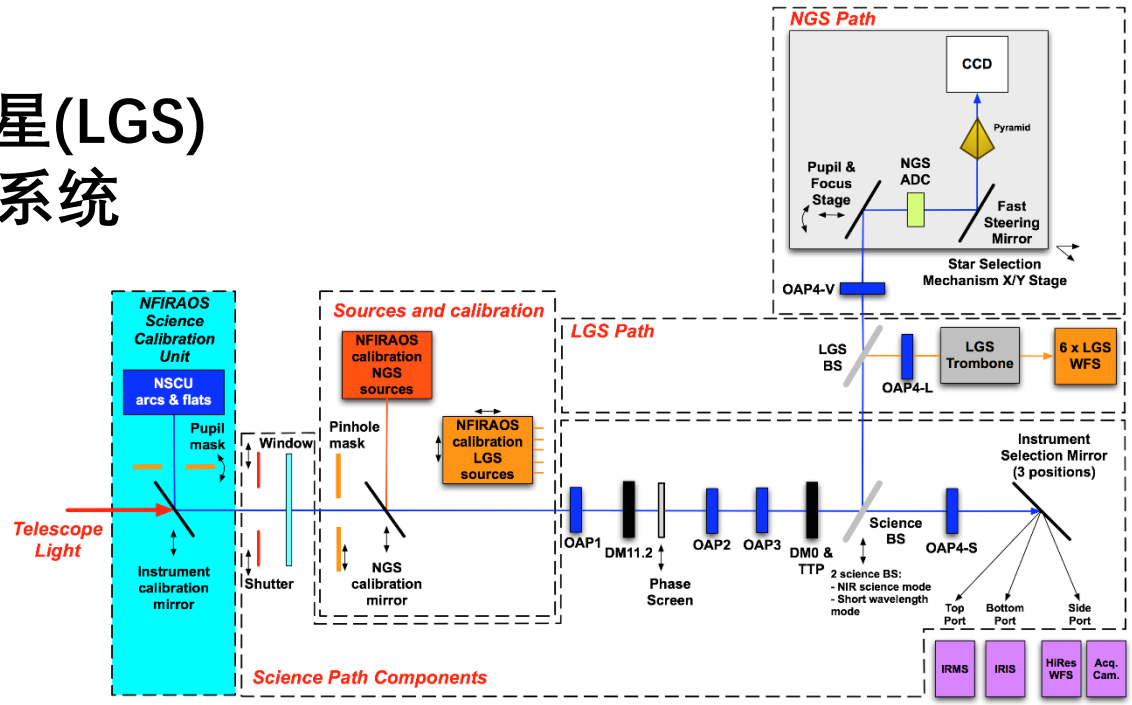
# 自适应光学

- 小视场，衍射极限，近红外 (NFIRAOS)
- 大视场，近衍射极限 ( $0.6 \sim 2.5\mu\text{m}$ ) (MOAO)
- 小视场，衍射极限中红外 (MIRAO)

NFIRAOS Optical Layout - 2014-12-12 - v1

构成：

- 60x 60阶激光导引星(LGS)
- 多共轭AO(MCAO)系统



# 进展情况

夏威夷的土著民族敬仰莫纳克亚山，  
他们认为山顶居住着雪神波利亚胡Poliahu  
只有部落酋长和牧师可以登上山顶。



迈  
淮  
在  
译

真、寒

# 命途多舛



- 2010，夏威夷州长在14次社区会议后签署了一项环境研究。
- BLNR在12月2日和2010年12月3日举行了关于申请许可证的听证会。
- 2011年2月25日，董事会在多次公开听证会后获得了许可证。
- 2011年8月举行了一场有争议的案件听证会，听证会官员于2012年11月作出了判决。该望远镜于2013年4月得到国家国土资源局的批准。
- 2014年5月下级法院的裁决中，这一程序在法庭上受到质疑。夏威夷州中级上诉法院拒绝听取有关许可证的上诉。夏威夷国土资源部从听证会上作出决定，可以向法院提出上诉。
- 2014年10月7日，该项目成为了政治冲突升级的焦点，警方逮捕了抗议者。
- 2015年12月，夏威夷州最高法院裁定夏威夷土地和自然资源委员会2011年的许可证无效。
- 2017年7月26日，阿玛诺法官提出建议，要求土地委员会批准建筑许可证。



## W. M. Keck Observatory Awarded NSF Grant To Develop Next-Generation Adaptive Optics System

October 4th, 2018 • [Science & Astronomy](#)

“This revolutionary system will significantly expand Keck Observatory’s scientific reach,” said Co-Principal Investigator Andrea Ghez, director of the UCLA Galactic Center Group. “KAPA will also serve as an intellectual springboard for the coming generation of extremely large telescopes. We are developing KAPA in partnership with the Thirty Meter Telescope, Giant Magellan Telescope, and European Extremely Large Telescope (ELT) so they can be...

## TMT Board Defers Decision on Thirty Meter Telescope Site



2d7

April 13th, 2018

Fun and learning at TMT Camp for Puna Keikis



F5572c6bb2994e20f9f3f9d8b3107c9c8baec24a

## The TMT Primary Mirror System Successfully Passes Final Design Review

September 10th, 2018 • [Engineering & Technology](#)

PASADENA (July 26-27, 2018)– The Thirty Meter Telescope Optics Group recently achieved a critical milestone by passing its Primary Mirror Optics System (M1S) final

选址属性 (media values, unless stated otherwise)	MKO (USA)	ORM (Spain)
海拔	4050	2250
年平均可用时间比	72	72
60m处视宁度 arcsec	0.50	0.55
Isoplanatic Angle等晕角 (arcsec)	2.55	2.33
Atmospheric Coherence Time (ms) 大气相干时间	7.3	6.0
Precipitable Water Vapor (% time <2mm) 大气可降水量	54	>20
平均夜间温度(°C)	2.3	7.6
消光 (V mag/airmass)	0.111	0.137
地面粉尘浓度( $\mu\text{g}/\text{m}^3$ )	0.815	1.006





海风的尽头，便是繁星的居所。