Large Millimeter Telescope

current status & future mm-VLBI

David Hughes

Director & Principal Investigator
Large Millimeter Telescope

Instituto Nacional de Astrofísica, Óptica y Electrónica
INAOE, Tonantzintla, Puebla, Mexico

mm VLBI workshop ESO, Garching 28 June 2012

Gran Telescopio Milimétrico (GTM)

- Bi-national project: INAOE (Mexico) & UMASS (USA)

  CONACYT MegaProject – largest scientific project
  Mexico 1,300M pesos ($120M USD)
  USA $60M USD

- 50-m main reflector (180 panel segments)
- active primary surface r.m.s. of ~75 microns (compensates gravity & thermal deformations)
- operational wavelengths 0.85 - 4 mm
  beam resolution (FWHM) 4 -18 arcsec
- FOV ~ 4 arcmin diameter
- site: Sierra Negra (4600m, 15100ft); Lat. +19
- LMT commissioning & first-light 1st June 2011


N
The Bahamas
Turks
Cuba
Mexico
Cayman Islands
Navass
Jamaica
Mexico City
LMT
Belize
Guatemala
Honduras
El Salvador
Nicaragua
US Dept of State Geographer
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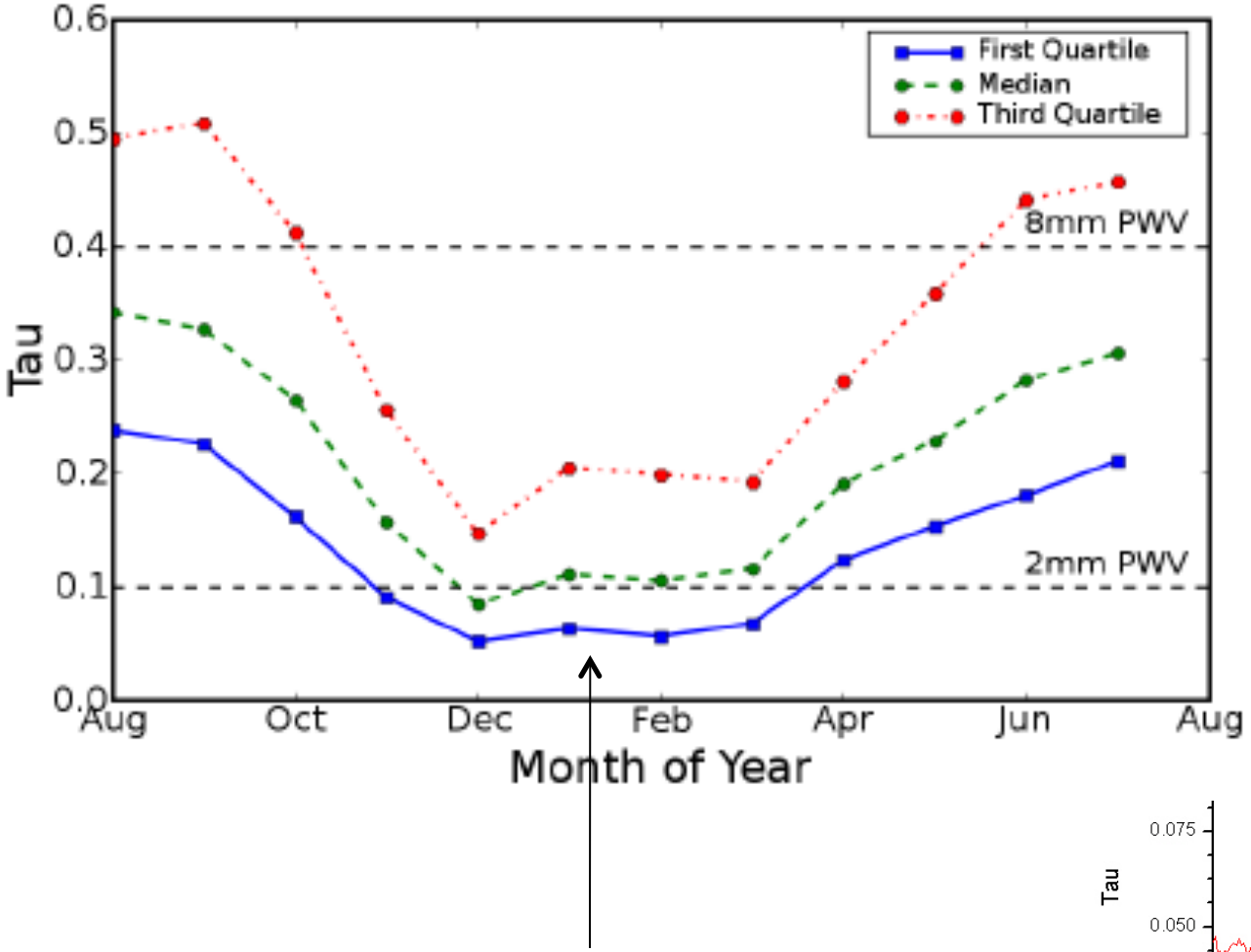
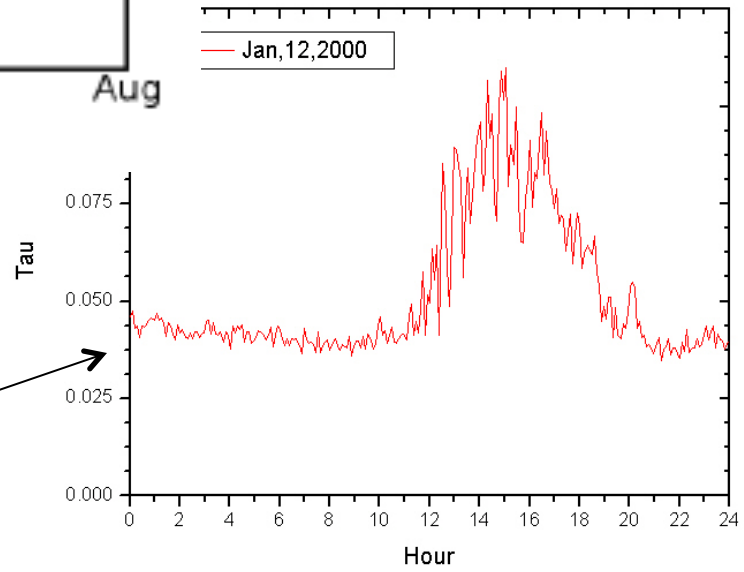
Clipperton Island
11°04'18.18" N 115°47'34.50" W elev -4073 m
Costa Rica
Eye alt 3419.82 km


Pico de Orizaba (Citlaltépetl)
5740 m; 18832 ft
LMT / Sierra Negra (Tliltépetl)
4600m; 15091 ft
97º 18’ 53” W, +18º 59’ 06”
Puebla 2200m - 120 km from INAOE/Puebla to LMT

Monthy-averaged night-time opacity (225 GHZ)

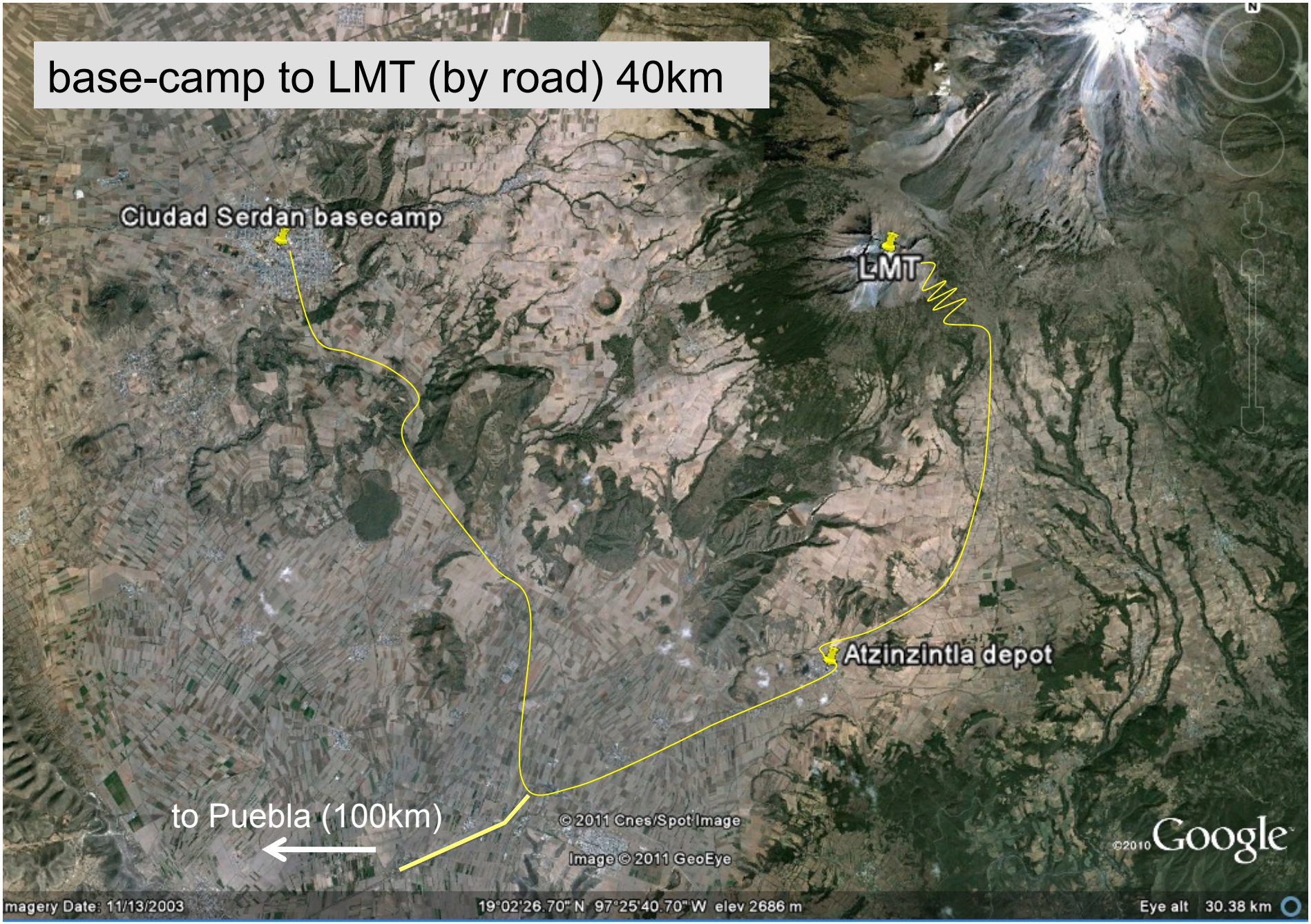




good submillimeter (345 GHz) conditions
25% time JCMT Band1 – December to March

LMT infrastructure
LMT Project Office – INAOE, Mexico

- LMT Project office coordinates activities at all LMT sites – Tonantzintla (office); Ciudad Serdan (basecamp); Atzinzintla (depot); Sierra Negra (LMT site) in Mexico (88 staff)
- LMT administrative office and INAOE infrastructure includes metrology & aspheric surfaces lab & astrophysics instrumentation labs, research offices, vehicles, …..


base-camp to LMT (by road) 40km
Ciudad Serdan basecamp
LMT
Atzinzintla depot
to Puebla (100km)
© 2011 Cnes/Spot Image
Image © 2011 GeoEye
©2010 Google
imagery Date: 11/13/2003
19°02'26.70" N 97°25'40.70" W elev 2686 m
Eye alt 30.38 km


5/21/2011
N
Image © 2012 GeoEye
© 2012 INEGI
© 2012 Google
Google earth
ha de las imágenes: 5/21/2011
2003
14 Q 677568.02 m E 2100043.20 m N elev. 4554 m
Alt. ojo 5.07 km

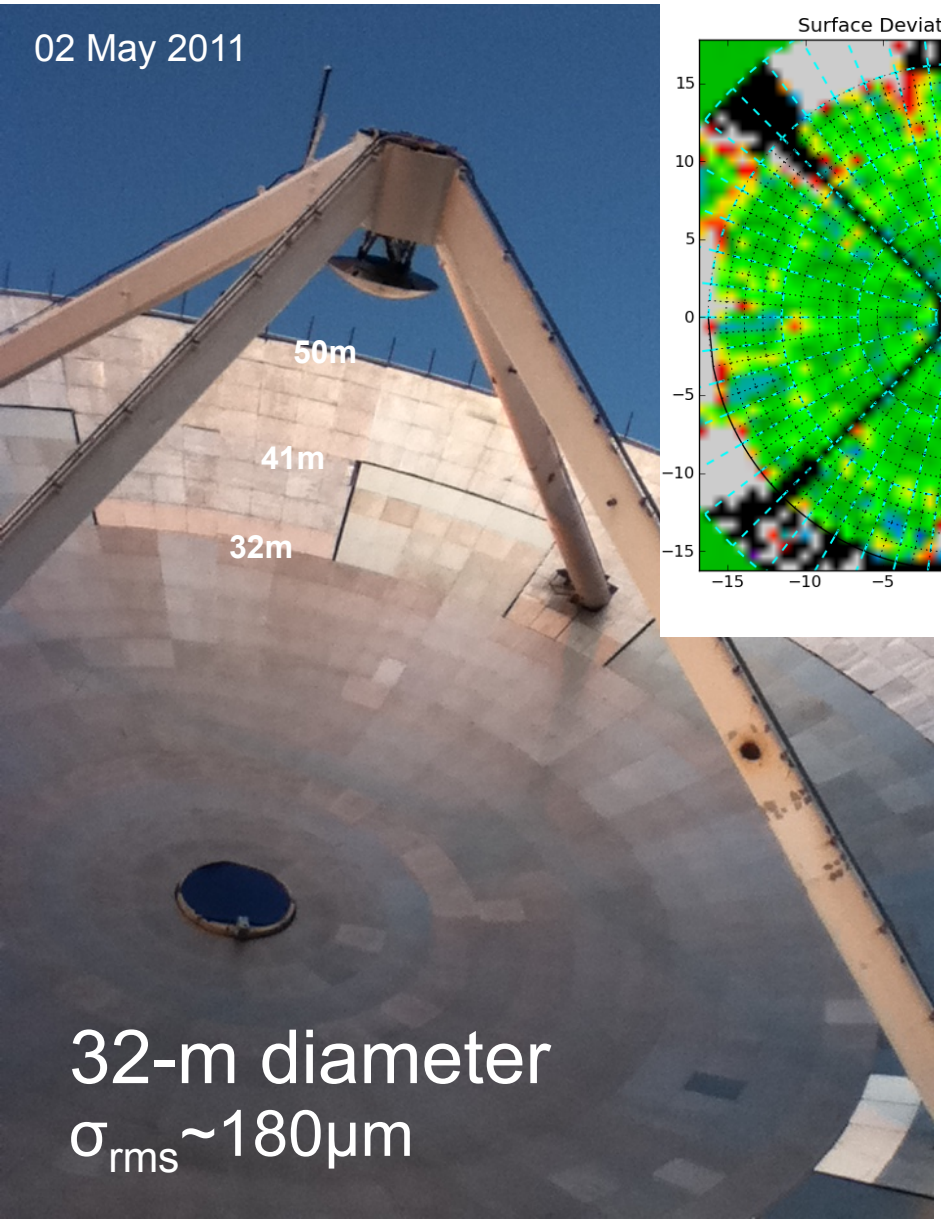
LMT first-light project
(March 2010 – July 2011)

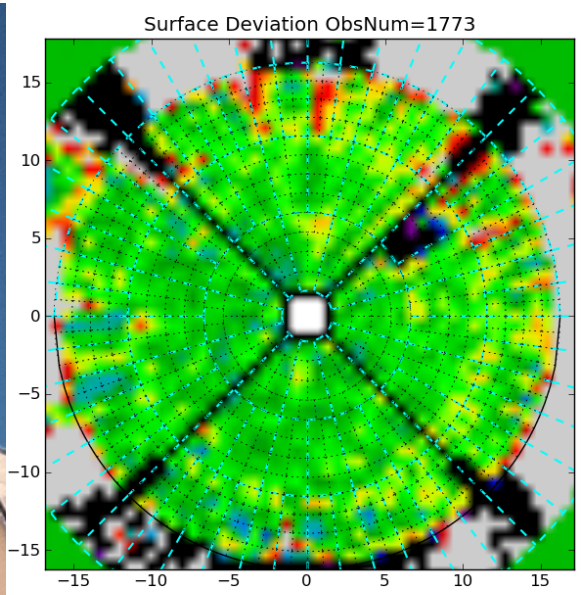
defined by Memorandum of Understanding between CONACYT, INAOE & UMASS

"completion of all telescope sub-systems and setting the inner 32 meter diameter of the reflector surface with sufficient accuracy to allow for a scientific demonstration at a wavelength of 3mm"

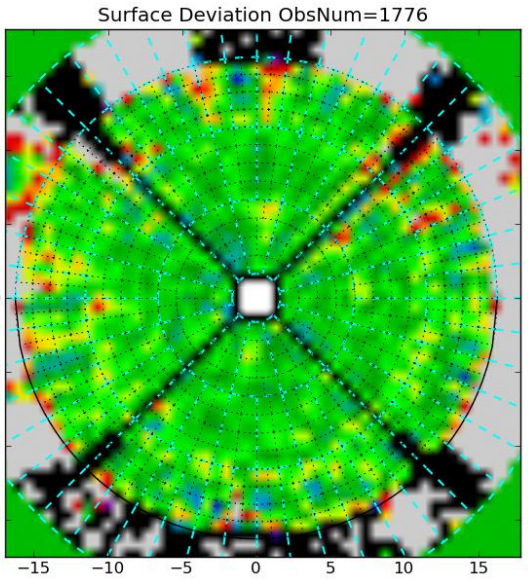
"to demonstrate the performance of all telescope components and to identify areas where more work is needed to complete the telescope according to its specifications "

12 GHz holography of LMT primary reflector
– global alignment of surface segments



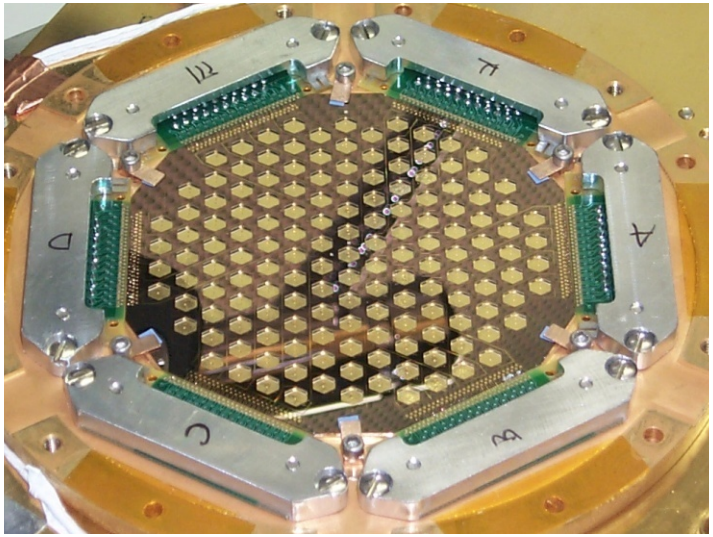


0.9m resolution map of surface

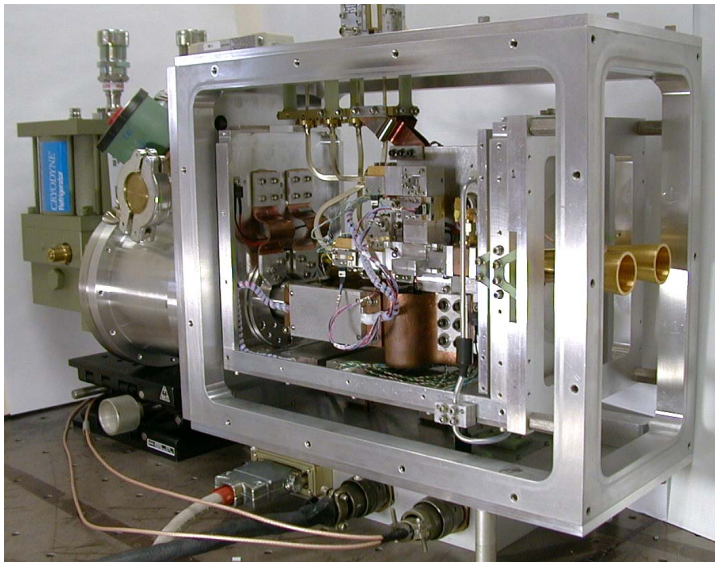


- Identified problems with actuators & sub-panel adjusters that limit surface precision

LMT commissioning & 1st-light scientific instrumentation

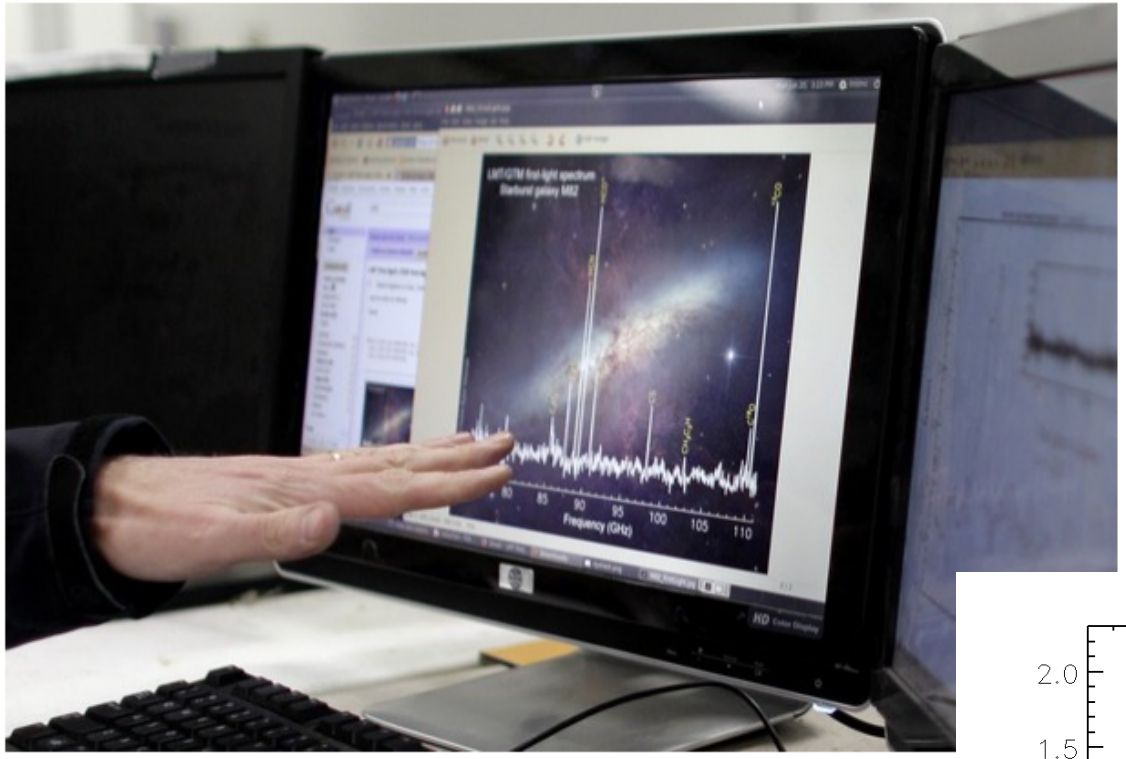


- **AzTEC** (P.I. Grant Wilson - UMASS)
- 1.1mm camera (144 pixels)
- 0.23 sq. deg/hr/mJy^2 (comparable to S2)
- wide-field & confusion-limited continuum mapping. Faster multi-frequency large-format camera planned.
- operational JCMT(2005), ASTE (2007-2008)



- **Redshift Seach Receiver** (P.I. Neal Erickson - UMASS)
- 75 – 111 GHz instantaneous bandwidth; ~100 km/s resolution; 2 pixel (2 pol).
- Receiver temp ~ 60K; stable baselines
- detect multiple molecular-lines without prior information on galaxy redshift
- operational FCRAO-14m (2007-2008)

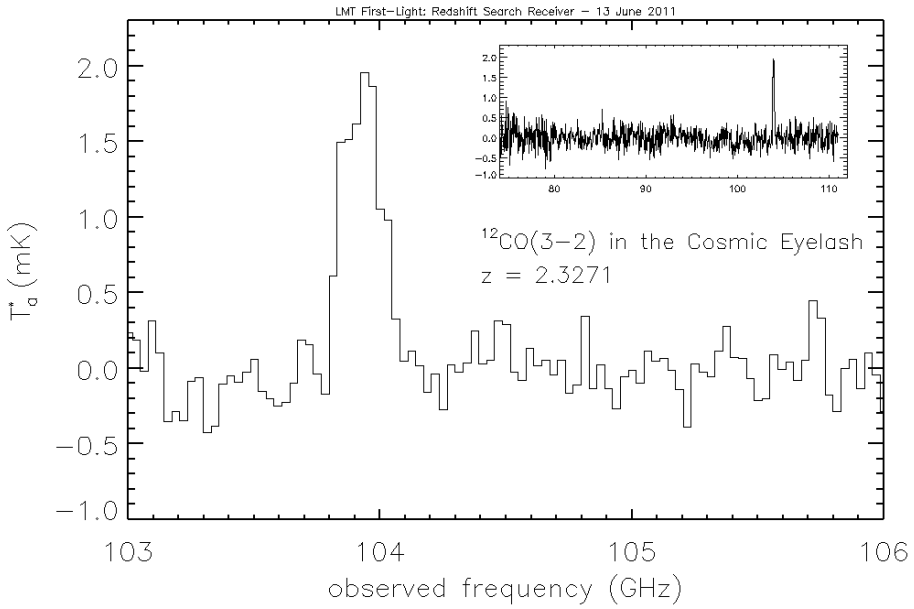
LMT first-light at 3mm – 1st June 2011



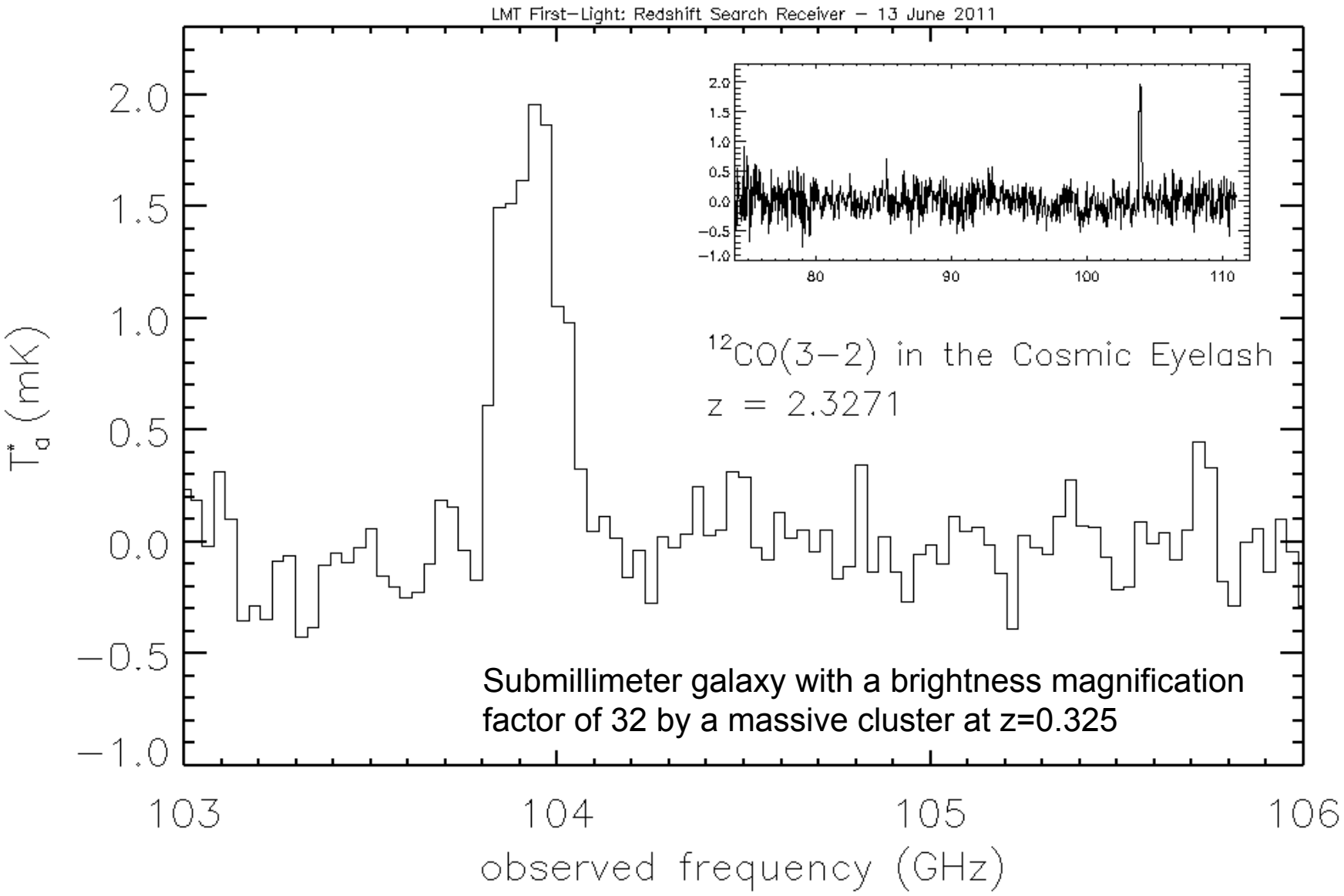
REUTERS PICTURES 3 MONTHS AGO Next »

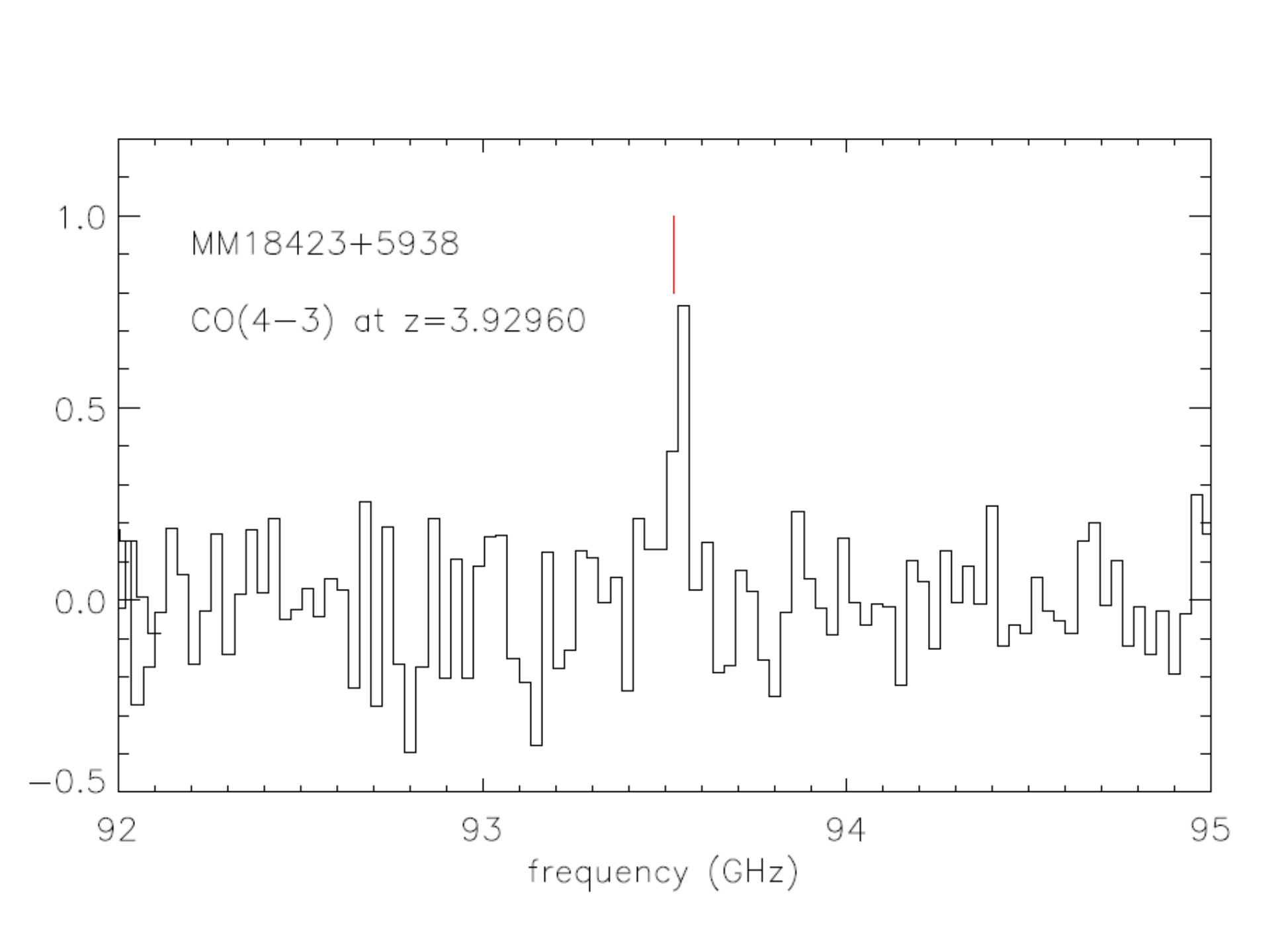
David Hughes, director of the world's largest millimeter telescope, shows on a screen an image of Galaxy M82 taken by the Hubble Space Telescope, during an interview with Reuters television in the Sierra Negra Volcano June 21, 2011. The superimposed spectrum shows molecular gas detected by the Large Millimeter Telescope between 2 and 4 millimeters. The emission lines of different molecular species are identified with their chemical symbol in yellow. Amongst others, different isotopes of carbon monoxide (CO), hydrogen cyanide (HCN) and methylacetylene (CH3C2H) and various hydrocarbons have been detected. The telescope, which sits on an altitude of 4,600 m (15,000 ft.), is the result of a bi-national project between Mexico and the U.S. , according to its website. The first observations were made at 3 mm on June 1, 2011, according to Instituto Nacional de

LMT detects starformation in local & high-redshift universe

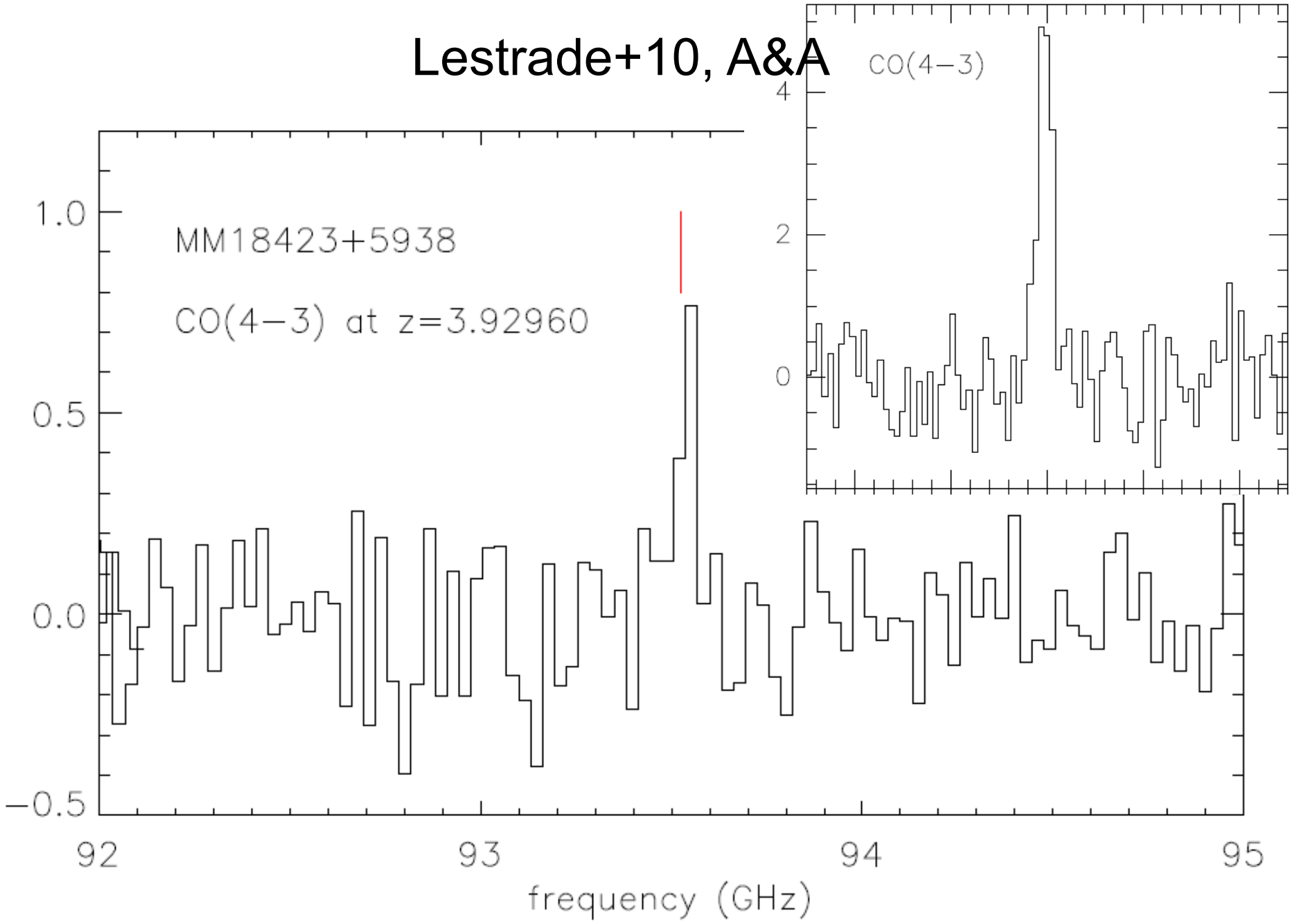


Starformation in the distant Universe: The “Cosmic Eyelash” at z~2.3



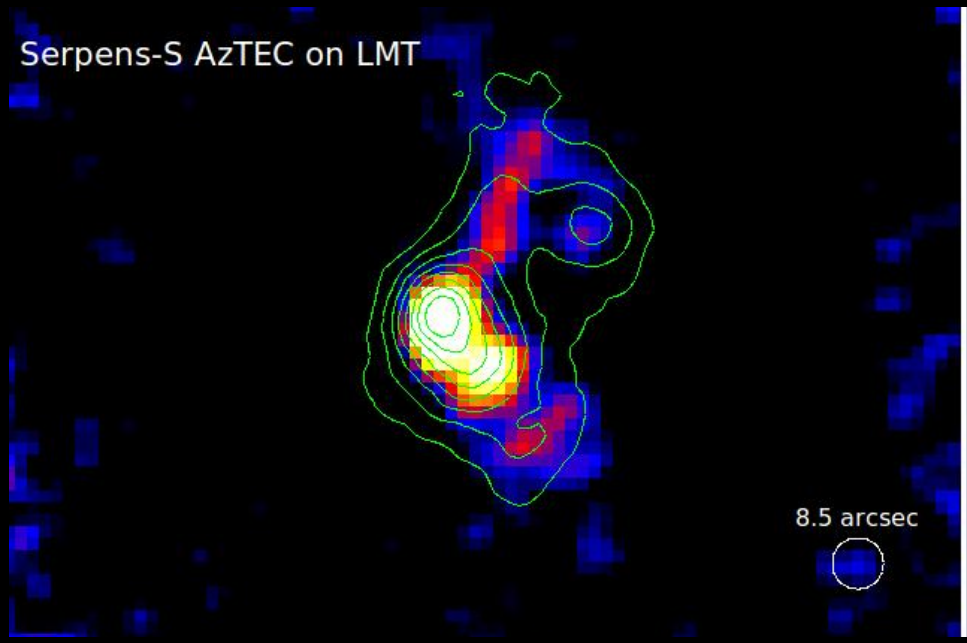

MM18423+5938
CO(4−3) at z=3.92960
1.0
0.5
0.0
−0.5
92
93
94
95
frequency (GHz)

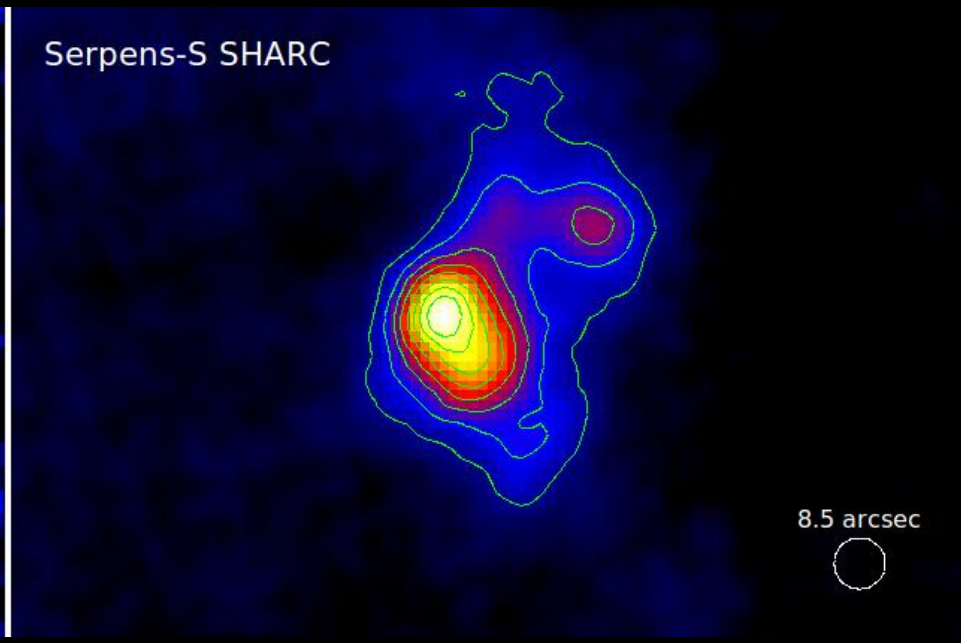
Lestrade+10, A&A



AzTEC 1.1mm first-light (July 2011)

starformation region in Serpens south

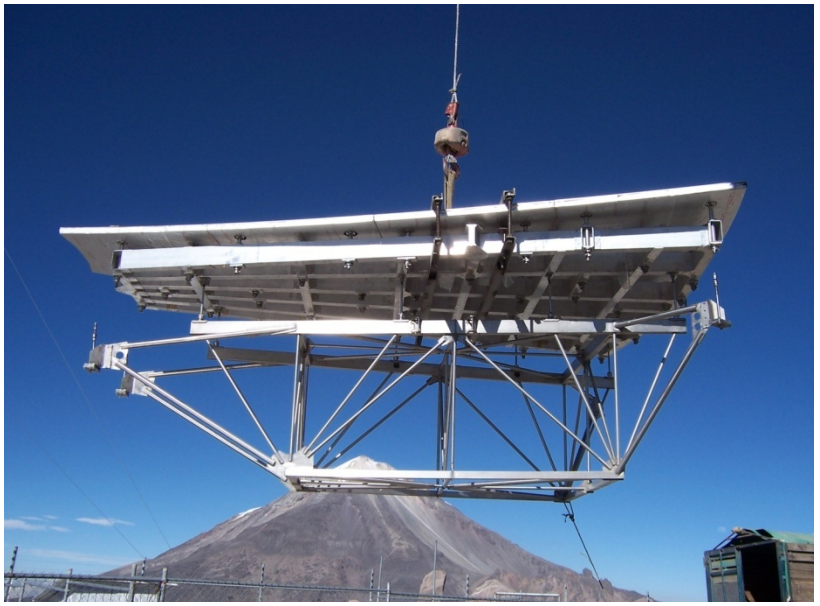




EL GRAN TELESCOPIO MILIMÉTRICO

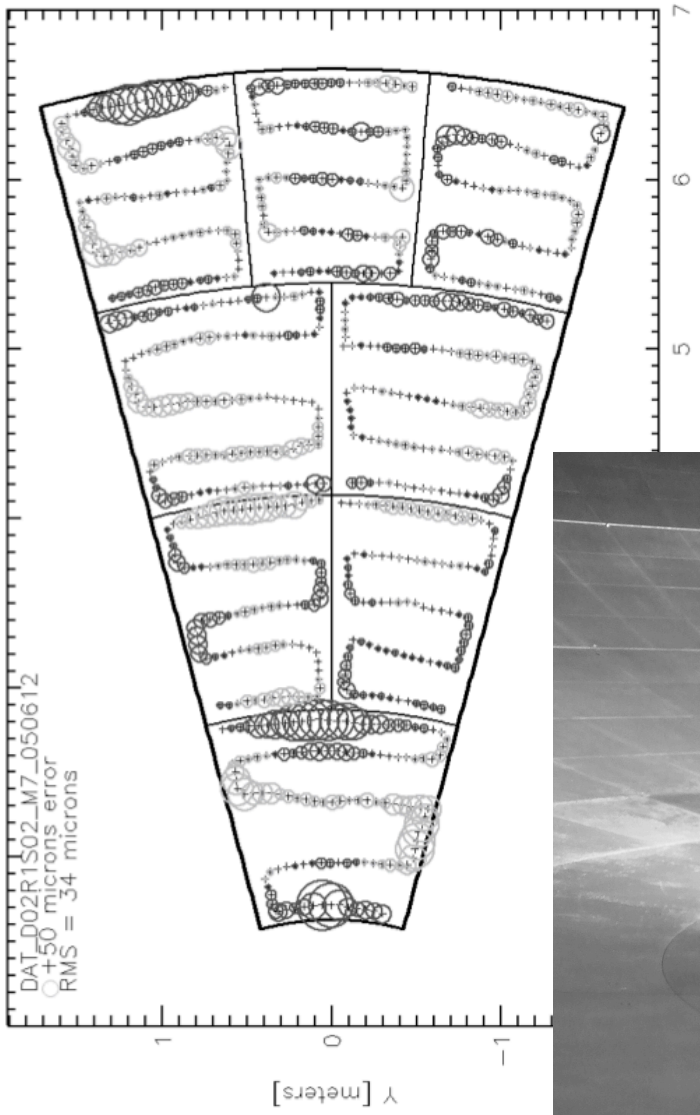
Fotografía: Jorge Reyes
GTM 100 0922 006

LMT surface segments

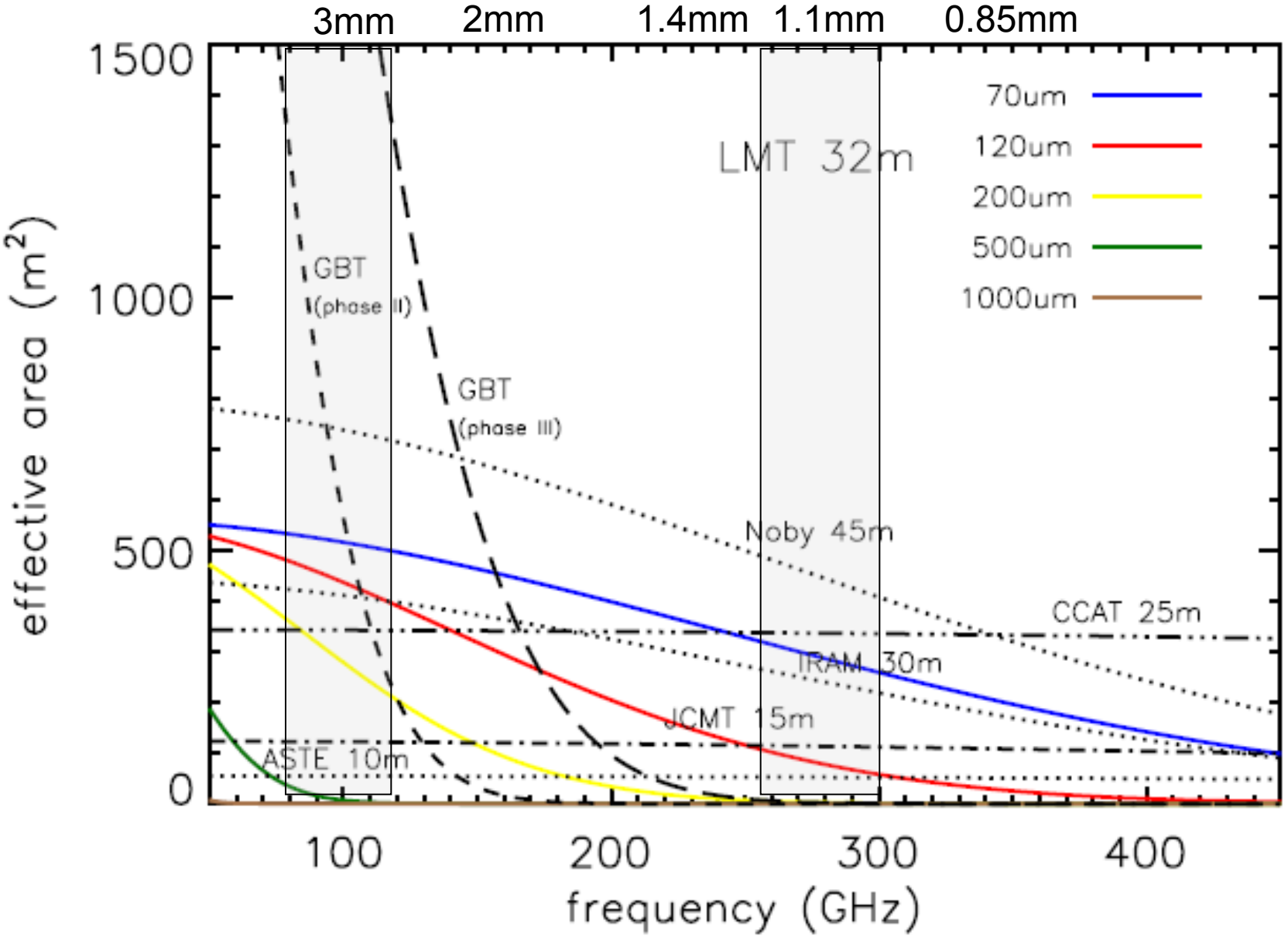


- 180 segments (~5 x 2m) in 5 concentric rings
- 8 sub-panels (<7 microns r.m.s.) electro-formed nickel - rhodium coating - (Media Lario, Italy)
- thermal insulation
- 40 adjusters (segments set to 20-30um at INAOE
- aluminium base plate
- stainless steel sub-frame & axial rods
- actuators & lateral bars

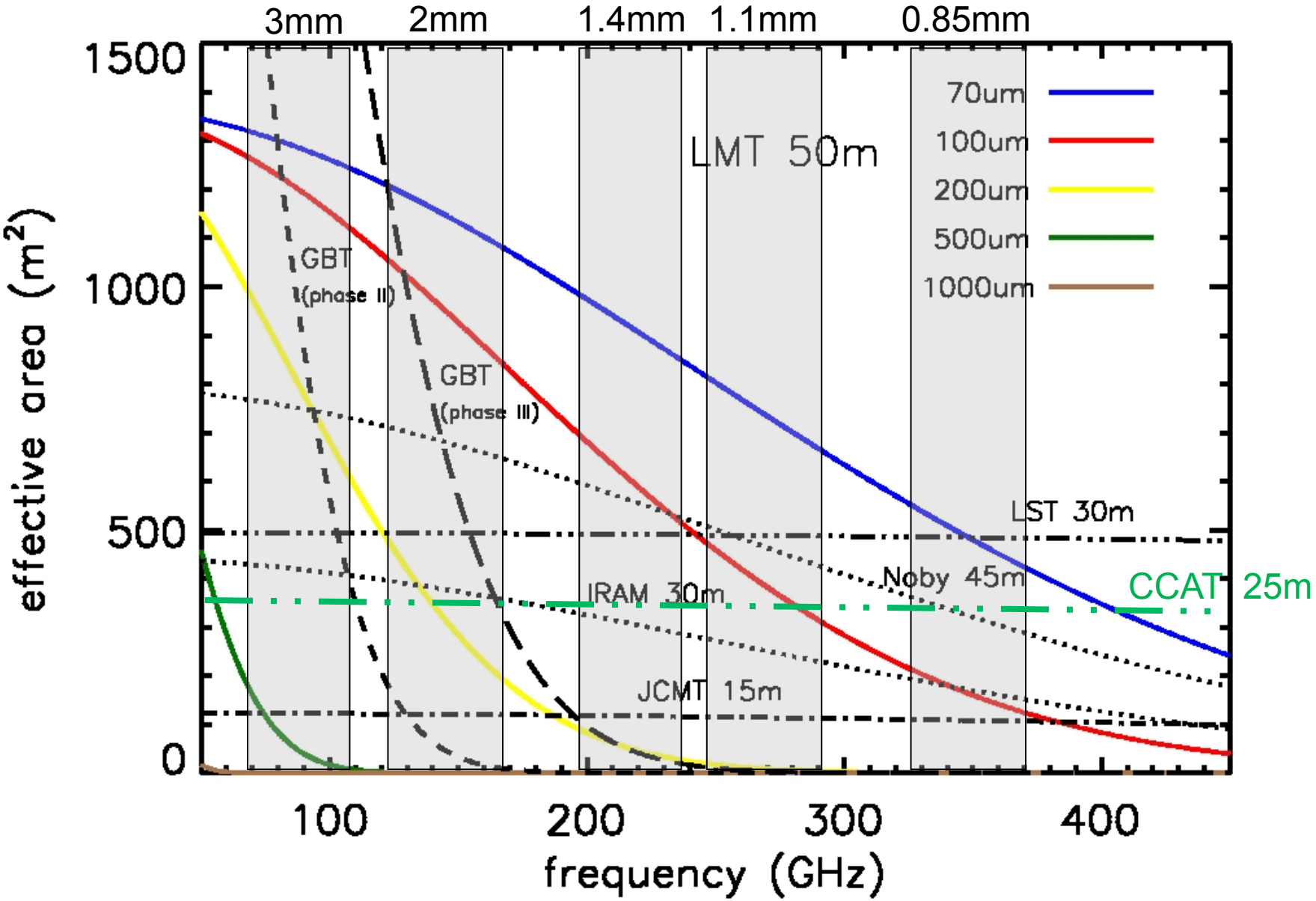
Primary surface alignment



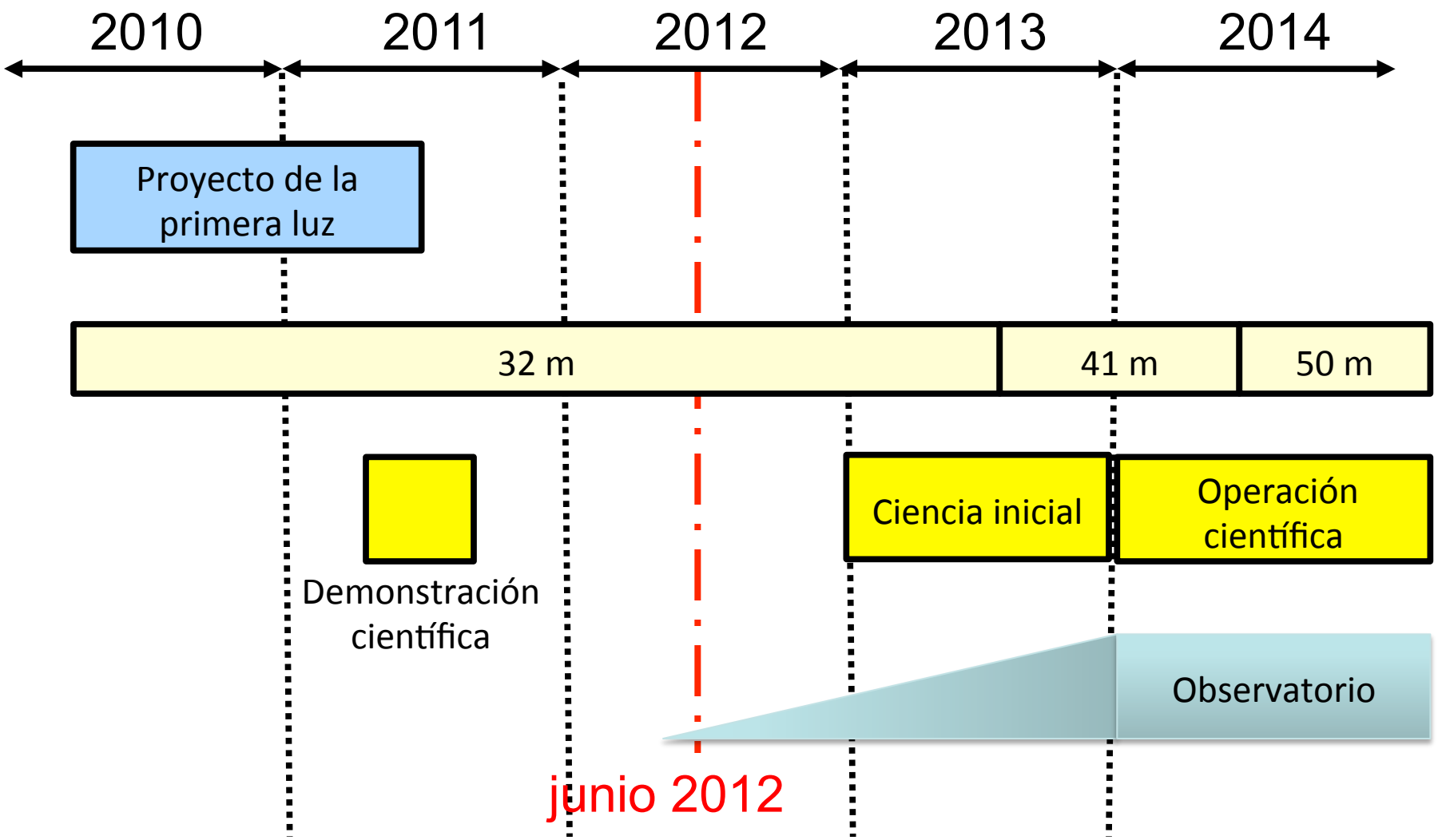
Effective area of (3-ring) 32m LMT



Effective area of (5-ring) 50m LMT



Calendario de la operación científica



mid-term goals: LMT 2013 - 2016

- complete 50-m diameter reach 75μm r.m.s surface

- utilize 100 m^2 receiver guest & external P.I. instruments
  - VLBI
  - Large-format continuum camera (1.1, 1.4, 2.1mm)
  - Multi-object spectroscopy
  - Sub-mm capability (345GHz)