6 y 7 de Octubre

cudi 08

Reunión de Otoño - Monterrey

Comunidad de Astronomía

Alfredo J. Santillán González

Universidad Nacional Autónoma de México

2009 Año Internacional de la Astronomía

¡El Universo para que lo descubras!

1a Conexión de Internet en México UNAM-ITESM

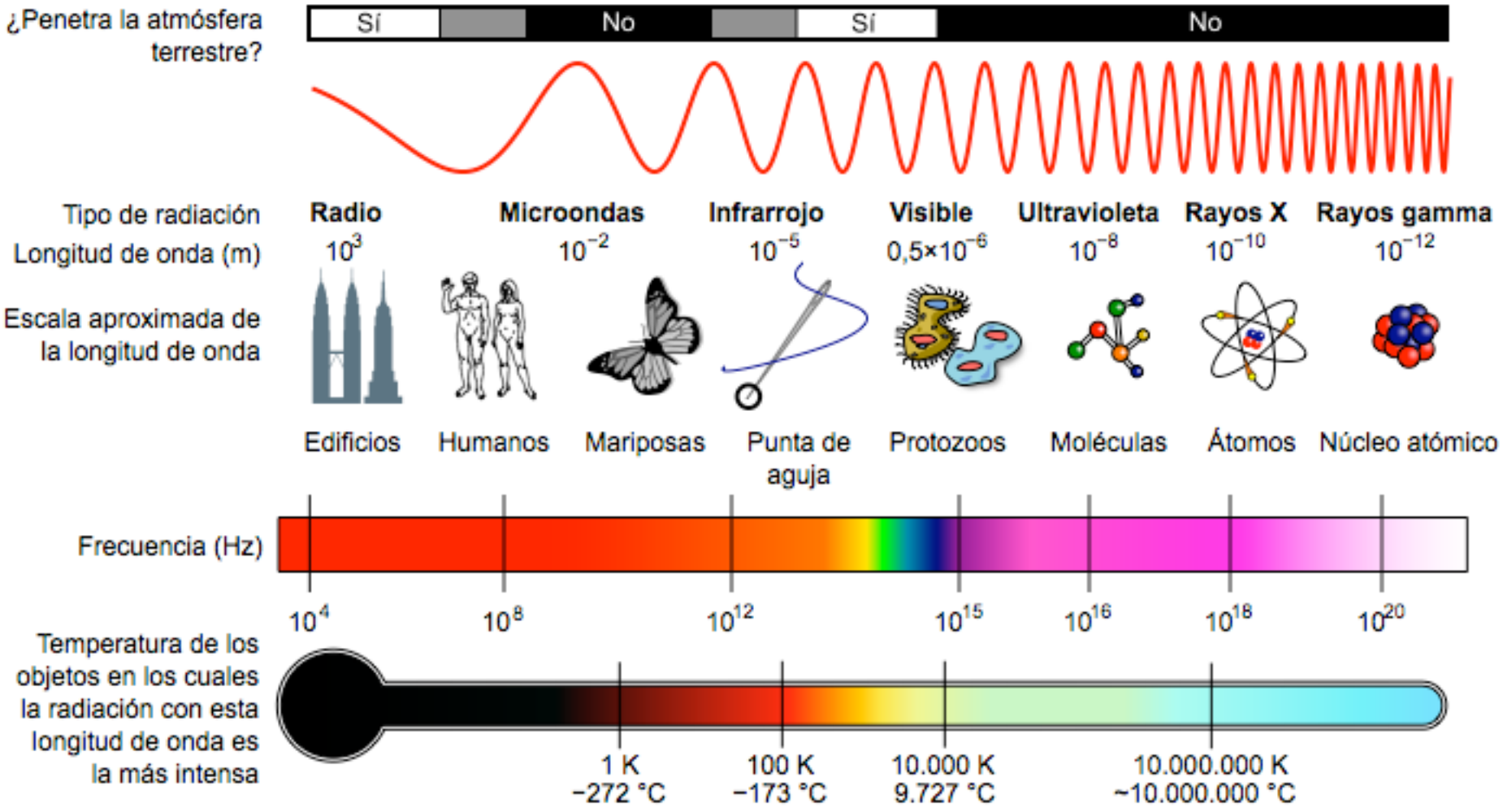
- Enlace satelital entre el National Center for Atmospheric Research (Boulder-Colorado, USA) y dos instituciones de Educación Superior Mexicanas: la UNAM y el ITESM.

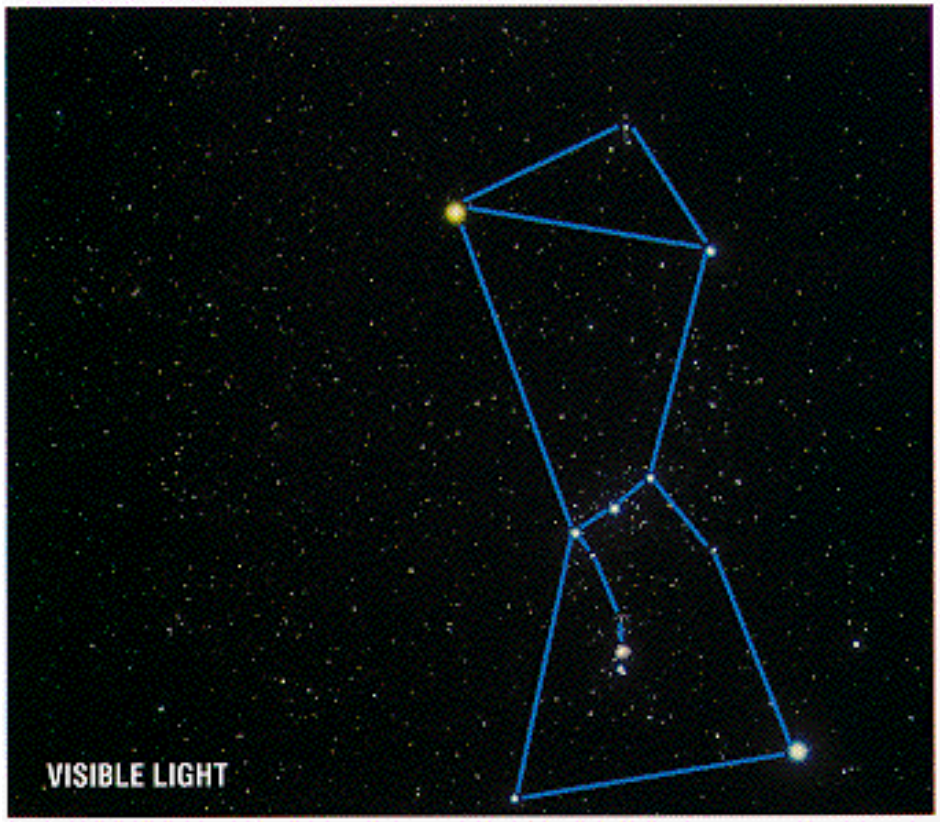
- Septiembre de 1989.

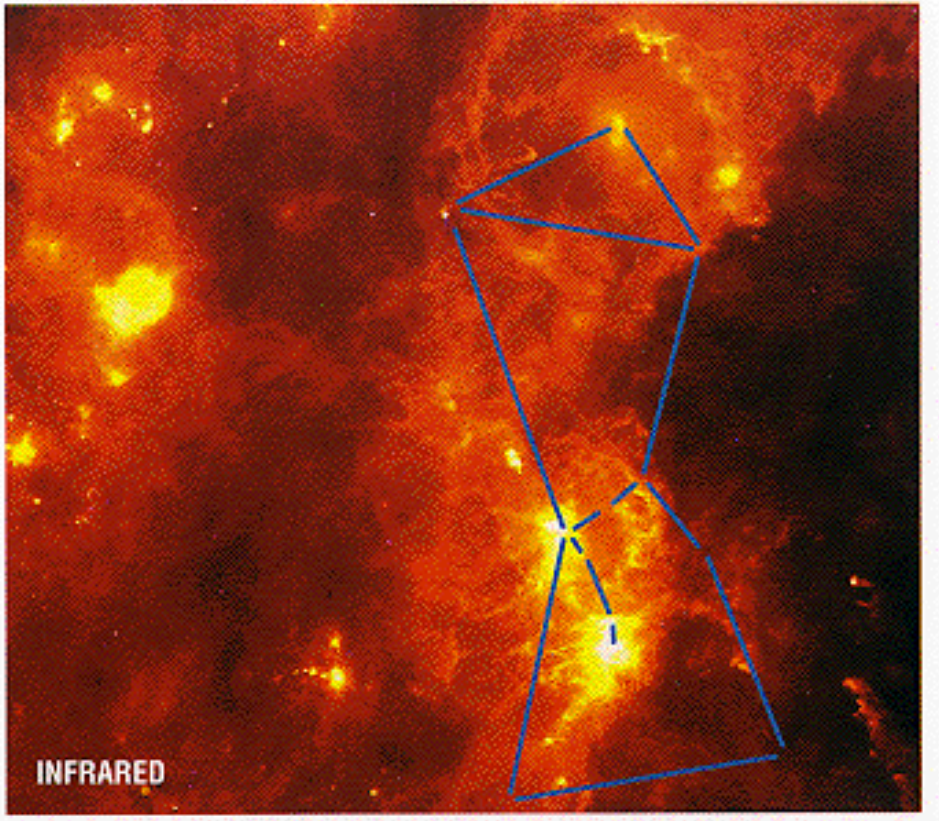
- Enlace México-USA era de 128 kbps.

¿Por qué la Astronomía necesita de Redes de Alto Desempeño?

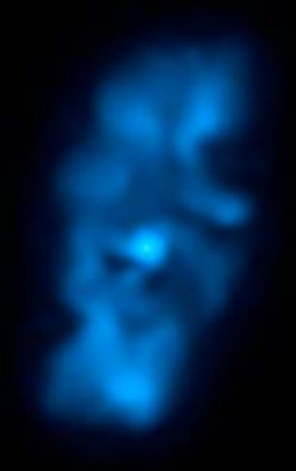
Espectro Electromagnético



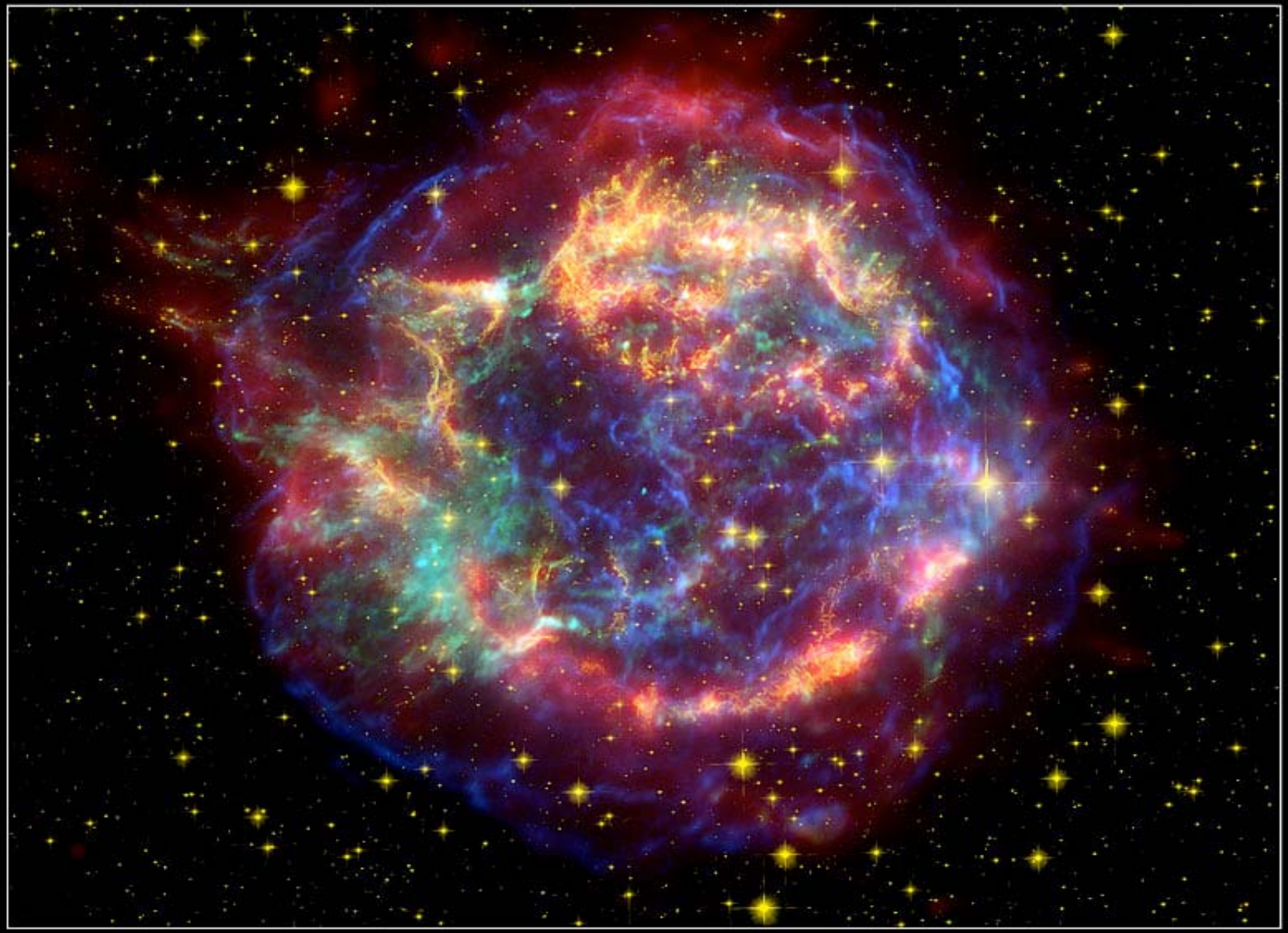

VISIBLE LIGHT


INFRARED

Chandra X-ray Image of
NGC 6534/Cat's Eye




Cats Eye Nebula
(NGC 6543)
Composite

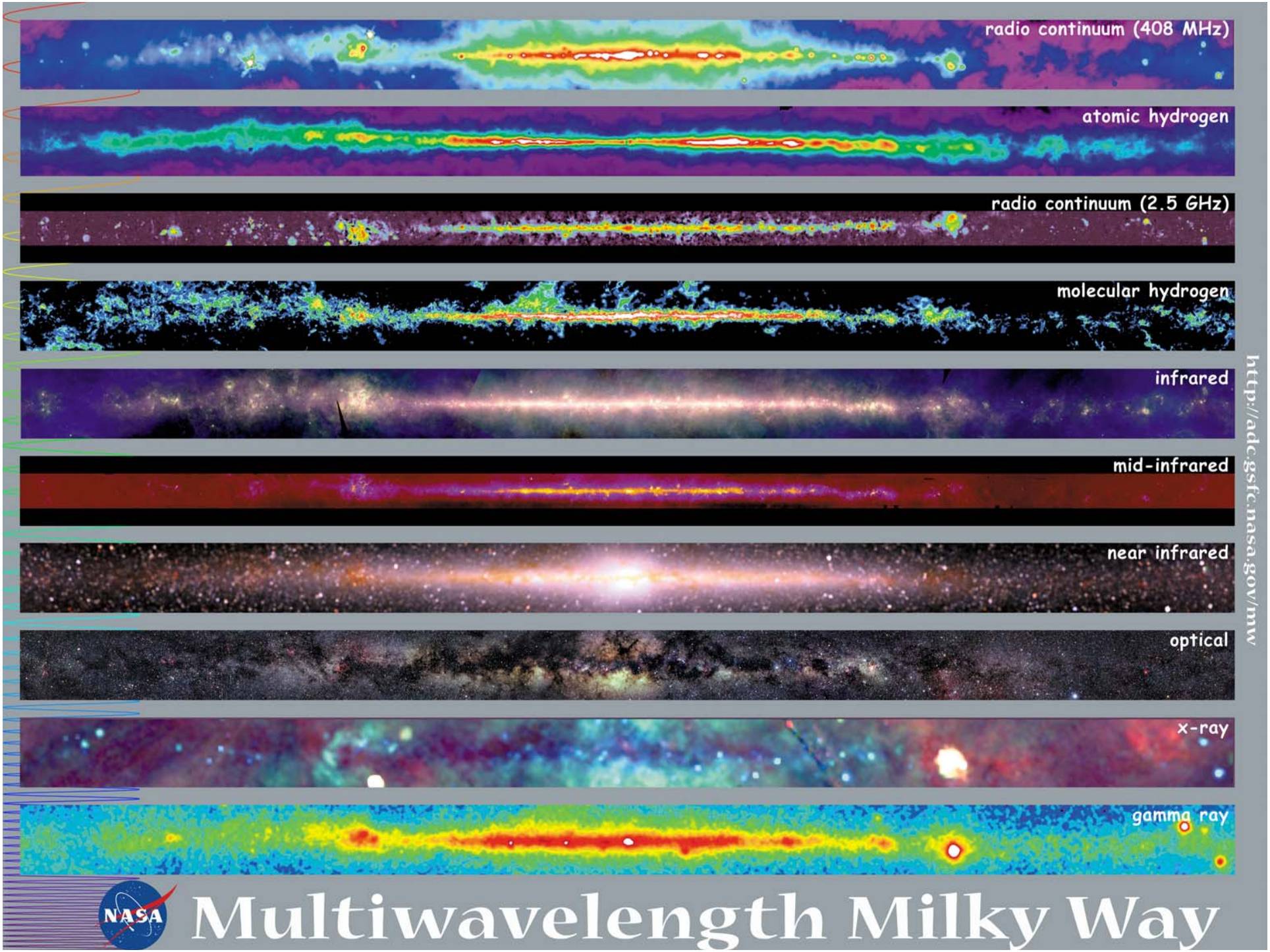


Cassiopeia A Supernova Remnant

NASA / JPL-Caltech / O. Krause (Steward Observatory)

ssc2005-14c

Spitzer Space Telescope • MIPS
Hubble Space Telescope • ACS
Chandra X-Ray Observatory


radio continuum (408 MHz)
atomic hydrogen
radio continuum (2.5 GHz)
molecular hydrogen
infrared
mid-infrared
near infrared
optical
x-ray
gamma ray
NASA
Multiwavelength Milky Way
http://adc.gsfc.nasa.gov/mw

The World's Largest Optical Telescopes

Operational

Aperture (meters)	Name	Location	Latitude; Longitude Altitude	Comments
10.4	Gran Telescopio Canarias	La Palma, Canary Islands, Spain	28 46 N; 17 53 W 2400 m	Observatorio del Roque de los Muchachos; segmented mirror based on Keck
10.0	Keck	Mauna Kea, Hawaii	19 50 N; 155 28 W 4123 m	each mirror composed of 36 segments operated separately or in tandem as the Keck Interferometer
	Keck II			
~10	SALT	South African Astronomical Observatory	32 23 S; 20 49 E; 1759 m	based on the HET design
9.2	Hobby-Eberly	Mt. Fowlkes, Texas	30 40 N; 104 1 W 2072 m	very inexpensive: spherical segmented mirror; fixed elevation; spectroscopy only
8.4	Large Binocular Telescope	Mt. Graham, Arizona	32 42 N; 109 53 W 3170 m	a pair of 8.4-m mirrors on one mount giving the light gathering of an 11.8m and eventually the resolution of a 23-m
8.3	Subaru	Mauna Kea, Hawaii	19 50 N; 155 28 W 4100 m	NAOJ
8.2	Antu	Cerro Paranal, Chile	24 38 S; 70 24 W 2635m	operated separately or as units of the VLT Interferometer
	Kueyen			
	Melipal			
	Yepun			
8.1	Gillett	Mauna Kea, Hawaii	1950 N; 155 28 W 4100 m	aka Gemini North
	Gemini South	Cerro Pachon, Chile	30 20 S;70 59 W (approx) 2737 m	twin of Gemini North

6.5	MMT	Mt. Hopkins, Arizona	31 41 N; 110 53 W 2600 m	
	Walter Baade	La Serena, Chile	29 00.2 S; 4 42 48 W 2282 m	aka Magellan I; Las Campanas Obs.
	Landon Clay			aka Magellan II
6.0	Bolshoi Teleskop Azimutalnyi	Nizhny Arkhyz, Russia	43 39 N; 41 26 E 2070m	Large Altazimuth Telescope
	LZT	British Columbia, Canada	49.28 N; 122.57 W 395m	Liquid mirror, points only at the zenith; UBC
5.0	Hale	Palomar Mountain, California	33 21 N; 116 52 W 1900 m	
4.2	William Herschel	La Palma, Canary Islands, Spain	28 46 N; 17 53 W 2400 m	Observatorio del Roque de los Muchachos
	SOAR	Cerro Pachon, Chile	70 44 W; 30 14 S 2738 m	Brazil/USA; CTIO
	LAMOST	Xinglong Station, China	105 50 E ? , 40 23 N 950 m	Beijing Astronomical Observatory; wide field spectroscopy
4.0	Victor Blanco	Cerro Tololo, Chile	30 10 S;70 49 W 2200 m	CTIO
3.9	Anglo-Australian	Coonabarabran, NSW, Australia	31 17 S;149 04 E	Siding Spring Obs.
3.8	Mayall	Kitt Peak, Arizona	31 57 N; 111 37 W 2100 m	NOAO
	UKIRT	Mauna Kea, Hawaii	19 50 N; 155 28 W 4200 m	dedicated to infrared
3.7	AEOS	Maui, Hawaii	20 42 30 N; 156 15 29 W 3058 m	mostly military
3.6	"360"	Cerro La Silla, Chile	29 15 S; 70 44 W 2400 m	European Southern Obs.
	Canada-France-Hawaii	Mauna Kea, Hawaii	19 50 N; 155 28 W 4200 m	
	Telescopio Nazionale Galileo	La Palma, Canary Islands, Spain	28 45 N; 17 53 W 2387 m	Italian

3.5	MPI-CAHA	Calar Alto, Spain	37 13 N; 2 33 W 2200 m	
	New Technology	Cerro La Silla, Chile	29 15 S; 70 44 W 2400 m	European Southern Obs.
	ARC	Apache Point, New Mexico	32 47 N; 105 49 W 2788 m	mostly remote controlled
	WIYN	Kitt Peak, Arizona	31 57 N; 111 37 W 2100 m	Wisconsin, Indiana, Yale, NOAO
	Starfire	Kirtland AFB, New Mexico	1900 m	military
3.0	Shane	Mount Hamilton, California	37 21 N; 121 38 W 1300 m	Lick Observatory
	NASA IRTF	Mauna Kea, Hawaii	19 50 N; 155 28 W 4160 m	infrared
2.7	Harlan Smith	Mt. Locke, Texas	30 40 N; 104 1 W 2100 m	McDonald Obs.; see also
2.6	BAO	Byurakan, Armenia	40 20N; 44 17 E 1405 m	Byurakan Astrophysical Observatory
	Shajn	Crimea, Ukraine	44 44 N; 34 E 600 m	Crimean Astrophysical Observatory
2.5	Hooker	Mt. Wilson, California	34 13N; 118 4 W 1700 m	built in 1917
	Isaac Newton	La Palma, Canary Islands, Spain	28 45 N; 17 53 W 2382 m	Observatorio del Roque de los Muchachos
	Nordic Optical			
	du Pont	La Serena, Chile	29 00.2 S; 4 42 48 W 2282 m	Las Campanas Obs.
	Sloan Digital Sky Survey	Apache Point, New Mexico	32 47 N; 105 49 W 2788 m	huge wide-field detector
2.45	CHARA	Mt. Wilson, California	34 13N; 118 4 W 1700 m	interferometer using 6 1-m scopes
2.4	Hiltner	Kitt Peak, Arizona	31 57 N; 111 37 W 2100 m	MDM Observatory
	Lijiang	Lijiang City, China	26 52 N; 100 14 E 3250 m	Yunnan Observatory (near Dayan)

2.3	WIRO	Jelm Mtn., Wyoming	41 03 N; 106 00 W 2900 m	infrared
	ANU	Coonabarabran, NSW, Australia	31 17 S;149 04 E	Siding Spring Obs.
	Bok	Kitt Peak, Arizona	31 57 N; 111 37 W 2100 m	Steward Obs.
	Vainu Bappu	Kavalur, India	12 34 N; 78 50 E 700 m	Indian Institude of Astrophysics
2.2	ESO-MPI	Cerro La Silla, Chile	29 15 S; 70 44 W 2335 m	
	MPI-CAHA	Calar Alto, Spain	37 13 N; 2 33 W 2200 m	
	UH	Mauna Kea, Hawaii	19 50 N; 155 28 W 4200 m	

Also

2.1 Kitt Peak
2.1 McDonald (Struve)
2.1 INAOE, Puebla, Mexico
2.1 UNAM, San Pedro Martir, Mexico
2.1 El Leoncito, Argentina
2.0 Ondrejov, Czech Republic
2.0 Tusi Astronomical Obs., Shemakha, Azerbaijan
2.0 Hanle, India (a few hundred meters higher than Mauna Kea)
2.0 (Schmidt) Tautenburg Germany
2.0 Ukrainian Academy of Sciences, Terskel, Caucasus
2.0 MAGNUM (Haleakala, may still be in progress)
2.0 Lyot, Pic-du-Midi, France
2.0 Faulkes Telescope North
2.0 Faulkes Telescope South

Under Construction

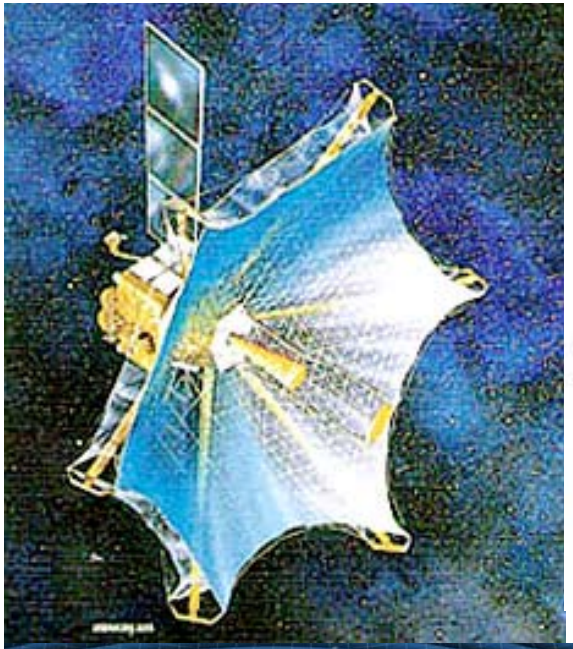
Aperture	Name	Location	Comments
21.4 (7x8.4)	Giant Magellan Telescope	Las Campanas, Chile	six off-axis segments plus one central segment form one optical surface
8	LSST	Cerro Pachon, Chile	aka Dark Matter Telescope; a fast wide field survey scope
4.2	DCT	Happy Jack, Arizona	Lowell Observatory wide field telescope
4	Vista	Cerro Paranal, Chile	wide field survey scope
2.5	SOFIA	stratosphere	airborne infrared
	VST	Cerro Paranal, Chile	wide field survey scope
2.4	Automated Planet Finder Telescope	Mount Hamilton, California	Lick Observatory
2.3	Aristarchos	Mt. Helmos, Greece	National Observatory of Athens
4x1.8	Pan-STARRS	Hawaii	Four separate telescopes; optimized for surveys; cheaper than LSST; PS1 first light was Aug 2007
2.4+10x1.4	Magdalena Ridge Observatory	Socorro, New Mexico	one single scope plus 10 mirror interferometer

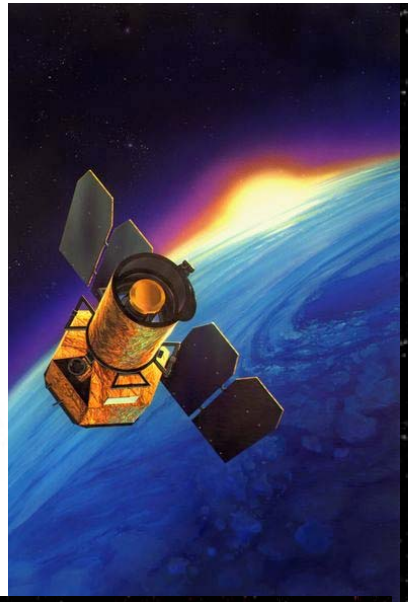
Extremely Large Telescope Studies

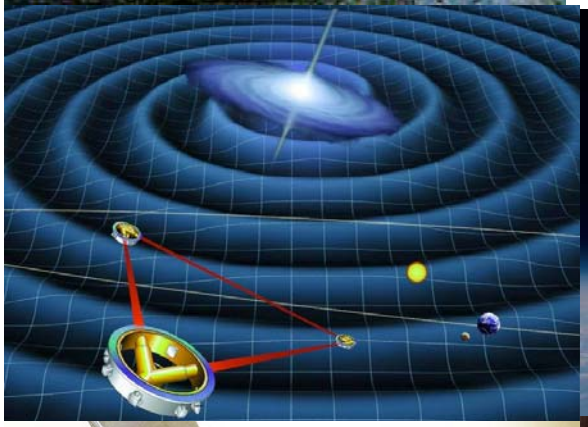
Aperture	Name	Comments
100	OWL	**O**ver**W**helmingly **L**arge Telescope
50	Euro50	
42	E-ELT	European Extremely Large Telescope
30-50	MaxAT	
~40	LAMA	array of liquid mirrors
30	TMT	Thirty Meter Telescope (was CELT, VLOT, GSMT)
Others		

Other interesting projects

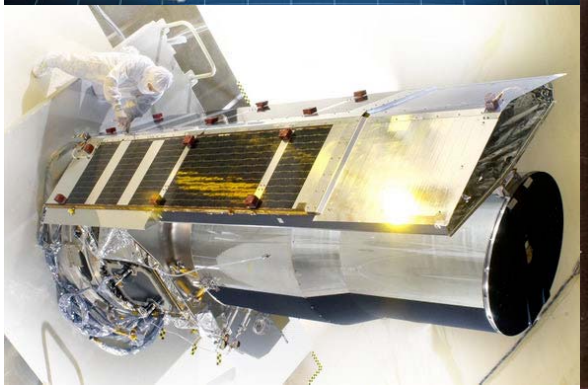
Aperture	Name	Location	Comments
42	LAMA	Chile	liquid mirror array
25	Cornell Atacama Telescope	Atacama, Chile	optimized for far IR, next to ALMA
6.5	JWST	L2 Halo orbit	aka NGST; cost reduced from initial 8m plans
4	ATST	Haleakala, Hawaii	Advanced Technology Solar Telescope
2.5	The MLO 100 inch	Mt. Laguna, CA	
2.0	Indian Astronomical Observatory	Hanle, India	4500m altitude
1.86	Dominion Astrophysical Observatory	Victoria, Canada	was once (briefly) the largest telescope in the world
1.8	The Leviathan of Parsonstown	Birr, Ireland	Lord Rosse's famous scope restored
1.5	Hexapod Telescope	La Silla	unique mount utilizing 6 hydraulic "legs"
1.2	Samuel Oschin Telescope	Palomar Mountain, California	found the "tenth planet"
1	Yerkes Observatory	Williams Bay, Wisconsin	world's largest refractor

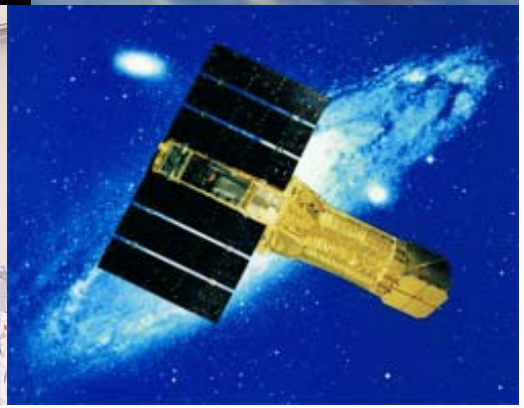










Gamma Ray Telescopes

Name	Space Agency	Launch Date	Terminated	Location
3rd High Energy Astronomy Observatory (HEAO 3)	NASA	20 September 1979	29 May 1981	Earth orbit (486.4–504.9 km)
Astrorivelatore Gamma ad Immagini LEggero (AGILE)	ISA	23 April 2007	—	Earth orbit (524–553 km)
Compton Gamma Ray Observatory (CGRO)	NASA	5 April 1991	4 June 2000	Earth orbit (362–457 km)
Cos-B	ESA	9 August 1975	25 April 1982	Earth orbit (339.6–99,876 km)
Gamma	RSA	1 July 1990	1992	Earth orbit (375 km)
Gamma-ray Large Area Space Telescope (GLAST)	NASA	11 June 2008	—	Earth orbit (555 km)
Granat	CNRS & IKI	1 December 1989	25 May 1999	Earth orbit (2,000–200,000 km)
High Energy Transient Explorer 2 (HETE 2)	NASA	9 October 2000	—	Earth orbit (590–650 km)
International Gamma Ray Astrophysics Laboratory (INTEGRAL)	ESA	17 October 2002	—	Earth orbit (639–153,000 km)
Low Energy Gamma Ray Imager (LEGRI)	INTA	19 May 1997	—	Earth orbit (600 km)
Second Small Astronomy Satellite (SAS 2)	NASA	15 November 1972	8 June 1973	Earth orbit (443–632 km)
Swift Gamma Ray Burst Explorer	NASA	20 November 2004	—	Earth orbit (585–604 km)

X-Ray Telescopes

Name	Space Agency	Launch Date	Terminated	Location
1st High Energy Astronomy Observatory (HEAO 1)	NASA	12 August 1977	9 January 1979	Earth orbit (445 km)
3rd High Energy Astronomy Observatory (HEAO 3)	NASA	20 September 1979	29 May 1981	Earth orbit (486.4–504.9 km)
A Broadband Imaging X-ray All-sky Survey (ABRIXAS)	DLR	28 April 1999	1 July 1999	Earth orbit (549–598 km)
Advanced Satellite for Cosmology and Astrophysics (ASCA)	NASA & ISAS	20 February 1993	2 March 2001	Earth orbit (523.6–615.3 km)
AGILE	ISA	23 April 2007	—	Earth orbit (524–553 km)
Ariel V	SRC & NASA	15 October 1974	14 March 1980	Earth orbit (520 km)
Array of Low Energy X-ray Imaging Sensors (Alexis)	LANL	25 April 1993	2005	Earth orbit (749–844 km)
Aryabhata	ISRO	19 April 1975	23 April 1975	Earth orbit (563–619 km)
Astron	IKI	23 March 1983	June 1989	Earth orbit (2,000—200,000 km)
Astronomical Netherlands Satellite (ANS)	SRON	30 August 1974	June 1976	Earth orbit (266–1176 km)
Astrosat	ISRO	April 2009	—	Earth orbit (650 km)
BeppoSAX	ASI	30 April 1996	30 April 2002	Earth orbit (575–594 km)
Broad Band X-ray Telescope / Astro 1	NASA	2 December 1990	11 December 1990	Earth orbit (500 km)
Chandra X-ray Observatory	NASA	23 July 1999	—	Earth orbit (9,942–140,000 km)
Constellation-X Observatory	NASA	TBA	—	—
Cos-B	ESA	9 August 1975	25 April 1982	Earth orbit (339.6–99,876 km)
Cosmic Radiation Satellite (CORSA)	ISAS	6 February 1976	6 February 1976	Failed launch
Dark Universe Observatory	NASA	TBA	—	Earth orbit (600 km)
Einstein Observatory (HEAO 2)	NASA	13 November 1978	26 April 1981	Earth orbit (465–476 km)

X-Ray Telescopes

EXOSAT	ESA	26 May 1983	8 April 1986	Earth orbit (347–191,709 km)
Ginga (Astro-C)	ISAS	5 February 1987	1 November 1991	Earth orbit (517–708 km)
Granat	CNRS & IKI	1 December 1989	25 May 1999	Earth orbit (2,000–200,000 km)
Hakucho	ISAS	21 February 1979	16 April 1985	Earth orbit (421–433 km)
High Energy Transient Explorer 2 (HETE 2)	NASA	9 October 2000	—	Earth orbit (590–650 km)
International Gamma Ray Astrophysics Laboratory (INTEGRAL)	ESA	17 October 2002	—	Earth orbit (639–153,000 km)
Nuclear Spectroscopic Telescope Array (NuSTAR)	NASA	August 2010	—	Earth orbit (525 km)
ROSAT	NASA & DLR	1 June 1990	12 February 1999	Earth orbit (580 km)
Rossi X-ray Timing Explorer	NASA	30 December 1995	—	Earth orbit (409 km)
Spectrum-X-Gamma	IKI & NASA	2010	—	—
Suzaku (ASTRO-E2)	JAXA & NASA	10 July 2005	—	Earth orbit (550 km)
Swift Gamma Ray Burst Explorer	NASA	20 November 2004	—	Earth orbit (585–604 km)
Tenma	ISAS	20 February 1983	19 January 1989	Earth orbit (489–503 km)
Third Small Astronomy Satellite (SAS-C)	NASA	7 May 1975	April 1979	Earth orbit (509–516 km)
Uhuru	NASA	12 December 1970	March 1973	Earth orbit (531–572 km)
X-Ray Evolving Universe Spectroscopy Mission (XEUS)	ESA	2018	—	—
XMM-Newton	ESA	10 December 1999	—	Earth orbit (7,365–114,000 km)

Ultraviolet Telescopes

Name	Space Agency	Launch Date	Terminated	Location
Astro 2	NASA	2 March 1993	18 March 1993	Earth orbit (349–363 km)
Astron	IKI	23 March 1983	June 1989	Earth orbit (2,000–200,000 km)
Astronomical Netherlands Satellite (ANS)	SRON	30 August 1974	June 1976	Earth orbit (266–1176 km)
Astrosat	ISRO	April 2009	—	Earth orbit (650 km)
Broad Band X-ray Telescope / Astro 1	NASA	2 December 1990	11 December 1990	Earth orbit (500 km)
Copernicus Observatory	NASA	21 August 1972	1980	Earth orbit (713–724 km)
Cosmic Hot Interstellar Spectrometer (CHIPS)	NASA	13 January 2003	—	Earth orbit (578–594 km)
Extreme Ultraviolet Explorer (EUVE)	NASA	7 June 1992	30 January 2002	Earth orbit (515–527 km)
Far Ultraviolet Spectroscopic Explorer (FUSE)	NASA & CNES & CSA	24 June 1999	12 July 2007	Earth orbit (752–767 km)
Galaxy Evolution Explorer (GALEX)	NASA	28 April 2003	—	Earth orbit (691–697 km)
Hubble Space Telescope	NASA	24 April 1990	—	Earth orbit (586.47–610.44 km)
International Ultraviolet Explorer (IUE)	ESA & NASA & SERC	26 January 1978	30 September 1996	Earth orbit (32,050–52,254 km)
Korea Advanced Institute of Science and Technology Satellite 4 (Kaistsat 4)	KARI	27 September 2003	—	Earth orbit (675–695 km)
OAO-2	NASA	7 December 1968	January 1973	Earth orbit (749–758 km)
Swift Gamma Ray Burst Explorer	NASA	20 November 2004	—	Earth orbit (585–604 km)
Tel Aviv University Ultraviolet Explorer (TAUVEX)	Israeli Space Agency	2008	—	—

Visible Telescopes

Name	Space Agency	Launch Date	Terminated	Location
COROT	CNES & ESA	27 December 2006	—	Earth orbit (872–884 km)
Dark Energy Space Telescope	NASA & DOE	TBA	—	—
Gaia mission	ESA	2011	—	Lagrangian 2 point
Hipparcos	ESA	8 August 1989	March 1993	Earth orbit (223–35,632 km)
Hubble Space Telescope	NASA	24 April 1990	—	Earth orbit (586.47–610.44 km)
Kepler Mission	NASA	February 2009	—	—
MOST	CSA	30 June 2003	—	Earth orbit (819–832 km)
Space Interferometry Mission	NASA	2009	—	—
Swift Gamma Ray Burst Explorer	NASA	20 November 2004	—	Earth orbit (585–604 km)
Terrestrial Planet Finder	NASA	TBA	—	—

Infrared Telescopes

Name	Space Agency	Launch Date	Terminated	Location
AKARI	JAXA	February 21, 2006	—	Earth orbit (586.47–610.44 km)
Darwin Mission	ESA	2015	—	Lagrangian 2 point
Herschel Space Observatory	ESA & NASA	31 October 2008	—	Lagrangian 2 point
IRAS	NASA	25 January 1983	21 November 1983	Earth orbit (889–903 km)
Infrared Space Observatory (ISO)	ESA	17 November 1995	16 May 1998	Earth orbit (1000–70500 km)
Infrared Telescope in Space	ISAS & NASDA	18 March 1995	25 April 1995	Earth orbit (486 km)
James Webb Space Telescope	NASA	2013	—	—
Midcourse Space Experiment (MSX)	USN	24 April 1996	26 February 1997	Earth orbit (900 km)
Spitzer Space Telescope	NASA	25 August 2003	—	Solar orbit (0.98–1.02 AU)
Submillimeter Wave Astronomy Satellite (SWAS)	NASA	6 December 1998	—	Earth orbit (638–651 km)
Terrestrial Planet Finder	NASA	TBA	—	—
Wide-field Infrared Explorer (WIRE)	NASA	5 March 1999	—	—
Wide-field Infrared Survey Explorer (WISE)	NASA	2009	—	Earth orbit (500 km)

Microwave Telescopes

Name	Space Agency	Launch Date	Terminated	Location
Cosmic Background Explorer (COBE)	NASA	18 November 1989	23 December 1993	Earth orbit (900 km)
Odin	Swedish Space Corporation	20 February 2001	—	Earth orbit (622 km)
Planck satellite	ESA	31 October 2008	—	Lagrangian 2 point

Radio Telescopes

Name	Space Agency	Launch Date	Terminated	Location
Highly Advanced Laboratory for Communications and Astronomy (HALCA, or VSOP)	ISAS	12 February 1997	30 November 2005	Earth orbit (560–21,400 km)
RadioAstron	IKI	October 2008	—	Earth orbit (10,000–390,000 km)
VSOP-2	JAXA	2012	—	—

Particle detection

Name	Space Agency	Launch Date	Terminated	Location
3rd High Energy Astrophysics Observatory (HEAO 3)	NASA	20 September 1979	29 May 1981	Earth orbit (486.4–504.9 km)
Astromag Free-Flyer	NASA	1 January 2005	—	Earth orbit (500 km)
Payload for Antimatter Matter Exploration and Light-nuclei Astrophysics (PAMELA)	ISA, INFN, RSA, DLR & SNSB	15 May 2006	—	Earth orbit (350–610 km)

Gravitational Waves

Name	Space Agency	Launch Date	Terminated	Location
Laser Interferometer Space Antenna	NASA	2018	—	Solar orbit (approx. 1 AU; trailing Earth)

- En 2005 se producían 1TB/día
- Crecimiento de datos observacionales y teóricos cumplen con la Ley de Moore
- Conocimiento NO cumple la Ley de Moore; los salarios MENOS; el desempleo posiblemente si...

PROYECTOS ASTRONÓMICOS QUE NECESITAN ANCHOS DE BANDA

- Observación remota
- Gran Telescopio Milimétrico
- HAWC (1.5 MB/s, 130 GB/day, 50TB/yr)
- Educación
- Observatorios virtuales (MVSO, VESO, MTVO, MVO, ...

HAWC

High Altitude Water Cerenkov

- Observatorio de rayos gamma de alta energía con gran apertura
- Detector de agua de 150m × 150m por encima de 4000m de altura
- Proyecto US-MX a instalarse en Sierra Negra.

México tiene excelentes proyectos científicos

lo que **NO** tiene es

ANCHO DE BANDA PARA REALIZARLOS

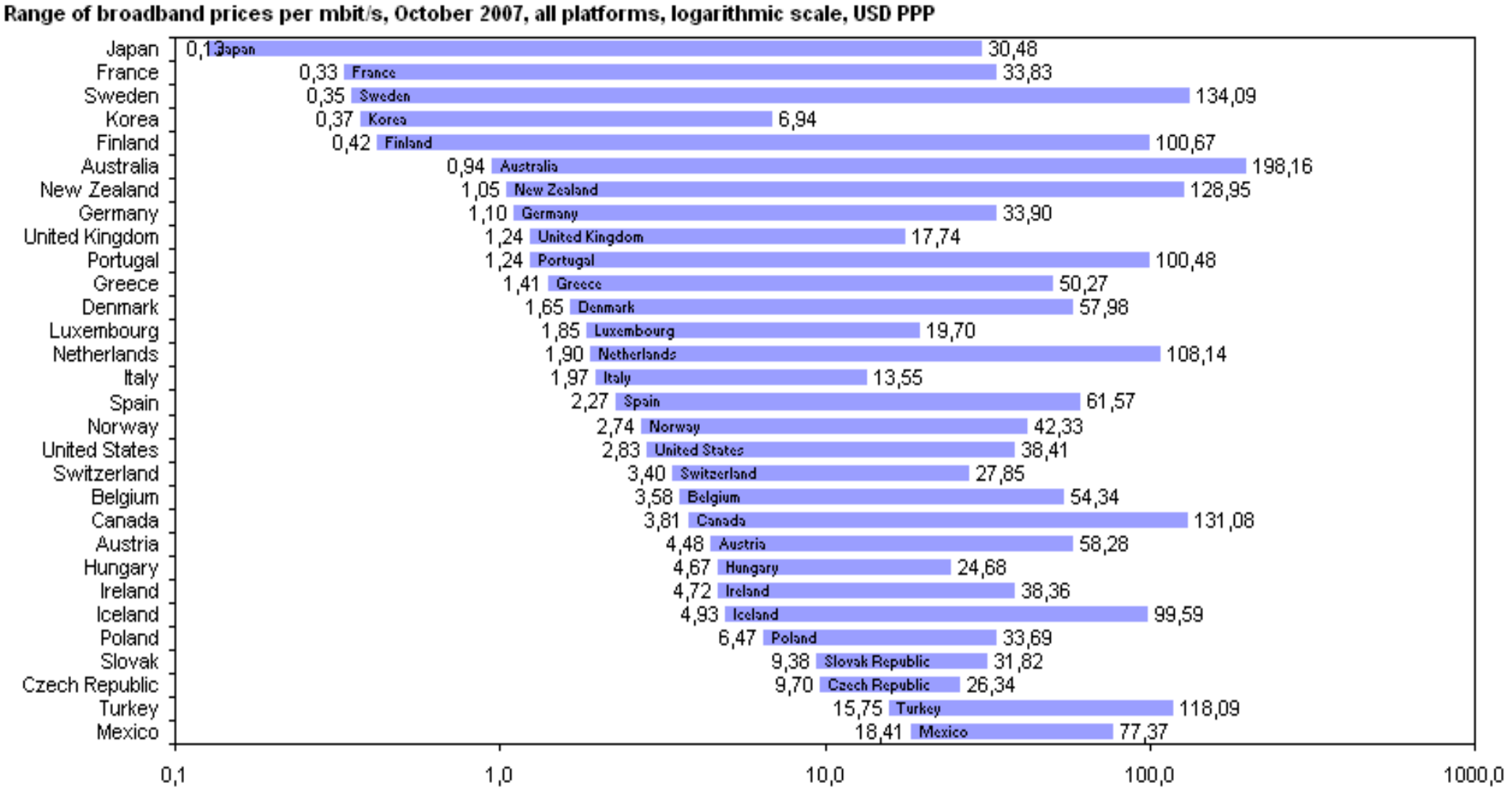
México tiene los precios de banda ancha más altos: OCDE

Quedan en desventaja firmas del país *(no solo las empresas los proyectos científicos también)*
Hugo Sandoval
El Universal, Martes 27 de mayo de 2008.

Un problema real: México ocupa el último lugar de los países que integran la Organización para la Cooperación y Desarrollo Económicos en cuanto a precios bajos de banda ancha.

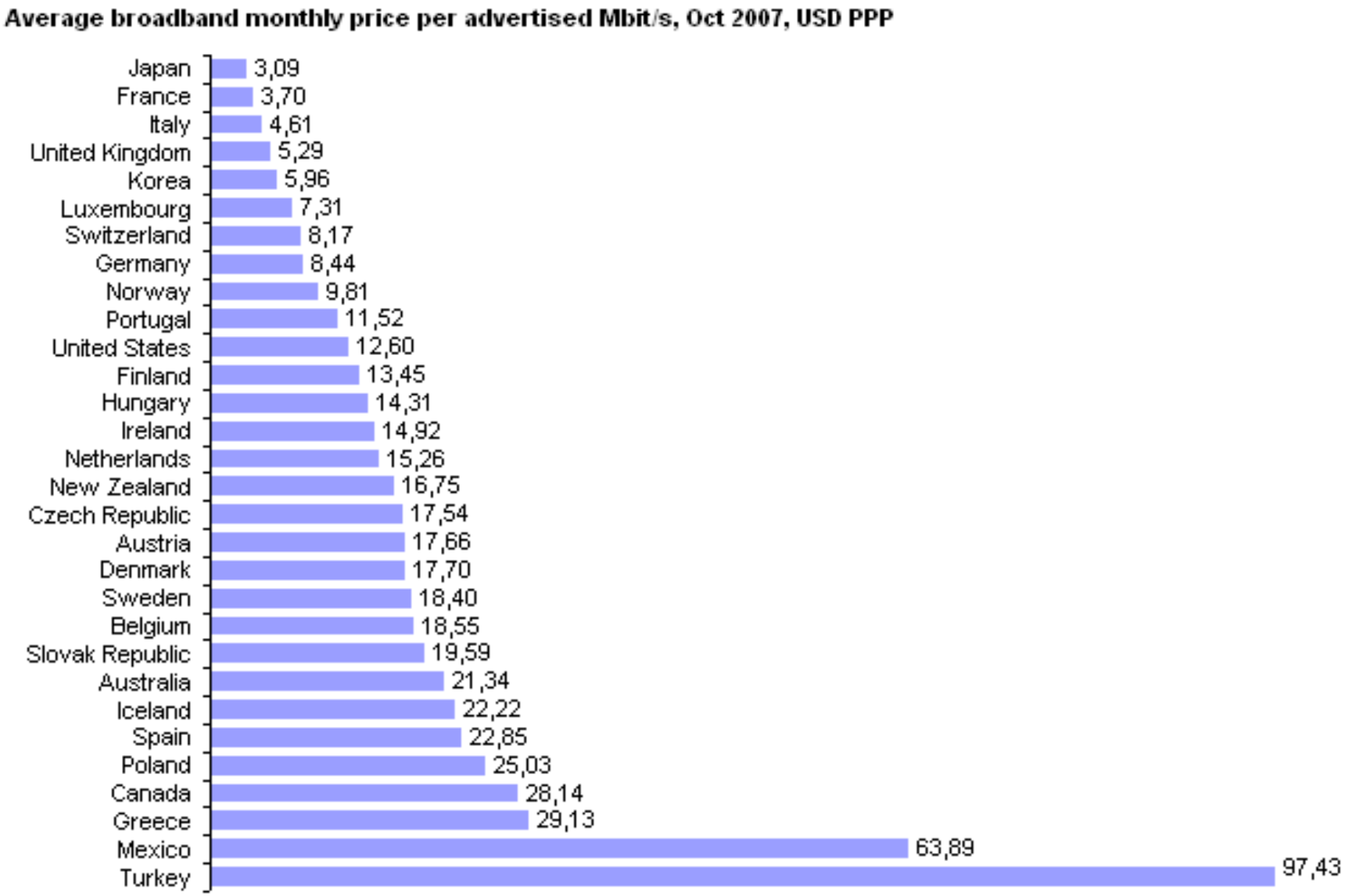
Algunos números así lo ilustran. Mientras que en Japón el precio promedio del megabit/segundo es de apenas 0.13 dólares estadounidenses, en México alcanza 18.41 dólares, de acuerdo con los datos en línea más recientes publicados por la OCDE.

http://www.eluniversal.com.mx/finanzas/64529.html



Directorate for Science, Technology and Industry

OECD Broadband statistics [oecd.org/sti/ict/broadband]



Directorate for Science, Technology and Industry

OECD Broadband statistics [oecd.org/sti/ict/broadband]

¡Muchas Gracias!