CASTOR'S "SPUTNIK 50TH ANNIVERSARY SATELLITE TRACKING BONANZA"

1957

2007

MICHAEL A. EARL

CANADIAN SATELLITE TRACKING & ORBIT RESEARCH

Russians Win Race To Launch Earth Satellite

Man On Threshold Of Space Travel

By DANIEL F. GILMORE
United Press Staff Correspondent

LONDON (UP)—The pulsating radio "beep" of the first manmade earth satellite signalled today to the world that man had crossed the threshold into the age of travel through space.

The Soviet Union announced it had won the race into space by launching an earth satellite Friday, a 184-pound, 22-inch globe now orbiting the earth at 18,000 miles an hour, 560 miles up.

Millions of persons throughout the world heard the "beep...beep...beep..." rebroadcast today by local stations and realized that man had taken his first faltering steps into the new era.

Launching of the satellite was a tremendous victory for science. It was a more tremendous victory for Soviet propaganda to be able to trumpet to the world the Russians were the first to break through the frontiers of space.

Bolsters ICBM Claims

— WEATHER —

WEST VIRGINIA—Partly cloudy with highest in the 60s today and Sunday. Lowest tonight 38 west and 40 east portions.

VIRGINIA—Fair with lowest 48 to 50 west and north and 50 to 55 southeast portions tonight. Sunday mostly sunny and a little warmer. Tides on the coast and lower bay will run a foot or two above normal.

How To Spot Satellite

By UNITED PRESS

Here's how to look for the Russian earth satellite which will be whizzing through the sky at 18,000 miles an hour.

The best time to spot it is at dawn or dusk when the sky is semi-dark. There is a chance that it could be seen if it travels across the face of the moon at night.

The best instruments to use are ordinary binoculars or telescopes. Powerful telescopes won't pick it up because of their narrow fields.

Through optical instruments, the satellite will look like the faintest star which can be seen with the naked eye.

Keep a sharp eye out. The satellite travels so fast it may appear on the horizon for only seconds and chances of spotting it have been estimated at one in a hundred.

U.S. May Spee[d] Up Satellite Program

By JOSEPH L. MYL[ER]
United Press Staff Corresp[ondent]

WASHINGTON (UP)—Am[erican] scientists, caught flatfoo[ted by] Russia's epic launching of th[e] man-made moon, indicated the United States may sp[eed] its own earth satellite progr[am].

Leaders of the U.S. satelli[te pro]gram also said that it [...] Russia rocketed its heav[y ...] pound satellite into a gird[ling] orbit with a rocket [...] to" an intercontinental [...] missile.

That could mean Rus[sia not on]ly has beaten this country [to the] frontiers of space, but also [...] has been called the "[...] weapon" for modern day [...] ICBM. This country has [...] tested a successful ICBM.

American diplomats [...]

4 OCTOBER
1957

SPUTNIK ORBITING THE EARTH

THE FIRST-EVER SOVIET
ARTIFICIAL SATELLITE OF
THE EARTH

40 KOPECS – USSR MAIL

USSR “SPUTNIK” STAMP

HOW MANY SATELLITES ARE ORBITING US TODAY?

OVER

11,000

INDIVIDUAL OBJECTS

WE DEPEND ON SATELLITES EVERY SINGLE DAY

WHAT DOES "SATELLITE TRACKING" MEAN?

Detecting and observing artificial satellite(s) for some length(s) of time;

Literally following it across the sky;

Observing the object, relocating the detector to observe it again, etc.;

Collecting data on the object as it is being detected and followed (tracking data); and

Determining an orbit for the satellite using observations in order to detect it again on a future date.

DO YOU THINK OF *THIS*
WHEN YOU THINK OF
"SATELLITE TRACKING"?

WHAT ARE THE TWO GREATEST MODERN INNOVATIONS IN ASTRONOMY?

THE GOTO TELESCOPE

THE CCD CAMERA

THE GOTO TELESCOPE AND CCD CAMERA

The Goto Telescope allows the amateur astronomer to “point and click” onto objects of choice and slew the telescope to their locations in the sky;

The Goto Telescope makes the astronomers’ lives easier by automatically knowing where the objects are located, i.e. no longer necessary to look up objects’ coordinates;

The CCD Camera is much more sensitive than photographic film and can detect faint celestial objects much more effectively. Very large apertures are not as necessary.

The CCD Camera has a linear response to light, therefore photometric measurements are much easier than with photographic film;

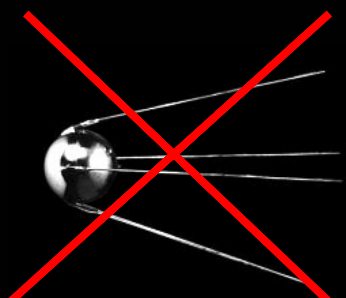
The CCD Camera produces images that are already based on a grid (pixels). It is not necessary to scan the images to produce a grid (as is required for photographic film images);

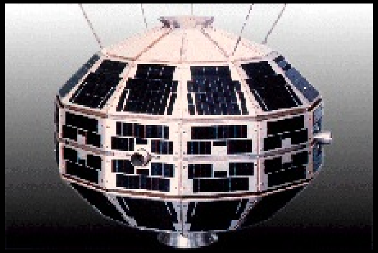
Measurements are generally much easier to conduct on CCD images than with photographic film images.

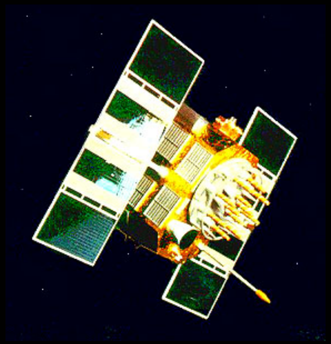
YOU MIGHT BE ASKING…

THE "SPUTNIK 50TH ANNIVERSARY SATELLITE TRACKING BONANZA"

TO OPTICALLY DETECT AND TRACK 1,957 UNIQUE ARTIFICIAL SATELLITES TO CELEBRATE SPUTNIK'S 50TH ANNIVERSARY AND 50 YEARS OF SATELLITE ACHIEVEMENT







WHY IS CASTOR DOING THIS?

TO CELEBRATE 50 YEARS OF SATELLITES AND SATELLITE TRACKING;

SATELLITE POPULATION;

TO OFFER ITS SERVICES AND DATA TO SATELLITE COMPANIES WHO WISH AN ALTERNATIVE TO HIGH-COST SATELLITE TRACKING METHODS;

TO EDUCATE THE GENERAL PUBLIC ABOUT THE VAST SATELLITE INFRASTRUCTURE ORBITING US;

TO DEMONSTRATE OUR DEPENDENCE ON SATELLITES IN JUST 50 YEARS SINCE SPUTNIK;

AND…

ITS FUN!!!!

CASTOR TRACKING EQUIPMENT

Celestron “NexStar 11 GPS” 11-Inch Aperture Schmidt-Cassegrain Telescope;

SBIG “ST-9XE” CCD Camera;

Compaq “Presario 2199C” Notebook Computer: Main Tracking Computer;

Software Bisque’s “TheSky” Astronomy Software (Satellite Orbit Propagation Tool);

Software Bisque’s “CCDSoft” Camera Control and Image Analysis Software;

The “Astro Power Cube”: Power Supply Housing Module;

Ricoh “Rikenon” 50mm SLR Camera Lens (30mm Aperture, f/4);

Hewlett-Packard “Pavillion 8750C” Personal Computer;

Celestron “NexStar 8i Special Edition” 8-inch Aperture Schmidt-Cassegrain Telescope;

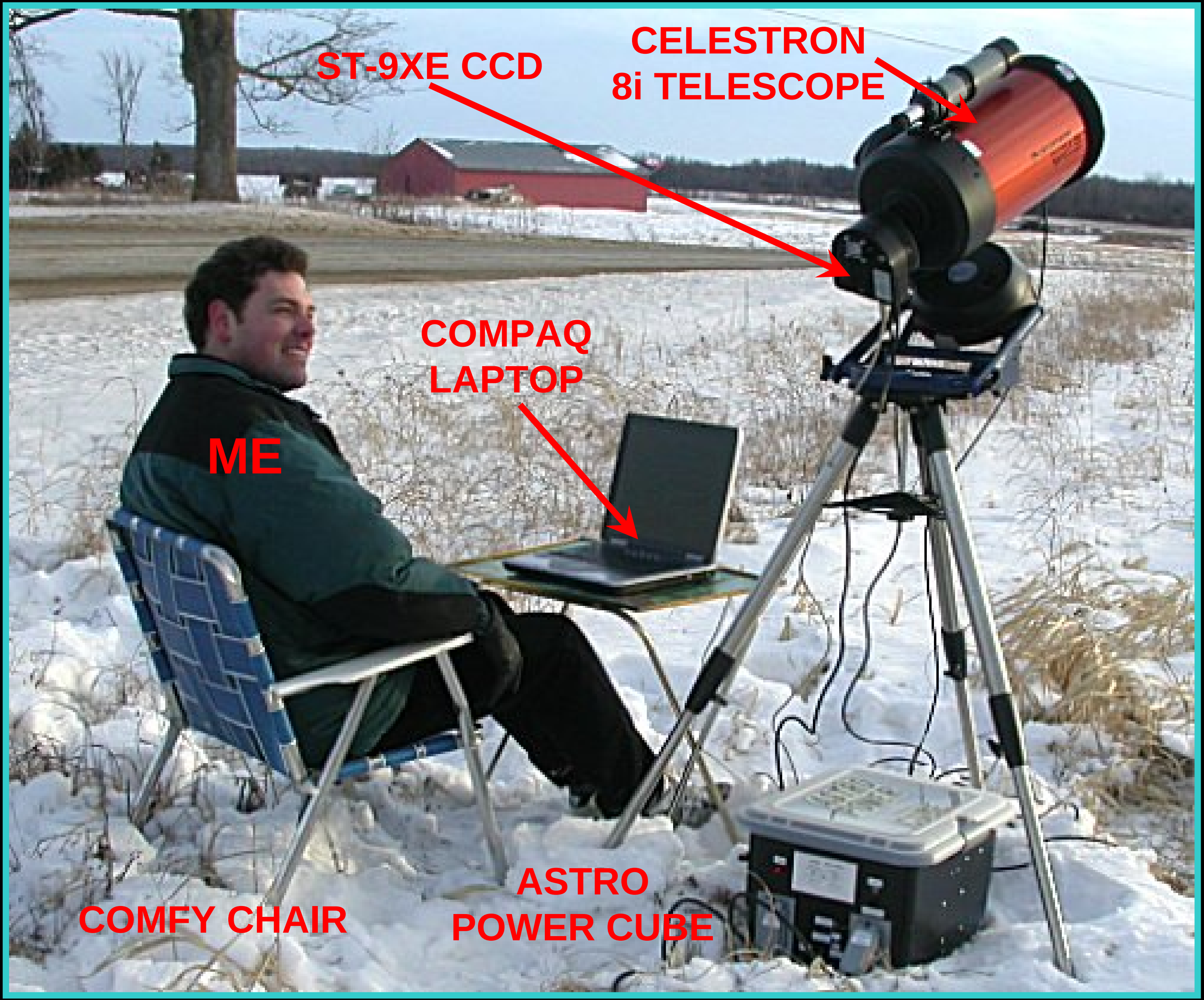
Timex “Triathlon” Stopwatch;

JVC Shortwave Radio;

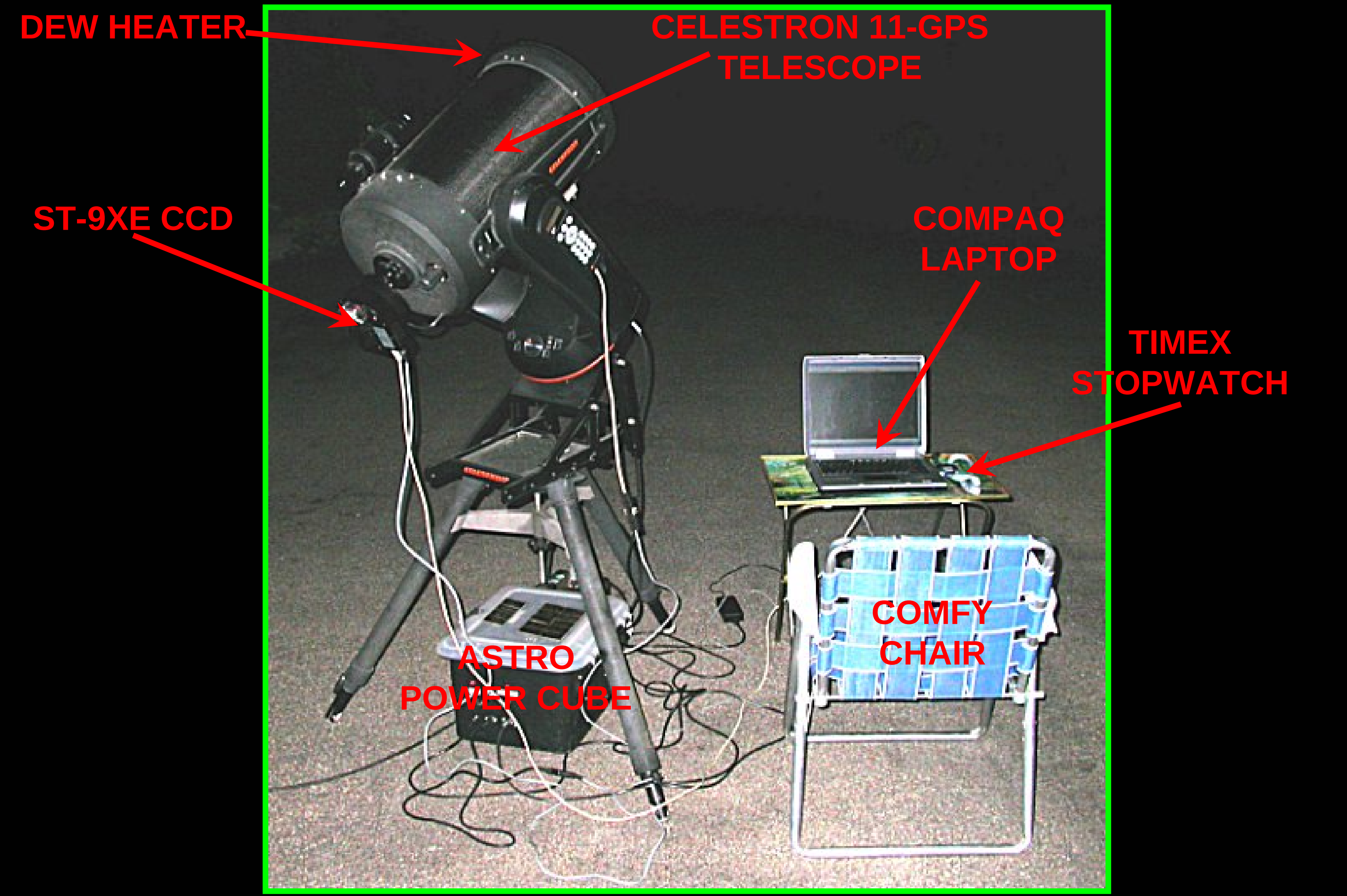
Nikon “CoolPix 4500” Digital Camera; and

AGI “Satellite Tool Kit” (STK)

THE “CASTOR WIDE FIELD” CAMERA



THE “CASTOR JUNIOR” FACILITY



THE “CASTOR” FACILITY

TRACKING LOCATIONS

Main Site: Brockville, Ontario (-75^{o} 41’ 16” +44^{o} 35’ 25”)

Secondary Site: Kemptville, Ontario (-75^{o} 38’ 53” +45^{o} 00’ 57”)

Tertiary Site: Orleans (East Ottawa), Ontario (-75^{o} 32’ 11” +45^{o} 28’ 27”)

Other Sites: Canada Science and Technology Museum, Ottawa; Mill of Kintail Conservation Area, Almonte

TONIGHT’S SITE: StarFeast; Alexandria, Ontario

-74^{o} 48’ 21” +45^{o} 14’ 01”

LOW EARTH ORBIT (LEO)

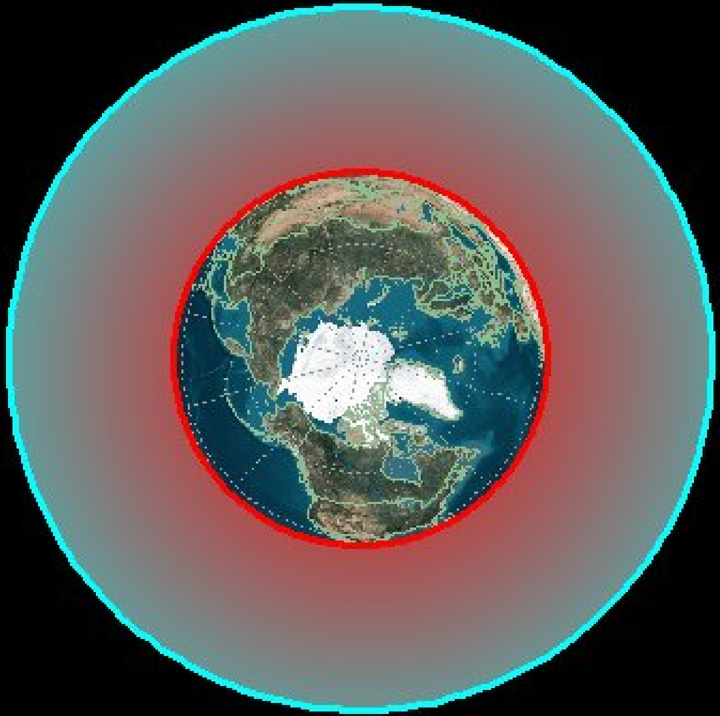
AVERAGE ORBIT ALTITUDE: 200 TO 1,000 KILOMETRES ABOVE EARTH

ORBIT PERIOD: 1.5 TO 2 HOURS

ORBITS PER DAY: 12.5 TO 16

NUMBER OF SATELLITES IN LEO ORBIT: 8,400

EXAMPLES: SPUTNIK, SPACE SHUTTLES, HUBBLE, INTERNATIONAL SPACE STATION, ALOUETTE, MOST



MID EARTH ORBIT (MEO)

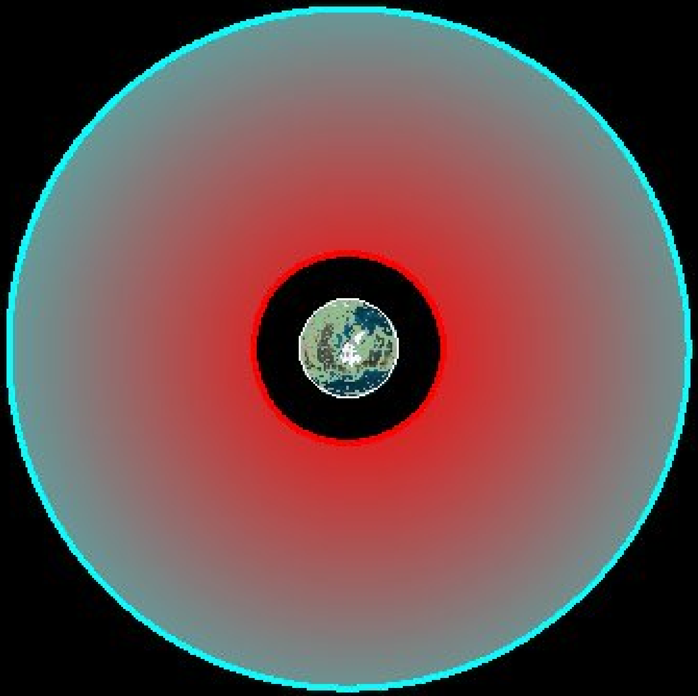
AVERAGE ORBIT ALTITUDE: 1,000 TO 35,600 KILOMETRES ABOVE EARTH

ORBIT PERIOD: 2 TO 24 HOURS

ORBITS PER DAY: 1 TO 12.5

NUMBER OF SATELLITES IN MEO ORBIT: 1,700

EXAMPLES: VANGUARD 1, 2 & 3, TELSTAR 1 & 2, MOLNIYA, GPS



GEOSYNCHRONOUS ORBIT (GEO)

AVERAGE ORBIT ALTITUDE: 35,600 KILOMETRES ABOVE EARTH

ORBIT PERIOD: 24 HOURS

ORBITS PER DAY: 1

NUMBER OF SATELLITES IN GEO ORBIT: 900

EXAMPLES: ANIK, NIMIQ, DIRECTV, GALAXY, ASIASAT, ECHOSTAR, XM, SIRIUS

HIGH EARTH ORBIT (HEO)

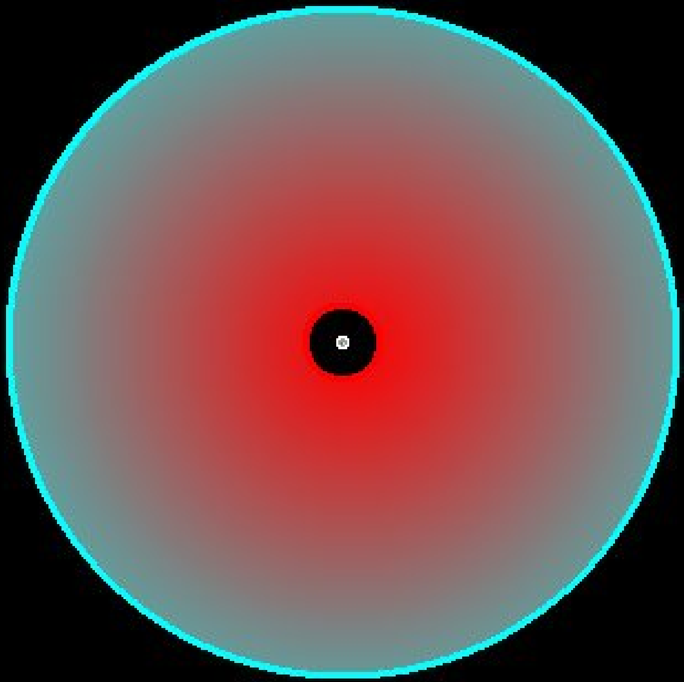
AVERAGE ORBIT ALTITUDE: 35,600 TO “INFINITE” KILOMETRES ABOVE EARTH

ORBIT PERIOD: BETWEEN 24 HOURS AND “INFINITY”

ORBITS PER DAY: BETWEEN 0 AND 1

NUMBER OF SATELLITES IN HEO ORBIT: 30

EXAMPLES: ASTRON, CHANDRA X-RAY OBSERVATORY



TARGET SATELLITES

January, February and Most of March: LEO Satellites: ISS, Space Shuttle, Weather, Remote Sensing, Debris and Rocket Bodies;

End of March, April and May: MEO Satellites: Molniya, GPS, Debris and Rocket Bodies;

June and July: GEO Satellites: Satellite TV, Weather, Debris and Rocket Bodies;

August: MEO, GEO and HEO Satellites: Molniya, GPS, MEO Debris and Rocket Bodies, GEO Rocket Bodies and Debris, Science Probes, Space Observatories, HEO Debris and Rocket Bodies;

September through December: “All of the Above” in order to reach the 1,957 satellite goal (and beyond?).

LEO ORBIT TRACKING

CASTOR Wide-Field is used.

The CCD and “Rikenon” lens is pointed at the local zenith using a bubble level.

Observing begins (and ends) when Sun is 6.5 degrees below the local horizon.

5-second exposure images are taken every 5 seconds (5 second exposure, 5 second delay, 5 second exposure, etc.).

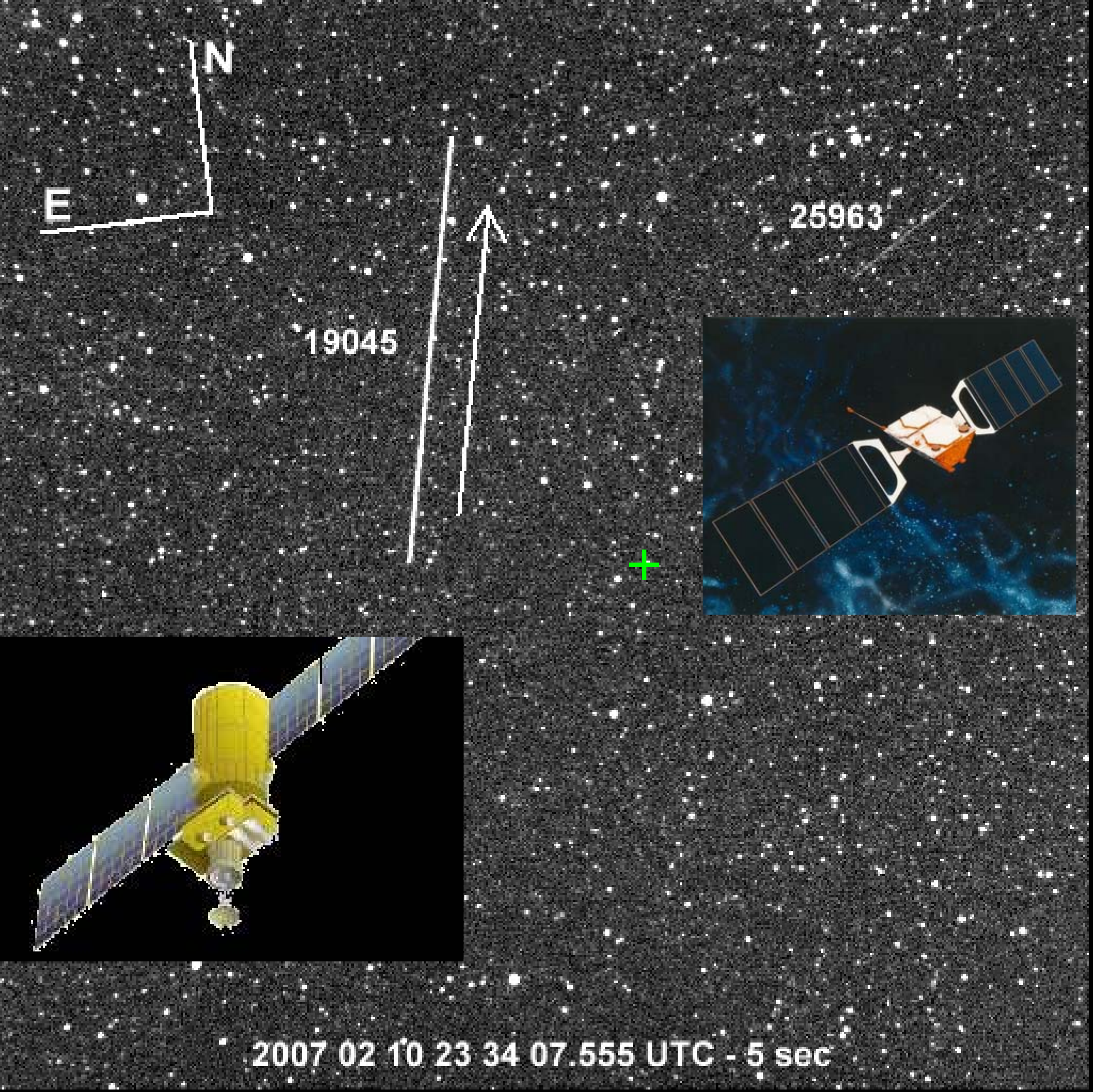
LEO satellites are observed as they “fly” through the FOV’s zenith.

Every image is automatically stored, numbered and time-tagged.

Imaging generally lasts for two hours (approximately 600 images are collected)

Images are analyzed carefully for any satellite streaks after the tracking has concluded.

Images containing streaks are separated from the raw images to be analyzed for tracking data.



COSMOS 1939

(RESURS-01)

ITNL: 1988-032A

NORAD: 19045

CASTOR: 0231

LAUNCH: APRIL 20, 1988

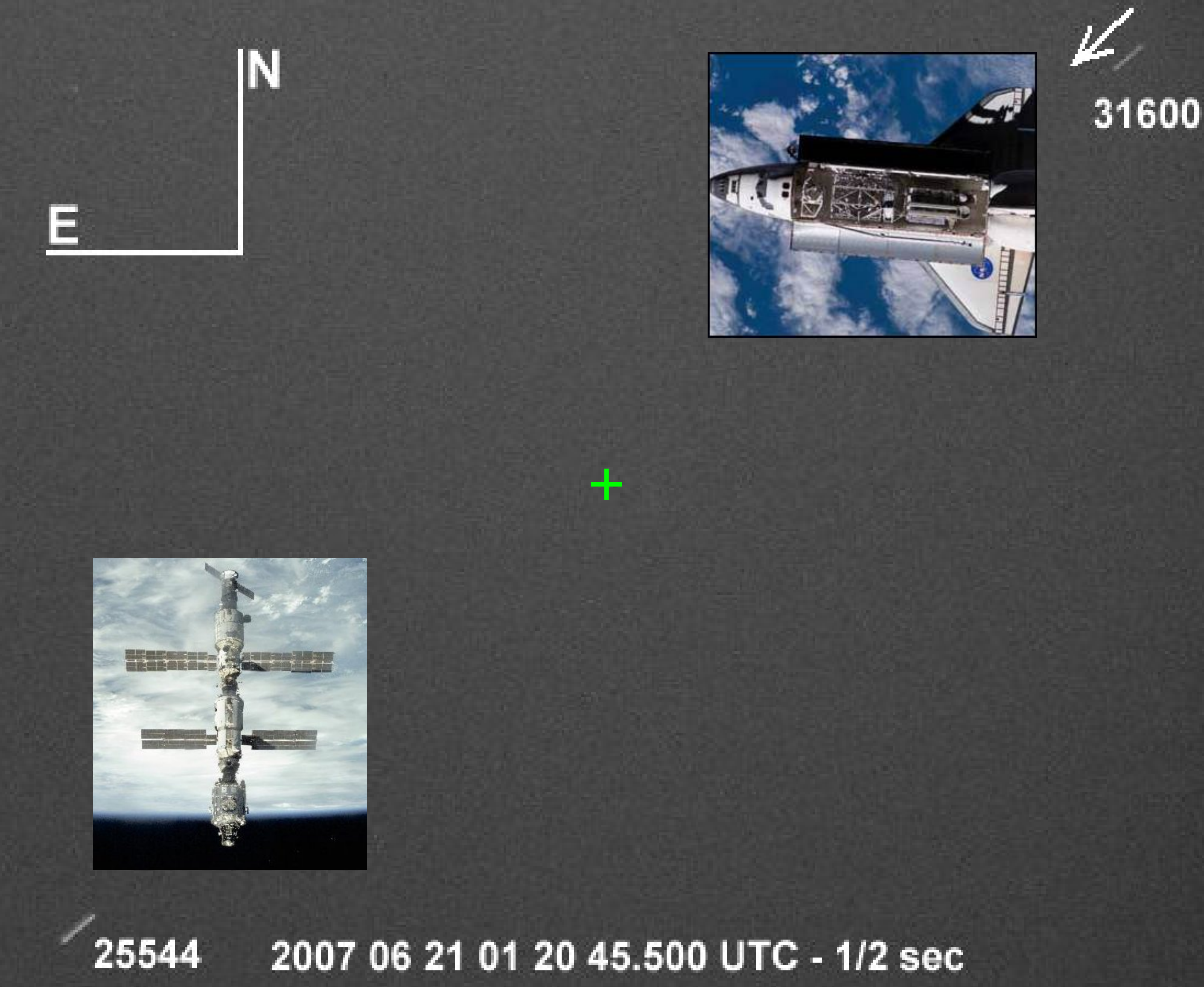
END OF LIFE: APRIL 1994

A REMOTE SENSING SATELLITE THAT MONITORED THE ENVIRONMENT

CASTOR WIDE FIELD

FOV: 11.26 DEGREES
ANG. RES.: 1.32'/pix
R.A.: $03^h\ 53^m\ 21^s.3$
Dec.: $+44^{o}\ 25'\ 49''$

THE COSMOS 1939 SATELLITE



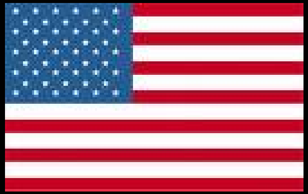
SPACE SHUTTLE ATLANTIS

(STS 117)

ITNL: 2007-024A

NORAD: 31600

CASTOR: 1020



LAUNCH: JUNE 8, 2007

LANDING: JUNE 22, 2007

SPACE STATION MAINTENANCE AND CREW REPLACEMENT

SPACE SHUTTLE ATLANTIS AND THE INTERNATIONAL SPACE STATION (ISS)

NIKON COOLPIX 4500
VERY WIDE FIELD

ZENITH POINTING

MEO ORBIT TRACKING

CASTOR Junior and CASTOR Main are used.

Tracking begins (and ends) when the Sun is 12 degrees below the local horizon.

Exposure times are set according to the satellite’s apparent angular velocity. Normally 5 to 30 second exposures are typical for these.

Every image is automatically stored, numbered and time-tagged.

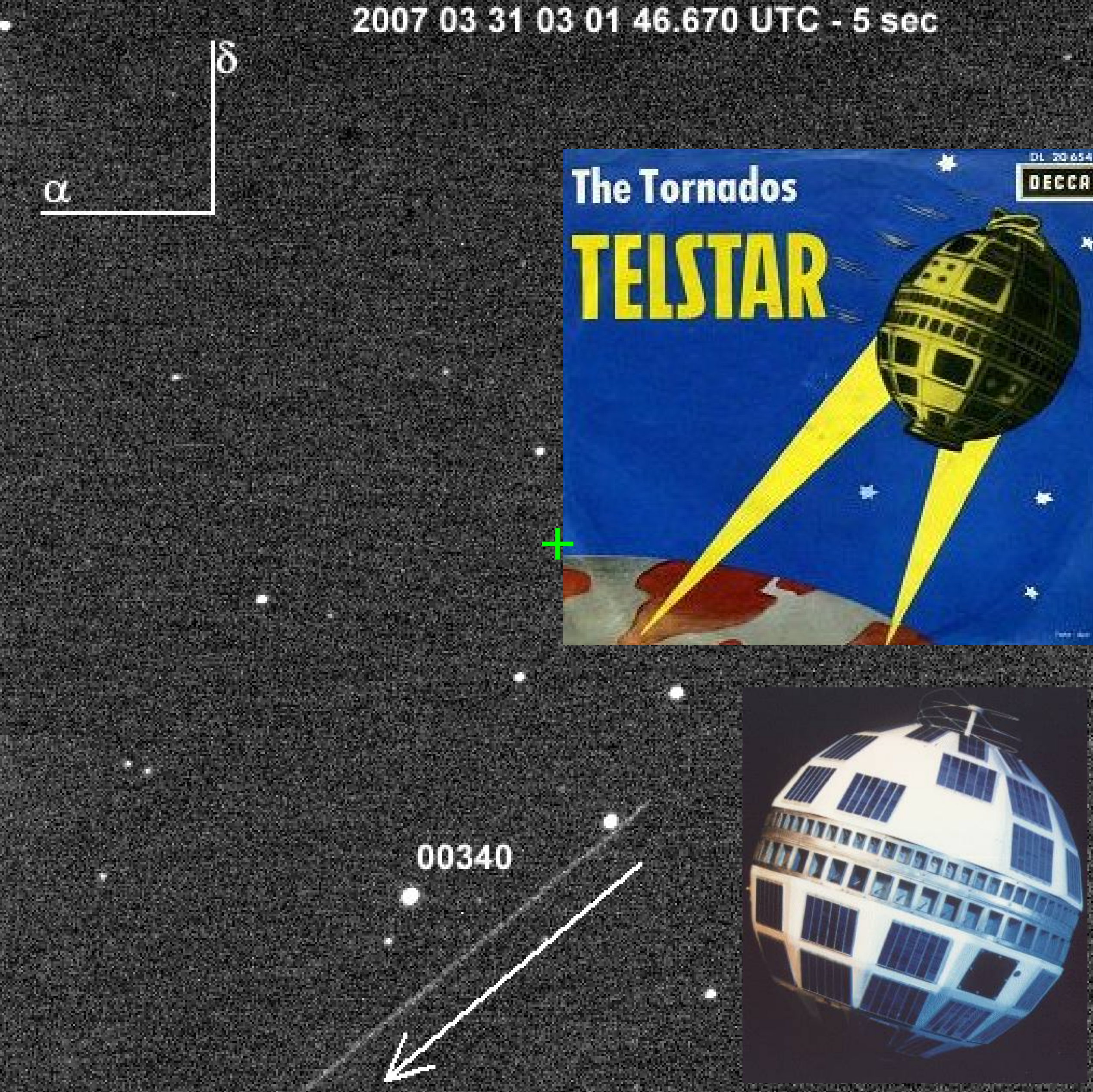
The command to open the CCD’s shutter is sent when the second’s last digit displays a “0” or a “5”. The time tag will be known to be either a “0” or a “5” during analysis. This avoids timing errors by the computer’s internal clock.

Imaging can last for the entire night, depending on the weather conditions and number of “new” MEO satellites available.

Images are analyzed carefully for any satellite streaks after the tracking has concluded.

“Repeat” satellites are collected and stored by their corresponding “CASTOR” number.

Images containing streaks are separated from the raw images to be analyzed for tracking data.

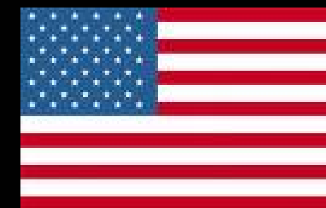


TELSTAR 1

ITNL: 1962-029A

NORAD: 00340

CASTOR: 0466



LAUNCH: JULY 10, 1962

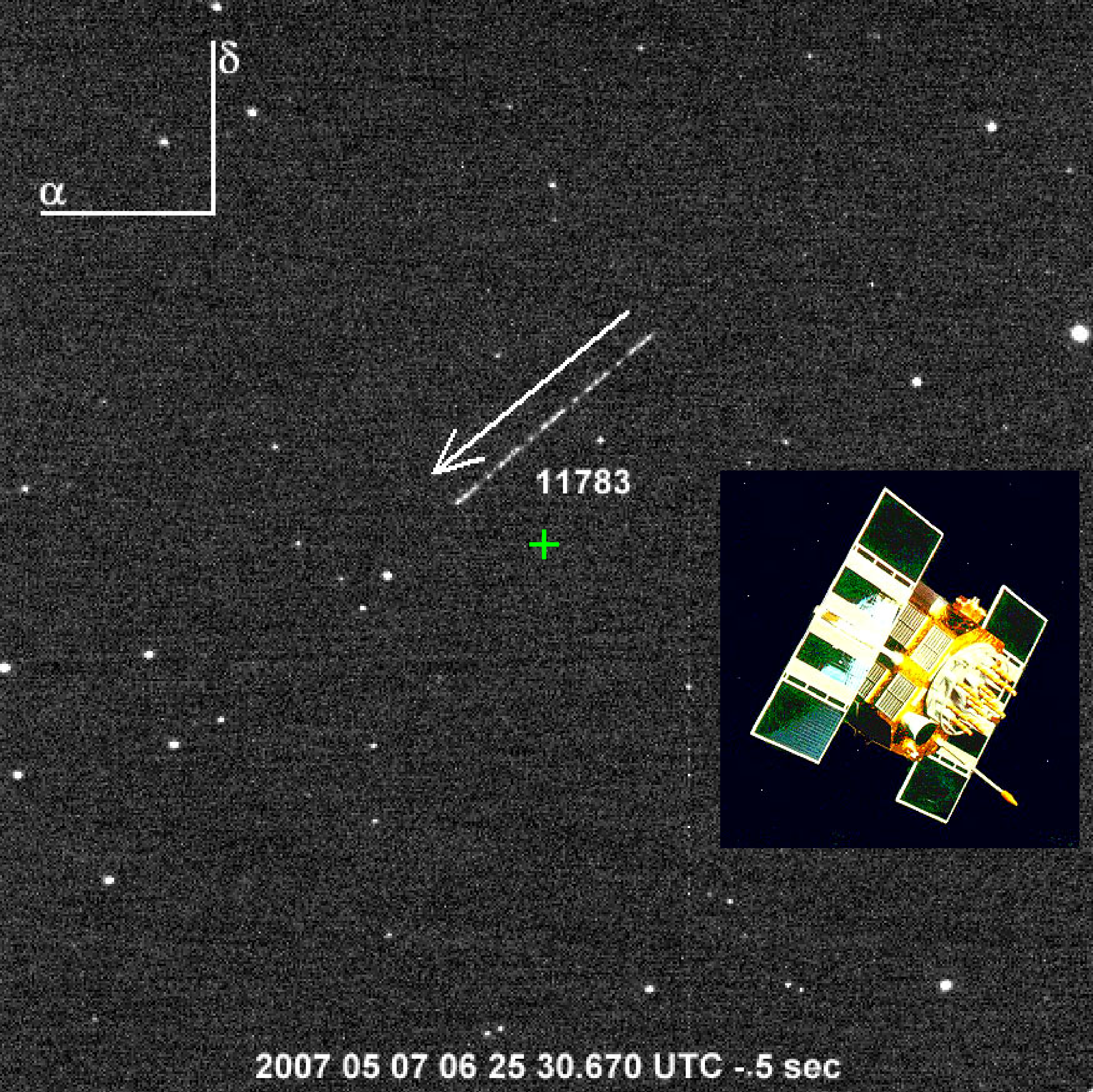
END OF LIFE: FEBRUARY 21, 1963

THE FIRST TRANSATLANTIC LIVE TELEVISION TRANSMISSION SATELLITE

CASTOR JUNIOR

FOV: 18.7 ARC-MINUTES
ANG. RES.: 2.20”/pix
R.A.: $14^h\ 22^m\ 01^s.16$
Dec.: $+20^O$ 20’ 56”.84

THE TELSTAR 1 SATELLITE



THE NAVSTAR 6 SATELLITE

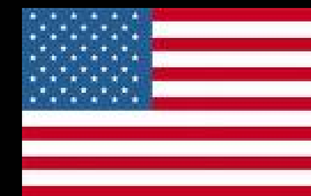
NAVSTAR 6

(OPS 5118)

ITNL: 1980-032A

NORAD: 11783

CASTOR: 0769



LAUNCH: APRIL 26, 1980

END OF LIFE: MARCH 1991

ONE OF THE FIRST GENERATION GLOBAL POSITIONING SYSTEM (GPS) SATELLITES

CASTOR

FOV: 13.33 ARC-MINUTES
ANG. RES.: 1.562”/pix
R.A.: 17^h 09^m $25^s.06$
Dec.: +57° 33’ 48”.47

GEO ORBIT TRACKING

CASTOR Main is used.

Tracking begins (and ends) when the Sun is 12 degrees below the local horizon.

Exposure times are normally 10 seconds; longer if special analyses (such as tumble period) are being conducted. The longest exposure so far has been 300 seconds.

Every image is automatically stored, numbered and time-tagged.

The command to open the CCD's shutter is sent when the second's last digit displays a "0" or a "5". The time tag will be known to be either a "0" or a "5" during analysis. This avoids timing errors by the computer's internal clock.

Observing can last for the entire night, depending on the weather conditions and number of "new" GEO satellites available.

Images are analyzed carefully for any satellite streaks after the tracking has concluded.

"Repeat" satellites are collected and stored by their corresponding "CASTOR" number.

Images containing streaks are separated from the raw images to be analyzed for tracking data.

THE ANIK A1 SATELLITE

ANIK A1

(TELESAT 1)

ITNL: 1972-090A

NORAD: 06278

CASTOR: 1170

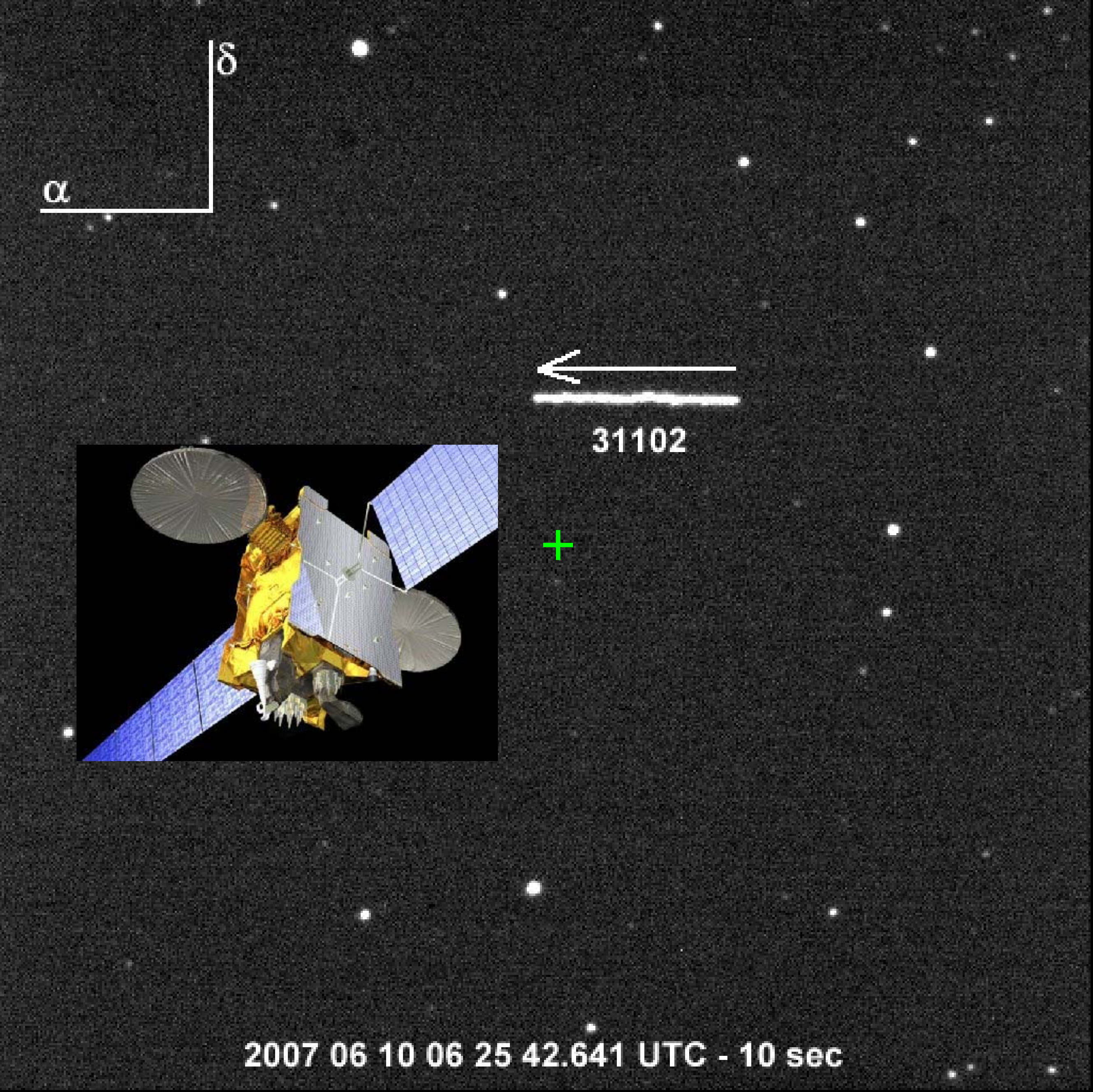
LAUNCH: NOVEMBER 10, 1972

END OF LIFE: JULY 15, 1982

THE FIRST DOMESTIC (NON-MILITARY) GEOSTATIONARY COMMUNICATIONS SATELLITE

CASTOR

FOV: 13.33 ARC-MINUTES
ANG. RES.: 1.562”/pix
R.A.: 22^h 54^m $06^s.17$
Dec.: -11^o 51’ 57”.04



ANIK F3

ITNL: 2007-009A

NORAD: 31102

CASTOR: 0882

LAUNCH: APRIL 9, 2007

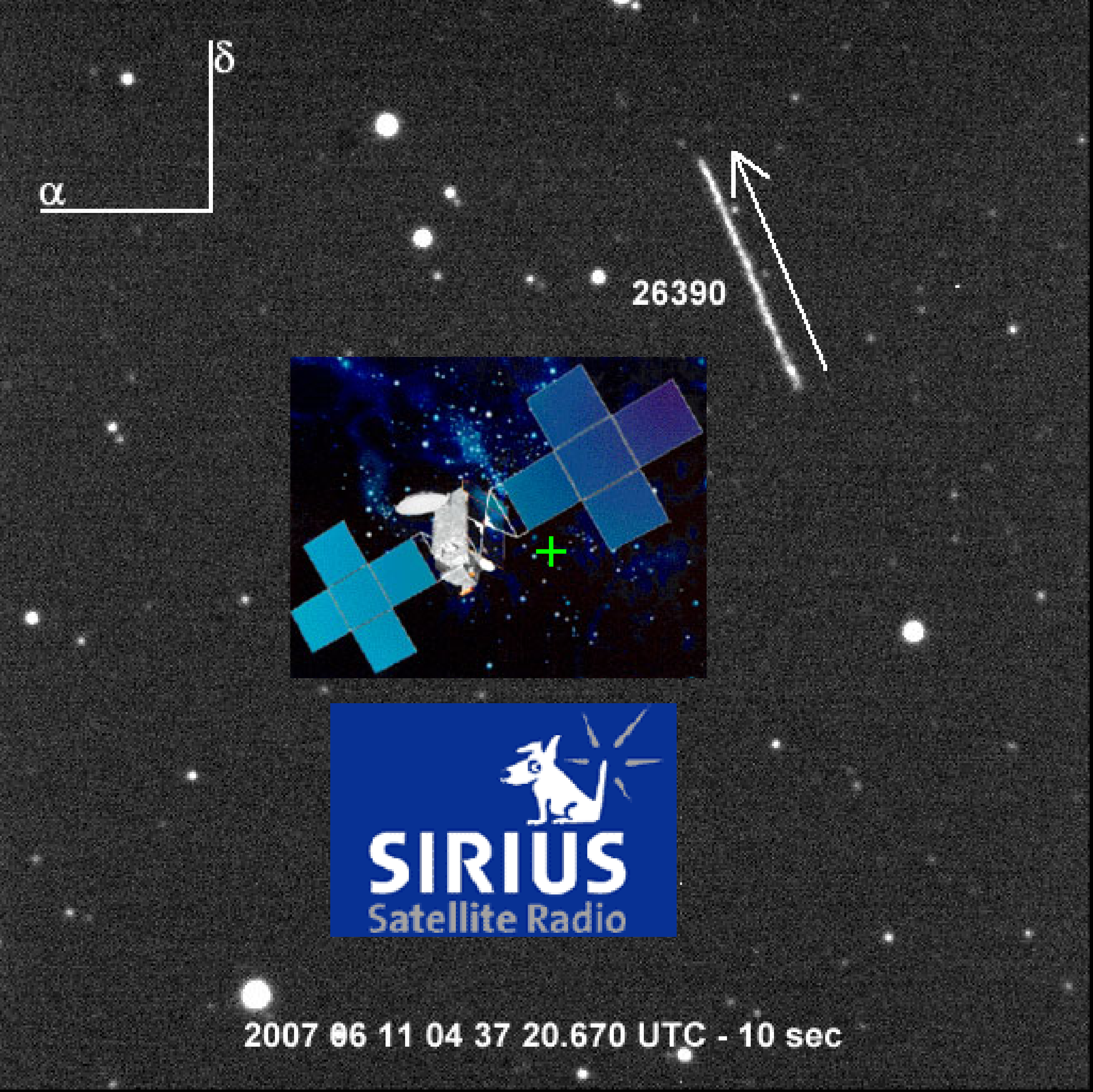
DESIGN LIFETIME: 15 YEARS

DOMESTIC GEOSTATIONARY COMMUNICATIONS, DIRECT-TO-HOME TV AND INTERNET SATELLITE

CASTOR

FOV: 13.33 ARC-MINUTES
ANG. RES.: 1.562”/pix
R.A.: 15^h 25^m $18^s.93$
Dec.: -06° 32’ 53”.02

THE ANIK F3 SATELLITE

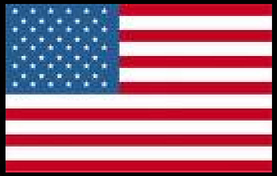


SIRIUS 1

ITNL: 2000-035A

NORAD: 26390

CASTOR: 0915



LAUNCH: JUNE 30, 2000

DESIGN LIFETIME: 10-15 YEARS

NORTH AMERICAN GEOSYNCHRONOUS RADIO BROADCASTING SATELLITE

CASTOR

FOV: 13.33 ARC-MINUTES
ANG. RES.: 1.562”/pix
R.A.: $17^h\ 34^m\ 07^s.40$
Dec.: -04° 53’ 52”.96

THE SIRIUS 1 SATELLITE

HIGH EARTH ORBIT TRACKING

CASTOR Main is used.

Tracking starts when the Sun is 12 degrees below the local horizon.

Exposure times are normally 30 seconds or longer. This is to allow the HEO satellite to travel significantly enough to reveal a streak on the image.

Every image is automatically stored, numbered and time-tagged.

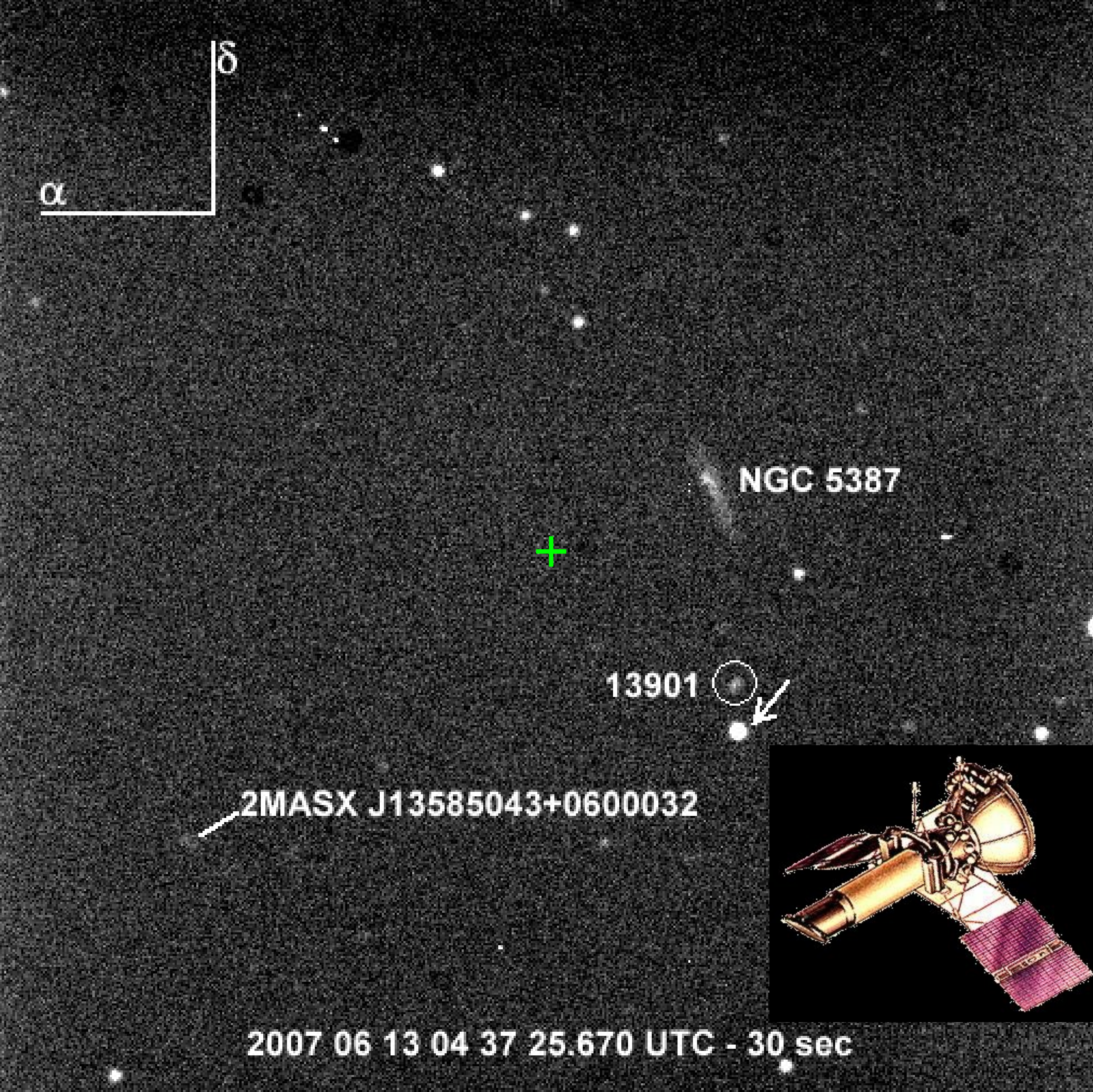
The command to open the CCD's shutter is sent when the second's last digit displays a "0" or a "5". The time tag will be known to be either a "0" or a "5" during analysis. This avoids timing errors by the computer's internal clock.

Imaging is normally sporadic, since there are so few HEO satellites in orbit at the present time.

Images are analyzed carefully for any satellite streaks after the tracking has concluded.

"Repeat" satellites are collected and stored by their corresponding "CASTOR" number.

Images containing streaks are separated from the raw images to be analyzed for tracking data.



THE ASTRON SATELLITE

ASTRON

ITNL: 1983-020A

NORAD: 13901

CASTOR: 0978

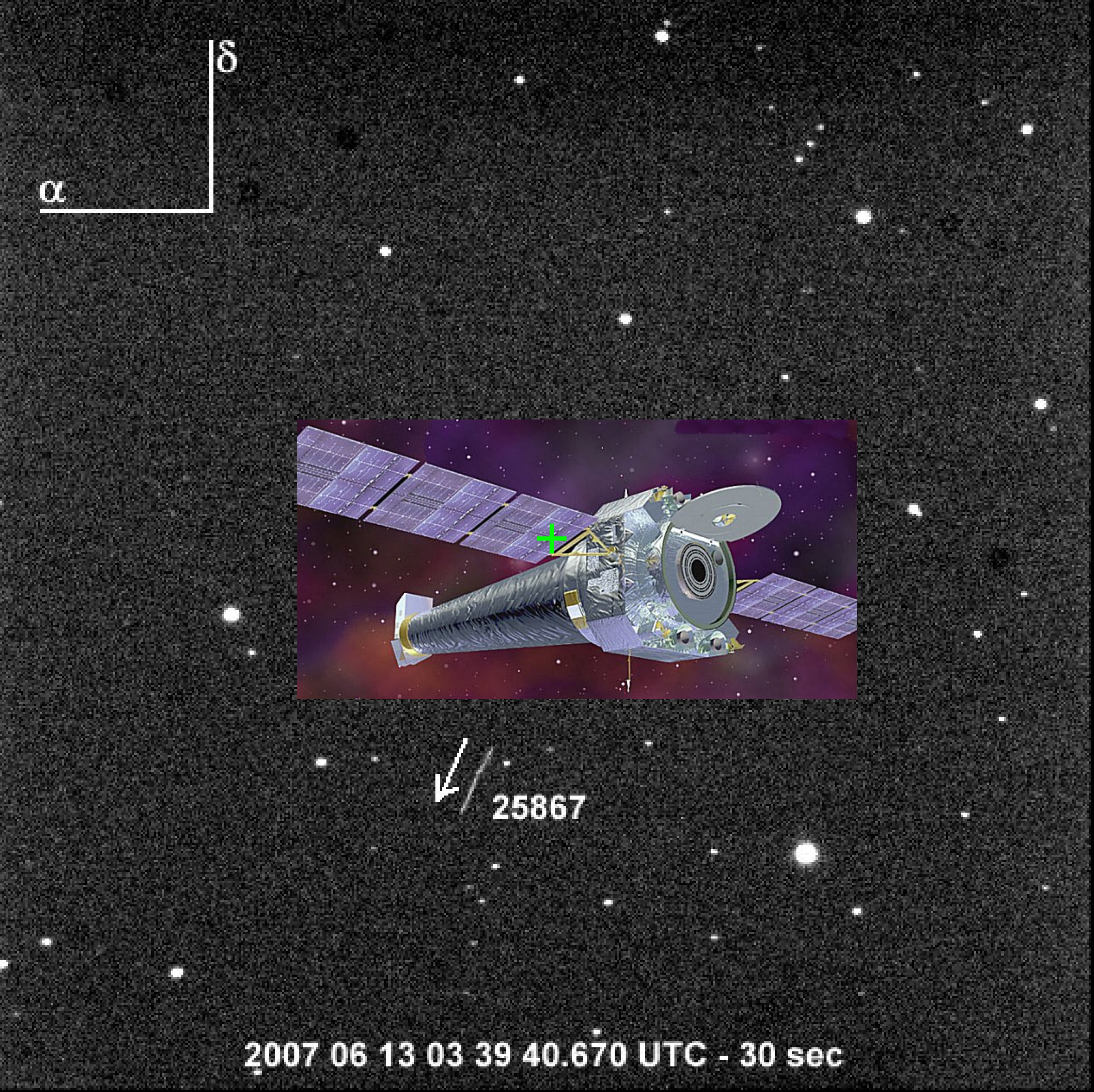
LAUNCH: MARCH 23, 1983

END OF LIFE: JUNE 1989

UV AND X-RAY ASTROPHYSICS OBSERVATORY

CASTOR

FOV: 13.33 ARC-MINUTES
ANG. RES.: 1.562”/pix
R.A.: 13^h 58^m $32^s.82$
Dec.: +06^O 03’ 33.65”



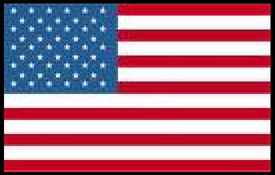
THE CHANDRA X-RAY OBSERVATORY

CHANDRA X-RAY OBSERVATORY (CXO)

ITNL: 1999-040B

NORAD: 25867

CASTOR: 0976



LAUNCH: JULY 23, 1999

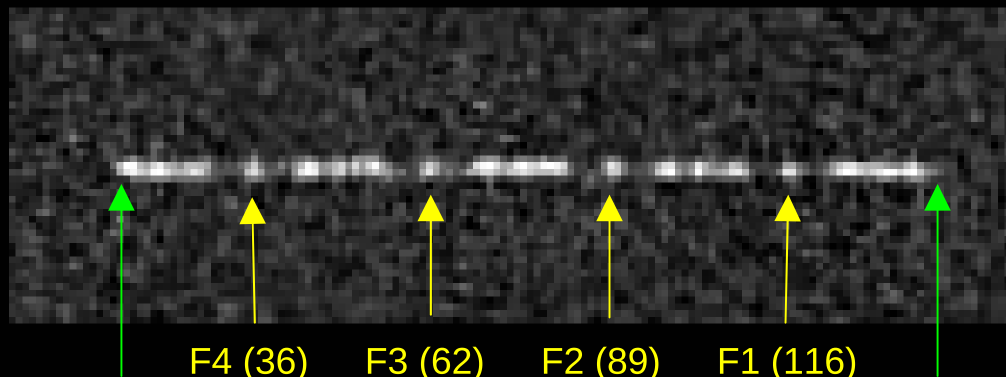
DESIGN LIFETIME: 5 YEARS

X-RAY ASTROPHYSICS OBSERVATORY

CASTOR

FOV: 13.33 ARC-MINUTES
ANG. RES.: 1.562”/pix
R.A.: $15^h\ 34^m\ 58^s.15$
Dec.: $+47^O$ 25’ 33.70”

MEASURING TUMBLE PERIODS



END 1 – END 2 = 137-16 = 121 pixels (Streak Length)

Time per Pixel = 5 seconds ÷ 121 pixels = 0.0413 seconds per pixel

F1 – F2 = 116-89 = 27 pixels (“Distance” Between Identical Flashes)

Tumble Period = Time per Pixel x “Distance” Between Flashes = 1.12 sec

USING ALL FOUR IDENTICAL FLASHES

F1 – F4 = 116-36 = 80 pixels (“Distance” Between Identical Flashes)

Tumble Period = Time per Pixel x “Distance” Between 4 Flashes ÷ 3 = 1.10 sec

SATELLITES DETECTED BY *CASTOR*

JANUARY 1 TO AUGUST 10, 2007

LEO Satellites:	552
MEO Satellites:	457
GEO Satellites:	355
HEO Satellites:	13

TOTAL: 1,377 Unique Satellites

12.5% of total population

NAKED-EYE SATELLITES WE CAN SEE TONIGHT

AUGUST 11, 2007

9:15 TO 9:20 P.M.: THE INTERNATIONAL SPACE STATION (ISS) WILL BE SEEN TRAVELLING FROM NORTH-WESTERN TO NORTH-EASTERN SKY. MAXIMUM ALTITUDE: 22 DEGREES (N); MAXIMUM BRIGHTNESS: 0 MAG.

10:50 TO 10:52 P.M.: THE INTERNATIONAL SPACE STATION (ISS) WILL BE SEEN TRAVELLING FROM NORTH-WESTERN TO NORTH NORTH-WESTERN SKY. MAXIMUM ALTITUDE: 30 DEGREES (NW); MAXIMUM BRIGHTNESS: -0.5 MAG.

SPACE SHUTTLE ENDEAVOR (STS-118) WILL BE SEEN NEAR OR AT THE ISS AT NEARLY THE SAME TIMES AS THE ISS. KEEP A SHARP EYE OUT FOR IT! IT WILL BE APPROXIMATELY HALF AS BRIGHT AS THE ISS.

YOU WILL SEE OTHER (DIMMER) SATELLITES FOR ABOUT 2 HOURS AFTER SUNSET TRAVELLING ROUGHLY NORTH TO SOUTH OR SOUTH TO NORTH. POINT THEM OUT AND WE CAN RECORD WHEN AND WHERE WE SAW THEM (FOR ID LATER).

NEW SATELLITES CASTOR WILL ATTEMPT TONIGHT

AUGUST 11, 2007

TELSTAR 302 (15237)

INTELSAT 4-F4 (05775)

RADUGA 13 (14307)

CS 3B (19508)

EKRAN 14 (15626)

INTELSAT 507 (14421)

SCATHA (11256)

INMARSAT 4-F2 (28899)

INTELSAT 501 (12474)

EKRAN 19 (19683)

LES 6 (03431)

MARISAT 3 (08882)

INSAT 2D (24820)

GORIZONT 15 (19017)

SL-12 ROCKET (16339)

LEASAT 2 (15236)

INTELSAT 1-F1 (01317)

OPS 9311 (IDSCS 1) (02215)

INTELSAT 3-F8 (04478)

SL-12 ROCKET (20110)

ATS 5 AKM (21052)

GORIZONT 14 (17969)

HIMAWARI 3 AKM (22266)

SL-12 ROCKET (14333)

CASTOR WEBSITE, ETC…

CASTOR website: http://www.castor2.ca

CASTOR e-mail: info@castor2.ca OR webmaster@castor2.ca

CASTOR FTP: ftp://castor2.com

CASTOR FTP UserID and Password: http://www.castor2.ca/15_Spy

CASTOR Presentation Slides: http://www.castor2.ca/11_Mike_Earl/05_Slides

About Mike Earl: http://www.castor2.ca/11_Mike_Earl