# 4 CAST programs

## 4.1 Scientific Satellites (SJ)

China's scientific satellite program began with the DFH-1 satellite launched in 1970 and continued with the Shi Jian satellite series, launched occasionally starting in 1971. The series remained a small part of the Chinese program compared to the FSW recoverable satellites and the DFH communications satellites.

• **Dong Fang Hong Yi Hao** (1970-34A)

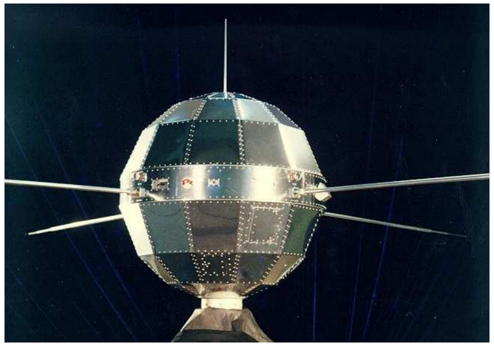


Figure 13: China's first satellite (via Sven Grahn)

The radio transmitter on China's first satellite played the anthem 'East is Red' (Dong Fang Hong), which became the name of the satellite - Dong Fang Hong Yi Hao or DFH-1. It was launched by a Chang Zheng 1 (Long March) rocket from the Jiuquan space center. Internally the project was designated Project 651. Western sources labelled the satellite PRC-1 or Mao-1. Mass of Dong Fang Hong 1 was 173 kg. The satellite operated for 28 days.

DFH1 was 1.0m polyhedron.

The third stage was 2050 kg full, 250 kg empty and delivered a dV of around 4.13 km/s over a 38s burn.

Dong Fang Hong

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1970 Apr 24 | 1335 | Launch by Chang Zheng 1 | Jiuquan |
| | 1336 | T+1:00 Stage 2 burn | |
| | 1338 | T+3:00? Stage 2 burnout | |
| | 1339? | Stage 3 sep | |
| | 1342? | Stage 3 burn | -5300? x 440 x 68.4 |
| | 1343? | Stage 3 burnout | |
| | 1348 | Stage 3 sep | 114.1 441 x 2386 x 68.4 |
| 1970 May 22? | | End of transmissions | |

PAYLOAD

Radio Transmitter

• **Shi Jian Yi Hao** (1971-18A)

China's second satellite was Shi Jian Yi Hao (SJ 1, PRC 2). Shi Jian has been translated as 'Practice' or 'Test'. SJ 1 was similar in construction to DFH 1. It carried a magnetometer and solar cells, and cosmic ray detectors. SJ 1 transmitted until at least 1977, and possibly until reentry in 1979. Transmissions continued on 20.008MHz from



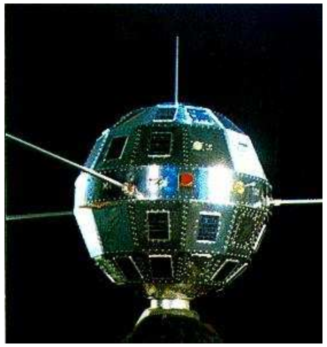


Figure 14: China's second satellite (via Sven Grahn)

the final stage rocket until Mar 11, after which 19.995 MHz transmissions from the payload began, and it appears that the rocket did not separate until then.

Satellite was a 1.0m dia sphere, spin-stabilized and covered with solar cells. Mass was 221 kg.

Shi Jian 1

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1971 Mar 3 | 1215 | Launch by CZ1 | JQ<br>106.2 268 x 1830 x 69.9 |
| 1971 Mar 11 | | Final stage separated | |
| 1971 Mar 26 | | End of tx from stage 3 | |
| 1979 Jun 17 | | End of transmissions | |
| 1979 Jun 17 | | Reentered over Lake Michigan | |

PAYLOAD

GM counter e 0.8 MeV, p 16.4 MeV
Ionization chamber, Solar X-rays 1-8A.
Magnetometer

• **Shi Jian** A satellite simulator of 3100 kg mass was test launched by FB-1 on 1977 Sep 15 and on 1978 Apr 15.

• **Shi Jian** (1979-F02)

A Feng Bao 1 rocket launched on 1979 Jul 30 failed to reach orbit. It carried a trio of Shi Jian 2 satellites, mass 250 kg, 480 kg and 30 kg. The stage 2 vernier engines failed.

SJ

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1979 Jul 30 | | Launch by FB1 | JQ |
| | | Stage 1 MECO | |
| | | Stage 2 burn | |
| | | Stage 2 MECO | |
| | | Stage 2 verniers fail | |
| | | Failed to orbit | |

- **Shi Jian Er Hao** (1981-93B)

The final FB-1 launch carried Shi Jian 2 (Shi Jian Er Hao, PRC 9) into orbit. The satellite was also referred to as Shiyan Kexuedi Weixing (Experimental Scientific Satellite) but the SJ-2 name has been consistently used since the late 1980s. Two small subsatellites were carried into orbit with SJ-2. SJ-2 was an octagonal cylinder with 4 solar panels, 1.1m long and 1.2m diameter (or 0.6m dia?). Mass was 257 kg. Span around 3.2m.

Figure 15: The SJ-2 satellites during checkout

.

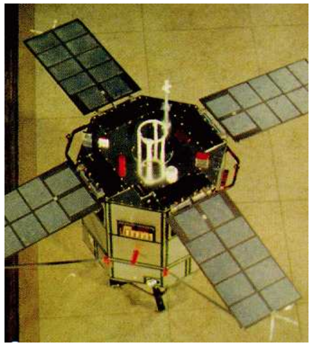


Figure 16: The SJ-2 satellite

SJ 2

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1981 Sep 19 | 2128:40 | Launch by Feng Bao 1 | JQ |
| | 2130:48 | T+2:08 Stage 1 MECO | |
| | 2130:48? | Stage 2 MES | |
| | 2132:45? | T+4:05? Stage 2 MECO | |
| | 2136:00 | T+7:20? Stage 2 VECO | |
| | 2136:00 | T+7:20 SJ-2A sep | |
| | 2136:00 | T+7:20 SJ-2B sep | |



SJ 2

| Date | Time | Event | Orbit |
|---|---|---|---|
| | 2137? | adapter sep from stage 2 | |
| | 2137? | SJ-2 sep from stage 2 | |
| | | | 240 x 1610 x 59.5 |
| 1982 Oct 6 | | Reentered | |

PAYLOAD

Ionization gauge
Magnetometer
IR radiometer and UV radiation from upper atmosphere
Solar protons and electrons
Solar UV,X

- **Shi Jian Er Hao Jia** (1981-93D)

The first subsatellite with the SJ-2 mission was named Shi Jian Er Hao Jia, loosely the equivalent of SJ-2A. The satellite was a tapered cone with 4 antennae which studied the magnetic field and the ionosphere. Mass was 483 kg. The satellite was in the upper part of the nosecone, and the SJ-2/SJ-2B pair were beneath and partly inside it.

SJ 2A

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1981 Sep 19 | 2128:40 | Launch by FB 1 | JQ |
| | | | 240 x 1610 x 59.5 |
| 1982 Aug 17 | | Reentered | |

PAYLOAD

Ionospheric beacons 40.5 MHz, 162 MHz

- **Shi Jian Er Hao Yi** (1981-93A)

The second subsatellite, Shi Jian Er Hao Yi, again approximately equivalent to Shi Jian 2B, was a 28 kg 0.45m dia metal sphere connected by a 600m silk cable to a passive 4m diameter balloon. It was a passive radar calibration test satellite (the balloon aided optical tracking but was also coated with aluminium) and was also used to study air density. It reentered after 6 days.

SJ 2B

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1981 Sep 19 | 2132 | Launch by FB1 | JQ |
| | | | 103.3 232 x 1598 x 59.5 |
| 1981 Sep 25 | | Reentered | |

Figure 17: The SJ-2A satellite

Figure 18: The SJ-2B satellite



- **Da Qui Weixing 1** (1990-81B)

The DQ (Atmosphere) or QQW balloon satellites were launched by a Chang Zheng 4 from the T'ai Yuan (Wuzhai) site in Sep 1990. They consisted of 2 40-cm diameter containers, which ejected a 3-m balloon and a 2.5 m balloon.

Atmosphere 1

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1990 Sep 3 | 0053 | Launch by CZ-4 | |

- **Da Qui Weixing 2** (1990-81C)

The DQ (Atmosphere) balloon satellites were launched by a Chang Zheng 4 from the T'ai Yuan (Wuzhai) site in Sep 1990. They consisted of 2 40-cm diameter containers, which ejected a 3-m balloon and a 2.5 m balloon. Total mass 8 kg for both balloons.

Atmosphere 2

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1990 Sep 3 | 0053 | Launch by CZ-4 | |
| 1991 Jul 24 | | Reentered | |

- **Shi Jian 4** (1994-10A)

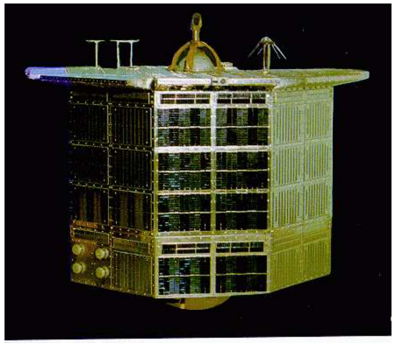


Figure 19: The SJ-4 satellite

SJ4, launched on the first Chang Zheng 3A test flight, carried a scientific payload from the Chinese Academy of Sciences [6]. The 400 kg satellite studied the radiation belts at synchronous altitudes, probably to support future comsat design. SJ4 was a 1.0m dia 2.0m long cylinder with a small boom.

SJ 4

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1994 Feb 8 | 0834 | Launch by CZ-3A | XSC |
| 1994 Feb 16 | | | 189 x 36152 x 28.7 |
| 1994 Apr 1 | | | 165 x 36114 x 28.5 |

Payload

Proton and electron detectors
Radiation effects on electronics (SEU monitor)
Electrostatic analyser.
Charging monitor

- **SJ-5** (1999-25B)

Shi Jian 5 was a secondary payload on the first CZ-4B launch in 1999 using a new SISE manufactured bus. Size is 1.2 x 1.0m box with two 5-m span solar panels. Mission design life is three months. It tested out attitude control, software, S-band telemetry, Al honeycomb structure, thermal control, and power supplies, as well as carrying a radiation dose and fluid physics payload. Mass is 298 kg. (or 350 kg, ISTS22-1295).

The CZ-4B carried two transition sections (A and B) and a conical adapter. The adapter was left in orbit and is 2.9m dia like the fairing and third stage.

SJ-5

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1999 May 10 | 0133 | Launch by CZ-4B | TYSC |
| | 0135 | T+2:32 St 1 sep | |
| | | St 2 burn | |
| | 0135 | T+2:47 Fairing sep | |
| | 0139 | T+6:48 Stage 2 MECO | |
| | 0139 | T+6:49 St 2 sep | |
| | | Stage 3 burn | |
| | 0145 | T+12:29 FY-1C sep | |
| | 0146 | T+13:34 SJ5 sep | |
| 1999 May 10 | | | 838 x 861 x 98.8 |
| 1999 Jun 14 | | | 844 x 868 x 98.8 |
| 2004 Jan 8 | | | 840 x 866 x 98.6 |

Payload

Particle precipitation
SAA measurements
SEU upset experiment
Microgravity fluid physics

- **Haiyang 1** (2002-24A)

Launched with FY-1D on 2002 May 15. HY-1 ("Marine No. 1") is the first Chinese marine survey satellite. Developed by China Space DFH Satellite Co. for the State Bureau of Oceanography. Uses SJ-5 bus. Box + 2 panels. 360 kg.

Satellite was cataloged as 27433/2002-024D until May 23; then 27430/2002-024A.



HY-1

| Date | Time | Event | Orbit |
|---|---|---|---|
| 2002 May 15 | 0150 | Launch by CZ-4B | |
| | 0152 | T+2:32? St 1 sep | |
| | 0152 | St 2 burn | |
| | 0152 | T+2:47? Fairing sep | |
| | 0156 | T+6:48? Stage 2 MECO | |
| | 0156 | T+6:49? St 2 sep | |
| | | Stage 3 burn | |
| | 0200? | Stage 3 MECO | |
| | 0202 | T+12:29? FY-1D sep | |
| | 0203? | Adapter sep? | |
| | 0203 | T+13:34? HY-1 sep | |
| 2002 May 15 | | | (D) 102.14 850 x 869 x 98.81 |
| 2002 May 19 | | | (D) 102.14 850 x 869 x 98.8 |
| 2002 May 20? | | Lower orbit | |
| 2002 May 23 | | Redesignated as 24A | |
| 2002 May 23 | | | 101.20 807 x 823 x 98.8 |
| 2002 May 24 | | | 100.83 796 x 799 x 98.8 |
| 2002 May 28 | | | 100.72 792 x 792 x 98.81 |
| 2002 May 28 | | Adapter orbit: | (D) 102.18 850 x 873 x 98.8 |

Payload

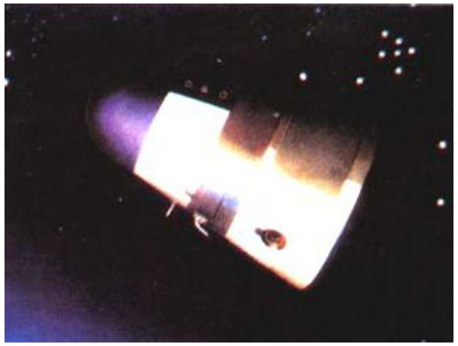
10-band ocean color scanner
4-band CCD camera
IR radiometer

Table 25: Experimental Chinese satellites

| Payload | Name | Launch Veh. | Site | Launch Date | Reentry Date | Dur | Orbit | Designation |
|---|---|---|---|---|---|---|---|---|
| DFH 1 | Dong Fang Hong Yi Hao | CZ-1 | JQ | 1970 Apr 24 | 1970 Jun | | 441 x 2386 x 68.4 | 1970-34A |
| SJ 1 | Shi Jian Yi Hao | CZ-1 | JQ | 1971 Mar 3 | 1979 Jun 17 | | 268 x 1830 x 69.9 | 1971-18A |
| SJ | Shi Jian | FB-1 | JQ | 1979 Jul 30 | 1979 Jul 30 | 0 | - | - |
| SJ 2 | Shi Jian Er Hao | FB-1 | JQ | 1981 Sep 19 | | | 240 x 1610 x 59.5 | 1981-93B |
| SJ 2A | Shi Jian Er Hao Jia | FB-1 | JQ | 1981 Sep 19 | | | 240 x 1610 x 59.5 | 1981-93D |
| SJ 2B | Shi Jian Er Hao Yi | FB-1 | JQ | 1981 Sep 19 | | | 232 x 1598 x 59.5 | 1981-93A |
| DQ 1 | Da Qui Weixing 1 | CZ-4 | T'ai Yuan | 1990 Sep 3 | | | | 1990-81B |
| DQ 2 | Da Qui Weixing 2 | CZ-4 | T'ai Yuan | 1990 Sep 3 | | | | 1990-81C |
| SJ 4 | Shi Jian 4 | CZ-3A | XSC | 1994 Feb 8 | | | | 1994-10A |
| SJ 5 | Shi Jian 5 | CZ-4B | T'ai Yuan | 1999 May | | | 1999-25B | |



## 4.2 Recoverable Satellites (FSW)



The Project 911 Fanhui Shi Weixing (FSW), Experimental Recoverable Satellite, was the first spacecraft to be recovered from orbit by a country other than the US and the USSR. It has also been referred to as Fan Hui Shi Yao Gan Weixing. A description of its development was given by Clark [5].

The mass and size of the FSW satellites has grown over time. FSW-0 was 1800 kg, 2.2m dia 3.1m long. FSW-1 was 2100 kg. FSW-2 was 2590 kg for first mission, up to 3100 kg, 2.2dia 4.6l. Later missions were 2760 and 2970 kg.

An AAS history paper[1] describes a retro-motor that is probably the FSW-0 retro. It is a 0.90l 0.68dia sphere-cone with a mass of 266 kg full 54 kg empty and delivering 583 kNs over 18.5s with an Isp of 280s. If the recoverable part of the spacecraft was 1000 kg, the dV delivered would be 0.65 km/s which is enough to lower perigee to -1500 km or, if the burn was in the nadir direction as suggested, change orbit to -200 x 950 km. Retroburn direction is cited as 100-110 deg from velocity vector. This would give (-0.17,0.00,-0.63) km/s.

For later FSW satellites with reentry mass about (guess) 1200 kg and an orbit of 191 x 328 km with deorbit just before perigee, a similar motor would give 533m/s or (-0.138,0.0,-0.515) km/s and a -426 x 554 km reentry orbit giving a fast reentry reaching 60 km altitude in only 3 minutes and 10 degrees of latitude.

Mass of the equipment module for FSW-0 is probably around 1000 kg with 266 kg for the retro and around 500 kg for the rest of the RV.

The payload in the RV was 150 kg for FSW-0, growing to 260 kg for FSW-2.

| | EM size | RM size | RV size | EM mass | RM mass | RV mass |
|---|---|---|---|---|---|---|
| FSW | 2.2d 1.6l | - | 1.7d 1.5l | 1100? | 266 | 434? |
| FSW-1 | 2.2d 1.6l | - | 1.7d 1.5l | 1300? | 266 | 534? |
| FSW-2 | 2.2d 2.5l | 0.65l 1.7d | 1.7d 1.5l | 1650? | 350? | 700? |
| JB-4 | 2.2d 2.8l? | 0.65l 1.7d | 1.7d 1.7l? | 2000? | 350? | 850? |

- **Fanhui Shi Weixing** (1974-F07)

The first FSW was lost in a launch failure in Nov 1974. Guidance control was lost due to a broken wire in the rate gyro and the rocket began huge oscillations before destruction.

FSW

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1974 Nov 5 | | Launch by CZ-2<br>T+20s, out of control<br>Failed to orbit | Jiuquan |

• **Fanhui Shi Weixing** (1975-111A)

The second FSW became the fourth Chinese satellite (PRC 4 in the West). The 1790 kg satellite ejected a recovery capsule after 6 days. The satellite was somewhat damaged on reentry due to a parachute failure and landed off course.

FSW

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1975 Nov 26 | 0329 | Launch by CZ-2C | JQ |
| | 0331 | T+2:10 MECO | |
| | 0331 | Stage 2 burn | |
| | 0333 | T+4:02? Stage 2 MECO | |
| | 0334 | T+5:06? Stage 2 VECO | |
| | | | 91.1 179 x 479 x 63.0 |
| 1975 Dec 2 | | Capsule sep | |
| | | Capsule deorbit | -200 x 900? |
| | 0218 | Capsule landed in China | |
| 1975 Dec 29 | | FSW reentered | |

• **Fanhui Shi Weixing** (1976-117A)

FSW No. 3 (PRC 7) recovered its capsule after 3 days in space. Mass was 1790 kg. The mission suffered from attitude control problems.

FSW

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1976 Dec 7 | 0436 | Launch by CZ2 | JQ |
| | | | 91.0 172 x 479 x 59.5 |
| 1976 Dec | | | 90.9 174 x 469 x 59.5 |
| 1976 Dec 9 | | Capsule sep | |
| 1976 Dec 9 | 0357 | Capsule recovered after 3d | |
| 1977 Jan 2 | | Reentered | |

• **Fanhui Shi Weixing** (1978-11A)

FSW No. 4 (PRC 8) was launched in Jan 1978. Mass was around 1810 kg.

FSW

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1978 Jan 26 | 0457 | Launch by CZ2 | JQ |
| | | | 90.9 161 x 479 x 57.0 |
| 1978 Jan 30 | | Capsule sep | |
| | 0431 | Capsule landed | |
| 1978 Feb 7 | | Reentered after 12d | |

• **Fanhui Shi Weixing** (1982-90A)

FSW No. 5 (PRC 10) was launched in Sep 1982 on a 5 day mission. Mass was 1780 kg. The new spacecraft had a CCD camera as well as the standard film camera. The apogee was reduced by 80 km relative to earlier flights.



FSW

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1982 Sep 9 | 0718 | Launch by CZ2 | JQ |
| | | | 90.20 180 x 390 x 63.0 |
| 1982 Sep 14 | | Capsule sep | 89.74 170 x 355 x 63.0 |
| | 0604 | Capsule landed in China, 5d | |
| 1982 Sep 21 | | Reentered | 87.3 127 x 156 x 63.0 |

• **Fanhui Shi Weixing** (1983-86A)


Figure 20: FSW satellite ready for launch on CZ-2C, 1983

FSW No. 6 (PRC 11) was launched in Aug 1983 and carried out a 5 day flight. Mass was 1840 kg.

FSW

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1983 Aug 19 | 0600 | Launch by CZ2 | JQ |
| | | | 90.1 173 x 389 x 63.3 |
| 1983 Aug 24 | 0443 | Capsule landed | |
| 1983 Sep 3 | | Reentered | |

• **Fanhui Shi Weixing** (1984-98A)

FSW No. 7 was launched in Sep 1984. Mass was 1810 kg.

FSW

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1984 Sep 12 | 0543 | Launch by CZ2 | JQ |
| | | | 171 x 389 x 68 |
| 1984 Sep 17 | 0439 | Capsule landed in China | |
| 1984 Sep 29 | | Reentered | |

- **Fanhui Shi Weixing** (1985-96A)

FSW No. 8 flew a standard 5 day mission in Oct 1985. Mass was 1810 kg.

| FSW | | | |
|---|---|---|---|
| Date | Time | Event | Orbit |
| 1985 Oct 21 | 0504 | Launch by CZ2 | JQ |
| | | | 172 x 395 x 63.0 |
| 1985 Oct 26 | 0351 | Capsule landed in China | |
| 1985 Oct 29 | | | 170 x 342 x 63.0 |
| 1985 Nov 7 | | Reentered | |

- **Fanhui Shi Weixing** (1986-76A)

FSW No. 9 flew a 5 day mission on 6-11 Oct 1986. Mass was 1770 kg. The final rocket stage remained in orbit until Oct 20. The recovery capsule landed in a lake.

| FSW | | | |
|---|---|---|---|
| Date | Time | Event | Orbit |
| 1986 Oct 6 | 0540 | Launch by CZ-2 | JQ |
| | 0700 | 173 x 385 x 56.96 | |
| 1986 Oct 9 | | | 172 x 378 x 57.0 |
| 1986 Oct 11 | 1200 | | 174 x 366 x 57.0 |
| 1986 Oct 11 | | D,E sep | 165 x 406 x 57.0 (D) |
| 1986 Oct 11 | 0420 | Capsule landed in China | |
| 1986 Oct 16 | | | 170 x 318 x 56.9 |
| 1986 Oct 21 | 1400 | | 155 x 226 x 56.9 |
| 1986 Oct 23 | 0200 | | 125 x 142 x 56.9 |
| 1986 Oct 23 | | Reentered | |

- **Fanhui Shi Weixing** (1987-67A)

FSW No. 10 was launched in Aug 1987. The capsule was recovered in central Sichuan province five days after launch. Mass was 1810 kg.

| FSW | | | |
|---|---|---|---|
| Date | Time | Event | Orbit |
| 1987 Aug 5 | 0637 | Launch by CZ2 | JQ |
| | | | 90.24 173 x 400 x 62.96 |
| 1987 Aug 5 | 2241 | | 90.16 171 x 393 x 63.0 |
| 1987 Aug 6 | | | 90.12 172 x 389 x 63.0 |
| 1987 Aug 6 | 1200 | Orbit trim? | 90.19 171 x 396 x 63.0 |
| 1987 Aug 10 | 0530 | Capsule landed in Sichuan | |
| 1987 Aug 11 | 1700 | | 89.92 172 x 370 x 63.0 |
| 1987 Aug 22 | | | 88.04 148 x 207 x 62.9 |
| 1987 Aug 23 | | Reentered | |

PAYLOAD

Recoverable capsule
Camera?
Materials processing experiment
MATRA microgravity experiment, with biological specimens



- **Fanhui Shi Weixing 1** (1987-75A)

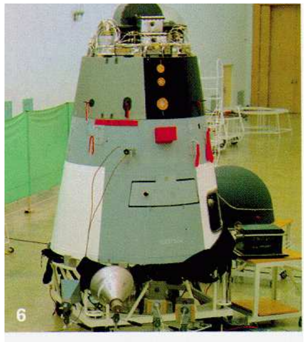



Figure 21: The FSW-1 satellite in checkout

A month after the 9th FSW flight, a new Chinese recoverable satellite was launched. This was the first FSW-1 model. Mass was 2070 kg. The recoverable capsule was about 1000 kg, 350 kg of retro solid fuel and 750 kg for the instrument module. The FSW-1 had improved avionics and attitude control as well as new payloads. Orbital altitude was lower; the mission lasted 8 days and was recovered on Sep 17.

Figure 22: The recovery vehicle after landing

| FSW-1 | | | |
|---|---|---|---|
| Date | Time | Event | Orbit |
| 1987 Sep 9 | 0715 | Launch by CZ2 | JQ |
| | | | 89.7 206 x 310 x 63.0 |
| 1987 Sep 17 | 0501 | Capsule landed in China, 8 d | |
| 1987 Sep 18 | | 75C,D cataloged | |
| 1987 Sep 22 | | End of transmissions | |
| 1987 Oct 4 | | Reentered | |

Payload

Materials processing experiments

• **Fanhui Shi Weixing 1** (1988-67E)

The second FSW-1 flight was in Aug 1988. After capsule separation, the main body was cataloged as 1988-67E, with the recovered capsule as 67A. Mass was 2130 kg.

FSW 1

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1988 Aug 5 | 0728:35 | Launch by CZ2 | JQ |
| | | | 89.70 206 x 313 x 63.0 |
| 1988 Aug 7 | | | 89.61 205 x 306 x 63.0 |
| 1988 Aug 13 | 0509 | Capsule landed after 8d | |
| 1988 Aug 27 | | Main satellite reentered | |

Payload

Recoverable capsule
Earth resources film unit
COSIMA 1, DLR/Intospace protein crystal growth experiment

• **Fanhui Shi Weixing 1** (1990-89A)

FSW-1 No. 3 was launched in Oct 1990. Mass was 2080 kg. This flight carried guinea pigs and as far as is known was the first flight by the Chinese which carried animals.

FSW 1

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1990 Oct 5 | | Launch by CZ2 | JQ |
| | | | 89.72 208 x 312 x 57.0 |
| 1990 Oct 13 | 0404? | Capsule recovered | |
| | | | 89.47 203 x 293 x 57.0 |
| | | | 89.46 199 x 295 x 57.0 |
| 1990 Oct 16 | 1400 | | 89.15 193 x 271 x 57.0 |
| 1990 Oct 20 | | End of transmissions (RAE) | |
| 1990 Oct 22 | 1400 | | 87.68 148 x 171 x 57.0 |
| | | Reentered | |

Payload

Recoverable capsule
Biological experiment capsule with guinea pigs and plants.

• **Fanhui Shi Weixing 1** (1992-64B)

The FSW-1 No. 4 flight carried the Swedish Freja satellite into orbit as a secondary payload. Mass was 2060 kg.

FSW 1

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1992 Oct 6 | | Launch by CZ2 | JQ |
| | | FSW sep from upper adapter | |
| | | Upper adapter sep from stage 2 | |
| | | Freja sep from stage 2 | |
| 1992 Oct 7 | | | 213 x 311 x 63.0 |
| 1992 Oct 13 | | Capsule recovered | 215 x 299 x 63.0 |
| 1992 Oct 15 | | | 212 x 289 x 63.0 |



FSW 1

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1992 Oct 30 | | | 169 x 193 x 63.0 |
| 1992 Oct 31 | | Reentered | |

• **Fanhui Shi Weixing 1** (1993-63A)

The FSW-1 No. 5 flight was announced as Jian Bing 93 (Progress or Pathfinder). Mass was 2100 kg.

FSW 1

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1993 Oct 8 | 0800 | Launch by CZ-2C | JQ |
| 1993 Oct 10 | | | 89.54 207 x 295 x 56.9 |
| 1993 Oct 16 | 0520 | Equipment module sep | |
| 1993 Oct 16 | | Capsule sep, wrong direction | |
| 1993 Oct 20 | 1900 | | 88.96 195 x 250 x 56.9 |
| 1993 Oct 28 | | Reentered over Pacific | |

• **Jian Bing 93 Capsule** (1993-63H)

The FSW-1 No. 5 capsule was separated from the main spacecraft on 1993 Oct 16, but the motor fired in the wrong direction. It finally reentered over the Atlantic in Mar 1996.

The delta-V was 650m/s.

Jian Bing 93 Capsule

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1993 Oct 8 | 0800 | Launch by CZ2C | JQ |
| 1993 Oct 16 | 0521 | Equipment module sep | |
| | 0521 | Retro module burn | |
| | | Retro sep? | |
| 1993 Oct 21 | | | 118.23 187 x 3015 x 56.59 |
| | | | 118.24 181 x 3022 x 56.53 |
| 1996 Mar 12 | 0405 | Reentered over S Atlantic 23S 20W | |

• **Fanhui Shi Weixing 2** (1992-51A)

The first FSW-2 engineering test flight was orbited in Aug 1992. Mass was 2590 kg. The FSW-2 used the standard FSW recovery capsule attached to a retrograde module and an equipment module [5]. The equipment module carried a monopropellant orbit adjust system.

FSW 2

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1992 Aug 9 | 0800 | Launch by CZ2D | JQ |
| | | | 175 x 330 x 63 |
| 1992 Aug 12 | | | 89.44 170 x 323 x 63.1 |
| | | Orbit raise | 89.70 171 x 347 x 63.1 |
| 1992 Aug 15 | | | 89.64 170 x 343 x 63.1 |
| 1992 Aug | | Maneuver engine failed | |
| 1992 Aug 20 | | | 169 x 335 x 63.1 |

FSW 2

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1992 Aug 25 | 0310? | EM sep | |
| | 0310? | Deorbit | |
| | 0311? | Retrograde module sep | |
| | 0320 | Capsule recovered | |
| 1992 Aug 25 | | | 89.23 170 x 302 x 63.0 |
| 1992 Sep 1 | | | 87.27 129 x 149 x 63.0 |
| 1992 Sep 1 | | Reentered | |

Payload

Recoverable capsule
Retrograde module
Equipment module, service section
Equipment module, pressurized section

- **Fanhui Shi Weixing 2** (1994-37A)

Mass was 2760 kg. On this flight the equipment module ended up in a higher orbit after capsule recovery. Phillip Clark speculated that following the 1993 failure, the EM remained attached until the moment of the deorbit burn, with the burn plume separating the vehicles and pushing the EM into a higher orbit. A debris object (37D) cataloged and decayed on Jul 18 was probably spurious, but might have been the retrograde module.

FSW-2 No 2

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1994 Jul 3 | 0800 | Launch by CZ-2D | JQ |
| 1994 Jul 4 | | | 174 x 353 x 63.0 |
| 1994 Jul 8 | | | 173 x 329 x 63.0 |
| | | apogee raise | 173 x 337 x 63.0 |
| 1994 Jul 11 | | | 173 x 330 x 63.0 |
| | | apogee raise | 174 x 338 x 63.0 |
| 1994 Jul 14 | | | 172 x 333 x 63.0 |
| | | apogee raise | 172 x 340 x 63.0 |
| 1994 Jul 18 | | | 171 x 324 x 63.0 |
| 1994 Jul 18 | | EM sep | |
| | | Deorbit burn | |
| | | Retro module sep | |
| | 0335 | Landed in Sichuan province | |
| | | EM orbit | 90.33 208 x 372 x 63.0 |
| | | Debris (37D) | 91.41 131 x 557 x 62.8 |

Payload

Recoverable capsule
Biological speciments (including rats?)
Retrograde module
Equipment module, service section
Equipment module, pressurized section

- **Fanhui Shi Weixing 2** (1996-59A)

The third FSW-2 satellite was launched in 1996 and successfully recovered after a 15 day flight. Mass was 2970 kg.

FSW-2 No. 3

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1996 Oct 20 | 0720 | Launch by CZ-2D | JQ |
| | | Stage 2 burn | |



FSW-2 No. 3

| Date | Time | Event | Orbit |
|---|---|---|---|
| | | Stage 2 sep | |
| | | | 172 x 338 x 63.0 |
| 1996 Oct 26 | | | 89.49 170 x 328 x 63.0 |
| 1996 Oct 27 | | Raise | 89.62 170 x 340 x 63.0 |
| 1996 Oct 28 | | | 89.57 171 x 335 x 63.0 |
| 1996 Oct 29 | | Raise | 89.62 171 x 340 x 63.0 |
| 1996 Oct 31 | | | 89.54 170 x 332 x 63.0 |
| 1996 Nov 1 | | | 89.59 170 x 338 x 63.0 |
| 1996 Nov 4 | | RV deorbit | |
| 1996 Nov 4 | 1058LT? | RV landed | |
| 1996 Nov 11 | | | 89.10 166 x 292 x 63.0 |
| | | | 89.61 211 x 298 x 63.0 |
| 1996 Dec 3 | | | 87.03 121 x 133 x 63.0 |

- **JB-4** (2003-51A)

A new generation FSW/JB satellite was launched by a CZ-2D with a stretched second stage in late 2003, shortly after the first piloted Shenzhou flight. It was reportedly designated Jianbing-4.

I speculate a slightly larger mass of 3200 kg for the JB-4, with a recoverable section mass of 1200 kg.

FSW-3

| Date | Time | Event | Orbit |
|---|---|---|---|
| 2003 Nov 3 | 0720 | Launch by CZ-2D | |
| | 0730? | Stage 2 MECO | |
| 2003 Nov 3 | | | 89.69 193 x 324 x 62.99 |
| 2003 Nov 4 | | | 89.78 193 x 333 x 62.99 |
| 2003 Nov 8 | 2154 | 89.75 192 x 331 x 62.99 | |
| | | Apogee raise 4 km | |
| 2003 Nov 9 | | | 89.79 192 x 335 x 62.99 |
| 2003 Nov 14 | | | 89.76 192 x 332 x 62.99 |
| | | Apogee raise 5 km | |
| 2003 Nov 15 | | | 89.81 192 x 337 x 62.99 |
| 2003 Nov 20 | | | 89.70 191 x 328 x 62.99 |
| 2003 Nov 21 | 0142 | Deorbit command over 54N 80E | |
| | | RV separation | -430? x 550? x 63.0 |
| 2003 Nov 21 | 0204 | Landed in Sichuan province | |
| 2003 Nov 22 | | Apogee raise 29km | |
| | | | 90.01 192 x 357 x 62.99 |
| 2003 Nov 28 | | | 89.82 190 x 340 x 62.98 |

Table 46: FSW

| Payload | Name | Launch Veh. | Site | Launch Date | Reentry Date | Dur | Orbit | Designation |
|---|---|---|---|---|---|---|---|---|
| FSW 1 | FSW | CZ-2A | JQ | 1974 Nov 5 | 1974 Nov 5 | 0 | - | - |
| FSW 2 | FSW | CZ-2 | JQ | 1975 Nov 26 | 1975 Dec 2 | 6d | 179 x 479 x 63.0 | 1975-111A |
| FSW 3 | FSW | CZ-2 | JQ | 1976 Dec 7 | 1976 Dec 9 | 3d | 174 x 469 x 59.5 | 1976-117A |
| FSW 4 | FSW | CZ-2 | JQ | 1978 Jan 26 | 1978 Jan 30 | 4d | 161 x 479 x 57.0 | 1978-11A |
| FSW 5 | FSW | CZ-2 | JQ | 1982 Sep 9 | 1982 Sep 14 | 5d | 170 x 355 x 63.0 | 1982-90A |
| FSW 6 | FSW | CZ-2 | JQ | 1983 Aug 19 | 1983 Aug 24 | 5d | 173 x 389 x 63.3 | 1983-86A |
| FSW 7 | FSW | CZ-2 | JQ | 1984 Sep 12 | 1984 Sep 17 | 5d | 171 x 389 x 68 | 1984-98A |
| FSW 8 | FSW | CZ-2 | JQ | 1985 Oct 21 | 1985 Oct 26 | 5d | 170 x 342 x 63.0 | 1985-96A |
| FSW 9 | FSW | CZ-2 | JQ | 1986 Oct 6 | 1986 Oct 11 | 5d | 172 x 378 x 57.0 | 1986-76A |
| FSW 10 | FSW | CZ-2 | JQ | 1987 Aug 5 | 1987 Aug 10 | 5d | 171 x 396 x 63.0 | 1987-67A |
| FSW-1 1 | FSW-1 | CZ-2C | JQ | 1987 Sep 9 | 1987 Sep 17 | 8d | 206 x 310 x 63.0 | 1987-75A |
| FSW-1 2 | FSW-1 | CZ-2C | JQ | 1988 Aug 5 | 1988 Aug 13 | 8d | 205 x 306 x 63.0 | 1988-67E |
| FSW-1 3 | FSW-1 | CZ-2C | JQ | 1990 Oct 5 | 1990 Oct 13 | 8d | 208 x 312 x 57.0 | 1990-89A |
| FSW-1 4 | FSW-1 | CZ-2C | JQ | 1992 Oct 6 | 1992 Oct 13 | 7d | 213 x 311 x 63.0 | 1992-64B |
| FSW-1 5 | FSW-1 | CZ-2C | JQ | 1993 Oct 8 | 1993 Oct 16 | 8d | 207 x 295 x 56.9 | 1993-63A |
| FSW-2 1 | FSW-2 | CZ-2D | JQ | 1992 Aug 9 | 1992 Aug 25 | 16d | 175 x 330 x 63.0 | 1992-51A |
| FSW-2 2 | FSW-2 | CZ-2D | JQ | 1994 Jul 3 | 1994 Jul 18 | 15d | 173 x 329 x 63.0 | 1994-37A |
| FSW-2 3 | FSW-2 | CZ-2D | JQ | 1996 Oct 20 | 1996 Nov 4 | 15d | 170 x 340 x 63.0 | 1996-59A |
| JB-4 | JB-4 | CZ-2D | JQ | 2003 Nov 3 | 2003 Nov 21 | 18d | 193 x 324 x 63.0 | 2003-51A |



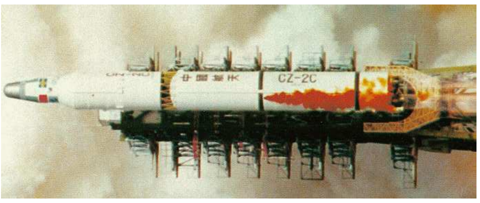



Figure 23: Launch of FSW-1-4 and Freja

### 4.3 Communications Satellites (STTW, DFH)

The DFH-2 satellite was 2.1m dia and 3.1m high. Mass is 915 kg launch, 420 kg BOL. The DFH-2A is 1024 kg launch, 441 kg BOL, 363 kg dry. Size is 2.1m dia 3.7m high.

The first Zhongxing 6 failed so the name was reassigned.

Table 47: Zhongxing (Chinastar) satellites

| Name | Type | Launch date | Desig | Notes |
|---|---|---|---|---|
| Zhongxing? | DFH-2 | 1984 Apr 8 | 1986-10A | |
| Zhongxing? | DFH-2 | 1986 Feb 1 | 1986-10A | |
| Zhongxing 1 | DFH-2A | 1988 Mar 7 | 1988-14A | |
| Zhongxing 2 | DFH-2A | 1988 Dec 22 | 1988-111A | |
| Zhongxing 3 | DFH-2A | 1990 Feb 4 | 1990-11A | |
| Zhongxing 4 | DFH-2A | 1991 Dec 28 | 1991-88A | |
| Zhongxing 5 | AS3000 | 1993 Jun 26 | 1984-49A | Previously Spacenet 1 |
| (Zhongxing 6) | DFH-3 | 1994 Nov 29 | 1994-80A | |
| Zhongxing 7 | HS-376 | 1996 Aug 18 | 1996-48A | |
| Zhongxing 6 | DFH-3 | 1997 May 21 | 1997-21A | |
| Zhongxing 22 | DFH-3 | 2000 Jan 25 | 2000-03A | |
| Zhongxing 20 | DFH-3 | 2003 Nov 14 | 2003-52A | |

• **Shiyan Weixing** (1984-08A)

The first Chinese experimental comsat was launched in Jan 1984. The third stage of the Chang Zheng 3 rocket failed to restart, leaving the satellite in a low orbit, but a successful test of the apogee motor and stationkeeping propulsion system was carried out. The satellite was referred to as Shiyan Weixing (Experimental Satellite) compared to the later STTW name, implying that this satellite may not have carried an actual communications payload.

The third stage failure was due to an error in the gas generator mixture ratio; the turbine overheated and failed.

The apogee motor was a Shanxi FG-15, with a mass of 525 kg.

SW

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1984 Jan 29 | 1225 | Launch by CZ-3 | XSC |
| | | Stage 1 sep | |
| | | Stage 2 burn | |
| | | Stage 2 MECO | |
| | | Stage 2 sep | |
| | | Stage 3 MES-1 | |
| | | Stage 3 MECO-1 | 92.0 347 x 408 x 31.0 |
| | 1240 | Stage 3 MES-2 | |
| | 1240 | Stage 3 cutoff after 3s, T+903s | |
| 1984 Jan 30 | | AKM burn | 160.7 360 x 6474 x 36.0 |
| 1984 Jan 31 | | | 160.80 358 x 6475 x 36.0 |
| 1984 Feb 8 | | | 160.74 355 x 6473 x 36.0 |
| 1984 Feb | | Hydrazine RCS burns | |
| 1984 Feb 10 | | | 160.78 356 x 6475 x 36.1 |
| 1984 Feb 11 | | | 161.28 378 x 6495 x 36.1 |
| 1984 Feb 12 | | | 161.51 379 x 6511 x 36.1 |
| 1984 Feb 14 | | | 162.27 394 x 6559 x 36.1 |
| 1984 Feb 15 | | | 162.64 401 x 6581 x 36.1 |
| 1984 Mar 11 | | | 162.63 402 x 6579 x 36.1 |
| 1984 Mar 12 | | Raise peri | 163.17 446 x 6579 x 36.1 |
| 1984 Mar 29 | | | 163.20 446 x 6581 x 36.2 |



SW

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1984 Mar 30 | | Raise peri | 163.60 480 x 6580 x 36.1 |
| 1984 Apr 16 | | | 163.55 475 x 6581 x 36.2 |
| 1984 May 12 | | Lower peri | 163.44 469 x 6578 x 36.2 |
| 1984 Jul 7 | | | 163.33 462 x 6577 x 36.2 |
| 1984 Sep 19 | | Last mv | 163.37 461 x 6580 x 36.1 |

• **Shiyan Tongbu Tongxin Weixing** (1984-35A)

The STTW satellite (Experimental Synchronous Communications Satellite) had a mass of 900 kg at launch, 420 kg on orbit. It was China's first geostationary satellite. The satellite remained at 124E until 1988 when its orbit was raised.

Figure 24: STTW (DFH-2) satellite

The satellite was a DFH-2 class satellite 2.1m dia 1.6m high with a mass of 920 kg. DFH-2 was spin-stabilized with a despun horn antenna.

STTW

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1984 Apr 8 | 1120 | Launch by CZ3 | XSC |
| | | Stage 2 burn | |
| | | Stage 3 burn | |
| | | Stage 3 MECO | |
| 1984 Apr 9 | | | 633.21 401 x 35694 x 31.0 |
| 1984 Apr 10 | 0041 | Apogee burn | 1431.94 35683 x 35727 x 0.9 GEO 142.4E+1.0E |
| 1984 Apr 10 | | | GEO 142E dr |
| 1984 Apr 12 | | | 1444.55 35520 x 36383 x 0.7 GEO 137.3E+2.1W |
| 1984 Apr 16 | | On station 125E | |
| 1984 Apr 26 | | | 1436.13 35782 x 35791 x 0.6 GEO 125.1E |
| 1984 May | | | GEO 125E |
| 1985 Jun 21 | | | 1435.92 35772 x 35794 x 1.5 GEO 125.1E |
| 1986 Oct | | | GEO 125E |
| 1987 Mar 19 | | | 1436.36 35788 x 35796 x 1.6 GEO 124.1E |
| 1988 Jan 21 | | | 1436.38 35788 x 35795 x 1.6 GEO 124.1E |

STTW

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1988 Jun 26 | | | 1436.49 35769 x 35819 x 1.9 GEO 124.1E |
| 1988 Jun 28 | | mv out | 1436.88 35784 x 35818 x 1.3 GEO 123.7E+0.2W |
| 1988 Jul 16 | | | 1437.02 35785 x 35824 x 1.3 GEO 119.9E+0.2W |
| 1999 Apr 7 | | | 1435.85 35746 x 35817 x 9.3 |

Payload

C-band transponders (2)

- **Shiyong Tongbu Tongxin Weixing** (1986-10A)


Figure 25: STTW (DFH2) satellite

The Feb 1986 launch carried the Shiyong Tongbu Tongxin Weixing (Operational Synchronous Communications Satellite), the second DFH-2 satellite. (DFH is an abbreviation for Dong Fang Hong, the East Is Red). Launch mass 920 kg. BOL mass was 433 kg.

STTW 1

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1986 Feb 1 | 1237 | Launch by CZ-3 | XSC |
| | | Stage 2 burn | |
| | | Stage 3 burn | |
| | 1255? | Stage 3 MECO | |
| | | | 633.89 420 x 35711 x 31.0 |
| 1986 Feb 3 | 0200? | Apogee burn | |
| 1986 Feb 3 | | | 1403.55 34411 x 35882 x 0.1 GEO 142.5E+8.3E |
| 1986 Feb 4 | | | 1450.09 35895 x 36224 x 0.2 GEO 148.9E+3.5W |
| 1986 Feb 18 | | mv in | 1436.02 35779 x 35790 x 0.1 GEO 102.9E |
| 1986 Feb 20 | | On station 103E | |
| 1987 Mar 12 | | | 1435.99 35782 x 35786 x 0.1 GEO 103.0E |
| 1988 Oct 10 | | | 1435.93 35781 x 35785 x 0.1 GEO 103.2E |
| 1989 Sep 20 | | | 1436.35 35783 x 35799 x 1.0 GEO 103.3E |
| 1990 Apr 18 | | Last mv | |
| 1990 Jun 11 | | | 1436.16 35782 x 35793 x 1.7 GEO 104.0E |
| 1991 Feb 16 | | | 1436.97 35793 x 35813 x 2.3 GEO 82.7E+0.2W |
| 1995 Nov 26 | | | 1436.64 35769 x 35825 x 6.1 GEO 52.8E+0.1W |

Payload

Antenna, 0.7m dia



- **Shiyong Tongbu Tongxin Weixing 2** (1988-14A)

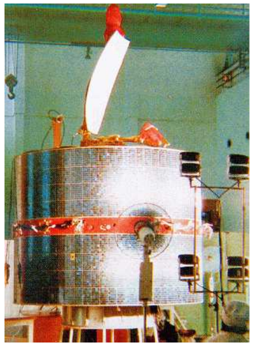


Figure 26: The DFH-2A class ZX-1 satellite

The STTW 2 (Zhongxing 1) satellite was launched on 1988 Mar 7 by Chang Zheng 3 from Xichang. It was the first DFH-2A class satellite and went to the 87.5E Chinasat 1 position. Launch mass was 1040 kg; 530 kg on orbit? The satellite was replaced by Zhongwei 1.

The DFH-2A apogee motor was 1.49 long 0.90dia with a mass of 580 kg full 70 kg dry, and an impulse of 1432 kNs over 40s. in very good agreement with the required 1.89 km/s dV.

Chinasat 1 (STTW 2)

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1988 Mar 7 | 1241 | Launch by CZ3 | XSC |
| | | stage 2 burn | |
| | | Stage 3 burn | |
| | | Stage 3 sep | |
| | | | 630.26 179 x 35765 x 31.2 |
| 1988 Mar 9 | 0148 | AKM burn | 1455.0 35715 x 36597 x 0.5 GEO 124E-5/d |
| 1988 Mar 10 | | | 1457.16 35784 x 36611 x 0.5 GEO 141.5E+5.2W |
| 1988 Mar 22 | | mv in | 1436.10 35782 x 35791 x 0.2 GEO 87.3E |
| 1988 Mar 23 | | | GEO 88E |
| 1988 Apr 3 | | On station | GEO 87.5E |
| 1988 Apr 7 | | | 1436.07 35767 x 35805 x 0.0 GEO 87.6E |
| 1989 Jun 24 | | | 1436.19 35783 x 35793 x 0.1 GEO 87.2E |
| 1991 May 19 | | | 1436.13 35779 x 35795 x 0.0 GEO 87.5E |
| 1993 Feb 20 | | | 1436.09 35781 x 35791 x 0.0 GEO 87.5E |
| 1995 Jan 27 | | | 1436.06 35776 x 35795 x 1.5 GEO 87.5E |
| 1996 Apr 9 | | | 1436.13 35782 x 35792 x 2.4 GEO 87.9E |
| 1997 Mar 5 | | mv | |
| 1997 Apr 17 | | mv | |
| 1997 Jul 14 | | last mv | |
| 1997 Jul | | End of ops | |
| 1997 Nov | | | GEO 87.5E drift |
| 1997 Dec 23 | | | 1436.47 35752 x 35835 x 3.6 GEO 82.9E+0.1W |
| 1999 Jun 15 | | | 1435.74 35757 x 35801 x 4.6 GEO 84.5E+0.1E |

Payload

C-band transponders (8)

• **Shiyong Tongbu Tongxin Weixing 3** (1988-111A)

STTW-3 (Chinasat 2, Zhongxing 2?) was launched in Dec 1988. The DFH-2A class satellite was stationed at 110.5E (Chinasat 2). The third stage has not been cataloged.

In 1997 the longitude of the spacecraft was allowed to vary in a slightly wider band, presumably indicating that fuel reserves were low. It finally drifted off station in Sep 1999, having been replaced by Sinosat 1.

Chinasat 2 (STTW 3)

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1988 Dec 22 | 1240 | Launch by Chang Zheng 3 | XSC |
| 1988 Dec 23 | 0700 | | 1471.03 35756 x 37179 x 0.5 GEO 152E-9/d |
| 1988 Dec 29 | 0930 | On station | 1436.05 35783 x 35788 x 0.6 GEO 110.3E |
| 1989 Feb 10 | | | 1436.10 35785 x 35788 x 0.4 GEO 110.7E |
| 1989 Nov 25 | | | 1436.24 35779 x 35799 x 0.1 GEO 110.9E |
| 1991 Jan 11 | | | 1436.02 35781 x 35788 x 0.1 GEO 110.8E |
| 1992 May 22 | | | 1436.13 35782 x 35792 x 0.0 GEO 110.6E |
| 1994 Jun 15 | | | 1436.21 35786 x 35790 x 0.0 GEO 110.4E |
| 1996 Apr 7 | | | 1436.03 35775 x 35794 x 0.8 GEO 110.5E |
| 1997 Feb | | Stationkeep band widened | |
| 1997 Jul 7 | | | 1435.86 35771 x 35792 x 1.7 GEO 110.3E |
| 1999 Jun 15 | | | 1436.32 35781 x 35800 x 3.1 GEO 110.6E |
| 1999 Sep | | Drifting | |
| 2003 Sep 1 | | | 1435.05 35737 x 35794 x 6.4 |

Payload

C-band transponders (8)

• **Shiyong Tongbu Tongxin Weixing 4** (1990-11A)

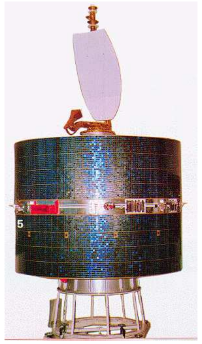


Figure 27: DFH-2A satellite

STTW-4 (Chinasat 3, Zhongxing 3?) was launched in Feb 1990 and was the third and last DFH-2A satellite. It was stationed at the 98E Chinasat 3 position. Mass was 1040 kg.

The satellite ended operations in mid 1998, and was apparently replaced by Feng Huo 1.

Chinasat 3

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1990 Feb 4 | 1228? | Launch by CZ-3 | XSC |
| | | Stage 3 burn | |
| | | Stage 3 MECO | |
| 1990 Feb 5 | | | 720.85 4732 x 35773 x 12.3 |
| 1990 Feb 6 | 0230? | AKM | |
| 1990 Feb 6 | | | 1470.64 35721 x 37199 x 0.5 GEO 146.0E+8.5W |
| 1990 Feb 12 | | mv in | 1436.40 35782 x 35802 x 0.1 GEO 97.9E+0.1W |
| 1990 Feb 18 | | | 1436.01 35779 x 35790 x 0.1 GEO 97.9E |
| 1990 Feb 27 | | | 1436.06 35784 x 35787 x 0.1 GEO 98.1E |
| 1991 Jul 7 | | | 1436.06 35778 x 35792 x 0.1 GEO 98.2E |
| 1992 Mar 12 | | | 1436.14 35783 x 35791 x 0.1 GEO 98.1E |
| 1993 Jun 13 | | | 1436.18 35777 x 35798 x 0.0 GEO 98.0E |
| 1994 Apr 22 | | | 1436.00 35782 x 35787 x 0.1 GEO 97.9E |
| 1995 May 19 | | | 1436.15 35780 x 35794 x 0.1 GEO 98.2E |
| 1998 Jul 2 | | Last mv | 1436.07 35777 x 35794 x 2.3 GEO 98.5E |
| 1998 Aug 12 | | | 1436.31 35781 x 35800 x 2.3 GEO 97.5E+0.06W |
| 1999 Jun 15 | | | 1436.44 35779 x 35807 x 3.0 GEO 54.3E+0.1W |



Payload

C-band transponders (8?)

• **Shiyong Tongbu Tongxin Weixing 5** (1991-88A)

STTW-5 was launched on 1991 Dec 28 but the second burn of the third stage failed after 58 seconds. A plumbing leak in the helium pressurization system was the culprit. The apogee motor was fired to place the spacecraft in GTO, and the fuel was depleted in early 1992 to raise perigee to 2100 km.

STTW 5

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1991 Dec 28 | 1202 | Launch by CZ-3 | XSC |
| | 1204 | Stage 1 sep | |
| | 1206 | T+4:15 St 2 MECO | |
| | 1206 | T+4:19 Fairing | |
| | 1206 | T+4:22 St 2 VECO | |
| | 1206 | T+4:23 Stage 2 sep | |
| | 1206 | T+4:23 Stage 3 burn 1 | |
| | 1213 | T+11:28 Stage 3 cutoff, parking orbit | |
| | 1217 | T+15:35 Stage 3 restart | |
| | | Stage 3 failed after 58s | |
| | 1219 | T+17:50 Engine thrust terminated at 135s | |
| | 1223 | T+21:32? Payload and stage 3 sep | 219 x 2451 x 31.1 |
| 1991 Dec 29 | 0043 | AKM fired | |
| 1992 Jan 9 | | | 617.49 208 x 35076 x 31.62 |
| 1992 Feb 17 | | | 609.20 185 x 34668 x 31.5 |
| 1992 Feb? | | Raise orbit | |
| 1993 Mar 28 | | | 632.72 2131 x 33939 x 31.5 |
| 1999 Aug 31 | | | 632.58 2012 x 34051 x 31.8 |

• **Kua Fu 1** (1994-10B)

The first test flight of the uprated CZ-3A launch vehicle carried a dummy version of the DFH-3 satellite. It was named KF 1 (Kua Fu), after a mythical character. Mass was 1342 kg. Shape was 2.5dia 2.2l cylinder + cone.

DFH-3 Mockup

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1994 Feb 8 | 0830 | Launch by CZ-3A | XSC |
| | | Stage 2 sep | |
| | | Stage 3 burn 1 | |
| | | Stage 3 cutoff, parking orbit | |
| | | Stage 3 restart | |
| | | Stage 3 MECO | |
| 1994 Feb 8 | | Stage 3 sep | 637.09 208 x 36086 x 28.6 |
| 1999 Sep 4 | | | 322.70 158 x 18254 x 28.4 |

- **DFH-3** (1994-80A)

A DFH-3 satellite was launched on 1994 Nov 29. The satellite failed to stabilize its orbit, due to a fuel leak. The satellite was a 2.2 x 1.7 x 2.0 m box with a 2m dish and two panels. Span 18.1m, deployed height 5.7m. Mass 2230 kg launch 1145 kg BOL. The satellite has an FY-25 apogee motor with a thrust of 490N.

The intended location was 125E.

DFH-3

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1994 Nov 29 | 1702 | Launch by CZ-3A | XSC LC2 |
| | | Stage 2 burn | |
| | | Stage 3 burn | |
| | | Stage 3 MECO | |
| 1994 Nov 29 | | | 635.35 180 x 36026 x 28.5 |
| 1994 Dec | | LAM | |
| 1994 Dec 13 | | | 760.79 6391 x 36064 x 12.4 |
| 1994 Dec 17 | | | 760.75 6389 x 36064 x 12.4 |
| 1994 Dec 18? | | LAM | |
| 1994 Dec 29 | | | 1425.91 35181 x 35992 x 0.3 GEO 126.8E+2.5E |
| 1995 Jan 8 | | | 1426.30 35225 x 35964 x 0.2 GEO 152.0E+2.5E |
| 1999 Oct 16 | | | 1426.26 35205 x 35982 x 3.3 GEO 171.3W+2.5E |

PAYLOAD

C-band transponders (24)

- **DFH-3** (1997-21A)

A DFH-3 (Dongfanghong 3) satellite was launched on 1997 May 11. The DFH-3-A2 satellite was also referred to as Zhongxing No. 6. Launch mass was 2260 kg. It was stationed at 125E.

DFH-3

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1997 May 11 | 1617 | Launch by CZ-3A | XSC LC2 |
| | | T+2:25 Stage 1 MECO | |
| | | T+2:27 Stage 2 MES, Stage 1 sep | |
| | | T+3:52 Fairing | |
| | | T+4:15 St 2 MECO | |
| | | T+4:20 St 2 VECO | |
| | | T+4:21 St 2 sep, St 3 MES | |
| | | T+10:19 St 3 MECO-1 | |



DFH-3

| Date | Time | Event | Orbit |
|---|---|---|---|
| | | T+20:00 St 3 MES-2 | |
| | | T+22:00 St 3 MECO-2 | |
| | | T+23:40 Stage 3 sep | |
| 1997 May 11 | | | 633.12 203 x 35888 x 28.5 |
| 1997 May 12 | 0830? | LAM1 | |
| 1997 May 12 | | | 765.87 6782 x 35919 x 12.1 |
| 1997 May 13 | 0959? | LAM2 | 1342.40 31866 x 35998 x 0.6 |
| 1997 May 14 | 0830? | LAM3 | |
| 1997 May 14 | | | 1410.05 34613 x 35936 x 0.1 GEO 105.5E+6.6E |
| 1997 May 17 | | | 1434.72 35661 x 35857 x 0.3 GEO 124.5E+0.3E |
| 1997 May 20 | | | 1435.40 35758 x 35787 x 0.3 GEO 125.0E+0.1E |
| 1997 May 30 | | | 1436.12 35784 x 35789 x 0.3 GEO 125.1E |
| 1999 Oct 17 | | | 1436.13 35773 x 35800 x 0.2 GEO 125.1E |

PAYLOAD

C-band transponders (24)

- **Zhongxing-22** (2000-03A)


2300 kg CAST-built DFH-3 comsat launched Jan 2000. Known as Zhongxing-22 (the ITU registered location) and as Feng Huo 1. Phillip Clark has suggested that Feng Huo 1 is used for military communications. Feng Hou was a message system (beacon fires?) used by the ancient Chinese along the Great Wall. Control from Xi'an SCC.

(Ascent times based on 1997 launch).

Zhongxing-22

| Date | Time | Event | Orbit |
|---|---|---|---|
| 2000 Jan 25 | 1645 | Launch by CZ-3A | XSC |
| | | T+2:25 Stage 1 MECO | |
| | | T+2:27 Stage 2 MES, Stage 1 sep | |
| | | T+3:52 Fairing | |
| | | T+4:15 St 2 MECO | |
| | | T+4:20 St 2 VECO | |
| | | T+4:21 St 2 sep, St 3 MES | |
| | 1655 | T+10:19 St 3 MECO-1 | |
| | | T+20:00 St 3 MES-2 | |
| | | T+22:00 St 3 MECO-2 | |

| Zhongxing-22 | | | |
|---|---|---|---|
| Date | Time | Event | Orbit |
| | 1708 | T+23:40 Stage 3 sep | |
| 2000 Jan 26 | | | 767.08 493 x 42266 x 24.9 |
| 2000 Jan 30 | | | 756.24 347 x 41887 x 24.3 |
| 2000 Feb 1 | | LAM burn? | |
| 2000 Feb 6 | | On station 98E | |
| 2000 Feb 7 | | | 1436.00 35781 x 35787 x 0.8 GEO 97.9E |
| 2000 May 27 | | | 1436.21 35777 x 35800 x 0.5 GEO 97.9E |

- **Zhongxing-20** (2003-52A)

  CAST/CASTC DFH-3.
  Mass 2300 kg. To go to 103E.

| ZX-20 | | | |
|---|---|---|---|
| Date | Time | Event | Orbit |
| 2003 Nov 14 | 1601 | Launch by CZ-3A | XSC |
| | | T+2:25 Stage 1 MECO | |
| | | T+2:27 Stage 2 MES, Stage 1 sep | |
| | | T+3:52 Fairing | |
| | | T+4:15 St 2 MECO | |
| | | T+4:20 St 2 VECO | |
| | | T+4:21 St 2 sep, St 3 MES | |
| | 1611? | T+10:19 St 3 MECO-1 | 200 x 200 x 28.5? |
| | 1621? | T+20:00 St 3 MES-2 | |
| | 1623? | T+22:00 St 3 MECO-2 | |
| | 1625? | Stage 3 sep | 212 x 41981 x |
| 2003 Nov 14 | | | 754.15 198 x 41934 x 24.98 |
| 2003 Nov 20 | | | 1435.96 35770 x 35796 x 0.31 GEO 103.0E |
| 2003 Nov 26 | | | 1436.00 35775 x 35793 x 0.29 GEO 103.0E |



Table 60: DFH

| Payload | Name | Launch Veh. | Site | Launch Date | Reentry Date | Dur | Orbit | Designation |
|---|---|---|---|---|---|---|---|---|
| DFH-2 | Shiyan Weixing | CZ-3 | XSC | 1984 Jan 29 | 1984 Sep? | 0.7yr | 476 x 6583 x 36 | 1984-08A |
| DFH-2 | Shiyan Tongbu Tongxin Weixing | CZ-3 | XSC | 1984 Apr 8 | 1988 Jun 28 | 4.2 yr | 35782 x 35791 x 0.6 GEO 125E | 1984-35A |
| DFH-2 | Shiyong Tongbu Tongxin Weixing | CZ-3 | XSC | 1986 Feb 1 | 1990 May? | 4.3yr | 35782 x 35786 x 0.1 GEO 103E | 1986-10A |
| DFH-2A | Zhongxing 1 | CZ-3 | XSC | 1988 Mar 7 | 1997 Jul | 9.3yr | 35783 x 35793 x 0.1 GEO 87E | 1988-14A |
| DFH-2A | Zhongxing 2 | CZ-3 | XSC | 1988 Dec 22 | 1998 Dec | 10.0yr | 35785 x 35788 x 0.4 GEO 110E | 1988-111A |
| DFH-2A | Zhongxing 3 | CZ-3 | XSC | 1990 Feb 4 | 1998 Jul | 8.4yr | 35784 x 35787 x 0.1 GEO 98E | 1990-11A |
| DFH-2A? | Zhongxing 4 | CZ-3 | XSC | 1991 Dec 28 | 1992 Mar? | 0.3yr | 2131 x 33939 x 31.5 | 1991-88A |
| DFH-3 Mockup | Kua Fu 1 | CZ-3A | XSC | 1994 Feb 8 | 1994 Feb 8 | 0.0yr | 208 x 36086 x 28.6 | 1994-10B |
| DFH-3 | Dong Fang Hong 3 | CZ-3A | XSC | 1994 Nov 29 | 1994 Dec | 0.1yr | 35225 x 35964 x 0.2 | 1994-80A |
| DFH-3 | Zhongxing 6 | CZ-3A | XSC | 1997 May 11 | | | 35784 x 35789 x 0.3 GEO 125E | 1997-21A |
| DFH-3 | Feng Huo 1 (Zhongxing-22) | CZ-3A | XSC | 2000 Jan 25 | | | | 2000-03A |
| DFH-3 | Feng Huo 2? (Zhongxing-20) | CZ-3A | XSC | 2003 Nov 14 | | | | 2003-52A |

## 4.4 Test payloads

- **Aussat B Mockup** (1990-59)

Figure 28: EPKM motor being loaded on the first CZ-2E

The 7300 kg payload of the first CZ-2E launch, on 1990 Jul 16, was a dummy mass model of the Aussat B satellite to be used on the first operational launch, together with a Chinese built EPKM kick motor. Although it is believed to have been in the form of an HS-601 satellite, the mockup was probably built by China and not by Hughes. The second stage of the CZ-2E rocket entered a 204 x 990 km orbit and remained in space until 1990 Oct 9. The Aussat mockup/EPKM combination reportedly reentered on the day of launch; it is possible that the EPKM fired in the wrong direction. Alternatively, the CALT web page suggests that the PKM was only a mockup, in which case it may have remained attached to the second stage.

Aussat B Mockup

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1990 Jul 16 | 0040 | Launch by CZ2E | XSC LC2 |
| 1990 Jul 16 | | Orbit insertion | 96.63 204 x 990 x 28.5 |
| | | Failed to orient | |
| | | Payload ejection failed | |
| 1990 Oct 9 | | Reentered | |

Payload

Dummy Aussat B, 2700 kg
EPKM, 4650 kg



Table 62: EPKM Test Flights

| Payload | Name | Launch Veh. | Site | Launch Date | Reentry Date | Dur | Orbit | Designation |
|---|---|---|---|---|---|---|---|---|
| EPKM-1 | Aussat B Mockup/EPKM | CZ-2E | XSC | 1990 Jul 16 | 1990 Jul 16 | 0 | 204 x 990 x 28.5 | 1990-59 |

## 4.5 ZY (CBERS)

- **Zi Yuan 1** (1999-57A)

Figure 29: ZY-1

The 1540 kg China-Brasil Earth Resources Satellite 1, ZY-1 ("Resource") is built by CAST. CBERS 2, launched three years later, was built by INPE. Size is 1.8 x 2.0 x 2.0 m, 9.8m span box +1 panel.

Xian control center, China; CRC/INPE, San Jose dos Campos.

From late October to early November the satellite's on board engine raised the orbit to sun-synchronous altitude [4]. Since then, very small orbital tweaks have maintained the altitude. A slightly larger burn on 2003 Aug 13 may have marked the satellite's retirement, according to analyst Phillip Clark.

The upper stage broke up into more than 125 pieces.

ZY-1

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1999 Oct 14 | 0316 | Launch by CZ-4B | TY |
| | | T+2:33 Stage 1 MECO | |
| | | T+2:34 Stage 1 sep | |
| | | T+2:54 Fairing | |
| | | T+4:37 St 2 MECO | |
| | | T+4:47 St 2 VECO | |
| | | T+4:48 St 2 sep | |
| | | T+4:48 St 3 burn | |
| | 0327 | T+11:18 St 3 MECO | |
| | 0328 | T+12:28 ZY 1 sep | |
| | 0330? | T+12:55 SACI-1 sep | |
| 1999 Oct 20 | | | 99.54 727 x 746 x 98.6 |
| | | Cal burn | 99.59 733 x 745 x 98.6 |
| 1999 Nov 3 | | Orbit raise | 99.63 734 x 748 x 98.6 |
| 1999 Nov 5 | | Orbit raise | 99.92 747 x 763 x 98.6 |
| 1999 Nov 6 | | Orbit raise | 100.06 753 x 770 x 98.6 |
| 1999 Nov 8 | | Orbit raise | 100.27 770 x 772 x 98.6 |
| 1999 Nov 9 | | Orbit raise | 100.32 773 x 774 x 98.6 |
| 1999 Dec 17 | | Orbit trim | 100.32 773 x 775 x 98.6 |
| 2000 Feb 28 | | Orbit trim | |
| 2000 Mar 29 | | Orbit trim | |
| 2000 Apr 22 | | Orbit trim | |



ZY-1

| Date | Time | Event | Orbit |
|---|---|---|---|
| 2000 Jun 23 | | Orbit trim | |
| 2000 Aug 16 | | Orbit trim | |
| 2000 Nov 10 | | Orbit trim | |
| 2000 Dec 21 | | Orbit trim | |
| 2001 Feb 12 | | Orbit trim | |
| 2001 Apr 12 | | Orbit trim | |
| 2001 Jul 6 | | Orbit trim | |
| 2001 Oct 10 | | Orbit trim | |
| 2001 Nov 1 | | Orbit trim | |
| 2001 Dec 6 | | | 100.31 772 x 775 x 98.5 |
| 2001 Dec 6 | | Orbit trim | 100.32 773 x 774 x 98.5 |
| 2000 Mar 11 | 1304 | Stage 4 breakup | |
| 2000 Jun | | WFI failed | |
| 2003 Aug 13 | | | 100.32 773 x 774 x 98.4 |
| | | mv | 100.41 774 x 782 x 98.4 |

Payload

Wide Field Imager, 860 km FOV with 260m res
Hi Res CCD Camera, 20m res
IR Multispectral Scanner, 80m res
Data Collection System
2 x 20 N hydrazine system

- **ZY-2** (2000-50A)

ZY-2 was a domestic remote sensing satellite developed by CAST. The satellite was flown into a 474 x 493 km orbit, much lower than ZY-1. In 2001, Bill Gertz of the Washington Times reported that the civilian ZY-2 name was a cover for the Jianbing-3 imaging military reconnaissance satellite.

The ZY-2 adjusted its orbit on a regular basis, keeping it within a few km of its operational altitude.

ZY-2

| Date | Time | Event | Orbit |
|---|---|---|---|
| 2000 Sep 1 | 0325 | Launch by CZ-4B | Taiyuan |
| | | T+2:33 Stage 1 MECO | |
| | | T+2:34 Stage 1 sep | |
| | | T+2:54 Fairing | |
| | | T+4:37 St 2 MECO | |
| | | T+4:47 St 2 VECO | |
| | | T+4:48 St 2 sep | |
| | | T+4:48 St 3 burn | |
| | 0336 | T+11:18 St 3 MECO | |
| | 0337 | T+12:28 ZY 2 sep | 94.28 474 x 493 x 97.4 |
| 2000 Sep 8 | | Orbit raise | 94.40 483 x 496 x 97.4 |
| 2000 Sep 10 | | Orbit raise | 94.44 484 x 499 x 97.4 |
| 2000 Sep 28 | | | 94.42 482 x 499 x 97.4 |
| 2000 Sep 28 | | Orbit trim | 94.45 485 x 499 x 97.41 |
| 2000 Oct 10 | | Orbit trim | 94.45 486 x 498 x 97.4 |
| 2000 Oct 25 | | Orbit trim | |
| 2000 Nov 6 | | Orbit trim | |
| 2000 Nov 24 | | Orbit trim | |
| 2000 Dec 3 | | Orbit trim | |
| 2000 Dec 22 | | Orbit trim | |
| 2001 Jan 12 | | Orbit trim | |
| 2001 Feb 6 | | Orbit trim | |
| 2001 Mar 2 | | Orbit trim | |

| ZY-2 | | | |
|---|---|---|---|
| Date | Time | Event | Orbit |
| 2001 Mar 24 | | Orbit trim | |
| 2001 Apr 3 | | Orbit trim | |
| 2001 Apr 26 | | Orbit trim | |
| 2001 May 17 | | Orbit trim | |
| 2001 Jun 18 | | Orbit trim | |
| 2001 Jul 17 | | Orbit trim | |
| 2001 Sep 2 | | Orbit trim | |
| 2001 Sep 20 | | Orbit trim | |
| 2001 Oct 3 | | | 94.41 488 x 492 x 97.4 |
| 2001 Oct 3 | | Orbit trim | 94.46 489 x 495 x 97.4 |
| 2001 Oct 19 | | Orbit trim | |
| 2001 Oct 30 | | Orbit trim | |
| 2001 Nov 13 | | Orbit trim | |



- **CBERS-2** (2003-49A)

The second China-Brazil Earth Resources Satellite, CBERS-2 was built at INPE in Brazil. It was launched from China in Oct 2003 on a CZ-4B and called ZY-1 No. 2 by the Chinese. Mass was 1550 kg.

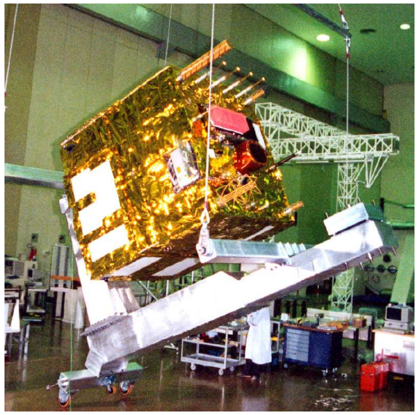


Figure 30: CBERS 2 before launch

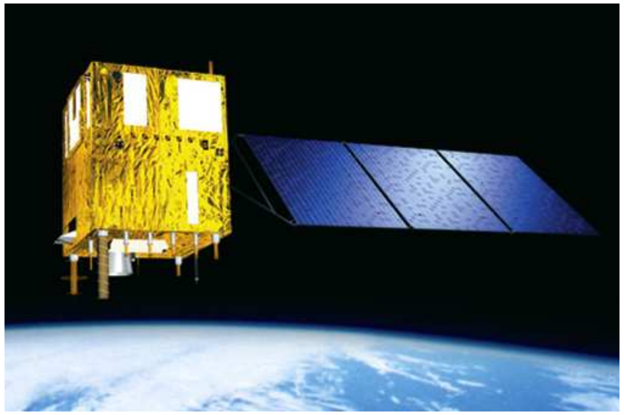


Figure 31: Illustration of CBERS 2 on orbit

| ZY-1 No 2/CBERS-2 | | | |
|---|---|---|---|
| Date | Time | Event | Orbit |
| 2003 Oct 21 | 0316 | Launch by CZ-4B | |
| | | T+2:33 Stage 1 MECO | |
| | | T+2:34 Stage 1 sep | |

Table 66: ZY

| Payload | Name | Launch Veh. | Site | Launch Date | Reentry Date | Dur | Orbit | Designation |
|---|---|---|---|---|---|---|---|---|
| ZY-1/CBERS-1 | Zi Yuan 1 | CZ-4B | TY | 1999 Oct 14 | 2003 Aug? | | 773 x 774 x 98.6 | 1999-57A |
| ZY-1/CBERS-2 | Zi Yuan 1 | CZ-4B | TY | 2003 Oct 21 | | | 772 x 774 x 98.5 | 2003-49A |
| ZY-2 | Zi Yuan 2 | CZ-4B | TY | 2000 Sep 1 | | | 474 x 493 x 97.4 | 2000-50A |
| ZY-2 | Zi Yuan 2 | CZ-4B | TY | 2002 Oct 27 | | | 470 x 483 x 97.4 | 2002-49A |



ZY-1 No 2/CBERS-2

| Date | Time | Event | Orbit |
|---|---|---|---|
| | | T+2:54 Fairing | |
| | | T+4:37 St 2 MECO | |
| | | T+4:47 St 2 VECO | |
| | | T+4:48 St 2 sep | |
| | | T+4:48 St 3 burn | |
| | | T+11:18 St 3 MECO | |
| | | T+12:28 ZY 1 sep | |
| | | T+12:55 CX sep | |
| 2003 Oct 22 | | | 99.62 730 x 750 x 98.54 |
| 2003 Oct 24 | | Orbit raise | 99.98 751 x 763 x 98.5 |
| 2003 Oct 27 | | Orbit raise | 100.27 770 x 771 x 98.5 |
| 2004 Jan 14 | | | 772 x 774 x 98.5 |

## 4.6 Beidou

• **Beidou** (2000-69A)

The Beidou ('Northern Dipper', or 'Ursa Major') navigation technology satellite for the People's Liberation Army was launched by CZ-3A in late 2000. It was built by CAST/Beijing. Also referred to as Beidou Daohang Jishu Weixing, 'Ursa Major Navigation Technology Satellite', and Chinasat-32 (in the UN registration).

On Nov 6, the apogee motor was fired to place the satellite at GEO 140E, the Chinasat-32 position. Phillip Clark speculates that further Beidou satellites will be launched to Chinasat-31 and -33, at 80E and 110.5E.

The Beidou uses the DFH-3 bus.

Mass probably around 2500? kg.

Beidou

| Date | Time | Event | Orbit |
|---|---|---|---|
| 2000 Oct 30 | 1602 | Launch by CZ-3A | XSC LC2 |
| | | T+2:25? Stage 1 MECO | |
| | | T+2:27? Stage 2 MES, Stage 1 sep | |
| | | T+3:52? Fairing | |
| | | T+4:15? St 2 MECO | |
| | | T+4:20? St 2 VECO | |
| | | T+4:21? St 2 sep, St 3 MES | |
| | 1612 | T+10:19? St 3 MECO-1 | |
| | | T+20:00? St 3 MES-2 | |
| | | T+22:00? St 3 MECO-2 | |
| | 1625? | T+23:40? Stage 3 sep | |
| 2000 Oct 30 | | | 753.14 194 x 41890 x 25.0 |
| 2000 Nov 6 | 0530? | AKM burn | |
| 2000 Nov 7 | | (?) | 753.77 192 x 41922 x 25.0 |
| 2000 Nov 9 | | | 1436.12 35772 x 35801 x 0.2 GEO 140.0E |
| 2000 Dec 1 | | | 1436.05 35773 x 35798 x 0.1 GEO 140.0E |

• **Beidou 2** (2000-82A)

The second Beidou entered orbit at 80E and was registered with the UN as Chinasat-31.

Beidou 1B

| Date | Time | Event | Orbit |
|---|---|---|---|
| 2000 Dec 20 | 1620 | Launch | |
| | 1630 | MECO-1 | |
| 2000 Dec 20 | 1642? | MECO-2 | |
| 2000 Dec 20 | | | 750.51 196 x 41760 x 25.0 |
| 2000 Dec 25 | | | 752.64 190 x 41870 x 25.0 |
| 2000 Dec 30? | | AKM | |
| 2000 Dec 30 | | | 1436.07 35776 x 35796 x 0.1 GEO 80.0E |
| 2001 Jan 13 | | | 1436.09 35776 x 35796 x 0.1 GEO 80.1E |

• **Beidou 3** (2003-21A)

The constellation was augmented with a third satellite in May 2003. An element set suggesting a perigee raise burn on May 26 may be in error, or may indicate a test of the RCS system; the AKM is probably liquid-fuelled, and made its main burn later on May 26.



Beidou 3

| Date | Time | Event | Orbit |
|---|---|---|---|
| 2003 May 24 | 1634 | Launch | |
| | | T+2:25? Stage 1 MECO | |
| | | T+2:27? Stage 2 MES, Stage 1 sep | |
| | | T+3:52? Fairing | |
| | | T+4:15? St 2 MECO | |
| | | T+4:20? St 2 VECO | |
| | 1638? | T+4:21? St 2 sep, St 3 MES-1 | |
| | 1644? | MECO-1 | |
| | 1650? | MES-2? | |
| | 1652? | MECO-2 | |
| | 1654 | Stage 3 sep | 749.29 196 x 41701 x 25.0 |
| 2003 May 26 | | | 790.82 1917 x 41981 x 38.8 |
| | 1413? | AKM | |
| 2003 May 26 | | | 1438.91 35716 x 35966 x 0.0 GEO 38.8E-0.7W |
| 2003 Jun 2 | | | 1436.67 35760 x 35835 x 0.3 GEO 110.5E-0.15W |
| 2003 Jun 9 | | | 1436.12 35752 x 35821 x 0.3 GEO 110.5E |

## 4.7 TC

- **Tan Ce 1** (2003-61A)


Figure 32: Launch of TC-1

Figure 33: The TC-1 satellite

Tan Ce (Explorer) 1, or Double Star DSP-E, Chinese/ESA magnetospheric satellites, to supplement the Cluster system and using backup European Cluster instruments. Equatorial DSP-E 550 x 66970 x 28.5 planned orbit. Launch Dec 2003 and Apr 2004 by CZ-2C/SM (or CTS). CTS top stage derived from SD. Places 1400 kg in SSO. Has FG-47 solid motor.

Spin-stabilized satellites, 350 kg built by CATC's Space Tech Inst. Spacecraft is a 2.1m dia 1.4m high spin stabilized (15 rpm) cylinder, with overall size 4.0m high 8.3m span. Used a direct ascent orbit with all three stages burning without coast phase, giving perigee around 23 deg N.

With Isp of 288s, and stage mass of 160 kg prop, guessing 350 kg empty 510 kg full), we would get a delta-V of 580 m/s. From a 555 km circular orbit would need 2.7 km/s, corresponding to m1/m2 = 2.6. If 160 kg is truly the prop, this is not possible. Actual FG-47 prop is only 125 kg.

Assuming Isp of 290s, and insertion orbit of -2000 x 590 km, delta-V required is 10.3 - 6.64 km/s = 3.66 km/s which corresponds to a mass factor of 3.62, so a prop of 1050-1200 kg is required.



TC-1

| Date | Time | Event | Orbit |
|---|---|---|---|
| 2003 Dec 29 | 1906:18 | Launch by CZ-2C/CTS | Xichang |
| | | Stage 2 burn | |
| | 1916? | Stage 2 sep | |
| | 1916? | SM burn | |
| | 1916? | SM burnout | 555 x 78051 x 28.5 |
| | 1918? | SM sep | |

Payload

| | |
|---|---|
| ASPOC | Active spacecraft potential control |
| FGM | Fluxgate magnetometer |
| PEACE | Plasma electron and current expt |
| HIA | Hot ion analyser |
| STAFF/DWP | Spatio-temporal analysis of field fluctuations |
| HEED | High energy electron detector |
| HEPD | High energy proton detector |
| HID | Heavy ion detector |

# 5 SISE/SAST programs

## 5.1 JSSW Satellites

A 1972 test flight carried a dummy JSSW of mass 1050 kg on a suborbital mission. Two more suborbital missions with dummy 3100 kg payloads flew in Sep 1977 and Apr 1978.

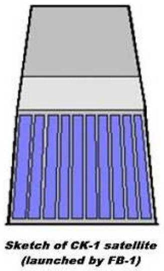



Figure 34: Sven Grahn's sketch of CK

• **Ji Shu Shiyan Weixing** (1973-F07)

The first Project 701 Test Experimental Satellite (JSSW) was reportedly launched in 1973 but the FB-1 rocket failed to reach orbit. The JSSW satellites are believed to have carried meteorological and military imaging systems with television radio readout. JSSW may also be called CK, according to Sven Grahn. It is believed to be a truncated cone about 2.5m long 1.7m dia. Mass was 1138 kg. Design lifetime is about 10 days.

JSSW 1

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1973 Sep 18 | | Launch by Feng Bao 1<br>Failed to orbit | JQ |

• **Ji Shu Shiyan Weixing** (1974-F05)

After the Jul 1974 launch failure the FB-1 engines were replaced by engines from the CZ-1. The second launch still failed to orbit. Payload mass was 1108 kg.

JSSW 2

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1974 Jul 14 | | Launch by FB1<br>Failed to orbit | JQ |



• **Ji Shu Shiyan Weixing** (1975-70A)

Mass of the JSSW was around 1107 kg.

JSSW 3

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1975 Jul 26 | 1328 | Launch by FB1 | JQ<br>91.0 184 x 461 x 69.0 |
| 1975 Sep 14 | | Reentered SW of Tasmania | |

PAYLOAD

Visible and IR meteo sensors
Radio transmission imaging recon camera

• **Ji Shu Shiyan Weixing** (1975-119A)

The second Feng Bao 1 launch to reach orbit carried another JSSW satellite, PRC 5. Mass was 1109 kg.

JSSW 4

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1975 Dec 16 | 0919 | Launch by Feng Bao 1 | JQ<br>90.3 186 x 387 x 69.0 |
| 1976 Jan 27 | | Reentered | |

• **Ji Shu Shiyan Weixing** (1976-87A)

The final sucessful JSSW launch (PRC 6) went into an orbit with a much higher apogee; however mass was similar at 1108 kg.

JSSW 5

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1976 Aug 30 | 1153 | Launch by Feng Bao 1 | JQ<br>108.8 195 x 2145 x 69.2 |

• **Ji Shu Shiyan Weixing** (1976-F03)

The last FB-1 launch failed to reach orbit on 10 Nov 1976. It probably carried another JSSW satellite. Mass was 1208 kg.

Table 76: JSSW

| Payload | Name | Launch Veh. | Site | Launch Date | Reentry Date | Dur | Orbit | Designation |
|---|---|---|---|---|---|---|---|---|
| JSSW 1 | Ji Shu Shiyan Weixing | Feng Bao 1 | JQ | 1973 Sep 18 | 1973 Sep 18 | 0 | - | - |
| JSSW 2 | Ji Shu Shiyan Weixing | Feng Bao 1 | JQ | 1974 Jul 14 | 1974 Jul 14 | 0 | - | - |
| JSSW 3 | Ji Shu Shiyan Weixing | Feng Bao 1 | JQ | 1975 Jul 26 | 1975 Sep 14 | | 184 x 461 x 69.0 | 1975-70A |
| JSSW 4 | Ji Shu Shiyan Weixing | Feng Bao 1 | JQ | 1975 Dec 6 | 1976 Jan 27 | | 186 x 387 x 69.0 | 1975-119A |
| JSSW 5 | Ji Shu Shiyan Weixing | Feng Bao 1 | JQ | 1976 Aug 30 | | | 195 x 2145 x 69.2 | 1976-87A |
| JSSW 6 | Ji Shu Shiyan Weixing | Feng Bao 1 | JQ | 1976 Nov 10 | 1976 Nov 10 | 0 | - | - |



## 5.2 Weather satellites (FY)

• **Feng Yun 1** (1988-80A)

The first FY-1 (Wind and Cloud) satellite carried radiometers to return Earth weather imagery. The 757 kg satellite failed after one month when its attitude control was lost. The FY satellites are built by SISE (Shanghai Inst of Satellite Engineering), part of CAST until 1993 and then part of SBA.

The China Meteorological Administration operates the National Satellite Meteorological Center in Beijing, which controls the satellites via ground stations in Beijing, Guangzhou and Urumqi.

Size was 1.4 x 1.4 x 1.2m box, 1.76m deployed, 8.6m span with 2 solar panels.

Feng Yun 1

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1988 Sep 6 | 2030 | Launch by CZ-4 | T'ai Yuan |
| | 2032 | T+2:31 St 1 MECO | |
| | 2032 | T+2:32 St 1 sep | |
| | 2032 | T+2:47 Fairing | |
| | 2036 | T+6:38 St 2 MECO | |
| | 2036 | T+6:48 St 2 VECO | |
| | 2036 | T+6:49 St 2 sep | |
| | 2036 | St 3 burn? | |
| | | St 3 burn 303s? | |
| | 2040 | T+10:10 St 3 MECO | |
| | 2041 | T+11:05 St 3 sep | 102.8 881 x 904 x 99.1 |
| 1988 Oct 15 | | End of operations | |

| | | |
|---|---|---|
| PAYLOAD | VIRR | 5-channel Vis/IR Radiometer |
| | HRPT | Hi Res picture transmission system (NOAA compatible) |
| | DRPT | Delayed picture transmission |
| | | AOCS 12 kg N2 gas |

• **Feng Yun 1B** (1990-81A)

The second FY satellite was launched in Sep 1990. Mass was 881 kg.

FY-1B temporarily lost attitude control in 1991 because of radiation damage, but control was regained in two months, although lost again later.

Feng Yun 1B

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1990 Sep 3 | 0053 | Launch by CZ-4 | T'ai Yuan |
| 1991 Feb | | Attitude control lost | |
| 1991 Apr | | Control regained | |
| 1991? | | End of ops | |
| 1994 Jan | | Operable inactive | |

• **Feng Yun 2** (1997-29A)

The FY-2 weather satellite was launched in Jun 1997 after a long delay caused by the explosion of the first flight model during testing.

The spin-stabilized FY-2 was built by the Shanghai Aerospace Technology Research Institute and had a mass of 1380 kg. It will be stationed at 105E and controlled from the Xi'an control center. The satellite is a 2.1m dia 4.5m high cylinder with antenna deployed and AKM attached. The main bus is 2.1 dia 1.6m high, with antenna but without AKM it is 3.0m high. The FG-36 AKM is a cylinder-cone 1.5m high 1.0m dia and 729 kg full, leaving a BOL mass for FY-2 of 651 kg.

FY-2 spins at 100 rpm. Resolution is 1.3km visible and 5 km in the IR. A despin system malfunctioned in Mar 2000 and FY-2 was relocated in Apr 2000 to a storage location at 85E.

FY2

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1997 Jun 10 | 1201 | Launch by CZ-3 | XSC |
| | | T+2:06 St 1 MECO | |
| | | T+2:07 St 2 burn | |
| | | T+4:15 St 2 MECO | |
| | | T+4:19 Fairing | |
| | | T+4:22 St 2 VECO | |
| | | T+4:23 Stage 3 burn | |
| | | T+11:08 MECO-1 | |
| | | T+15:35 MES-1 | |
| | | T+20:53 Stage 3 MECO-2 | |
| | | T+21:32 Stage 3 sep | |
| 1997 Jun 10 | | | 635.12 206 x 35987 x 28.5 |
| 1997 Jun 11 | 0420? | AKM burn | |
| 1997 Jun 11 | | AKM separated | 1399.72 34099 x 36044 x 0.3 |
| 1997 Jun 11 | | | 1396.45 34015 x 35998 x 1.3 |
| 1997 Jun 11 | | | 1403.34 34069 x 36216 x 1.3 GEO 114.9E+8.4E |
| 1997 Jun 17 | | | 1436.08 35780 x 35792 x 1.2 GEO 105.0E |
| 1997 Jul 10 | | | 1436.01 35781 x 35788 x 1.1 GEO 104.1E |
| 1999 Oct 13 | | | 1436.09 35784 x 35788 x 0.7 GEO 104.8E |
| 2000 Apr 23 | | Moved out | 1548.33 35773 x 36278 x 0.1 GEO 104E dr |
| 2000 May 10 | | mv in | GEO 85.5E |
| 2000 Jun 11 | | | 1436.15 35767 x 35807 x 0.3 GEO 85.6E |

| | | |
|---|---|---|
| Payload | VISSR | Scanning Radiometer 0.55-1.05 mu (4 channels), 10.5-12.5 mu channel, H2O 6.3-7.6mu channel.<br>Cloud cover monitor<br>Data collection relay: WEFAX, S-FAX<br>Space environment monitor |

- **FY-1C** (1999-25A)


The first operational FY-1, FY-1C, was launched in 1999. The number of channels in the radiometer was increased, as well as on board data storage capacity. The resolution is 1.1 km. Vehicle is a 1.4m cube with two solar panels of 8.6m span. Mass is 958 kg. According to AvWeek, FY-1C was built by CAST/Beijing for the National Satellite Meteorological Center [2] but most sources say the FY-1 series were built in Shanghai.



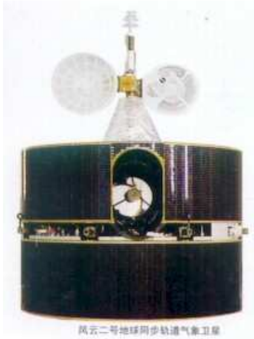
FY-1C

| Date | Time | Event | Orbit |
|---|---|---|---|
| 1999 May 10 | 0133 | Launch by CZ-4B | TYSC |
| | 0135 | T+2:32 St 1 sep | |
| | | St 2 burn | |
| | 0135 | T+2:47 Fairing sep | |
| | 0139 | T+6:48 Stage 2 MECO | |
| | 0139 | T+6:49 St 2 sep | |
| | | Stage 3 burn | |
| | 0145 | T+12:29 FY-1C sep | |
| | 0146 | T+13:34 SJ5 sep | |
| 2001 May | | Still operating | |

Payload

Vis and IR radiometer, 0.5-3.9 mu, 11mu; 10 channels

- **Feng Yun 2** (2000-32A)



FY-2B was developed by SARTI/Shanghai for CASC. It carries a 1.2km resolution radiometer. Launch mass is 1380 kg.

In the table below, velocities (supplied by CALT) are Earth-fixed.

FY-2C/D/E will have 5 radiometer channels but are otherwise similar.

FY-2

| Date | Time | Event | Orbit |
|---|---|---|---|
| 2000 Jun 25 | 1150 | Launch by CZ-3 | XSC |
| | | T+2:00 St 1 sep 55 km, 2.274 km/s | |
| | | T+4:13 Fairing 178 km, 5.224 km/s | |
| | | T+4:17 St 2 sep 181 km, 5.226 km/s | |
| | 1201 | T+11:43 St 3 MECO-1 299 km, 7.089 km/s | -400? x 300 x 27.4 |
| | | T+17:48 St 3 MES-2 243 km, 7.189 km/s | |
| | 1213 | T+23:00 St 3 MECO-2 207 km, 9.804 km/s | |
| | 1213 | T+23:44 St 3 sep, 223 km, 9.797 km/s | 233 x 35820 x 27.4 |
| 2000 Jun 26 | 0400? | AKM burn | |
| | | AKM sep | |
| 2000 Jul 2 | | | 1438.22 35796 x 35859 x 1.1 |
| 2000 Jul 6 | | First image | |

FY-2

| Date | Time | Event | Orbit |
|---|---|---|---|
| 2000 Jul 8 | | | 1436.00 35776 x 35793 x 1.1 GEO 104.4E |
| 2001 Jun 9 | | | 1435.72 35766 x 35792 x 0.3 GEO 103.1E |
| 2004 Jan 16 | | | 1436.11 35781 x 35791 x 0.3 GEO 104.7E |

Payload

Scanning Radiometer
IR Cloud cover monitor (H20 vapor)
Data collection relay
Space environment monitor

- **FY-1D** (2002-24B)

950 kg satellite launched by CZ-4B from TYSC.
Advertised as supporting the 2008 Olympic Games. FY-1C still operating in May 2002.

FY-1D

| Date | Time | Event | Orbit |
|---|---|---|---|
| 2002 May 15 | 0150 | Launch by CZ-4B | |
| | 0152 | T+2:32? St 1 sep | |
| | 0152 | St 2 burn | |
| | 0152 | T+2:47? Fairing sep | |
| | 0156 | T+6:48? Stage 2 MECO | |
| | 0156 | T+6:49? St 2 sep | |
| | | Stage 3 burn | |
| | 0200? | Stage 3 MECO | |
| | 0202 | T+12:29? FY-1D sep | |
| | 0203? | Adapter sep? | |
| | 0203 | T+13:34? HY-1 sep | |
| 2002 May 17 | | | 102.19 851 x 873 x 98.8 |

Payload

10-channel scanning radiometer



Table 83: FY

| Payload | Name | Launch Veh. | Site | Launch Date | Reentry Date | Dur | Orbit | Designation |
|---|---|---|---|---|---|---|---|---|
| FY-1 | Feng Yun 1 | CZ-4 | T'ai Yuan | 1988 Sep 6 | 1988 Oct 15 | | 881 x 904 x 99.1 | 1988-80A |
| FY-1B | Feng Yun 1B | CZ-4 | T'ai Yuan | 1990 Sep 3 | | | | 1990-81A |
| FY-1C | Feng Yun 1C | CZ-4B | T'ai Yuan | 1999 May 10 | | | | 1999-25A |
| FY-2 | Feng Yun 2 | CZ-3 | Xichang | 1997 Jun 10 | | | 35781 x 35788 x 1.1 GEO 105E | 1997-29A |

## 5.3 CX

• **Chuangxin 1** (2003-49B)

Chuanxin or Chuang Xing is 'innovation'. CX-1 is a SAST store-relay comsat developed by Chinese Academy of Sciences. Piggyback on CZ with CBERS-2. Mass is under 100 kg.

| ZY-1 No 2/CBERS-2 | | | |
|---|---|---|---|
| Date | Time | Event | Orbit |
| 2003 Oct 21 | 0316 | Launch by CZ-4B | |
| 2003 Oct 22 | | | 99.24 685 x 759 x 98.5 |



# 6 Tsinghua and HSTSL

• **HSTSL-1** (2002-F01)

50 kg Tsinghua microsat planned for 300 x 300 x 91 orbit. (Max White, private comm) for Tsinghua spinoff.

The Kai Tuozhe-1 rocket is based on the DF-31 missile. Solid fuel mobile launch vehicle from CAMEC (China Aerospace Machinery and Electronics Corp).

| KT-1 | | | |
|---|---|---|---|
| Date | Time | Event | Orbit |
| 2002 Sep 15 | 1030 | Launch by KT1 | TYSC |
| | 1032? | Failed second stage | |

• **KT-1 Test** (2003)

A suborbital test of the KT-1 was carried out on Sep 16.

From Chen Lan,

```
- It is confirmed that payload of this KT-1 launch is the 40-kg PS2 =
microsat. The target orbit is 300kmx300km polar orbit.
- The PS2 launch service contract was signed on July 29 between =
Aerospace Solid Launch Vehicle Corp.(ASLVC) and Harbin Fenghua-Aerospace =
Hi-Tech CO.LTD, a Shenzhen listed company (stock code 0901). Beijing =
Launch System Technologies, a subsidiary of Harbin Fenghua, provided =
KT-1 launch service at RMB48.5 million (USD 5.8 million). ASLVC is the =
customer of this R\&D launch but is also the developer of the launch =
vehicle, while the latter acts as the launch service provider. China =
Aerospace Science and Industry Corp.(CASIC) are major shareholder of =
both companies. ASLV has also shares in Harbin Fenghua.
- KT-1 is developed purely by CASIC funding, without any government =
investment. Last year's failure has already put the project in difficult =
situation.
```

# 7 Bibliography

## References


[1] AAS History Series Vol. 25, p 143.

[2] Aviation Week, 1999 May 17, p 28.

[3] Aviation Week, 2000 Oct 9, p 126.

[4] JBIS 55, 236.

[5] Quest, 6, 2, p 36.

[6] Jane's Spaceflight Directory 1994, ed. A. Wilson.

[7] Phillip S. Clark, personal communication.




# 8 Some things I don't know about China's space program

- 1. Organizations:
- 1.1 What are the exact organizational relationships between CNSA, CASC, CGWIC?
- 1.2 Some sources say FY-2 was built by SARTI (Shanghai Aerospace Research Tech. Inst.) - is this group distinct from SISE?
- 1.3 What are the transliterated Chinese names for all the organizations?
- 2. Launch vehicles
- 2.1 Trajectory details of the FB-1 launch failures (apogee, velocity..)
- 2.2 Trajectory details of the suborbital FB-1 tests of 1972, 1977 and 1978.
- 2.3 Details of alleged KT-1 launch failures in 2002 and 2003.
- 3. Spacecraft masses.
- 3.1 What are the separate masses for the Shenzhou orbital module, descent module and propulsion module, for each mission?
- 3.2 Separate masses for FSW/FSW-1/FSW-2 reentry vehicle, reentry motor and equipment section.
- 3.3 What is the mass of the ZY-2 satellite?
- 3.4 What is the mass of the JB-4 satellite launched 2003 Nov 3?
- 4. Spacecraft names.
- 4.1 Confirm match of Zhongxing 1-4 designations to DFH-2A satellites launched 1988-1991; designations for 1984 and 1986 GEO satellites and *especially* 1994 Nov 29 launch (the one that failed) - ZX-6?
- 5. Spacecraft propulsion
- 5.1 What is the delta-V in km/s of the FSW retrofire burn?
- 5.2 Details (propellant, thrust, size) of the CTS used for the Tan Ce 1 launch.