Military Space and Public Transparency

Independent Analysis of Space Activities

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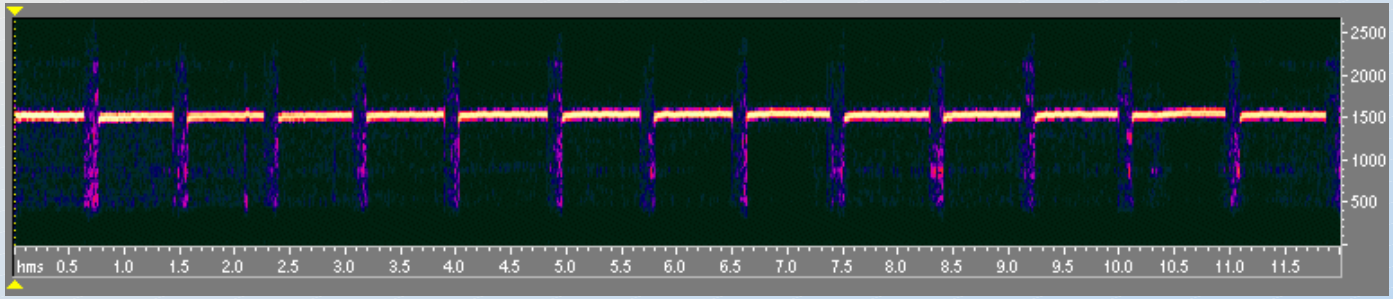
and
Kettering Group

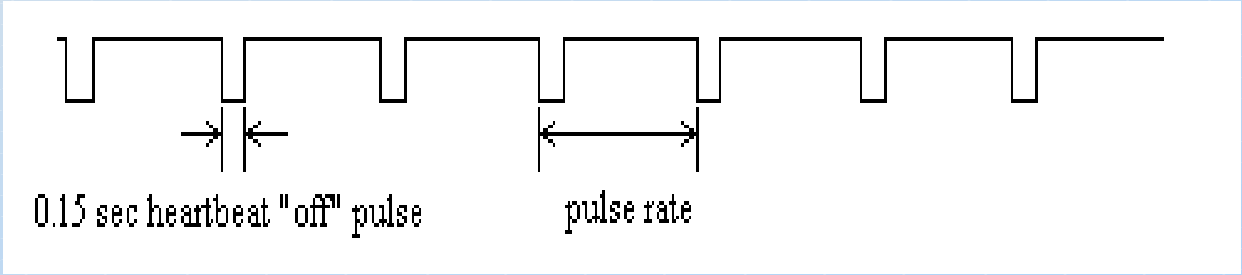
History of independent analysis

- Kettering Group, 1960s:
  - School children located secret Plesetsk launch site by Doppler tracking of satellites using short wave radio
  - Telemetry analysis identified navigation system
- Canadian Space Society, 1980s-1990s:
  - Amateurs with binoculars determined orbits of US military satellites
  - US refused to confirm sat deployed from STS-28 but was almost as bright as Saturn!

Geoff Perry and the Kettering Group

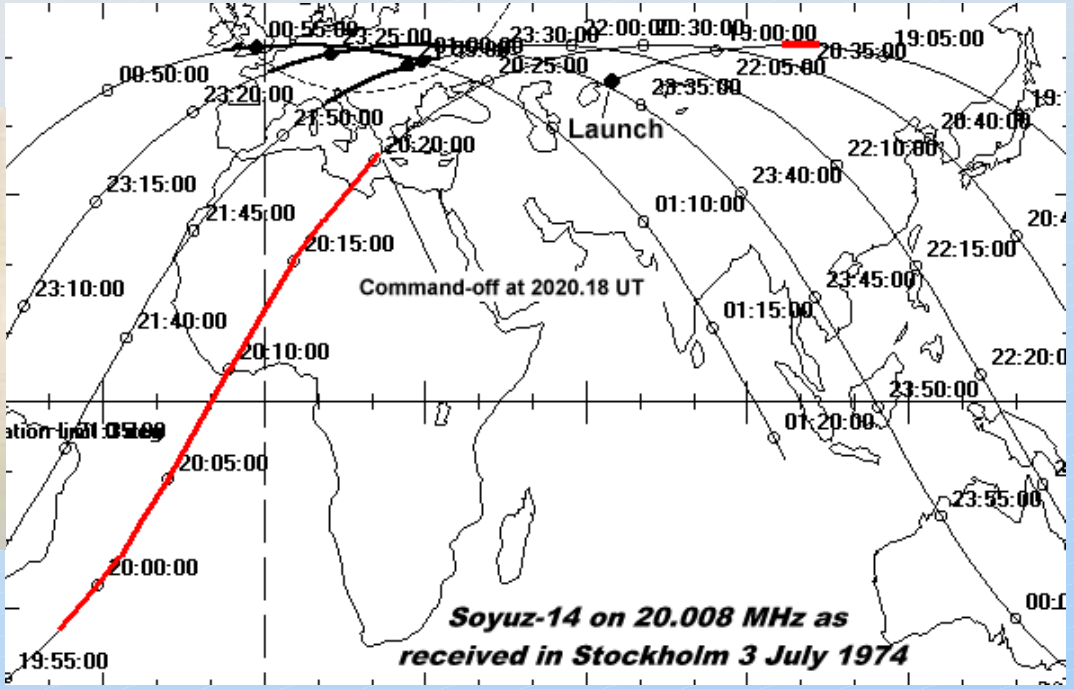
Vostok cosmonaut pulse data





The Russian Military Space Station

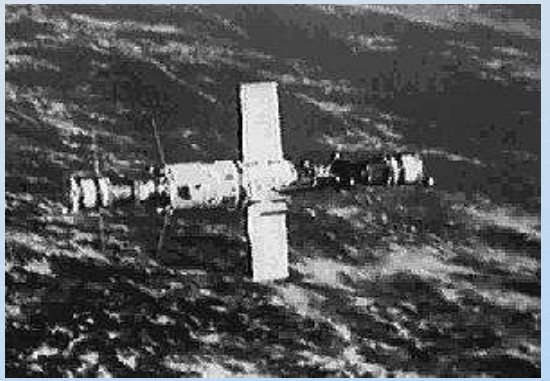
- Sven Grahn in 1974

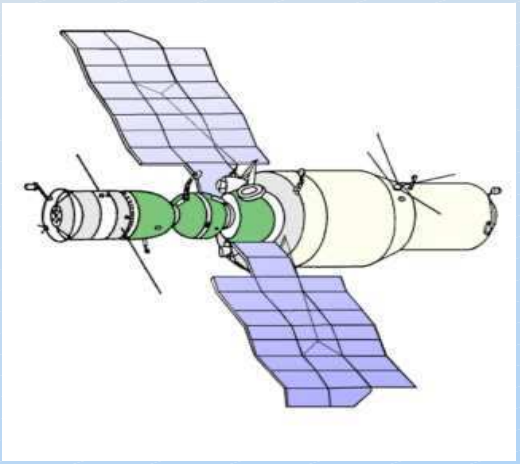


The Russian Military Space Station

- ALMAZ (left) DOS (right)

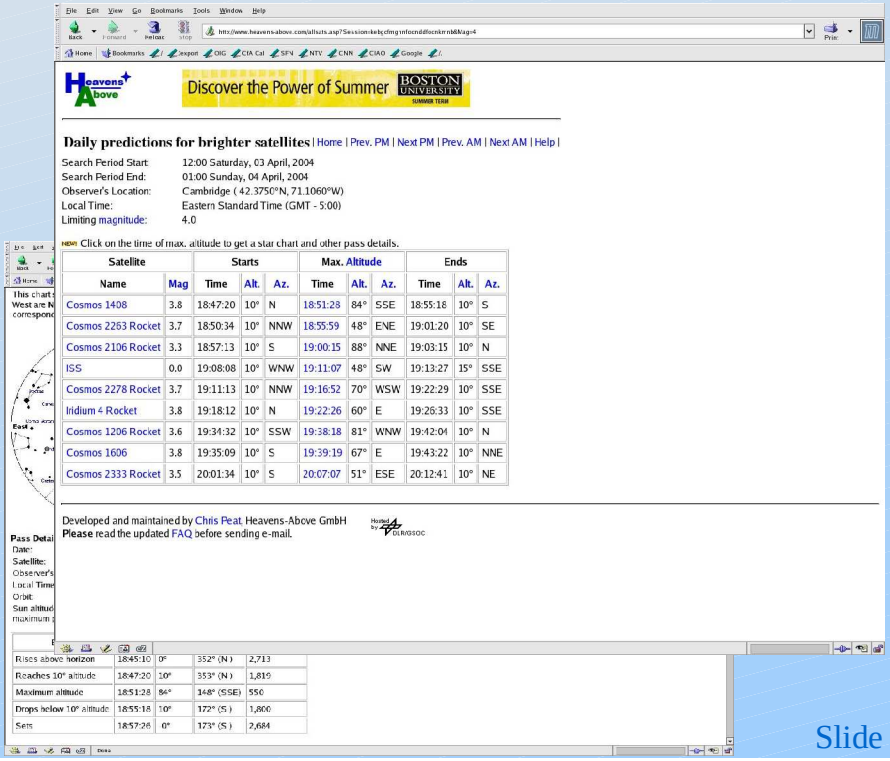
Military	Civilian
Low orbit	High orbit
No pictures	Press coverage
Telemetry	Telemetry
(like recon)	(like Soyuz)





Optical tracking

- Easy to track low earth orbit payloads!



Heavens-Above

Discover the Power of Summer BOSTON UNIVERSITY SUMMER TERM

Daily predictions for brighter satellites | Home | Prev. PM | Next PM | Prev. AM | Next AM | Help |

Search Period Start: 12:00 Saturday, 03 April, 2004
Search Period End: 01:00 Sunday, 04 April, 2004
Observer's Location: Cambridge (42.3750°N, 71.1060°W)
Local Time: Eastern Standard Time (GMT - 5:00)
Limiting magnitude: 4.0

NEW! Click on the time of max. altitude to get a star chart and other pass details.

Satellite		Starts			Max. Altitude			Ends		
Name	Mag	Time	Alt.	Az.	Time	Alt.	Az.	Time	Alt.	Az.
Cosmos 1408	3.8	18:47:20	10°	N	18:51:28	84°	SSE	18:55:18	10°	S
Cosmos 2263 Rocket	3.7	18:50:34	10°	NNW	18:55:59	48°	ENE	19:01:20	10°	SE
Cosmos 2106 Rocket	3.3	18:57:13	10°	S	19:00:15	88°	NNE	19:03:15	10°	N
ISS	0.0	19:08:08	10°	WNW	19:11:07	48°	SW	19:13:27	15°	SSE
Cosmos 2278 Rocket	3.7	19:11:13	10°	NNW	19:16:52	70°	WSW	19:22:29	10°	SSE
Iridium 4 Rocket	3.8	19:18:12	10°	N	19:22:26	60°	E	19:26:33	10°	SSE
Cosmos 1206 Rocket	3.6	19:34:32	10°	SSW	19:38:18	81°	WNW	19:42:04	10°	N
Cosmos 1606	3.8	19:35:09	10°	S	19:39:19	67°	E	19:43:22	10°	NNE
Cosmos 2333 Rocket	3.5	20:01:34	10°	S	20:07:07	51°	ESE	20:12:41	10°	NE

Developed and maintained by Chris Peat, Heavens-Above GmbH
Please read the updated FAQ before sending e-mail.

Rises above horizon	18:45:10	0°	352° (N)	2,713
Reaches 10° altitude	18:47:20	10°	353° (N)	1,819
Maximum altitude	18:51:28	84°	148° (SSE)	550
Drops below 10° altitude	18:55:18	10°	172° (S)	1,800
Sets	18:57:28	0°	173° (S)	2,684

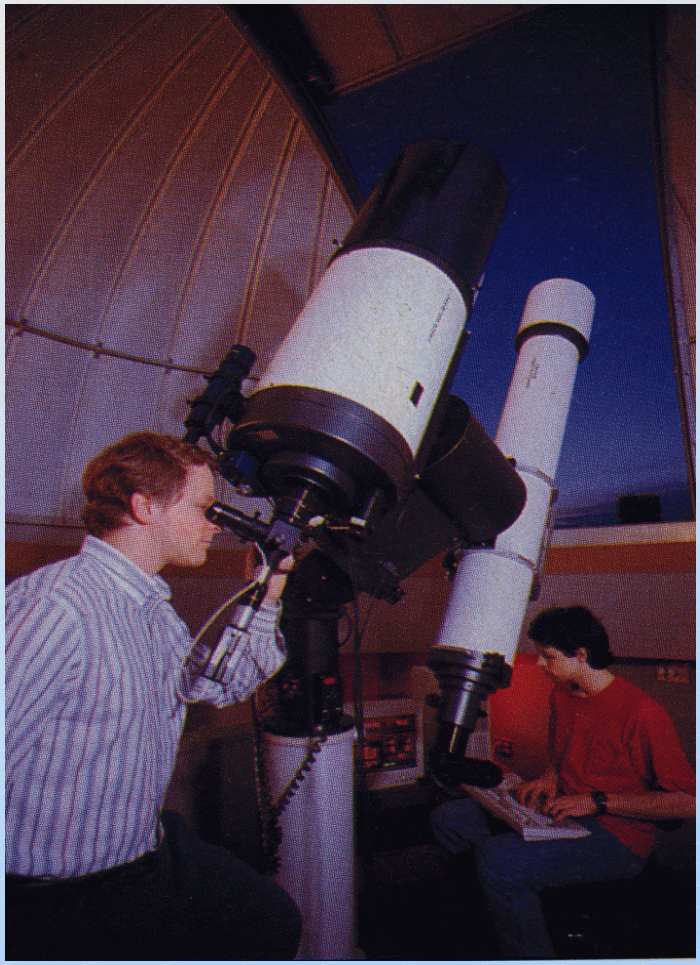
Orbit analysis

- Modern personal computer is much more powerful that USAF computers of 1960s-1970s!

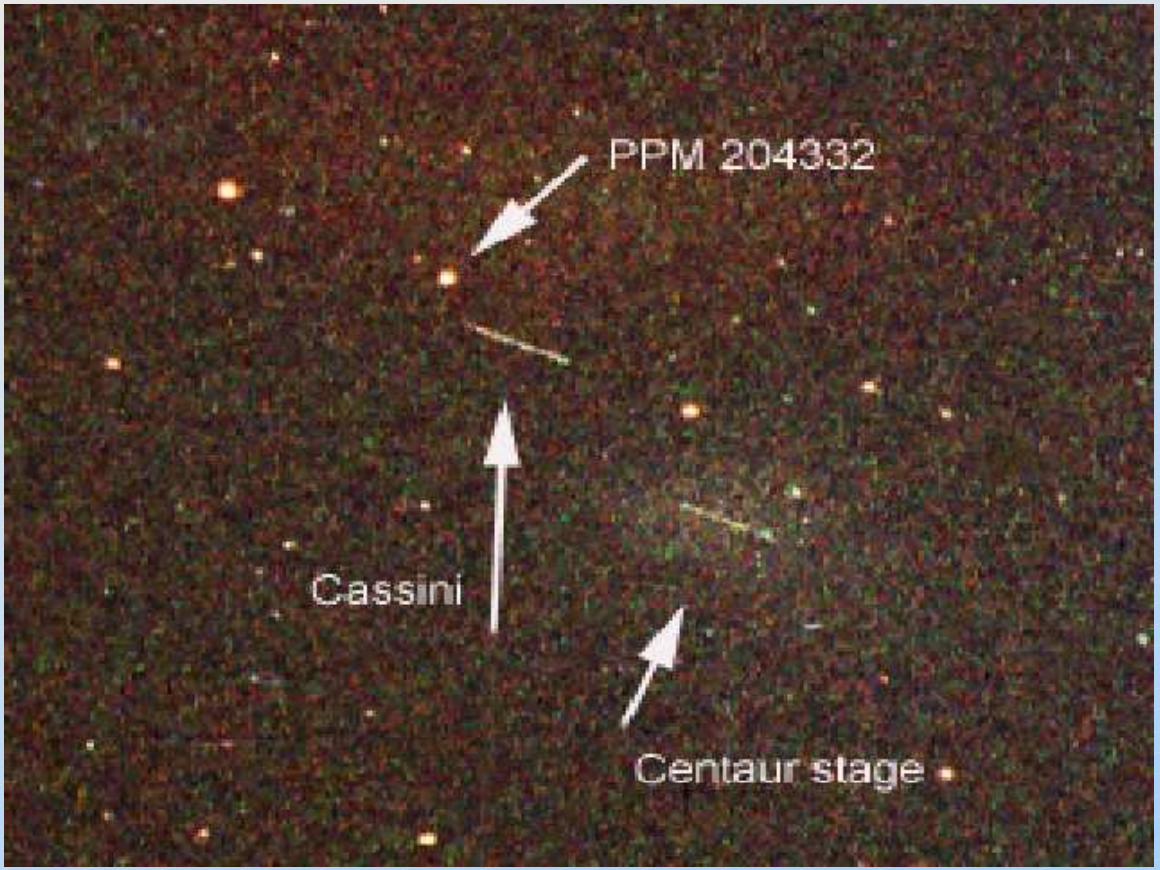
What we can learn

- Basic orbit shape: constrains possible missions
- Detailed orbital data: gives groundtrack, local times, etc.; reconstruct maneuvers and mission profile
- Mission-related objects: further inference on mission profile (e.g., discarded manuever engines, despin weights)
- Launch vehicle: easy to figure out approximate capacity (e.g Titan 4 triplets in 1990+, predicted existence of secret SLDCOM payload from missing weight)
- From orbit changes, infer propulsion system; or if propulsion system known, derive weights.
- Synthesize with public information and compare with previous missions

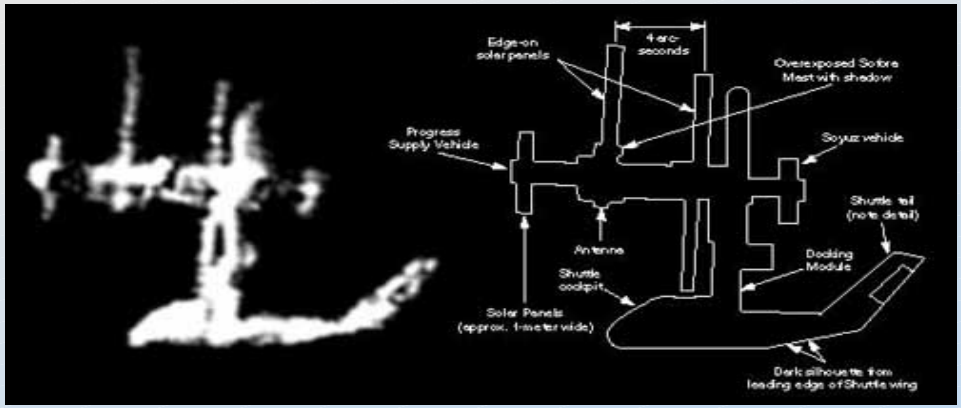
Ron Dantowitz and amateur satellite imaging

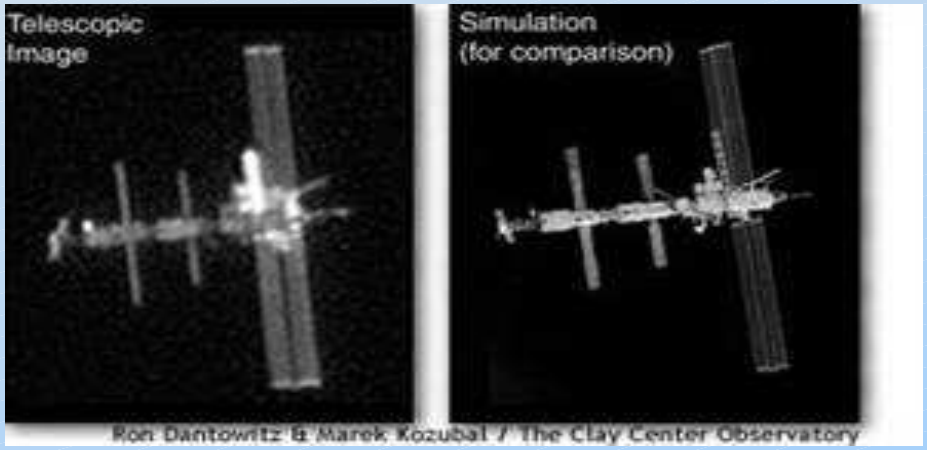


Satellite imaging

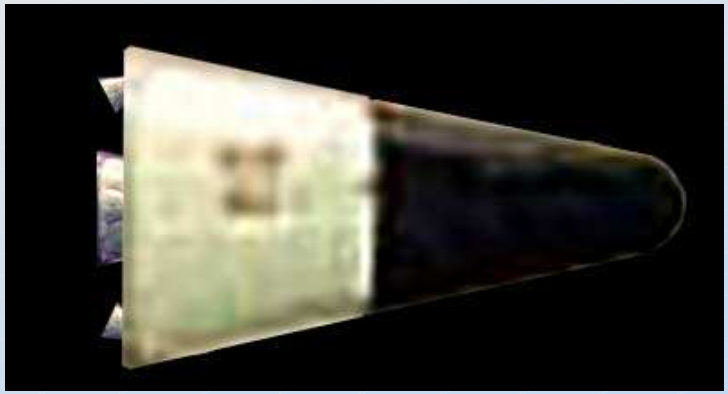


Satellite imaging – 2

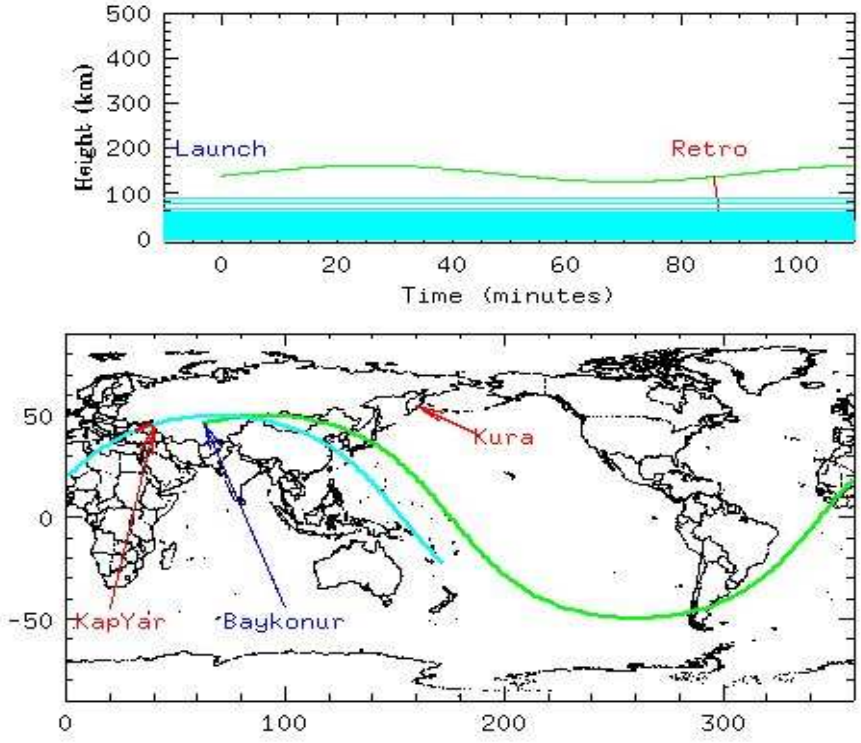




Space Weapon Testing: The R-36O

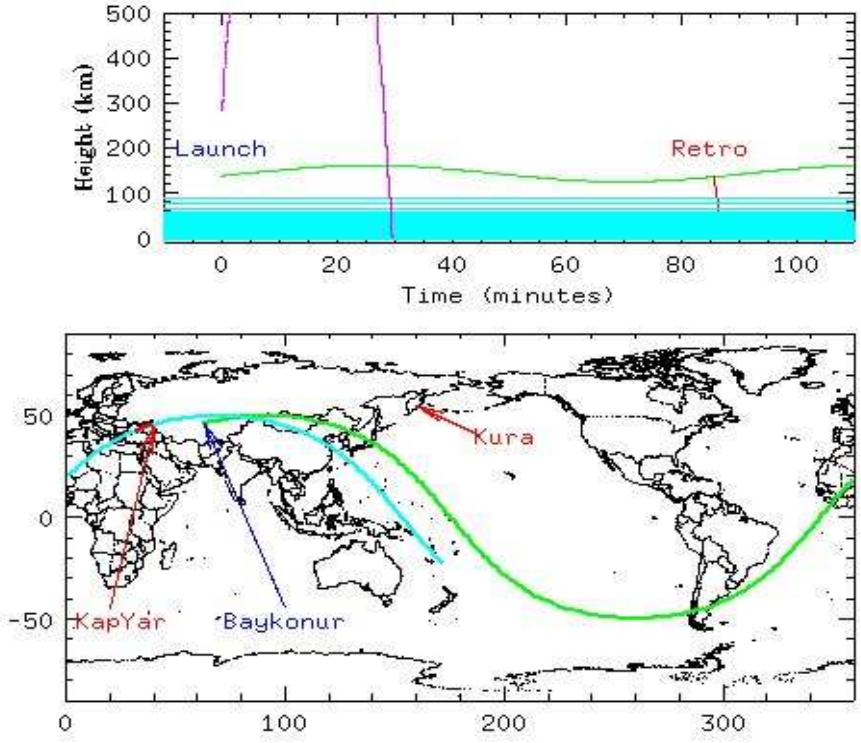


Kosmos-139, January 1967



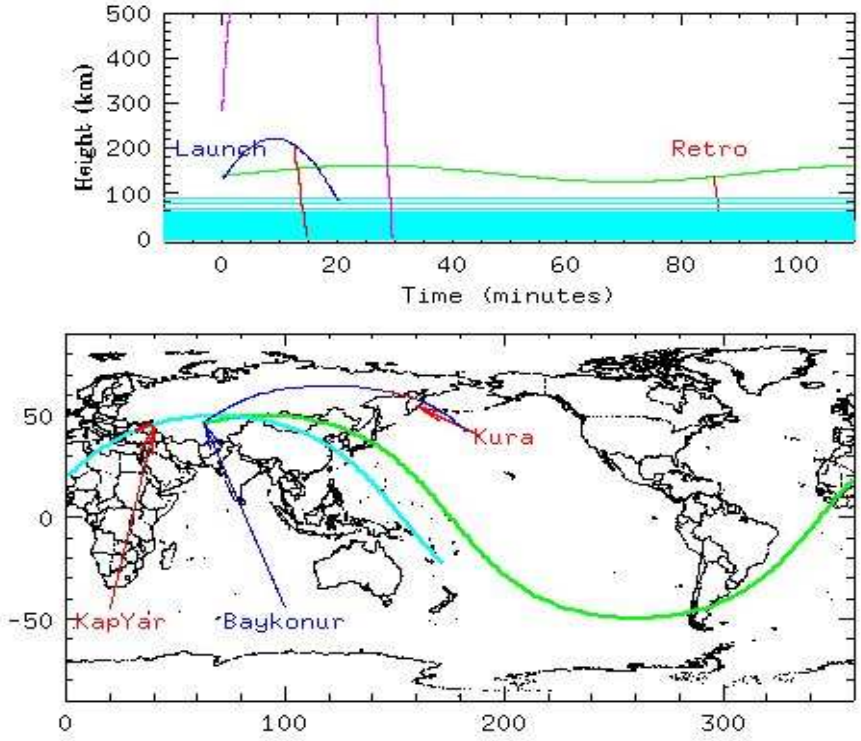
- R-36-O with OGCh payload
- Called FOBS (Fractional Orbital Bombardment System) in USA
- One orbit of Earth
- Retrofire: 2 minutes from orbit to impact
- Archival orbital elements for analysis

Comparison Atlas ICBM trajectory



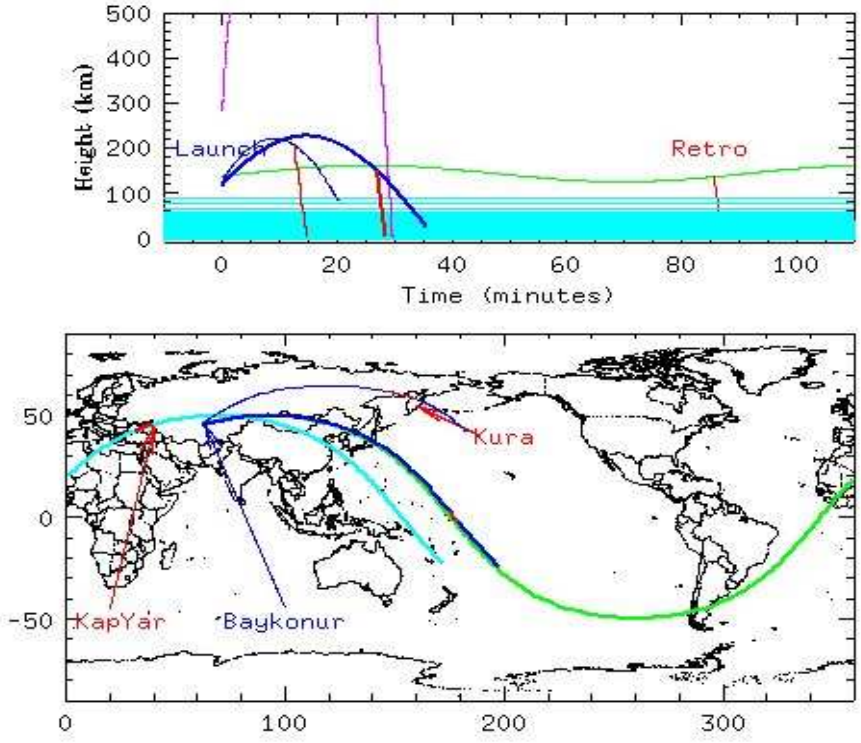
- Purple line is typical ICBM trajectory
- Apogee around 1000-2000 km
- Perigee around 5000-4000 km below Earth surface.
- Less energy required

Suborbital firing to Kura, Feb 1966



- Perigee is around 700 km below surface?
- Much shallower than usual suborbital flights
- Second stage falls in Pacific
- Retrorocket slams warhead down into atmosphere
- Kura is standard Russian target point, like Kwajalein for USA

Suborbital firing to Pacific, May 1968



- Perigee is around 0 to 250 km below surface?
- This is nearly in orbit!
- Reconstruction from information that impact was 'near equator'
- Assumed same inclination as K-139

Secrecy implications of independent analysis

- Waste of energy to deny or conceal some activities
- If amateurs can do it, so can other governments
- Space activities are
  - Observable from many places on Earth
  - Highly constrained by simple physics
  - Therefore, difficult to conceal on a large scale

Security advantages of independent analysis

- In Europe and America, independent groups may have more credibility than politicians' statements
- Public ignorance: many fear worst, assume space already weaponized! Need trustworthy (independent) assessment
- Independent analysts provide credible, unbiased evidence on extent of treaty compliance
- Less public pressure for arms race

What we know

- Analysed 28200 space objects
- Very few are mysterious
- NO plausible candidates for secret space weapons systems- conclude none are yet deployed
- Openness about non-weapon military space systems makes it easier to verify absence of weapons – reduces tensions.

Analysis methods

- Patterns – easy for large constellations or frequently used launch vehicles
- Orbital mechanics and rocket physics – infer space vehicle properties from orbit changes
- Piece together different evidence – public statements, physical data, known capabilities
- What we miss: small secret payloads sharing space on host sat (e.g. GRAB satellite 1960-1962)

Data Sources

- Press statements
- Published technical papers
- UN Registration Data
- Space Command unclassified orbit data (for now)
- Amateur optical and radio tracking
- Known latitude, longitude of launch sites

Analysis used is very simple:

- Keplerian orbits with 1st order (J2) perturbations, drag ignored, spherical Earth
- Rocket equation dV= V ln(m1/m2) and dm = Tt/V
- Approximate but fairly accurate Earth rotation model (ephemeris to sidereal time conversion)
- Statistical analysis and data mining to sift through 5 Gbyte of data
- PLUS – 25 years of learning every satellite in orbit!