Russia's "Civil" Space Program: An American Perspective

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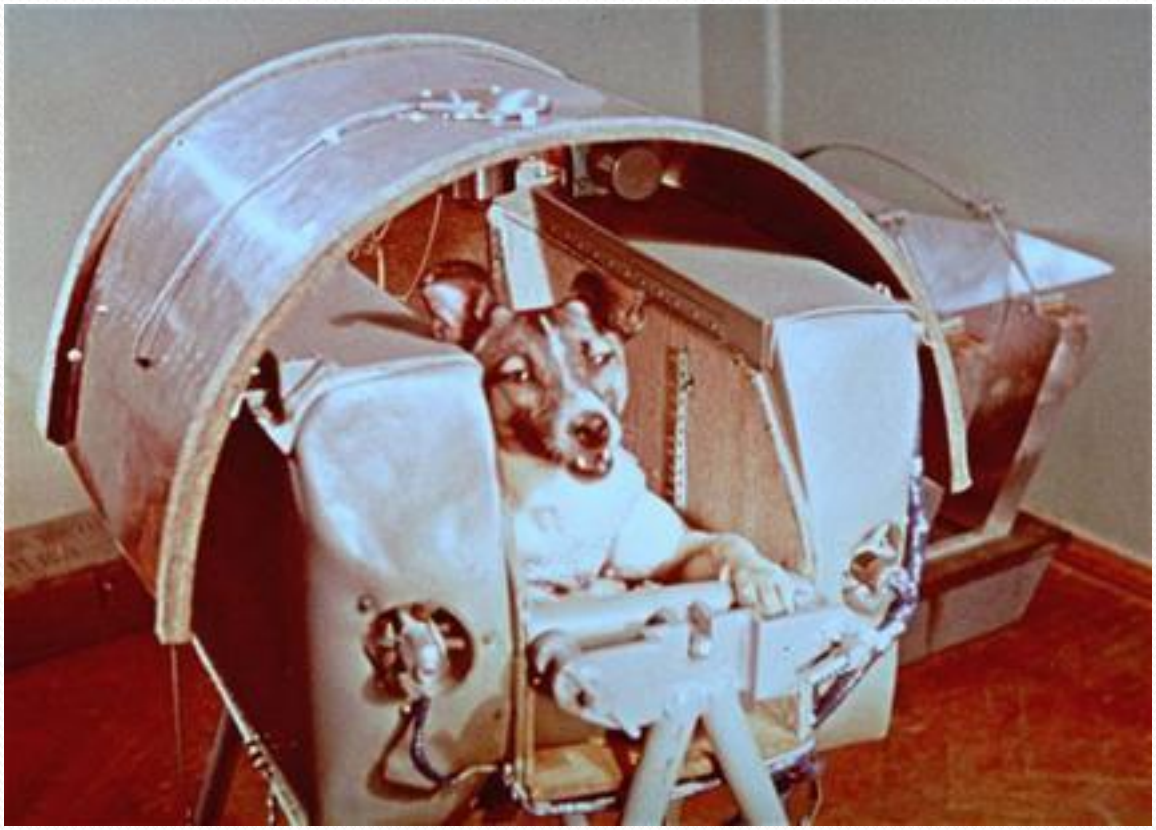
"Civil" Space Activities in Russia

- "Civil" space activities
  - Soviet Union did not distinguish between "civil" and "military" space programs until 1985
  - Line between the two can be quite blurry
  - For purposes of this presentation, "civil" means Soviet/Russian activities analogous to NASA and NOAA (though no time to discuss metsats today)
- Roscosmos is Russian civil space agency.
  - Headed by Army General (Ret.) Vladimir Popovkin
  - Recent reports of $3.5 billion budget, but probably does not include money from US and others

Key Points to Take Away

- Space cooperation takes place in the broad context of U.S.-Russian relations
  - Russia may not be a superpower today, but it is a global power and strategically important to the United States
  - Complex US-Russian relationship, as New START and INKSNA demonstrate
- Russian space program modest by Soviet standards, but
  - Retains key elements
  - Leverages legacy capabilities for current activities and commercial gain
  - Is a global launch service provider from four launch sites from Arctic to equator
- Proud history of many space "firsts," but also tragedies and setbacks
- U.S.-Soviet/Russian civil space relationship has transitioned from primarily competition to primarily cooperation/interdependence today
  - Cooperation not new, dates back to 1963, but much more intensive today
  - U.S. is dependent on Russia for some things, but they also need us
- Bold dreams endure as Mars 500 demonstrates

Today is 54th Anniversary of First Female in Space



Just One of Many "Firsts"

- First satellite (Sputnik, Oct. 4, 1957)
- Human Spaceflight Firsts (examples)
  - Animal in space (Sputnik 2, Laika, Nov. 3, 1957)
  - Man in space (Vostok 1, Gagarin, Apr. 12, 1961)
  - Woman in space (Vostok 6, Tereshkova, 1963)
  - Extravehicular activity (Voskhod 2, Leonov, 1965)
  - Space station (Salyut 1, 1971)
  - International crew (Soyuz 28/Salyut 6, Remek-Czechoslovakia, 1978)
  - Woman EVA (Soyuz T-12/Salyut 7, Savitskaya, 1984)
  - Modular space station (Mir, beginning in 1986)
  - "Space tourist" (Soyuz TM-11/Mir, Akiyama-Japan, 1990)

… more …

- Space Science and Applications Firsts (examples)
  - Return pictures from lunar farside (Luna 3, 1959)
  - Return pictures from lunar surface (Luna 9, 1966)
  - Return lunar samples robotically (Luna 16, 1970)
  - Land robotic rover on Moon (Luna 17/Lunokhod 1, 1970)
  - Soft land on Venus (Venera 7, 1970)
  - Orbit Venus and images from surface (Venera 9, 1975)
  - Soft land on Mars (Mars 3, 1971)
  - Domestic communications satellite system (Molniya, 1965)

…But Not All of Them Good

Examples:

- First death caused by spaceflight (Soyuz 1, Komarov, 1967)*
- First abort during launch phase (Soyuz 18A or "Apr. 5 Anomaly," 1975)
- First launch abort using escape tower (Soyuz T-10A, 1983)
- First docking abort requiring ballistic return to Earth (Soyuz 33/Salyut 6, 1979)
- First collision between a spacecraft and a space station (Progress M-34 and Mir, 1997)
- First serious fire on a space station (Mir, 1997)

*The Apollo 204 fire that claimed the lives of the first Apollo crew occurred 3 months before this, but that was a ground test, not a spaceflight.

Key Topics for Today

- Impossible to summarize 54 years of civil space activities in 15-20 minutes
- Today's brief presentation will focus on
  - Human spaceflight (HSF)
  - Rockets
  - Space Science
  - The interdependence of our programs today

US-Soviet HSF Rivalry

- Soviets were first with Gagarin, but we took off with Gemini and Apollo in 1960s
- Soviets declined to cooperate with US in Apollo, but could not do lunar landing alone so focused on earth orbit missions
- US got the brass ring for humans on the Moon, but US interest in HSF faded, while Soviets proceeded at steady pace with space station program
- For 6 years (July 1975-April 1981), no U.S. astronauts in space, while Soviets marched ahead with space stations
- Soviets have extensive earth orbit HSF experience, including record for longest time on orbit for one person – 14 months

Soviet/Russian Space Stations

- Seven successful space stations 1971-2001
  - First generation (1 docking port): Salyut 1, 3, 4, 5
  - Second generation (2 docking ports): Salyut 6, 7
  - Third generation (6 docking ports): Mir (modular)
- Currently partner in International Space Station
- Progress cargo spacecraft in use since 1978. Three generations: Progress (42 flights), Progress M (67 flights), Progress M-M (13 so far, 1 launch failure)
- Soyuz crew spacecraft in use since 1967. Five generations: Soyuz (40 flights, 2 w/fatalities), Soyuz T (15 flights), Soyuz TM (34 flights), Soyuz TMA (21 flights so far), Soyuz TMA-M (2 flights so far)

End of the Soviet Union-1991

- Soviet space program was broadly based and robust, with bold plans for the future; collapse of Soviet Union in 1991 changed its fortunes dramatically
- Russian space program had to make hard choices
  - First to go was their space shuttle (Buran) which flew only once w/o crew and almost-Saturn V-class booster (Energiya) which flew only twice
  - Space science withered; remaining "flagship" – Mars '96 – failed to leave Earth orbit
  - Major Soviet launch site, Baikonur, now in a different country, Kazakhstan
  - Quick to appreciate appeal of commercial launches and cooperation in human spaceflight

George H.W. Bush and Clinton

- GHWB and Clinton Administrations used space program as carrot to keep Russian scientists from working for non-friendly nations, and get Russia to agree to nonproliferation norms
  - We wanted Russia to abide by MTCR (& modify deal with India), Russia wanted commercial launches and space station
- Human spaceflight key element of this effort
  - Idea of joint mission between US shuttle and Soviet space station dates back to 1970s
  - No traction till GHWB 1991 agreement for Russian on shuttle and American on Mir
  - Clinton Administration expanded that significantly in 1993
- Ultimately 9 shuttle-Mir missions, 7 US astronauts on long duration Mir missions, 7 cosmonauts on US shuttles
- And, of course, partnership in the ISS

Space Science

- Soviet/Russian space science program has checked a lot of boxes, but few transformative scientific findings akin to US or European space science programs
  - Venus is probably only example so far
- Very modest effort since 1991, but resurging
  - Spectrum-R finally launched in June for radio astronomy, others in series (x-ray, uv)scheduled for next several years
  - Phobos-Grunt (soil) sample return mission to/from Phobos scheduled for launch on Nov. 8
    - Chinese Mars orbiter (Yinghuo-1) included
    - Will it break the jinx?
    - Will Roscosmos join ESA's ExoMars?

Russian Rockets & Launch Sites

- Many existing launch vehicles from small to large
  - Proton is largest: 21 tons to LEO; 5.5 tons to GTO
  - Also Soyuz , Molniya, Kosmos 3M, Dnepr, Rockot, Zenit (with Ukraine)
- Russia currently launches from Plesetsk, Baikonur, Sea Launch platform, and Kourou; planning new site at Vostochny
- First attempt to build Saturn V-equivalent failed
  - N1 failed four times in four attempts 1969-1972
  - NK-33 engines for N1 now being used for Orbital Sciences' Taurus II rocket
- Later attempt succeeded, but Energiya booster flew only twice
  - Flew in 1987 with Polyus and 1988 with unoccupied Buran
  - Was 100 tons to LEO; 18-20 tons to GTO; 32 tons to lunar trajectory.
  - RD-170 engines for Energiya's strap-ons now used for Zenit, Atlas V, and Angara (under development)

Future Outlook

- Russians have made grand statements over decades about sending people to the Moon and Mars, but never enough money to proceed, but dream endures
  - Mars 500 mission ends tomorrow
  - Member of Intl Space Expl Coordination Group (ISECG)
- Commercial launch services doing well
- Space science – a lot is riding on Phobos-Grunt
- For cooperation, geopolitical forces should not be forgotten

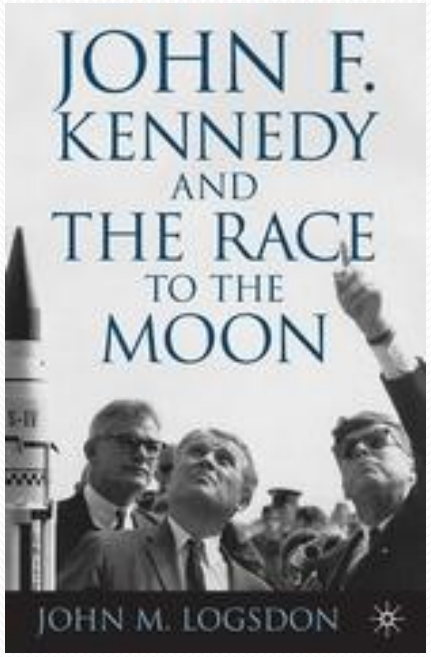
U.S.-Russian Space Relationship is Interdependent Today

- ISS
  - we are dependent on them for crew transport until a "U.S." replacement for shuttle is available, dependent on them for lifeboats indefinitely
  - they need our money … and a space station
- Rocket engines
  - we are dependent on them for engines for --
    - Atlas V, which launches our most precious national security payloads and perhaps CCDev spacecraft to ISS in the future
    - Taurus II, which will launch cargo to ISS
    - So will these new ISS capabilities be "U.S."?
  - they need us as a market for their engines

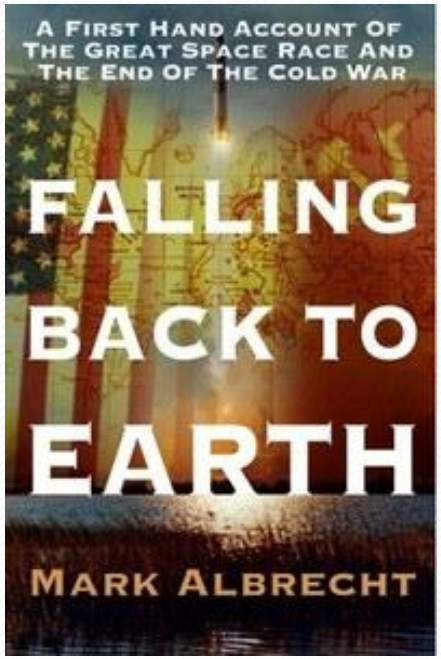
Challenges of Interdependence

- Some in U.S. object to dependence on Russia because—
  - Undermines U.S. national pride and prestige
  - U.S. taxpayers are supporting jobs overseas instead of jobs at home
  - Risky to have only one way to get to/from the ISS – single point failure, as Aug. Soyuz launch failure demonstrated
  - Risky to be tied to ever-changing geopolitical relationships
- But we put ourselves in this position long ago
  - Killed Crew Return Vehicle, killed shuttle, little money for rocket engine development
  - More INKSNA waivers may be needed

New Books of Interest



James T. Andrews and Asif A. Siddiqi, eds.



Backup

Soviet/Russian HSF in Brief (1)

- Extensive experience in earth-orbital human spaceflight
  - First animal (1957), first man (1961), first woman (1963), first spacewalk (1965), first space station (1971)
  - Seven successful space stations (Salyut 1, 3, 4, 5, 6, 7 and Mir) before partnering in International Space Station (ISS)
  - For earth orbit, continue to rely on Soyuz, first launched in 1967, but upgraded many times; key to ISS operations
  - Designed space shuttle, Buran, but launched only once in automated mode (no crew) in 1988 on Energiya booster – both discontinued after Soviet Union collapsed
- No cosmonauts beyond low Earth orbit, however
  - JFK twice asked Khrushchev to cooperate on Apollo, but no go

Soviet/Russian HSF in Brief (2)

- Four cosmonauts have died in spaceflights
  - Komarov (Soyuz 1, 1967)
  - Dobrovolskiy, V. Volkov, Patsayev (Soyuz 11, first crew to live aboard a space station – Salyut 1)
- By comparison, 14 astronauts died in U. S. spaceflights (1986 and 2003) and three died in a ground test of the first Apollo mission (1967)
- Russia has had several "sporty" launches and reentries that did not result in loss of life, but highlighted risks inherent in spaceflight