ASTP: The Beginning of 50 Years of East-West Collaboration in Outer Space

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Limitations and Bias: Availability of peer reviewed publications is limited. The medical results identify each astronaut by name or crew position and in conformance with the NASA guidelines for release of public information following mission anomaly or crew injury. Most of the ASTP mission and experiments results were published on government websites.

Abstract

At the end of World War II, the allied alliance was replaced by the East and West "Cold War" marked by the United States (U.S.) and the Union of Soviet Socialist Republics (USSR) rivalry on Earth and in space. The launch of the Sputnik 1, followed by Cosmonaut Yuri Gagarin spaceflight, shook the American political and technological confidence and launched the "Space Race." The space rivalry lasted 25 years, until the start of the Détente [1967–1979]. One of the first highly publicized peaceful collaboration was a joint ASTP space mission and the launch of the U.S./USSR Joint Working Group on Space Biology and Medicine. Apollo and Soyuz space crafts were launched on July 15, 1975, and docked on July 17, 1975. The space crafts remained docked for two days with multiple successful crew transfers using the *Docking Module*. The crew

 doi: 10.18278/sesa.6.1.6

completed 28 experiments before returning to Earth but was exposed to a highly toxic nitrogen oxide [N_2O_4] compound used as an oxidizer of the Apollo command module thrusters. The crew developed a chemical pneumonitis requiring hospitalization and treatment at the Tripler Army Medical Center in Honolulu, Hawaii before returning to the NASA Lyndon B. Johnson Space Center in Houston, Texas. ASTP was a demonstration of the rendezvous and docking systems and space rescue. An important outcome of ASTP was to serve as a template for future more ambitious international collaboration in space. This collaboration survived many political East-West tensions.

Keywords: history, Apollo-Soyuz, international collaboration, space docking, space rescue

ASTP: El comienzo de 50 años de colaboración Este-Oeste en el espacio exterior

Resumen

Al final de la Segunda Guerra Mundial, la alianza aliada fue reemplazada por la "Guerra Fría" entre Oriente y Occidente, marcada por la rivalidad entre Estados Unidos (EE. UU.) y la Unión de Repúblicas Socialistas Soviéticas (URSS) en la Tierra y en el espacio. El lanzamiento del Sputnik 1, seguido del vuelo espacial del cosmonauta Yuri Gagarin, sacudió la confianza política y tecnológica estadounidense e inició la "Carrera Espacial". La rivalidad espacial duró 25 años, hasta el inicio de la Détente [1967-1979]. Una de las primeras colaboraciones pacíficas altamente publicitadas fue una misión espacial conjunta ASTP y el lanzamiento del Grupo de Trabajo Conjunto EE. UU./URSS sobre Biología y Medicina Espacial. Las naves espaciales Apolo y Soyuz fueron lanzadas el 15 de julio de 1975 y acopladas el 17 de julio de 1975. Las naves espaciales permanecieron acopladas durante dos días con múltiples transferencias exitosas de tripulación utilizando el Módulo de Acoplamiento. La tripulación completó 28 experimentos antes de regresar a la Tierra, pero estuvo expuesta a un compuesto altamente tóxico de óxido de nitrógeno [N_2O_4], utilizado como oxidante de los propulsores del módulo de mando del Apolo. La tripulación desarrolló una neumonitis química que requirió hospitalización y tratamiento en el Centro Médico Tripler del Ejército en Honolulu, Hawái, antes de regresar al Centro Espacial Lyndon B. Johnson de la NASA en Houston, Texas. El ASTP fue una demostración de los

sistemas de encuentro y acoplamiento, así como del rescate espacial. Un resultado importante del ASTP fue servir de modelo para futuras colaboraciones internacionales más ambiciosas en el espacio. Esta colaboración sobrevivió a numerosas tensiones políticas entre Oriente y Occidente.

Palabras clave: Historia, Apolo-Soyuz, colaboración internacional, acoplamiento espacial, rescate espacial

阿波罗-联盟测试计划：东西方在太空领域50年合作的开端

摘要

二战结束后，同盟国被东西方“冷战”所取代，其标志是美国和苏联在地球和太空的竞争。苏联发射人造卫星1号，随后宇航员尤里·加加林进入太空，动摇了美国的政治自信和技术自信，并开启了“太空竞赛”。这场太空竞赛持续了25年，直到缓和时期（1967-1979年）的开始。最早备受瞩目的和平合作之一是阿波罗-联盟测试计划（ASTP）任务以及美苏空间生物学和医学联合工作组的成立。阿波罗号和联盟号飞船于1975年7月15日发射升空，并于1975年7月17日完成对接。飞船对接持续了两天，期间利用对接舱成功进行了多次宇航员转移。在返回地球前，宇航员完成了28项实验，但却暴露于一种剧毒的氮氧（N_2O_4）化合物中，这种化合物被用作阿波罗指令舱推进器的氧化剂。宇航员患上了化学性肺炎，需要在夏威夷檀香山的特里普勒陆军医疗中心接受住院治疗，之后返回位于德克萨斯州休斯顿的美国宇航局林登·约翰逊航天中心。ASTP是对交会对接系统和太空救援的演示。ASTP的一个重要成果是为未来更具雄心的国际太空合作树立了典范。这项合作经受住了东西方之间诸多政治紧张局势的考验。

关键词：历史，阿波罗-联盟测试计划，国际合作，太空对接，太空救援

Background

Prior to the Apollo Soyuz Test Project (ASTP), NASA robotic missions did include international participation, which was not the case for crewed missions. The exception was the flight of the *Biostack* device, designed to study the biological effects of high energy cosmic radiation (HZE/GCR) were flown on Apollo 16 and 17 missions (Facius et al. 1979; Horneck 1993).

In 1945, with the end of World War II, the East-West alliance was replaced by the "Cold War," marked by the United States (U.S.) and the Union of Soviet Socialist Republics (USSR) rivalry on Earth and in Space and by regional conflicts (Schlesinger 1967; Westad 2017). The launch of the Sputnik 1, followed by Cosmonaut Yuri Gagarin space flight, challenged the American political and technological leadership on a global scale launching the "Space Race" (Devezas et al. 2012; Orr 2004). The détente timelines and ASTP agreement are shown in **Table 1.**

Table 1. The Détente Timelines 1969–1979

Policy Level	**Space Agencies (ASTP)**
Nixon/Brezhnev U.S.-USSR summit meetings held in Moscow on May 24, 1972, and Washington June 25, 1973	NASA visit to USSR 1971
Agreements on nuclear arms control, space and health collaboration	U.S./USSR JWG on Space Biology and Medicine 1971
President Richard Nixon and Premier Alexei Kosygin also signed an agreement calling for an Apollo-Soyuz mission for July 1975	NASA and USSR Academia of Sciences with Chairs: Glynn Lunney (NASA) and Konstantin Bushuyev (Director, Energia RKK)
The cooperation renewed in 1989 (Russia leaving Afghanistan)	Three years of training 1972–1975
	• USSR: Star City, Baikonur, TsNIIMASH/TSUP
	• U.S.: JSC, KSC, and aerospace companies

The start of the Détente [1967–1979] ended 25 years of space competition and heralded the beginning of a new era of nuclear arms control and collaboration in space symbolized by the "*hand shake in space*." The ASTP was one of the center pieces of this collaboration. Another but less publicized event was the launch of the U.S./USSR Joint Working Group on Space Biology and Medicine (Doarn et al. 2010).

The primary focus of the ASTP was to showcase the U.S. and the USSR in the new era of détente and demonstrate the ability of on orbit render help and rescue of astronauts and cosmonauts (Ross-Nazzal 2010). The mission was also a first demonstration of the peaceful use of space consistent with the Outer Space Treaty (OST) principles (Hall 1969). Supplementary objectives consisted of conducting engineering, physical, and biomedical experiments (El-Baz and Warner 1977; Fitts et al. 2011).

Method

Google Scholar, Web of Science, PubMed were used as primary search engines using terms [but not limited to] such as "international

collaboration in space; U.S. and USSR collaboration in space; ASTP mission requirements; bends prevention; space medicine; NASA-USSR joint space experiments; ASTP docking module; crew safety; nitrogen tetroxide inhalation; and ASTP crew post mission medical care." Preference was given to peer reviewed articles in English language published since 1912.

Results

Abstracts from 73 publications of interest were reviewed. A total of 28 publications met the inclusion criteria. Seven publications are either conference papers, websites, books or NASA Technical Reports (El-Baz and Warner 1977; Facius et al. 1977; Page and Page 1977; Kay 1998; Sandler and Grigoriev 1990; Westad 2017; Hanhimäk 2012) were judged influential and included in the reference list. The remainder are peer-reviewed publication considered as both influential and robust evidence.

Discussion

During the "Cold War," the U.S. President John F. Kennedy's offer to the USSR for a joint exploration of the Moon (Kay 1998) partnership was not realized. During the "Cold War," President Kennedy's offer to USSR for a joint exploration of the Moon (Kay 1998) partnership was not realized. Both nations pursued their space activities independently, with the U.S. landing astronauts on the Moon and operating three Skylab missions in low Earth orbit, while the Russians operated orbital Salyut stations.

It was not until the early 1970 that President Nixon's desire to reduce the threat of a nuclear war created the opportunity for scientific collaboration, with the USSR including a joint space mission (Zelizer 2009).

The ASTP envisioned docked Apollo and Soyuz spacecrafts with three astronauts Thomas Stafford, Donald "Deke" Slayton and Vance Brand to meet Russian cosmonauts Aleksey Leonov and Valeriy Kubasov as a center piece of this "détente" policy.

Mission Docking Requirements

- All transfers between spacecraft will be in "shirtsleeves." Crewmen will sleep in their own spacecraft.
- Docking module systems will be operated by an Apollo crewman, and two men will be in the docking module during a transfer operation.
- Spacecraft hatches. will be operated by the crew of that spacecraft,
- No provision for contingency.
- Each Apollo crewman and each Soyuz crewman will visit the other spacecraft at least once during the two days of docked operations.
- During transfers at least one host crew member in each space craft and respective spacecraft hatch to the docking module is close.

1. ***Pre-flight Crew Health***

    a. Donald "Deke" Slayton, one of the seven original Mercury astronauts was removed from the flight status in 1962 after being diagnosed with a benign idiopathic intermittent atrial fibrillation.

    b. After exhaustive medical evaluations by the then leading cardiologists, Mr. Slayton was reinstated to flight status (aviation).

    c. Mr. Slayton was assigned to the last Apollo mission (ASTP) in 1970.

    d. During the pre-flight and through the ASTP mission Mr. Slayton remained free of atrial fibrillation (Nicogossian 1977).

2. ***Transfer and docking module***

    a. The docking on orbit and crew transfers was required to be in a shirt sleeve environment. The Apollo command module was designed to operate at 1/3 atmosphere and 100% O_2, while the Soyuz capsule was pressurized to one atmosphere with 21% O_2 and 79% N_2. The pressure and gas composition of the two spacecrafts were incompatible with his requirement and presented a danger for decompression sickness.

    b. To meet the mission requirements, NASA designed a docking module, built by the Rockwell International Corporation to allow the docking of the spacecrafts using the standard Apollo probe and drogue docking system and the Russian androgynous docking mechanism designated as the APAS-75 (Lewis and Donahoe 2023).

    c. The docking module also acted as an airlock to prevent bends and ensure a safe crew transfer.

    d. Multiple altitude chamber studies at the Institute for Biomedical Problems, in Moscow, USSR, United States Air Force Brooks Medical Laboratory in San Antonio, Texas, and the NASA Lyndon B. Johnson Space Center, Houston, Texas with a pool of over 41 subjects were used to validate a bends free protocol. The final procedure required the Soyuz spacecraft to drop its pressure to 10.2 psia [527.5 mmHg] during the docking and transfer allowing crews to equalize the pressure and gas composition during transfers (Nicogossian and

Campbell 2023).

e. During the 44 hours of the docked time four transfers were completed with the participation of all five crewmembers. The docking module protocol safety was validated without either cosmonauts or astronauts suffering from decompression sickness (Weathersby et al. 1984).

f. No medical issues were encountered during the flight portion of ASTP.

3. **Post-flight**

What started as a celebrated and successful space mission ended up as a medical emergency. During the reentry into the Earth's atmosphere the Apollo Command Module (CM) reaction control system (RCS) thrusters were not turned off. Nitrogen oxide [N_2O_4] entered the CM exposing the crew for at least four minutes to the toxic compound. The mission commander acted rapidly and after the Pacific Ocean splashdown administered oxygen to himself and the other two crewmembers. A short ceremony was held in the hangar deck of the recovery USN LPH 1. Toward the end of a telephone call with President Gerald Ford, the ASTP commander informed the crew surgeon of the toxic "smoke" exposure. The crew was promptly showered, administered steroids and moved to the LPH 11 dispensary for further care and observations.

All post-flight planned medical evaluations and on deck ceremonies were cancelled. Twelve hours later the crew exhibited moderate respiratory distress, with the chest radiograms revealing diffuse opacifications consistent with a chemical pneumonitis (Nicogossian 1977; Nicogossian and Campbell 2023), The crew was hospitalized at the Tripler Army Medical Center in Honolulu, Hawaii, remained on steroid and oxygen therapy until the resolution of the pneumonitis. The crew continued their convalescence at the Marine Corps Base Hawaii, located in Kaneohe Bay, for a week before returning to the Lyndon B. Johnson Space Center, Houston, Texas (Nicogossian 1977).

Conclusion

Fifty years after the ASTP, American astronauts and Russian cosmonauts live and work together in low Earth orbit on the International Space Station (ISS). Many international partners from the Canadian, European and Japanese space agencies have joined this partnership. ASTP proved the viability of an androgynous docking system, laying the groundwork for this technology still in use on the ISS program. This system called the *Androgynous Peripheral Attachment System* (APAS) allowed two different spacecraft to dock with one another.

After a symbolic docking of the country's spacecraft, two cosmonauts and three astronauts visited with each other spacecrafts, using a NASA provided transfer airlock, completing five joint experiments and exchanging

commemorative items. This mission and collaboration between biomedical personnel and the astronauts and cosmonauts paved the way for many joint research projects culminating in the assembly and operation of the ISS starting 2008. A major contribution of the ASTP to future crewed missions was the development and formulation of joint medical standards and research protocols using a joint U.S./USSR bedrest study as a testbed (Sandler and Grigoriev 1990).

Less publicized were the results of research across different fields scientific, engineering, biomedical, and social disciplines (El-Baz and Warner 1977; Page and Page 1977). Prior to ASTP, NASA robotic missions did include international participation, which was not the case for crewed missions. The exception was the flight of the *Biostack* device, designed to study the biological effects of high energy cosmic radiation [HZE/GCR] were flown on Apollo 16 and 17 missions (Facius et al. 1979, Horneck 1993). ASTP was the first Apollo mission flown at 51.8^0 inclination to match the orbit of the Soyuz space crafts (Blackmer 1974), which offered an opportunity to follow up on the "light flashes" reported by the Apollo Lunar and Skylab astronauts (Huesman et al. 1976; Tobias et al. 1971) and more recently together with the considered a risk to the vision for interplanetary travel (Aleci 2020).

Summary

ASTP was the first Apollo mission flown at a 51.8° inclination to match the orbit of the Soyuz space craft (Blackmer 1974), which offered an opportunity to follow up on the "light flashes" reported by the Apollo Lunar and Skylab astronauts (Huesman et al. 1976; Tobias et al. 1971) and more recently in combination with the Spaceflight-Associated Neuro-Ocular Syndrome (SANS) considered a risk to the astronaut or cosmonaut's vision for interplanetary travel (Aleci 2020; Brunstetter et al. 2025).

The successful treatment of the chemical pneumonitis was a benchmark for future occupational handling of propellants in the aerospace industry. The increase breakdown of collagen detected after the exposure to N_2O_4 was proposed as a screening test for such exposures (Hatton et al. 1977).

The ASTP was a successful symbol of détente at less than 0.04% of the total Apollo program an estimated cost (Dreier 2020).

Limitations and Bias

Most of the ASTP mission and experiments results were published on government websites. ASTP political success and global benefits beyond cooperation in space has been challenged (Ellis 2019). Compared to other space projects the scientific output is limited since the primary objectives were political and engineering. The majority of the ASTP publica-

tions can be found as NASA technical reports and can be found in the NASA STI Repository[1] detailing the engineering, NASA published scientific and policy outcomes of ASTP. While individual findings may have been written up and submitted for peer review in scientific journals, the comprehensive summaries of mission results are found in official NASA reports, which are technical documents rather than traditional peer-reviewed journal articles. The ASTP medical results identify each crewmember by name or crew position and in conformance with the NASA guidelines for release of public information following significant mission anomaly or crew injury.

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1 NASA Technical Reports Server [NTRS]: https://nters.nasa.gov

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