The 'Cervantes' Mission

- Another European Astronaut at the ISS

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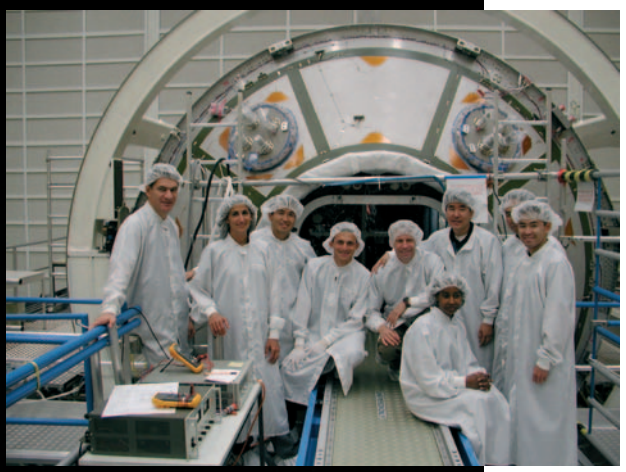


Astronauts from NASA, NASDA and ESA in front of the Columbus module during the European part of their Space Station training

Training in the US Lab simulator

Press Conference at the Spanish Ministry for Science and Technology on 4 February 2003

How It Came to Pass

When Spain expressed interest in sponsoring a Soyuz to the International Space Station (ISS), I was informed that I might be assigned to such a mission. At the time I was a member of the Columbus Project team, where I had been working since 1999 in the areas of crew interfaces, maintainability, EVA/robotics interfaces and also to some extent NASA interfaces. In addition, I was one of a group of ESA astronauts training to operate the systems of the Space Station, with the four of us being candidates for the first Permanent Crews with ESA participation.

Several months passed between the initial flight idea and the official announcement by the Spanish Government, during which it became increasingly probable that I would have to train in Russia to operate the Soyuz TMA as Flight Engineer, learn how to execute experiments in the (as yet undefined) ESA Utilisation Programme, and therefore also hand over my Columbus duties. Our Training Division and the Gagarin Centre considered one year a reasonable time to devote to this, based on their experience with previous such projects (Cassiopée, Marco Polo and Odissea). By September 2002, therefore, the time pressure began to mount and so at the beginning of October I went to Russia to start training, six months before the flight. Then the adventure really began.....

The Framework Agreement

ESA and the Russian Aviation and Space Agency (Rosaviakosmos) have developed an extensive and fruitful cooperation in the area of human spaceflight activities, both on the Mir space station and through the current International Space Station (ISS) Programme. The resulting operational interaction and cooperation between Russian cosmonauts and European astronauts has proved beneficial to the strengthening of the human spaceflight expertise and experience of both agencies.

In order to further pursue common endeavours in the field, in May 2001 ESA and Rosaviakosmos established a Framework Agreement for European-Russian cooperation in the organisation of flights for ESA astronauts using Russian flight opportunities to the ISS. The goal was to undertake a number of flights in order to utilise the ISS for scientific research and applications through well-established experimental programmes. Two types of opportunities are foreseen in the Agreement: *ISS Taxi Flights*, which are defined as short-duration Soyuz flights to the ISS for exchanging the Soyuz docked with the Station, including a short-duration stay on-board, and *ISS Increment Flights*, which are defined as crew-exchange flights, including a stay of several months (one increment) on-board the Station.

Within the scope of the Framework Agreement, CNES (F) sponsored the first ISS Taxi Flight in October 2001, known as the 'Andromède' mission, with ESA astronaut Claudie Haigneré on board. In April 2002, ESA astronaut Roberto Vittori flew on the 'Marco Polo' Taxi Flight sponsored by ASI (I), followed by ESA astronaut Frank De Winne in October 2002 on the 'Odissea' mission, sponsored by Belgium.

With those precedents established, Rosaviakosmos offered ESA two further flight opportunities, in April and October 2003. At ESA's invitation, Spain decided to sponsor the first one, with ESA astronaut Pedro Duque in the role of Flight Engineer, and The Netherlands took the second one, with ESA astronaut André Kuipers also serving as Flight Engineer.

Following the Spanish decision, the experimental programme for Pedro Duque's flight, which subsequently became known as the 'Cervantes' mission, was then drawn up in close cooperation with the sponsoring organisation, namely the Spanish Ministry for Science and Technology, through the Centre for Technological and Industrial Development (CDTI). Pedro eventually performed more than twenty experiments during his stay aboard the ISS.

Pedro was fully engaged in his Cervantes mission training in Russia when, on 1 February 2003, tragedy struck the US Space Shuttle 'Columbia' during its return from the STS-107 mission. The days and weeks that followed saw the mourning space community considering its options following the grounding of the Shuttle fleet, and assessing the best way to proceed in order to keep the ISS safe. The outcome of the assessment in terms of the number of crew on-board ISS was that, as from April, it would be reduced to just two until the Shuttle's return to flight. It also meant that the next Taxi Flight had to become a crew-exchange flight and that Pedro Duque could not therefore fly as early as originally planned. Rosaviakosmos and ESA, together with the Spanish Ministry and CDTI, agreed to postpone his flight until October 2003. Similarly, the two partners and the Dutch government agreed to postpone André Kuipers' flight until April 2004. Agreeing to the two postponements was Europe's contribution to protecting the ISS crew.

The eventual successful completion of the 'Cervantes' mission is solid proof of the good co-operation between the sponsoring entities, in this case Spain, ESA and Rosaviakosmos, within the Framework Agreement, and marks another positive milestone in the long-standing relations between ESA and Rosaviakosmos.

With the forthcoming flight of André Kuipers in April 2004, the Framework Agreement continues to be a solid and stable basis for the strategic planning of the activities of the European Astronaut Corps, as well as an important tool in the further development of the operational expertise of ESA's astronauts prior to full European utilisation of the ISS with the launch of Columbus. While the Framework Agreement allows for attractive financial conditions commensurate with the number of flights actually implemented, at the same time it supports the Russian space effort through the involvement of ESA astronauts. It is therefore intended to continue with this mutually very fruitful approach.

Manuel Valls
Head of Programme Integration Department
ESA Directorate of Human Spaceflight

A Fast Pace

The astronaut colleagues who had preceded me in undertaking similar training – Jean-Pierre and Claudie Haigneré, Roberto Vittori and Frank De Winne – had already warned me that six months was a very short time in which to learn the Flight Engineer's job fully. Everybody was therefore braced for furious activity, with no time to relax, but the objective was clear to all: no half-hearted attempts, we must continue to show that Europe's astronauts make valuable crew members, able to cope with the full range of responsibilities, and at the same time continue to demonstrate our excellence in executing experimental programmes with commitment and precision. It's hard to be seen as a junior partner…but so far I believe that we all at ESA, in all of our relations with our partners, have been able to show that we compare favourably with the best from the other agencies. This time it was my turn! And I know that the people who were there to help prepare my training, the experiments, the overall programme for my flight, etc., and for whom the six months was even shorter, felt exactly the same way.

It was straight into the classroom and the simulator, and so October and November were already gone without noticing. I was starting to believe that I was actually going to make it at the beginning of December, when I was told that the Christmas holiday period in Russia followed the old calendar, and so only four or five free days were allowed around New Year. It was strange to spend the last week of December in the classroom and simulator, but it was all in a good cause – namely to fly in April in the knowledge that I had been fully trained.

The Columbia Accident Takes its Toll

Training as a complete crew started as early as December 2002. Gennadi Padalka was my Commander, and his very extensive Soyuz experience and his excellent operational skills both challenged me to keep up and accelerated my learning process. All was well, with the last examinations taking place in January (in Russia you take an oral examination for every system you are supposed to operate), and the rest of the learning programme being made up of simulator training for Soyuz and procedural training for the experiments.

At this stage in the flight-preparation process, the ESA programme of activities to be conducted aboard the ISS was not yet very full. The Announcement of Opportunity (AO) had only been issued to the scientists in late November and most of

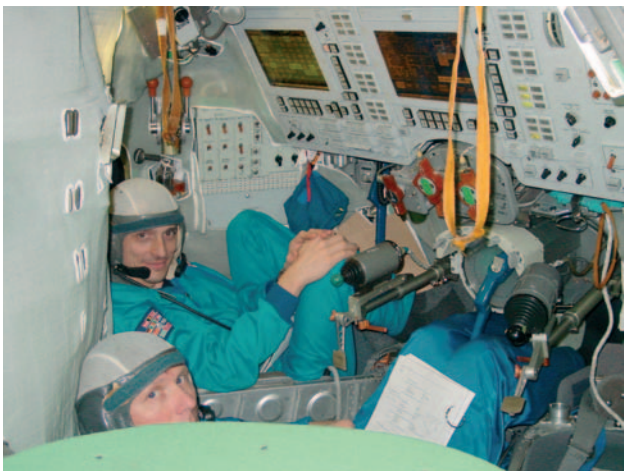
About to go into the centrifuge for an 8-g test

In the barochamber

the experiment hardware was supposed to be transported to the Station on a Progress flight scheduled for 2 February. The short lead time available meant that very few of the potential instruments for that Progress flight would make the deadline. This was, of course, a cause for concern, but the programme's management was determined to make the best use of the equipment that would arrive, and to re-use almost all of the hardware that had already been delivered and proven during the previous three flights.

On 1 February 2003 the world of all of us involved in human spaceflight was turned upside down, when Space Shuttle 'Columbia' was destroyed during re-entry and seven colleagues died. Everything was in turmoil. It quickly became clear that the Shuttle would not be flying again any time soon, and so the current Space Station crew would have to return home in a Soyuz spacecraft. Obviously, there was no time to send a new one, and so they would have to use the one that Gennadi Padalka and I had been planning to use to return to Earth at the end of our visit.

Interesting times followed during which all of the various options were carefully studied. Two or three people had to go up, making up a long-duration crew, one of whom needed to be a Soyuz Commander and another a Flight Engineer according to crew-composition rules. Three would return, one of whom had to be a Commander. If an ESA astronaut was to go up and down, obviously only two of the three current crew members could return, so one would have to stay for another six-month tour of duty. Another option was for me to fly up and stay for the whole six months, making up the first three-nation permanent crew. The third option was to postpone the ESA flight for six months and fly up the next crew, but only with two astronauts, taking a NASA astronaut with a Flight Engineer qualification. Eventually the latter option was taken, but since no NASA astronaut was suitably qualified at that point, Edward (Ed) Lu was chosen to train at almost impossible speed between February and April. He worked extremely hard, including nights and weekends, and eventually the bare minimums were met, although no-one but Ed could have accomplished that much.



With Gennadi Padalka in the Soyuz simulator at the end of January 2003

Preparing for EVA teamwork…

…and executing it

The good news was that we had six more months in which to train, to prepare instruments for later Progress shipments, to define the procedures better, etc., and we all made very good use of that extra time. We even managed to fit in an EVA training course for Thomas Reiter and myself in Houston as part of our continued preparation for the first European long-duration expedition.

My Flight to the Space Station

It turned out to be a totally different kind of flight for me than for the ESA astronauts who had made similar trips previously. To start with, it was not very clear who were 'my crew'. I launched with the Expedition 8 and returned with the Expedition 7 crews. None of them was really involved in the ESA programme because they had their own jobs to do, both during training and at the Station. Being a technical person, I sometimes joked that I was the Commander of the Fifth Visiting Expedition, and its only crew member! This turned out to be more accurate than I thought.

Before Yuri Malenchenko left to command the ISS for six

months, we spent a number of training sessions together in order to qualify 'as a crew' for a later descent. The position of Flight Engineer for both the outward and return legs was, I'm told, hotly debated, with both ESA and NASA proposing crew members. ESA eventually prevailed, probably in part because I had had the opportunity to devote much more time to my Soyuz training than my NASA colleagues.

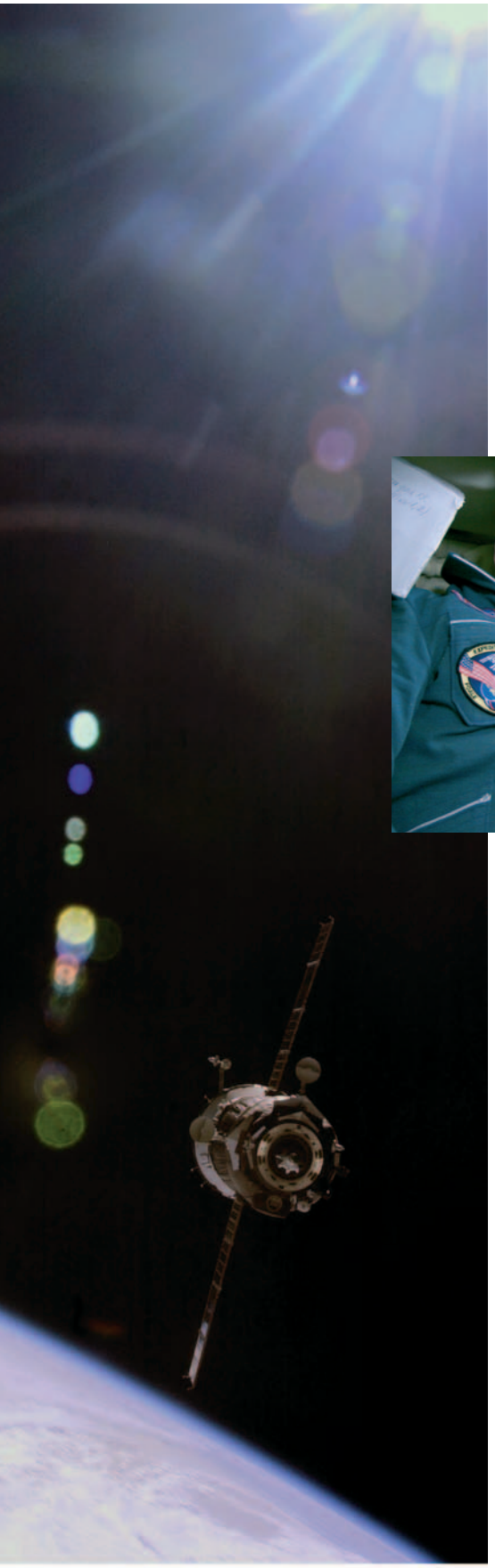
Training with Alexander Kaleri turned out to be as enlightening as with Gennadi Padalka, but in a different way. Being the first non-military, non-pilot astronaut to be launched in the Commander's seat in Russia, a lot of attention was focused on his performance, and he did not let anyone down. Both being engineers, we tended to look at problems in the same way, and he always took just a little longer than the 'immediate-reaction approach' I have seen from other Commanders. He would always first assess how much time he had to available to make a decision, and only then start considering the options.

A little later, Michael Foale arrived following his last training session for the US segment of the ISS. His contributions during training were always helpful and his long experience as a Shuttle Mission Specialist was very apparent. During Station simulations, Michael assumed his role as Station Commander with a lot of character and always had his own approach, based on sound principles, to every problem.

The three-nation crew training for Soyuz launch and docking

Our launch vehicle lifted-off on 18 October, on a perfect sunny day on which, they say, our rocket was visible for hundreds of kilometres down range. Inside were the three of us – Alexander, veteran of three such flights, Michael and myself – on our first ride on the legendary 'Semyorka' rocket. Michael and I agreed that the launch was much smoother than on the Space Shuttle, especially compared with the first two minutes of Shuttle flight when you are being propelled by the very loud, resonating solid-rocket boosters. With the several detailed briefings that I had had from Alexander about the intricate workings of the Semyorka, I was not at all surprised by the falling sensation at the end of the first phase of flight, the noticeable roll oscillation during the second, or the loud separation charges at the end of the third.

The crew before launch



The Soyuz craft performed flawlessly during the forty-eight hours that we spent going around the Earth waiting for the 'gods of orbital mechanics' to pull us into the correct position with respect to the Space Station, using the minimum amount of propellant. Every system worked well, with the exception of a manual valve that had accidently been left closed during pre-launch ground processing. The approach and docking manoeuvre was also performed flawlessly, with the crew and ground staff supervising the automatic systems, which did all the work from start to finish.

Not much room in the Soyuz at lunchtime

The International Space Station Today

Opening the hatch was an unforgettable experience. It took some time to check for air tightness, equalise the pressures, plug the Soyuz into the Space Station's power, and carry out all the procedures that ensure that two spaceships could become one. We in the Soyuz were eager to meet the crew and to see the Station itself, about which we had heard so many stories. I can imagine that the Station crew were eager to open the door to anyone at all, as we were the first people they had seen in six months!

Our hatch was opened first and the characteristic smell of something like gunpowder filled the Soyuz; I don't know if anyone has ever succeeded in explaining why the space vacuum always seems to have this kind of smell. Then their hatch opened and we saw them to be in pretty good shape, shaved, with short hair and dressed in matching clothes – not the look of shaggy explorers seeing a ship come ashore, but the look of a pair of officers proudly welcoming visitors aboard a large vessel.

The size of the ISS, or more accurately its length, is staggering. One cannot see one end from the other; in fact one can hardly see either end from the centre. Both airlocks are attached sideways-on to the Station, so the structure is not completely linear. Contrary to the Russian Mir station, however, the ISS has not yet grown large enough for one to become disoriented when inside.

Opening the hatch also made us aware of the smell in own Soyuz: after the two days inside it, it was a relief to breathe the much cleaner and cooler air in the Station. Everybody on board agreed that during the eight days of our stay the air was perfectly clean. The ventilation is good and one does not see floating dust, the filters 'swallowing it' very efficiently.

Work started right away: there was no time to lose in getting experiment operations underway, because the investigators had done a lot of work in defining a meaningful programme for the whole eight days available, and data needed to be gathered from the very first moment. The biological samples were

The Expedition 7 crew opens the hatch for us

introduced into the incubator, the protein crystal growth was started, the medical experiments prepared, etc.

Upon arrival at the Station, there is an unavoidable adaptation phase to be gone through, which can range from simply getting used to the crew restraints and how to move around, to even nausea and disorientation. Therefore, planning a very full first-day programme is always a risk, of which both the crew and ground control are well aware, so we all were very relieved to see all of the day's tasks get done.

The timeline for the eight days involved 21 different activities, as shown in the accompanying table. Every day there were eight to nine hours of scheduled activities, timelined by the ESA Operations Group resident in the Erasmus building at ESTEC (NL), within the constraints imposed by general Station operations. They were ready for any contingency, although there were luckily very few of those and we were able to execute the plan practically as originally envisaged. Nevertheless, space missions at ESA, whether automated or with astronauts, are always taken very seriously and means are always in place to cope with any foreseeable problems.

Every Space Station day starts with a planning conference, during which the American, Russian and ESA ground teams discuss very briefly with the crew the tasks of the day, and all make sure they will be working with the same information. Then all of the crew members 'fly' in different directions and start performing their planned activities, either alone or in pairs if required.

In our case, most of the time the permanent members of the Station crew were working in pairs, with the newly arrived member looking over the shoulder of the one about to leave or being briefed about the various details they should keep in mind for their six-month stay. I was mostly working alone, on operations that were not particularly complex when taken one by one, but which nevertheless required my full attention. It is our responsibility as astronauts to be the eyes and hands of the dedicated groups on the ground, the success of whose experiments depends on our careful handling and accurate operation of their hardware.

The planners on the ground always try to schedule the lunch break so that we all meet at the 'table', and most days it was possible to get at least three crew members together there. The break is over all too soon, however, and off we go again in different directions. During the day there may be conversations with the ground at the request of the crew, for instance if we are having difficulties in performing a particular task or have any doubts about the correct way to proceed. Normally, ground control rarely calls the crew, because they know that reaching a headset and activating the correct lines can sometimes be difficult, depending on where we are working at a particular moment, and consumes valuable time. However, it is unavoidable once in a while and in the worst case can involve three crew members: the one who happens to be closest to the radio, the one who goes to find whoever is being paged, and the one who actually has to answer the call.

We conducted a number of television interviews during my time at the Station. Some were with all or several of the crew, but many were only with me. This was a

Discipline	Code	Experiment Name	Principal Investigator
Biology	AGE	AGEING	R. Marco (E)
	ROO	ROOT	F. J. Medina (E)
	GEN	GENE EXPRESSION	
Microbiology	MSS	MESSAGE	M. Mergeay (B)
Human Physiology	COG	NEUROCOG	G. Cheron (B)
	SYM	SYMPATHO	N. Christensen (DK)
	BMI	BMI	C. Gharib (F)
	RYT	CARDIOCOG	A. Aubert (B)
	MED	MEDOPS	R. Lentzen (ESA)
Physical Science	PRS	PROMISS	J. M. García-Ruiz (E) A. Chernov (US) L. Wyns (B)
	NAN	NANOSLAB	J. Martens (B)

Discipline	Code	Experiment Name	Principal Investigator
Earth Observation	LSO	LSO	E. Blanc (F)
Educational	WIN	WINOGRAD	R. Dhir (UK)
	CHO	CHONDRO	University of ETHZ(CH)
	VID	VIDEO-2	M. Paiva (B)
	API	APIS	Universidad Politécnica de Madrid (E)
	THE	THEBAS	
	ARS	ARISS	G. Bertels (B) E.Grifoni (ESA)
Support Equipment	CRR	Crew restraint	P. Mitschdoerfer (ESA)
	3DC	3D Camera	D. Isakeit (ESA)
PR & Symbolics	PAS	PR and SYMBOLICS	C. Mattok/D. Isakeit (ESA)
Ground	CHR	CHROMOSOMES	G. Obe (G)

ESA activities during the Cervantes mission

'Flying' back into the Service Module

Giving a TV interview from the Service Module

sign not only that the European public is generally much more interested than the American or Russian public in space missions, but also that Europeans fly very seldom and thus it was a rare media opportunity. Some days we gave several interviews, and we worked hard to make every one valuable and to prepare the cameras, backgrounds, etc. as appropriate. Interviews in the Service Module (where the living quarters are) were the most common, but also the hardest, since we were blocking the table, the drinking water, the exercise treadmill and access to the bathroom during those times!

The Space Station day also ends as it began, with a planning conference. During this one, we check that we have received all the necessary messages and instructions from the ground that may be useful in preparing for the next day, such as indications of any hardware that may be difficult to find, prior warnings of activities that require very tight co-ordination, etc. After the main working day is over, there are also unavoidable tasks that have to be done at specific times, sometimes during dinner or immediately thereafter. The control centres do a good job in minimising those needs as much as possible. Worthy of special mention in this context are the medical experiments that are supposed to run during the night. If one of those is planned, then we have to prepare any sensors, electrodes or whatever after dinner. Experiments of this kind are a severe test of any astronaut's work discipline!

Returning Home

After eight days in the Station, it was time to return to Earth. The outgoing permanent crew was, of course, eager to see their families and friends after six months in space, although in no way did they give the impression of having lost their enthusiasm for work. As for me, I would certainly have stayed somewhat longer if I could. Ten days away from home is not so much, and opportunities like this don't come along often! But taking the next flight home was never a real option, so we three packed the results of our labours into the Soyuz on the last day.

The packing itself is not a simple task, since the spacecraft is very small and hardly anything else can be fitted in when you already have three crew members on board. Stowing the dozen or so items that we were returning for ESA, together with those for the Russian and NASA programmes, was very complex and required prioritisation. People are still discussing which priority should have been assigned to each item and whether the crew interpreted correctly the priorities sent from the ground. Packing for the return trip is therefore difficult, and only one person can really work on it because the space in the Soyuz capsule is so limited. Ed and I could only help by having everything ready, and by packing all the trash that had to be returned into the other part of the Soyuz, which burns up on reentry.

After an unexplained firing of the Soyuz thrusters had initially put everyone on edge, we detached normally from the Space Station and landed with no more malfunctions, exactly as planned and at the foreseen location. That was greeted by everybody with a sense of relief - not least we three inside - since this was only the second test of the new TMA landing avionics and the first one had suffered a failure that sent the crew more than 400 km off-course.

The Path Ahead

Now, with the flight debriefings having taken place and the medical people having completed all of their post-flight measurements, the ESA team is gearing up for the next challenge, Soyuz flight TMA-4 or 8S, which will carry our ESA colleague André Kuipers to the International Space Station on a mission, not unlike 'Cervantes', called 'Delta'. Have a good mission and a soft landing, André! esa

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