

Expert testimony on the space age

The full Q&A with moonwalker Buzz Aldrin

By Alan Boyle – Science Editor
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MOJAVE, Calif. - When the VIPs of the space world gathered for the SpaceShipOne rocket plane's historic launch into outer space, it was Buzz Aldrin who served as a living bridge between the end of the 1960s space race and the start of a 21st-century space race, fueled by private capital rather than taxpayer dollars.

Celebrity followed him everywhere — as he mixed with the Rutans and the rocket fans during a launch-eve reception, as he took his place among "Star Trek" captain William Shatner and Virgin tycoon Richard Branson in the distinguished VIP viewing area on the morning of the SpaceShipOne mission. And celebrity wasn't the only thing following him: A videographer chronicled every turn of Aldrin's visit to Mojave for a future documentary.

Over the past 35 years, the story of Aldrin's role in the Apollo 11 mission has been told and retold, so this interview focused instead on the new buzz over private spaceflight and NASA's space vision.

Q: You've talked for a long time about space tourism and the idea of having ordinary people get into space someday. How do you think the SpaceShipOne launch, the X Prize and everything else that's going on this summer fit into that vision you've had for so many years?

Aldrin: I think the people who experienced the Apollo missions came away from that experience wondering to themselves, "When can we get a chance to experience spaceflight?" I've heard that many, many times: that people got into a new career field hoping that they would be able to experience spaceflight. So I have been a witness to the enthusiasm that has been generated by the thinking of going into space, by seeing people do sensational things. And that has motivated people.

That motivation retained a number of people into the aerospace business, but a number have been somewhat let down, because it didn't keep going in the way that they thought it could. I'm saying this because I feel that anything that we can do in the near future that begins to stimulate the interest of people — seeing somebody down the street have an opportunity to go into space — buoys up the whole neighborhood. They know somebody, they identify with them, and a person [gets a sense of] somehow being able to qualify themselves. I know this because I've seen the enthusiasm that's generated with people like Dennis Tito, who gets a chance to fly, and other people who really wanted to. And I can see that a nation that begins to do

this to its populace is a nation that's going to have tremendous support for the space program continuing to do things of an expensive exploration nature.

Without this enthusiastic support by the people, the contentiousness of politics is going to whittle away the opportunity to be able to chart a course for a long way into the future. People will tire. They will get impatient. They will see their expectations not quite met.

Q: And there's some sense that that is indeed what's been happening since the halcyon days of the Apollo program.

A: Of course it has been happening. And you can't really put the blame on a particular organization. That organization did a marvelous job when it was put together, and it's had to live with the compromises that were made that resulted in the space shuttle and its design the way it is, and the space station the way it is. And we can't walk away from those commitments. We have those assets that we're working with now. So we're charting a course of exploration into the future that is going to take a tremendous amount of support by the people.

For the next five years, all we're going to be doing is the same thing we've been doing all along, which is flying the shuttle and the space station until we finish completing it. Now, in those five years, without exciting things happening, the public will begin to lose interest.

Q: How do you feel about that?

A: I feel there's something that has to be done about it. And I applaud the efforts that have been made in the direction of maintaining that interest by suborbital flying, by bringing people more than just being in a centrifuge, or in a jet fighter flying to 80,000 feet, or in a zero-gravity aircraft experiencing 20 or 30 seconds of zero gravity. Now we have the opportunity for people to go even higher, with rocket propulsion, on up to that dividing line that has been set of 100 kilometers. That is called going into space.

Now I think there's a little bit of debate as to whether that's really into space. If you want to say that the sky is black, and if I'm there, even if I fall back down again, I will be weightless for a period of time – maybe that's the definition of space. But at 100 kilometers, you cannot maintain orbit. That's 62 miles. And you will not even complete one orbit if you were going fast enough. These flights to attain the record of reaching 100 kilometers are going up and coming back down again. And they attain a velocity of something less than 3,000 miles an hour. The velocity that's needed to attain orbit is 17,000 miles an hour – between five and six times that much.

Q: Do you have a sense that privately funded space efforts would be able to make that leap to orbital flight?

A: Eventually they will. I'm not sure when. But it's going to be very expensive, because the jet engines would have to go ramjet, scramjet, air-breathing and then rocket travel into orbit. The National Aerospace Plane made an attempt to do that with single stage. That, in many of our estimations, was ill-advised, because we just didn't have the technology to be able to take off from a runway with a turbojet, go through a ramjet, a scramjet, and then end up with a rocket – putting all of those into one stage that's reusable. That's really pushing technology, and that's why that program didn't go very far.

The military services are looking for a scramjet and ramjet for hypersonic flight, and we just witnessed one example of that with the X-43, going Mach 7. It didn't accelerate much faster than that, and it was rather small. To take the leap that we're going to be able to take off from a runway and accelerate on into orbit with sufficient payload to carry a few passengers ... how much is that going to cost, and who's going to invest in that for the period of time that it takes for development with the idea that there will be a payback?

Q: Some people in the private spaceflight movement say that government should get out of the way, that private enterprise should take care of this, and government should just buy the service from these entrepreneurs. But it sounds as if you're siding with those who say that government must have a role in the future of spaceflight.

A: Absolutely, the government needs a role in carrying out exploration. They will be leading the development of the engines that are needed, and the private sector will take advantage of those. But the cost of attaining the energy needed ... the energy varies with the square of the velocity, so if you need five times the velocity, that's 25 times the energy. It's not easy to get human beings into orbit. So far only three nations have been able to do that, with all the resources that they put together. And I'm just a little skeptical that that's going to be done by the private sector without making use of what has been done by the government.

I have to feel that vertical launch is the way that we're putting things into orbit these days, not horizontal. When we can demonstrate that we can take off horizontally and put something into orbit, then we can begin to talk about increasing the amount of payload. But to say "I'm going to do that and put people into orbit" is a real leap.

Q: If you had a chance to correct those unfulfilled expectations, what would you tell people who might see this SpaceShipOne launch and say to themselves, "OK, this is the wave of the future"? How would you bring them back down to Earth?

A: Well, it *is* the way of the future, because we're not able to do that now. So we can take people up for three or four minutes of weightlessness, and they can see the blackness of space.

Q: But in terms of making that revolution so that we can get back into the business of exploring and also developing space as some sort of resource, either through tourism or, say, asteroid mining. What course do you think we should follow to do that? Is the NASA vision on the right track?

A: I totally support the NASA vision, the nation's vision as we are developing it now, and we hope that NASA will fill out that vision that we have defined. It's not necessarily NASA's vision yet, hopefully it will be. It's the nation's vision that was put forth by the administration. And I think the timetable is an appropriate one: to do things as they are affordable. We have to gradually cease doing some of the things that are quite expensive. We can't stop doing them right now and convert that savings into exploration.

We've made commitments to international partners, to the science community, to finish the space station. We estimate we can do that in 2010. That may be a little optimistic, depending on when we are actually able to return to flight. At that time we can begin to retire the orbiter.

Now will we have developed its replacement by that time? That's not the timetable that we have. The timetable that has been set out is to have the first flights of the Crew Exploration Vehicle in 2014. That is a gap. And I'm making some efforts to try to close that gap by encouraging the Chinese to participate in the space station, and for the space station partners to enthusiastically invite the Chinese to participate in the space station – thereby providing an alternative lifeboat at the space station to the Russian Soyuz. Otherwise, the Russians can begin to charge whatever they can get from the international partners; and the past seems to indicate that they would take the maximum bargaining position that they possibly could.

But I think providing some competition will provide the Russians an incentive to want to gradually phase out that three-person Soyuz and move into the six-person Clipper spacecraft. Now they can't afford to do that by themselves, and we're just not going to give them the resources to do that, unless that spacecraft, the six-person Clipper, has some commonality with the Crew Exploration Vehicle that we're trying to develop, so that there is a degree of similarity between those two.

We know for sure that if we help finance the Russians to have a six-person spacecraft, they're going to start carrying tourists into space. We know that because they would do that with the three-person [Soyuz] if they could get enough return. So are we going to just finance them to do that, and allow them to take the entire orbital market for tourism? No, I don't think so. I think we should develop that, and we *can* do that, by taking the exploration vehicle, the exploration crew module, assuming that the launch vehicle is robust enough to send the crew module to the vicinity of the moon with one launch. That means it has to have the propellant and the engines to not just get into orbit, but to take that crew module beyond there.

So if we don't use the propellant, we can use more than one crew module, we can use maybe four crew modules. We can upgrade this entire shuttle-derived heavy-lift vehicle as it is needed, to be developed to support the cargo that's needed on the moon, and eventually toward Mars. So that launch vehicle gradually grows larger and larger, and as it does its ability to take more and more crew modules into low Earth orbit [also grows], as a partnership with exploration and private-sector access to space.

That's what I feel this nation can do and should support, because it will increase this nation's stature in the rest of the world. It will do for exploration things that they wouldn't otherwise be able to do. It will increase the flight rate, which enables you to then amortize the cost of venturing into reusable components of that heavy-lift vehicle. That's reusable boosters. It increases the reliability by increasing the flight rate. All of these things benefit the nation's exploration program. They should see the benefit, in addition to providing a tremendously enthusiastic population behind this, because they now have the opportunity to fly into orbit themselves.

Q: Why hasn't the shuttle-derived heavy-lift concept gained more traction, if NASA is really looking for a new technology that takes advantage of the database they already have?

A: Well, because the Air Force made a decision to accept two winners in the evolved expendable launch vehicle program. We now have two winners in the EELV program: Boeing's Delta rocket and Lockheed's Atlas. And the payloads that were expected for those two winners have not materialized. So they are both hungry for payloads. They're both losing money unless they have more payloads. And the Air Force has to make up for that. So we have three organizations that want NASA to use the expendable vehicles for the crew module: Boeing, Lockheed and the Air Force.

Q: So what is your strategy?

A: It's to point out that it's better to operate one vehicle than two or three for the nation's exploration program. And that vehicle is a shuttle-derived lift vehicle that's more than twice as powerful as the EELVs right now, and it has the growth potential to be even greater, three or four times as powerful, approaching that of the Saturn 5. We can't start all over and develop a Saturn 5-type vehicle from scratch. We need to build on what exists now, and what exists now has flown 100 times now and has been improved. It's had its flaws, and we've fixed the flaws with the solid rockets.

Eventually we could phase out the solid rockets and put liquid rockets on the core stage, the same size as the external tank. When we retire the orbiter, we'll put the engine from the orbiter on the bottom of the tank, and put the cargo on the top. That's a real heavy-lift vehicle, and it grows gradually.

Q: It strikes me that, ironically, when NASA is talking about a new vehicle for crew exploration, a lot of the concepts go back to what

the Apollo-era spacecraft looked like, and here you're arguing to stick with the shuttle technology instead of going back to the technology that brought you to the moon. Can you reflect on that irony, or how things have come full circle since 1969?

A: I'm not sure that I understand the "going back to the Apollo" angle.

Q: Some of the concepts for the Crew Exploration Vehicle are similar to Apollo-era capsules.

A: That's so they're lightweight enough to be able to go on an expendable launch vehicle. They need to be a little heavier to be able to be a lifting body-type vehicle. The Russians have developed a capsule. They're moving toward a lifting body biconic. I think they're moving in the right direction.

We moved from a capsule to a vehicle to a winged vehicle that landed on a runway. And now people are suggesting we go back to landing in the ocean, with an escape tower and a capsule? I think that's the wrong move.

Q: Isn't that interesting? Strategically thinking about how to get back to the moon and go on to Mars, I'm curious what your view is on the moon-vs.-Mars debate – for example, whether we should go to a Mars Direct approach? If you're in favor of the vision, I assume you would favor going back to the moon first, building moonbases, and then perhaps going on to Mars – in a sense, picking up where Apollo left off.

A: The time for debating what our strategy is, is over. We have charted a course. If we start debating whether that's what we want to do or not, I can guarantee we will end up doing nothing. Because as we begin to be uncertain as to what we're going to do, the opposing political sides will see to it that we don't spend any money at all, and we will go nowhere.

We have a course. We've set that course with the vision for space exploration. We need to gather together behind that, execute it and then see where that begins to lead us as we can afford it. We go as we can pay.

Q: How do you view the legacy of Apollo, then, in light of the future plans for going back to the moon in the 2015-2020 time frame?

A: If we've designed a course for the future that enables us to have an exploration vehicle by 2014, how could we possibly get to the moon much before 2020? If we want to accelerate that more, it's going to cost more money, and that's not going to sell to the Congress.

We have an affordable program that's been set out. And I think we need to gather behind that and not say that it's too slow. What we've done since Apollo, as far as exploration goes, is way too slow. In the last 30 years,

we've not done any exploration. Let's chart a course and start it in an appropriate way.

I would rather see things done in four-year increments, starting with the first increment that started in '01 and ends in '05. We've launched the vision for space exploration. In the second increment, we'll return to flight, and we may send some robots to the moon. The third increment will complete the space station and retire the orbiter. The fourth increment, we'll begin to fly the exploration vehicle, and perhaps set up a facility close to the moon, an L1 station. The fifth interval, from 2017 to 2021, that's when we should be landing on the moon.

Why four-year intervals? Because that's when the president comes into office to validate the next eight-year programs. The eighth four-year program should have us reaching the moons of Mars, and then Mars, and then establishing permanence on Mars. We need to set that as a goal, not one or two missions to Mars, but moving toward a permanent station on the surface of Mars.

Q: Back in 1969, you probably didn't think it would take a 15- to 20 year program to return to the moon – or did you? Did you have a sense that what you did back then was extraordinary and amazing, and that it would take a long time to solidify that advance?

A: I wasn't in a position to be able to make a judgment. I knew that we had set a course toward a reusable space shuttle, and it took a good bit longer than most of us thought it would. There were about six years when there was not one American who went into space. We shouldn't do that again.

But it took us that long to develop that very technologically advanced space shuttle orbiter, and it didn't live up to its expectations. It cost much more than we thought. It did not fly as frequently. And its system has developed flaws and has had a safety record that is far less safe than we thought it would be. So it's time to move on, after we fulfill our commitments.

Q: If you could project forward to 2020, as you've done for the vision for exploration, what role would you see for private-enterprise spaceflight by 2020? How does that mesh with the vision for exploration?

A: I think that as we begin to have landings on the moon, we can alternate those with vertical launch of similar crew modules on similar launch vehicles for vertical-launch tourism in space, if you want to call it that ... adventure travel.

I do not think that we will reach by that time the point where we will be taking several economical numbers of people into space with horizontal launch. That's not what Burt Rutan would say, however. It's in his position to

want to make it look promising that he'll be able to within a few years follow this with the engine technology to get into orbit with horizontal launch with the private sector. I believe it's going to be beyond the affordable range of Wall Street or other people to invest in it.

Q: Have you discussed this with Burt or other folks who might be interested in investing in private spaceflight?

A: Yeah, I've discussed it. We disagree. I wouldn't expect him to be pessimistic about what he can do with horizontal aircraft launches.

Q: If you had \$20 million, and you wanted to invest it in something that would really further spaceflight for regular folks, how would you invest it?

A: I have no idea.

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