Space Shuttle Launch & Re-entry and International Space Station

22th Dec, 2018

Hajime Nishimura (JAMSTEC)/ Yan Lauria (Abyss Observatory) in SL

Participants:

Arianne (ArianneJP), Banker Tomorrow, CB Axel, Delia Lake, Elena Westland, Fosdick (ElectronicDetectiveSubstitute), Fumon Crystal, Khar (Kharissa Indigo), Mike Shaw (Shawza Tunwarm). pyo Igaly, ☨ Åąяои Ẅɘxɦoɯɘ ☨ (seaturtle008), Stephen Xootfly, Syzygy Asymptote (Syzygy0Asymptote), Talliver Hartnell, thief Burner, Trent Platthy, Vic Michalak

Organizer:

Chantal Jager (Nymf Hathaway), Hades Nostram (Movie), Jawesome (Jes Cobalt)

Abstract:

I was working on development of Japan Experiment Module, “Kibo” (“Hope” in English) of International Space Station (ISS) Program at Japan Space Development Agency (current JAXA) 30 years ago.
When I visit International Spaceflight Museum (ISM) in SL, I found ISS at that time didn’t have “KIbo”, so I proposed to provide “Kibo” to ISM members, and made “Kibo” with help of my friend, unico Bailey and docked to the ISS in 2014.
Last year, I found my friend, pyo Igaly made a very nice Space Shuttle ride so I proposed to ISM members again. I and pyo checked final launch, re-entry and landing sequences of space shuttle, and finally pyo installed the new space shuttle ride at ISM on this summer. Pyo also made new version of Newton cannon of Exploratorium. I had several remote class rooms for children at RL science museum in Japan using Newton cannon, Space shuttle ride and ISS exhibits.

At first, I’ll guide you to new Newton Cannon at the sky of Abyss Observatory (Farwell). You can learn about relation between initial launching speed and the orbit of spacecraft.
Next, we’ll move to ISM, you can experience Space Shuttle launch and landing.
The atmospheric re-entry sequences of the winged space shuttle is very tricky and it has been improved much better than I was involved in the space station project.
At the ISS, I'll talk about design features of US-Russia complex, uniqueness of space environment and living pattern of astronauts there.

(Newton Cannon)

https://youtu.be/P5JyxbV8haI?t=217

(Skip from 0:00-3:37 due to confusion of landing point)

Yan: Welcome, everyone.

Here is 3,700 m sky of Abyss Observatory

Yan: Did you visit Newton cannon at Exploratorium before?

That cannon has a bug since Physics Engine changed, but Patio said they couldn't bug-fixed. So, my friend, pyo-san made this new Newton Cannon and I proposed to Exploratorium about replacement but Exploratorium will closed next April? so I'm searching alternate place.

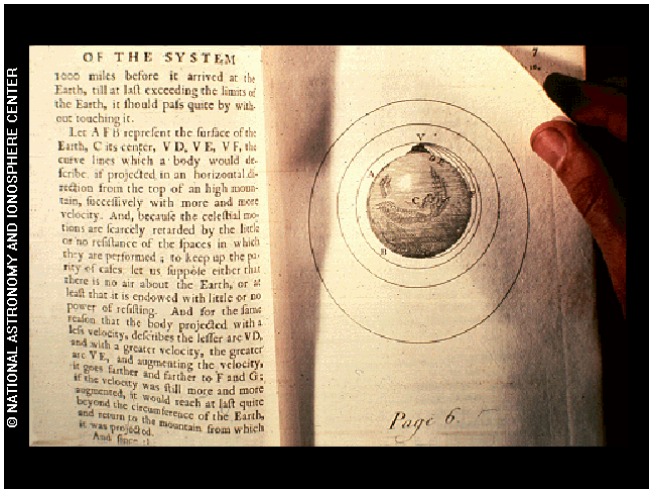
Yan: By the way, It is said Newton discovered Law of Gravity when he saw falling apple.

But one Nobel Prize winner, Hideki Yukawa wrote in his book,

One day, Newton lied under an apple tree and looked up the sky, then he saw an apple of the tree and the moon beyond the tree at the same time..

He through that apple will falls but the Moon doesn't fall. Why? He found a law common for falling apple and the staying moon.

Yan: Please look at this photograph of this panel



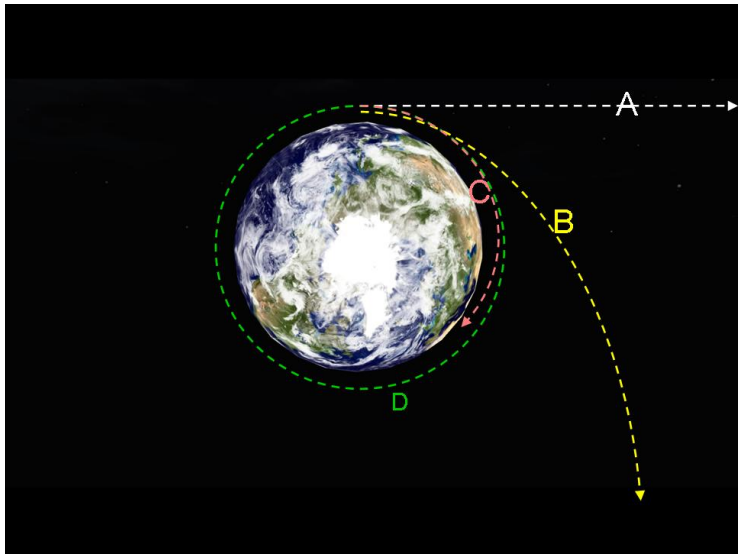
Yan: Newton thought of a “Thought Experiment”.

On the top of high mountain, there is a cannon. When the cannon fire a cannon ball, what kind of trajectory does the cannon ball depict?

Yan: Come on, here are three Rail gun.

[07:13] Chantal: Follow Yan, please

Yan: Please look at this panel



A is strait.

B is falling downward

C is falling on the Earth

[07:13] Chantal: Narrow area to move in ㋡

[07:14] Syzygy: Yep, don't want to experience free-fall, right now.

[07:14] Chantal: ㋡ Syzy

[07:14] Chantal: Left mouse, Alt and Shift... easy to view the entire region

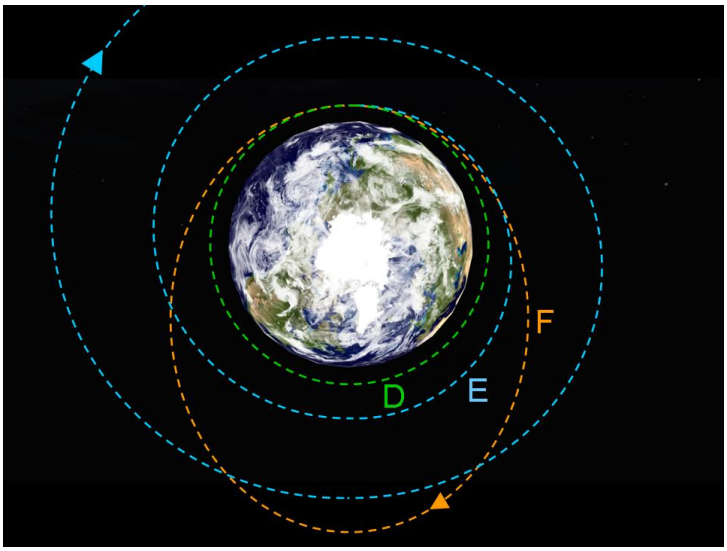
(Skip from 7:27 to 11:30 due to presenter's PC trouble)

Yan: In a classroom, I’ll ask students but today, for time saving, I continue explanation.

Yan: This is 7.9 km/sec rail gun. This speed is called “First Cosmic Speed”.

Usually Rocket is launched eastward, sunrise direction, from a place near the equator because the rocket can use Earth’s rotation speed. Then, at the equator, initial speed becomes 7.5 km/sec.

Yan: And this is 9 km/sec rail gun. then



E is go away from the Earth spirally

F is continue revolving around the Earth along an elliptical orbit.

Yan: Then please ride 3 rail guns. Each spacecraft is 4 crew ride.

[07:21] Fumon: oh

[07:21] Delia: This board is great

(Yan: Maybe Delia said about above Parabolic trajectory simulator by Nyachio)

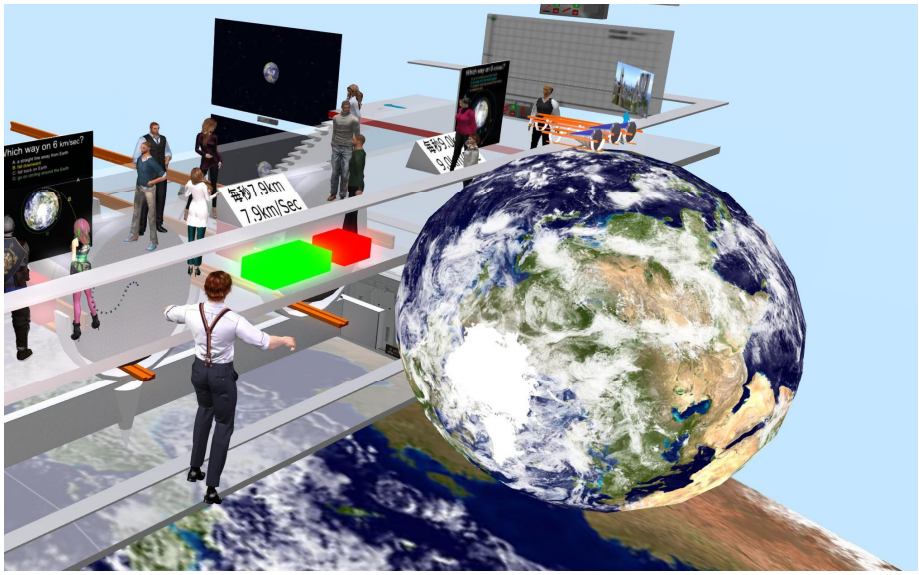
[07:21] Yan: All people, please try these 3 rail guns

[07:21] Fumon: wb:)

[07:21] Mike: ♥

[07:21] Fumon: go CB"

[07:22] pyo: Just showing miniature model is over there



[07:22] Fumon: Go Khar!

[07:22] CB: Cool

Yan: Are you enjoyed? Then, let's go to next. Please use this teleporter.

[07:22] Khar: That was fun

[07:22] Arianne: You can see the orbit way of these bullet by high bird view.

[07:22] Syzygy: Compressed the time on those orbits. Cool though.

[07:24] Arianne: Let's move to museum by clicking and teleport with this poster [http://ismuseum.org], Hades!

[07:25] Fumon: ISM again

(International Spaceflight Museum)

https://youtu.be/P5JyxbV8haI?t=1203

Yan: Here is famous International Spaceflight Museum.

Yan: Please set sun position to “Sunrise”. So, sun direction is eastward. That is, Rocket will be launched for sunrise direction. Please remember.

[07:26] Syzygy: I'm on sunrise.

[07:26] CB: Set sky to sunrise.

[07:26] Mike: ☺

[07:26] Syzygy: It is sunrise for me in RL too.

[07:26] Fumon: sunrise

[07:26] Chantal: World>Sun>Sunrise, please

Yan: Then, come on, that is Space Shuttle Launch Ride. Before try this ride, I’ll explain Space Shuttle Launch sequence using miniature model

[07:27] Chantal: What a gorgeous vehicle it is

Yan:

1. Liftoff - 90 deg roll -> Inverted flight (head down attitude, for Telecommunication with ground, and emergency escape
   Why 90 deg roll after launch? Because the launch tower is converted from Saturn rocket. Space Shuttle Carried from south, so Space Shuttle stands like this.
2. Solid Rocket Boosters Separation -> 180 deg roll - Normal flight for Telecommunication with Tracking and Data Relay Satellite, and for External Tank Separation.

[07:28] pyo: SRB

[07:28] Syzygy: To thrust up on the fuel tank.

Yan

3. Main Engine Cut off -> External Tank Separation (not reach 1st Cosmic Speed yet, so External tank will fall to the Earth)
4. Fire OMS (Orbital Maneuvering System) to reach 1st Cosmic Speed
5. 360 deg pitching for damage inspection after Columbia disaster but omitted the inspection from this ride for time saving
6. Docking with ISS

Yan: Then please ride. 2 people at once, 50 sec interval.

[07:33] Jes: wooah

[07:33] Fosdick: Sorry

[07:33] Chantal: waaaaaaaaaaaaaaah

[07:33] Syzygy: I'll wait for the next bus.

[07:33] Seaturtle: coool

[07:33] Jes: HAHAHAH syzy

[07:33] Chantal: My view is going with the shuttle :))

[07:33] Syzygy: Pretty breezy here.

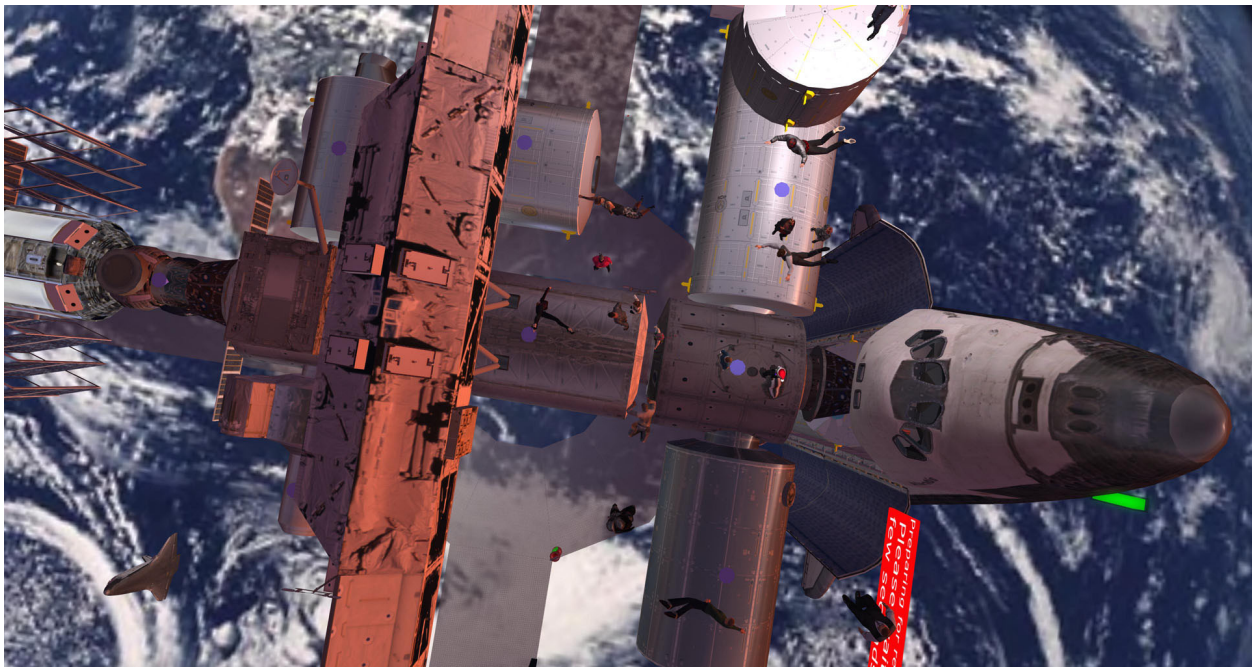
[07:33] Mike: Holy s***! That's Awesome!

[07:33] Chantal: ❤

[07:33] Chantal: wow

[07:33] thief: How much money went to air right now?
(Yan's answer: NASA paid 81.7 million USD for one astronaut as training and launching by Soyuz in 2015 - 2018)
[07:33] Vic: Wonder if you could fly along besides it (in SL)?
[07:33] Fumon: lol
[07:33] Chantal: Lovely, Yan!!!!
[07:34] Syzygy: NEXT!
[07:34] pyo: 全員上にあがるまで 20 分かかるｗ
[07:34] Chantal: ❤
[07:34] Chantal: Incredible
[07:34] Arianne: 2 person for each launching, interval is 50 sec. plz be patient to wait your bus :XD.
[07:35] Chantal: Phil reached the ISS ツ
[07:35] pyo: バス出しますｗ
[07:36] Mike: Wow, I followed that along the whole way... amazing detail!
[07:36] Chantal: Great education material!
[07:37] thief: hop in
[07:38] Syzygy: I guess we do wait.
[07:38] thief: Do we still need air in space
[07:38] Syzygy: We need a bus with a bigger seating capacity.
[07:38] Khar: lol
[07:39] Khar: ささやき: back to the ground?
[07:39] Syzygy: I'm hearing sounds up here! Amazing!
[07:40] Chantal: Oh Smart, Aaron ツ

(International Space Station)



[07:40] thief: Do not forget to take selfi in space
[07:40] Chantal: hehhe yes :))
[07:40] Syzygy: This is a good selfie space.
[07:41] Mike: I like zero-g!
Yan: At first, please remember here is forward part of ISS, and this way is backward of ISS
So this way is left side and this way is right side.
[07:42] thief: Yes no gravity to help us move right or left
[07:42] Chantal: heheh snapshot of Xootfly upside down ツ
Yan: ISS go around the Earth only in one and half hour.

(Accommodation and Transportation of Astronauts)
Yan: Then, here is US module "Harmony". There is 4 crew compartments or sleeping lockers.
Both sides are Japan Laboratory "Kibo" and European Laboratory "Columbus"
[07:42] Fumon: Kibo 希望 lab
Yan: Here is US Laboratory "Destiny". and 73m Truss. There are solar battery paddles and
Radiators and Canada Mobile Servicing System, "Canadarm2".
[07:43] Syzygy: YEA, CANADA!
Yan: Please go through truss.
[07:43] Chantal: How many people worked on this project, Yan?
Yan: Here is US module "Unity" for galley and meeting space.
Right side is Air lock module. Look at bottom side, there is a hatch for extravehicular activity.
Left side is Life support system, Toilet, bathroom and physical exercise facility. Look at bottom side, there is the "Cupora" for Earth observation and the maneuvering Canadarm for catching unmanned vehicle.
[07:43] Fosdick: The whole thing looks great, great sense of huge scale.
[07:44] Chantal: Yes, very
[07:45] Chantal: Busy taking awesome photos
Yan: 1st Question: Do you know how to enjoy starry sky at ISS?
There isn't any window at upper side of modules. Only way is to use TV camera.
[07:46] Fumon: Cupola https://en.wikipedia.org/wiki/Cupola_furnace
(Russian Module)
Yan: From here, Russian modules
Look at bottom side, there are two Soyuz manned vehicles stay ISS every time.
After space shuttle retirement, ISS depends crew transportation on Soyuz only.
One Soyuz carries captain and two passengers.
So two Russian captains, two American, one European and one Japanese, total 6 crews stay at ISS. If severe emergency occurs, all crews can return to the Earth.
[07:47] Chantal: ooooh Zoooom out!

Yan: Two Russian captains are living at this module, Zvezda.

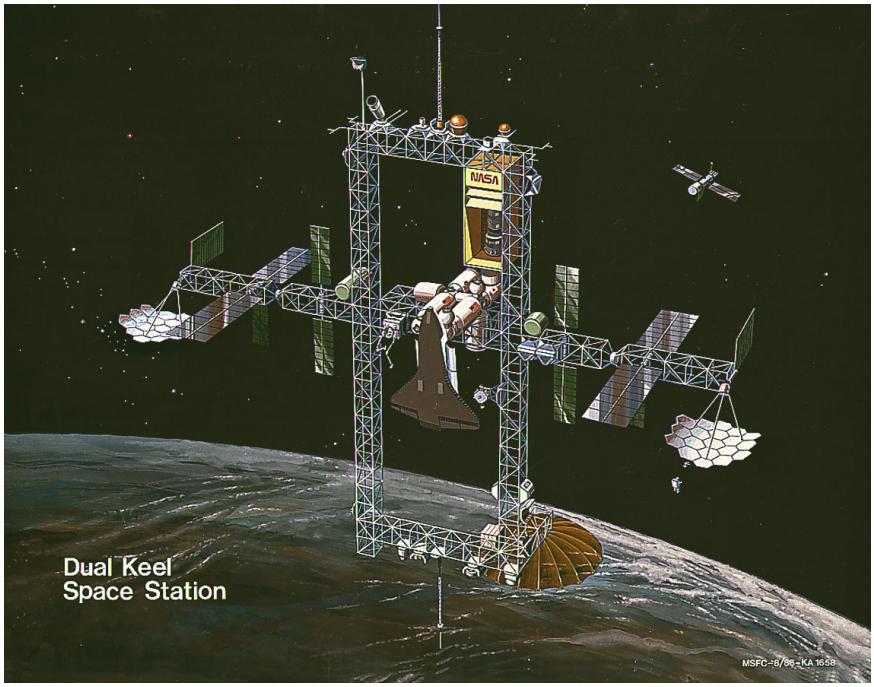
[07:47] Vic: Great way to get an overview of the ISS

[07:47] Chantal: yes ㋡

[07:48] Chantal: Amazing work!

(USA-Russia complex)

Yan: I was working on ISS development 30 years ago, initial design phase of this program, ISS was named “Freedom”, symbol of USA-Canada-EU-Japan collaboration in Cold War,
At that time, space station had dual keels, made more stable by centrifugal force and Earth gravity.
https://en.wikipedia.org/wiki/Space_Station_Freedom#Dual-keel_design_(1986)



Yan: But ISS became more complex, maintenance time became longer, because, out of atmosphere, “space radiation” caused malfunction of electronics devices. Astronauts need to work every hours a day for maintenance and they couldn’t engage in experiment and research works.
So NASA was forced to simplify the space station.

Yan: Another problem, integration in space is very difficult. NASA’s space station is differentiated in functions into various modules and they can work only after completion of assemble.
In other hand, Russia’s space station Mir’s each module is an independent spacecraft. each has solar panel and radiator and work independently.
So ISS assemble was started from Russian module.

[07:48] Chantal: The one field we are capable to work together

[07:49] Fumon: yes

[07:49] Fumon: We can see the panel

(Vacuum in space)

Yan: Then, you know space is vacuum, but in fact, ISS receives air resistance. So, when ISS comes night side of the Earth, solar paddles set horizontal to reduce the air resistance. Still it will descended by 2.5 km every month. So when unmanned transport vehicle “Progress” visits and dock ISS, Progress reboosts ISS.

Yan: Let’s go back to forward.

Yan: Vacuum in space causes another problem.
2rd Question: Which do you think space is hot or cold?

[07:52] Stephen: Space is cold.

[07:52] Stephen: 3 degree Kelvin

[07:52] Mike: Good question... chilly unless you can see the sun?

[07:52] Stephen: or so

Yan: Space temperature is 3 degree Kelvin or minus 270 degree celsius.
But do you know “Vacuum bottle”? Outside of spacecraft is vacuum, so heat inside of spacecraft can’t be removed”. So, spacecraft need radiator which removes heat by infra-red radiation.
(Where is radiator of space shuttle? Inside of cargo bay hutch.)

[07:53] Syzygy: But you still have to deal with radiation.

[07:53] Stephen: No material for transference

[07:53] Vic: Very interesting!

(Radiation)

Yan: I said about Space Radiation outside of atmosphere.

3rd Question: If the sun's storm occurs, what will the crew do?

[07:55] Stephen: Go into the mating adapters that is refuge for solar storm?

Yan: Here, docking adopter of Russia modules and USA module is most insulated area from space radiation, so when the sun's storm is predicted, crews refuge here.

[07:57] Syzygy: We all need asbestos suits.

(Space Shuttle Re-entry and Landing)

Yan: Well, it is time to go back to ground with space shuttle. I'll explain about atmospheric re-entry sequence of space shuttle using miniture again.

1. Un-docking -> 90 deg pitching up -> OMS back-boost,
2. 180 + 40 deg nose up (40 deg up trim) -> re-entry
   Space shuttle is covered by plasma caused "Adiabatic Compression". Not air friction.
3. 80 deg bank because upward force prevents descending. And 80 deg bank for opposite side.

Trajectory depicts S letter like Ski Slalom.

4. Catch air - Gliding
5. Landing

[07:57] Chantal: No words, Yan... this is excellent educational material. Grateful you and others created this exhibit.

[07:57] Syzygy: Nicely done.

[07:58] Syzygy: It would be nice to breathe again though. :)

[07:58] Chantal: :))

[07:58] CB: Next someone needs to build an interior of the ISS unless there is one already.
[07:58] Chantal: yes, CB
[07:58] Chantal: I mean would be great
[07:59] Syzygy: For a hot re-entry.
[08:00] Syzygy: /me limbers up a bit.
[08:02] Banker: <aside> ISM is indebted to Yan and pyo for the models of the ISS module and the Space Shuttle, and the programming that makes the Shuttle work. Thank you! You make a difference! ISM is always looking for Builders, please apply to Kat Lemieux here in Second Life.
[08:02] Chantal: Thank you, Banker ツ for the information :)
[08:02] Mike: ☺

(Closing)

Yan: Then you can experience the re-entry by touch that space shuttle.
But before ride, I'll announce two things.
Yan: One: When you land on the ground, there is an amphibious car ride. Once you ride on it, you can return to the Space Shuttle launch site.
Yan: Two, at same time of next Saturday, I will give a Field Trip of Ultra Deep Ocean Drill Ship at Japan Open Grid, one of OpenSim Grids. SL avatar can't teleport to JOGrid, So please check information from Science Circle.
Yan: Then, my guide is finished here. Pls enjoy re-entry ride freely.
Is there any comment or question?

[08:03] Stephen: Wonderful, Yan. Thank you.
[08:03] Vic: Excellent, Yan!! Thank you!
[08:03] Fumon: .•*❤¨`•Applause•´¨`❤*•.
[08:03] Chantal: Incredible work!!!!!!!!!!
[08:03] CB: Thank you, Yan. This was interesting and great fun!
[08:03] Syzygy: Thanks, Yan.
[08:03] Elena: Thank you
[08:03] Khar: Thank you so much This is Amazing
[08:03] Talliver: Thanks for the awesome experience
[08:03] Mike: Incredible work!
[08:03] Vic: [I imagine one way to reenter ISS is just to fall from here... :)]
[08:04] Mike: Thanks much for your time this morning, Yan!
[08:04] Delia: Thank you, Yan! Great work and great tour. I'll come back here later to explore things that have been done since I've last visited
[08:04] Jes: Great fieldtrip Yan ツ Thank you so much for hosting it
[08:05] Chantal: Made some wonderful photos we will be able to advertise with on social media, Y, lovely ツ

[08:05] Yan: I'm grad you all enjoy Pyo's Ride
[08:05] Chantal: Yan
[08:05] Yan: Pyo-san, pls say something
[08:06] pyo: Thanks for all peoples.　Fun this tour ride and some object pls.
[08:08] Chantal: Got ya, Fosdick ツ
[08:08] Arianne: Great opportunity, we are the champion !!!!
[08:08] Jes: ツ
[08:08] pyo: :D
[08:08] Mike: Great photo opportunities today!
[08:08] Chantal: yes, very ツ
[08:08] Jes: indeed Mike
[08:08] Chantal: again because Yan works hard...
[08:09] Jes: yayyyy
[08:11] Chantal: Yan, thank you for this amazing experience
[08:11] Jes: Indeed! Thank you Yan ツ
[08:11] Chantal: and I do think we should advertise in the sc region for this work
[08:11] Jes: yessss
[08:11] Yan: yw
[08:11] Jes: agree
[08:11] Chantal: make a poster somewhere it gets extra attention
[08:12] Arianne: international cooperation is the most important thing like as ISS. We can do it !!!!!
[08:13] pyo: ISS has re-entry tour ride have. plz try it :D
[08:14] Yan: Yes Space Shuttle re-entry is very acrobatic.
[08:14] Yan: Please try!
[08:14] Chantal: Thank you, Pyo ツ
[08:14] Yan: Pyo is genius of ride.
[08:16] Arianne: Thanks everyone, I will nor forget the things we have today.
[08:16] Fumon: ❤
[08:16] Yan: I experienced international collaboration is very good 30 years ago.
[08:17] Yan: And I love Space station is consisted by US-Russia complex.
[08:17] Jes: okay I'm logging, see you all later ツ Thanks for the great time Yan!
[08:17] Arianne: We are the one, Terran.