

Università degli Studi di Padova – Dipartimento di Ingegneria Industriale

Corso di Laurea in Ingegneria Aerospaziale

Relazione per la prova finale

**Il programma Artemis: Una panoramica del grande ritorno sulla Luna e
una analisi dettagliata dello Space Launch System (SLS)**

***Artemis Program: An Overview on Humanity's big return on the Moon and
a detailed discussion on the Space Launch System (SLS)***

Tutor universitario: Prof. Luca Malavolta

Laureando: *Anziliano Patrick*

mat. 1190932

Padova, 14/11/2024

Il programma Artemis

- Cos'è Artemis?
- Artemis Vs Apollo
- Perché la Luna? E perché tornarci?

Space Launch System (SLS)

- Panoramica
- Innovazioni
- Core Stage
- Motori RS-25
- Boosters
- Payload

Conclusione

- Considerazioni Finali
- Bibliografia e Sitografia



5 Missioni

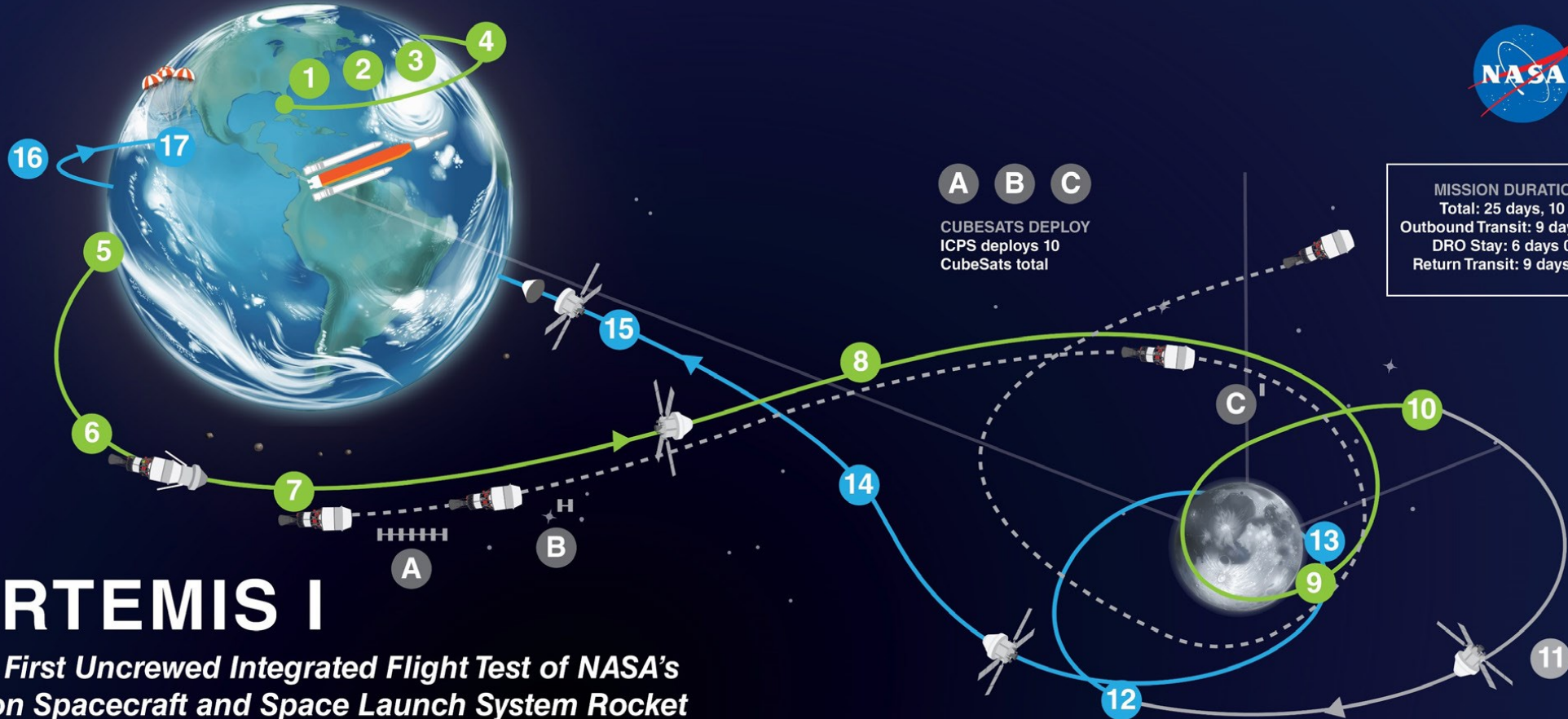
- Artemis 1
- Artemis 2
- Artemis 3
- Artemis 4 e 5

4 Obiettivi Principali

- Cercare ed usare l'acqua lunare
- Imparare a vivere e lavorare sulla superficie di un altro corpo celeste
- Testare le tecnologie necessarie prima di inviare astronauti in missioni su Marte
- Studiare la Luna per scoprirne i misteri

3 Componenti Chiave

- SLS
- Orion
- Gateway



MISSION DURATIONS:
Total: 25 days, 10 hrs
Outbound Transit: 9 days 13 hrs
DRO Stay: 6 days 0 hrs
Return Transit: 9 days 19 hrs

A B C
CUBESATS DEPLOY
ICPS deploys 10
CubeSats total

ARTEMIS I

The First Uncrewed Integrated Flight Test of NASA's Orion Spacecraft and Space Launch System Rocket

- 1 LAUNCH (11/16/22)**
SLS and Orion lift off from pad 39B at Kennedy Space Center.
- 2 JETTISON ROCKET BOOSTERS, FAIRINGS, AND LAUNCH ABORT SYSTEM**
- 3 CORE STAGE MAIN ENGINE CUT OFF**
With separation.
- 4 PERIGEE RAISE MANEUVER**
- 5 EARTH ORBIT**
Systems check with solar panel adjustments.
- 6 TRANS LUNAR INJECTION (TLI) BURN**
Maneuver lasts for approximately 20 minutes.
- 7 INTERIM CRYOGENIC PROPULSION STAGE (ICPS) SEPARATION AND DISPOSAL**
ICPS commits Orion to moon at TLI.
- 8 OUTBOUND TRAJECTORY CORRECTION BURNS**
As necessary adjust trajectory for lunar flyby to Distant Retrograde Orbit (DRO).
- 9 OUTBOUND POWERED FLYBY**
105.5 miles from the Moon; targets DRO insertion.
- 10 LUNAR ORBIT INSERTION**
Enter Distant Retrograde Orbit.
- 11 DISTANT RETROGRADE ORBIT**
Perform a half revolution (6 day duration) in the orbit 43,730 miles from the surface of the Moon.
- 12 DRO DEPARTURE**
Leave DRO and start return to Earth.
- 13 RETURN POWERED FLYBY**
RPF burn prep and return coast to Earth initiated. Closest approach in middle of burn, 81 miles.
- 14 RETURN TRANSIT**
Return Trajectory Correction burns as necessary to aim for Earth's atmosphere.
- 15 CREW MODULE SEPARATION FROM SERVICE MODULE**
- 16 ENTRY INTERFACE**
Enter Earth's atmosphere.
- 17 SPLASHDOWN (12/11/22)**
Pacific Ocean landing within view of the U.S. Navy recovery ship.

ARTEMIS	APOLLO
Obiettivi Scientifici e di Ricerca	Obiettivi Politici e Militari
Allunaggio al Polo Sud Lunare	Allunaggio nella fascia equatoriale Lunare
Missioni di più giorni consecutivi	Missioni di poche ore
3 distinte componenti chiave SLS, Orion, Gateway	Tutti i moduli a bordo di un unico razzo: il Saturn V
Sforzo Internazionale: 40+ Nazioni	Sforzo Nazionale Statunitense
4 Membri Equipaggio	3 Membri Equipaggio
Riutilizzo di infrastrutture e materiale esistente	Creazione di infrastrutture e materiale da zero



Logistica

- Vicina
- Missioni di lunga durata

Valore Scientifico

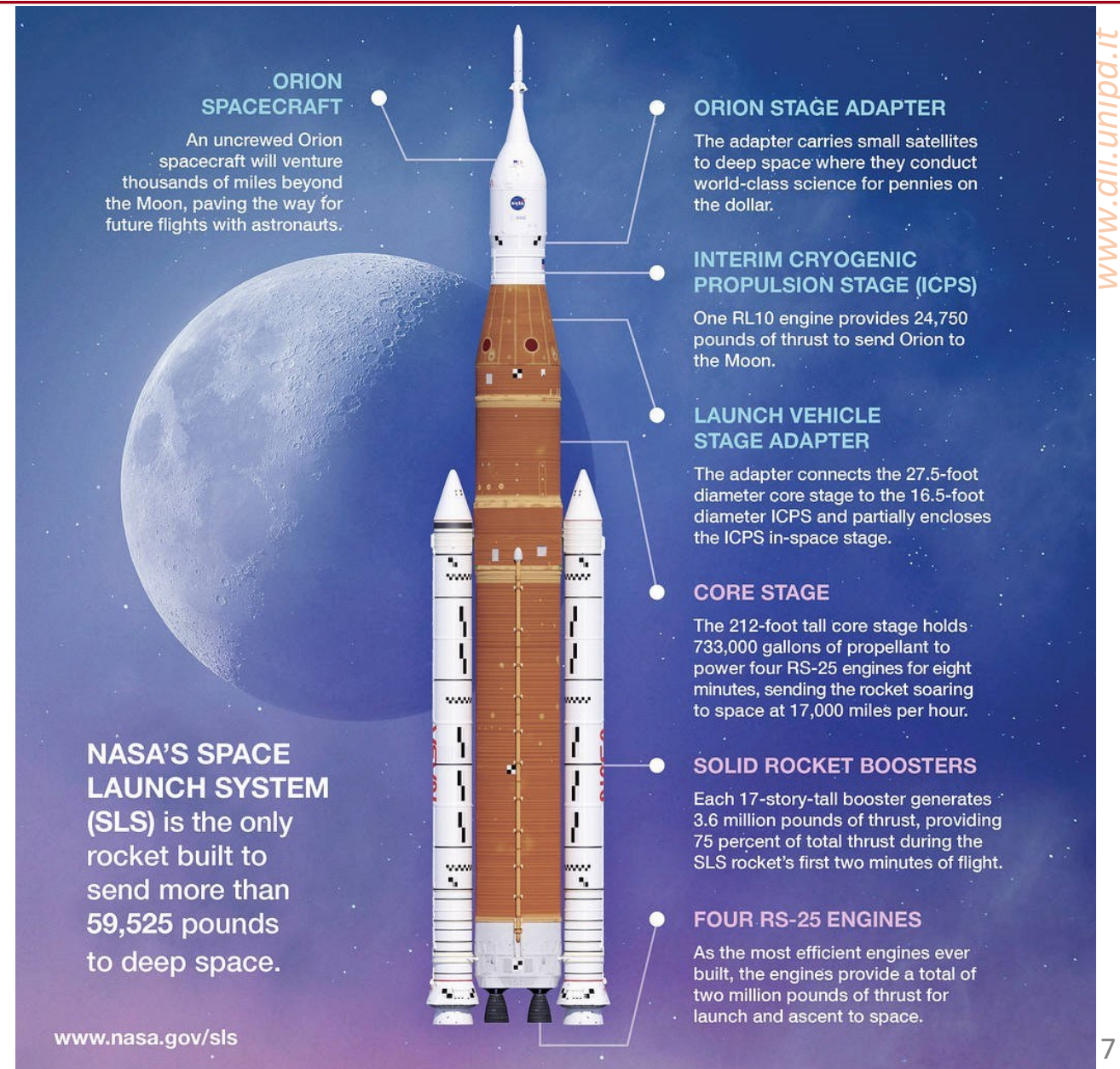
- Processi interni fondamentali del nostro Sistema Solare
- Storia geologica
- Ricca di risorse

Sviluppi Futuri

- Base permanente
- Radiotelescopio
- Nuove tecnologie

I numeri del Blocco 1:

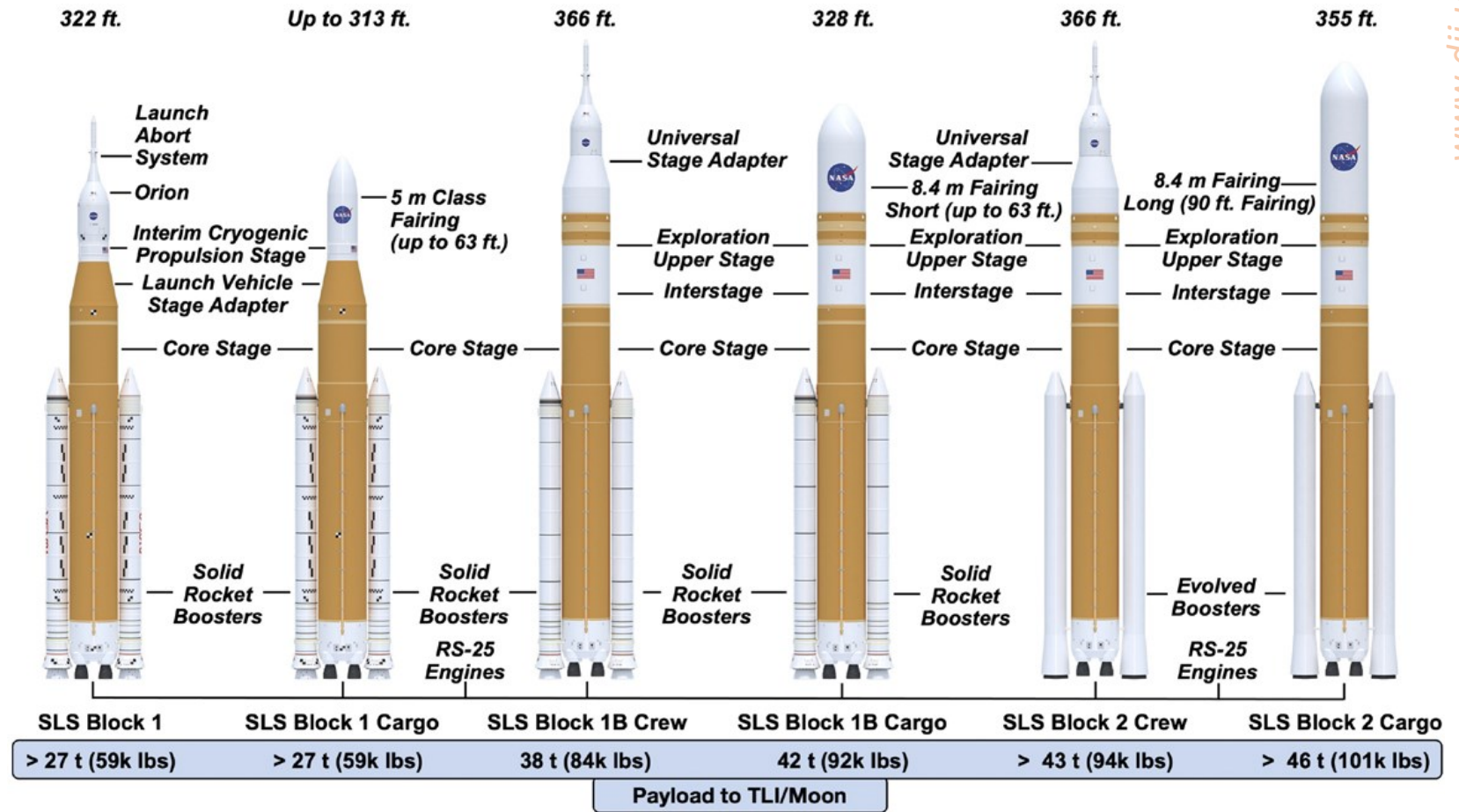
- Spinta Massima: 39144 kN.
- Spinta al Lancio: 36786 kN.
- Peso massimo: 2603 t.
- Altezza: 98,3 m.
- Velocità Massima: 36484 km/h al TLI.
- Payload al TLI: 27 t.



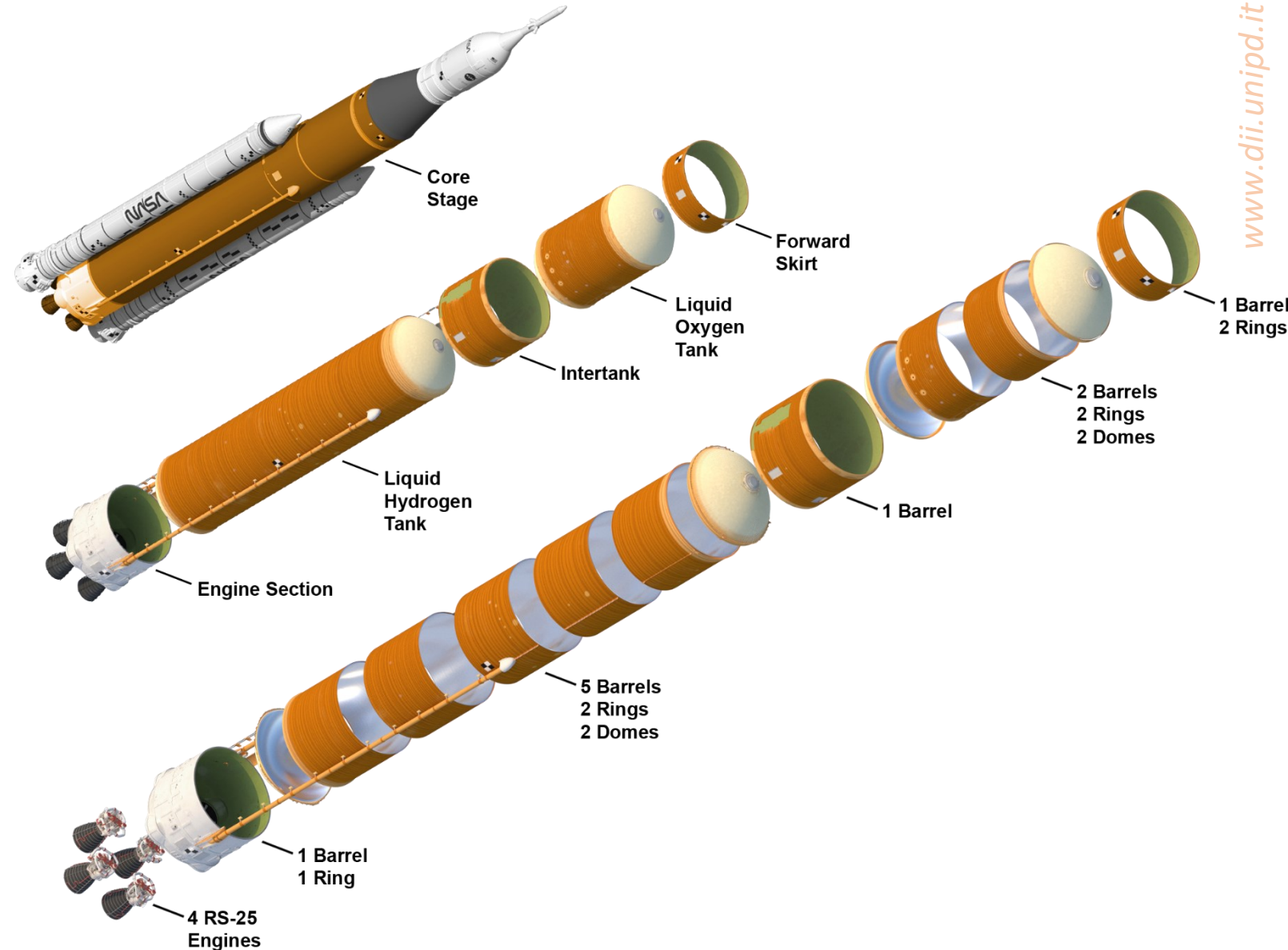
Design



**Evolvibile Modulabile e
Migliorabile**

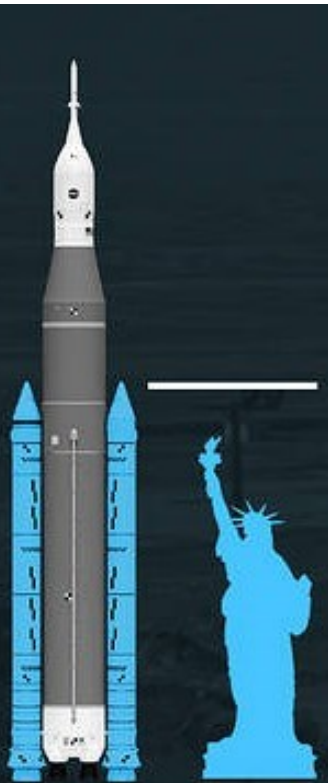


- Mach 23 > 28000 km/h.
- 1088 t di peso esclusi i motori.
- Riutilizzo efficiente delle componenti dello Shuttle.
- 4 Sottosistemi.
- 9 test di qualifica.



- Usati nel programma Space Shuttle, con forte aumento delle prestazioni.
- Funzionamento con propellenti criogenici.
- Combustione a stadi.
- Test di adattamento.





- Ripresi dal programma Shuttle e potenziati.
- Ottimizzati per l'uso singolo.
- Mach 4,3 > 5300 km/h a 2 min e 12 s.
- 54,1 m d'altezza, più della statua della libertà.
- Diverse ispezioni e test di qualifica.

FORWARD ASSEMBLY

MOTOR ASSEMBLY

AFT ASSEMBLY



- **Propulsione**



ICPS

- **Copertura**

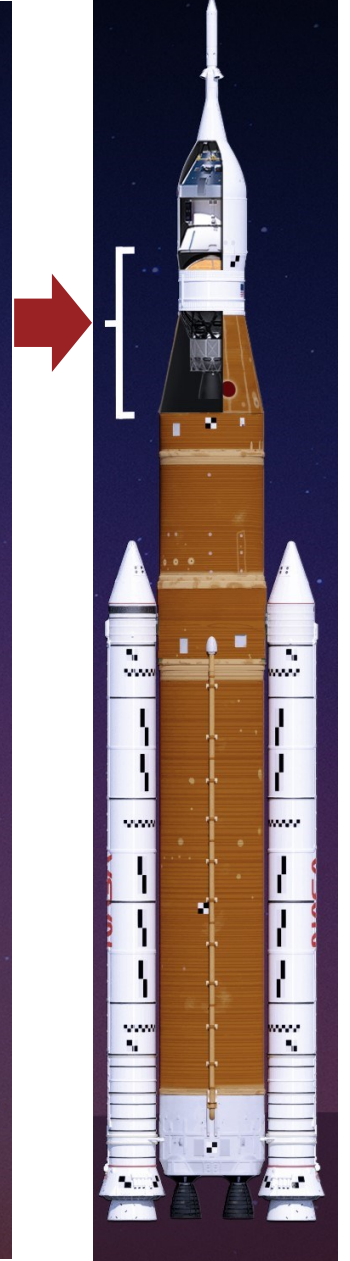
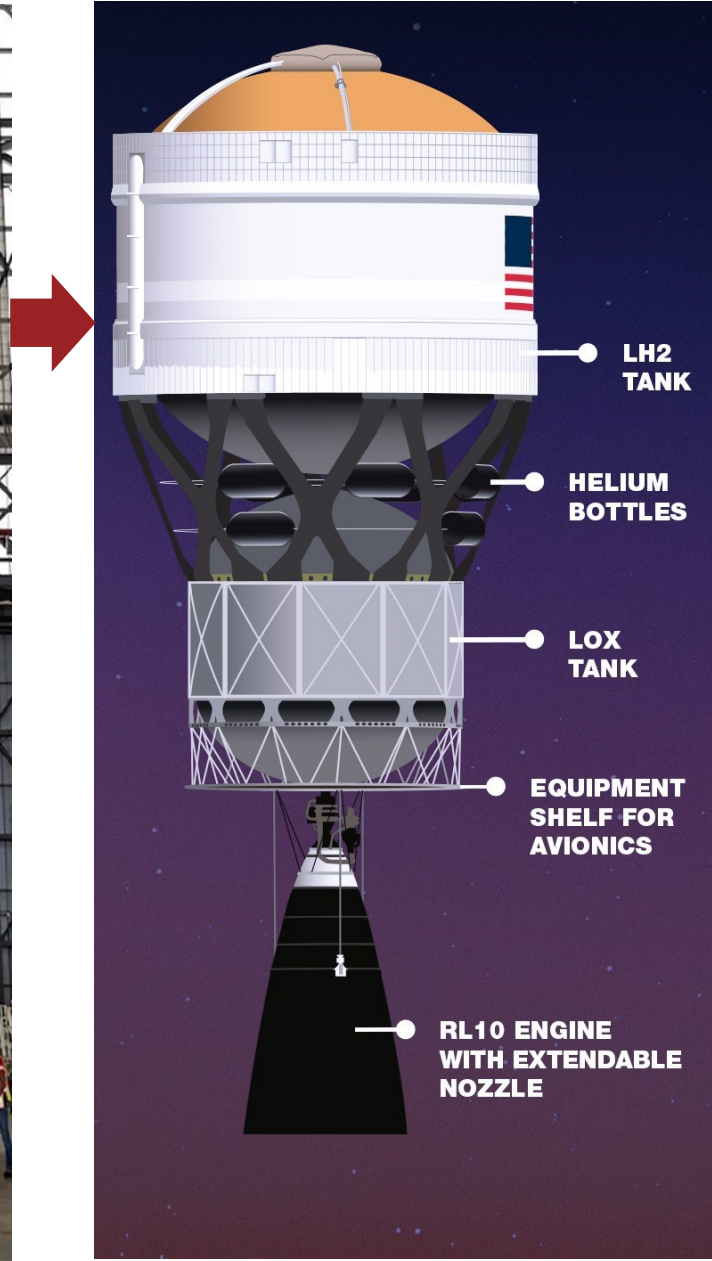


**Launch Vehicle
Stage Adapter**

- **Connessione
al Payload**



Orion Stage Adapter



Dando un semplice scorcio al programma in generale, e in uno dei suoi aspetti fondamentali, al razzo SLS, sono evidenti gli avanzamenti tecnologici, scientifici e a lungo termine, i benefici per l'umanità intera.

GRAZIE PER LA VOSTRA ATTENZIONE!

DOMANDE?

NASA:

- NASA's Space Launch System Reference Guide (SLS v2 - August, 2022), National Aeronautics and Space Administration.
 - <https://www.nasa.gov/humans-in-space/artemis/#accords>
 - <https://www.nasa.gov/mission/artemis-i/>
 - <https://www.nasa.gov/mission/artemis-ii/>
 - <https://www.nasa.gov/mission/artemis-iii/>
 - <https://www.nasa.gov/general/nasas-artemis-iv-building-first-lunar-space-station/>
 - <https://www.nasa.gov/learning-resources/for-kids-and-students/what-is-the-artemis-program-grades-5-8/>
 - <https://www.nasa.gov/podcasts/houston-we-have-a-podcast/apollo-vs-artemis/>
 - <https://www.nasa.gov/podcasts/houston-we-have-a-podcast/the-value-of-the-moon/>
 - <https://www.nasa.gov/gallery/space-launch-system-infographics/>
 - <https://www.nasa.gov/artemis-partners/#:~:text=The%20Orion%20and%20Extravehicular%20Activity,periods%20on%20the%20lunar%20surface.>
 - <https://www.state.gov/artemis-accords/#:~:text=Artemis%20Accords%20signatories%20as%20of,%2C%20Peru%2C%20Poland%2C%20the%20Republic>
- <https://science.nasa.gov/lunar-science/focus-areas/>

ESA

- [https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/Orion/Artemis I](https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/Orion/Artemis_I)
- [https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/Orion/Artemis II](https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/Orion/Artemis_II)
- [https://www.esa.int/ESA_Multimedia/Images/2020/05/Artemis 3 step-by-step](https://www.esa.int/ESA_Multimedia/Images/2020/05/Artemis_3_step-by-step)
- [https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/Orion/Artemis V](https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/Orion/Artemis_V)

JPL

- <https://www.jpl.nasa.gov/news/nasa-cubesat-will-shine-a-laser-light-on-the-moons-darkest-craters/>
- <https://www.jpl.nasa.gov/news/nasa-solar-sail-asteroid-mission-readies-for-launch-on-artemis-i/>
- <https://www.jpl.nasa.gov/news/nasa-to-stream-artemis-i-rollout-briefings-on-science-tech-payloads/>

CSA

- <https://www.asc-csa.gc.ca/eng/astronomy/moon-exploration/canada-role.asp>
- <https://www.asc-csa.gc.ca/eng/multimedia/search/video/18447?search=artemis&type=2>
- <https://www.asc-csa.gc.ca/eng/multimedia/search/image/18530>
- <https://www.asc-csa.gc.ca/eng/astronomy/moon-exploration/canadian-utility-rover-on-the-moon.asp>

[Crediti Immagini: NASA.](#)