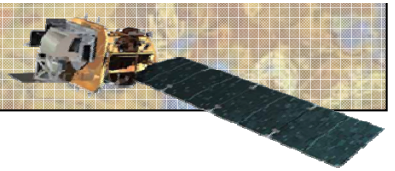
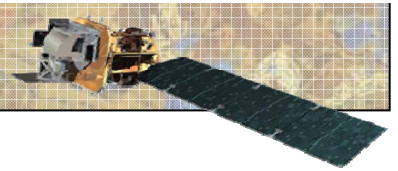


Compte enrere

Joan Masó

Llançament d'avui

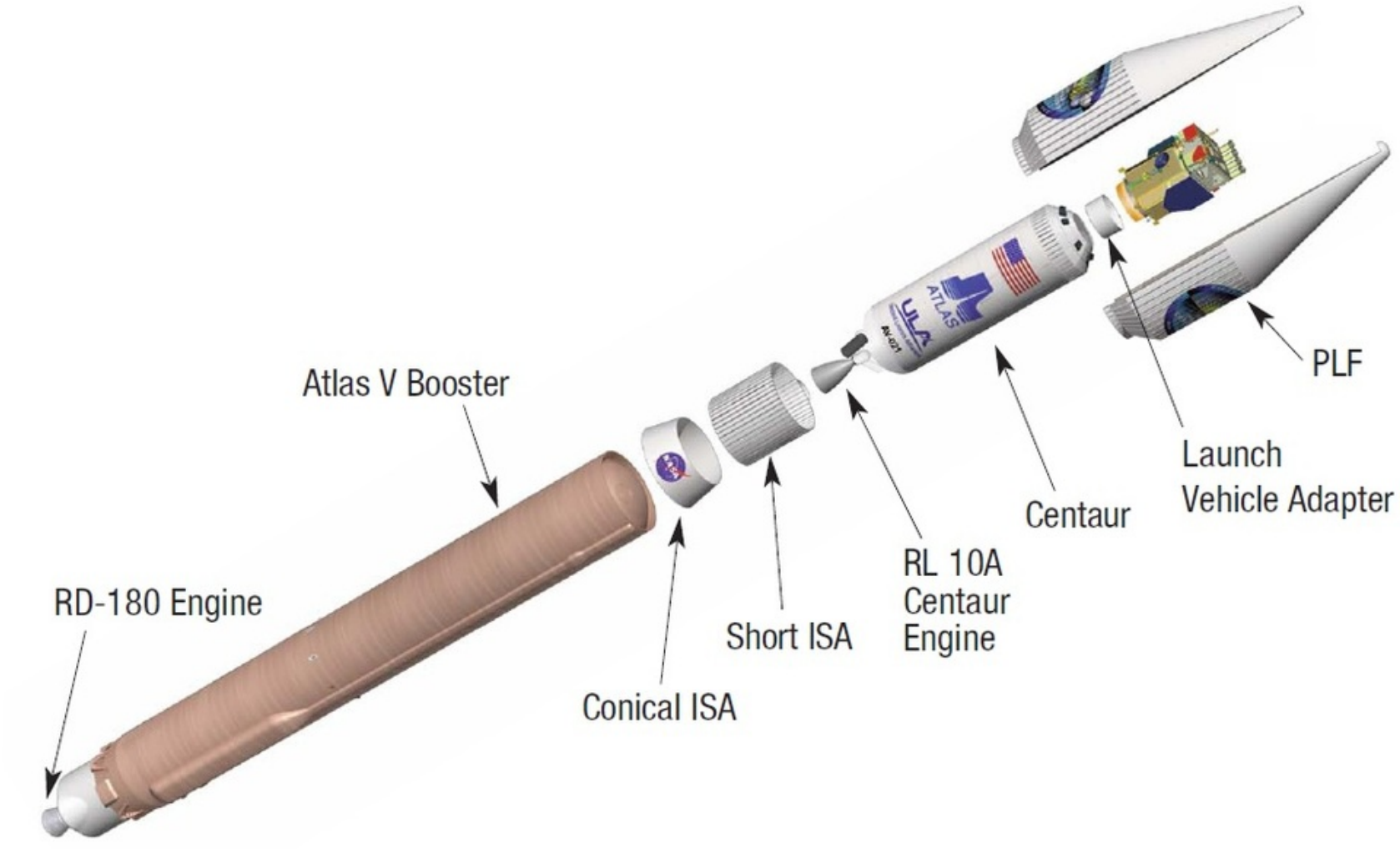
- Coet:
  - Atlas 5
- Carrega útil:
  - LDCM
- Dia:
  - Feb. 11, 2013
- Hora:
  - 10:02 a.m. local (19:02 p.m. CET)
- Finestra de llançament:
  - 48 minuts
- Lloc:
  - SLC-3E, Vandenberg Air Force Base, Calif.
- Narrador de la NASA:
  - George Diller



Mission Status

- El compte enrere ha començà el dilluns a les 2:22 hores locals (1122 CET) a la plataforma *Space Launch Complex 3-East* en preparació per a l'enlairament a les 10:02 hores locals (1702 CET) des de Vandenberg Air Force Base a Califòrnia.
- United Launch Alliance va començar a treballar en la missió LDCM fa quatre anys i va començar a construir el vehicle Atlas-Centaur fa gairebé dos anys,
- Serà el primer llançament de l'Atles de la NASA des de la costa oest des de l'any 1999 i el primer Altas V de la història des de Califòrnia
- La previsió meteorològica preveu perfectes condicions en el moment de l'enlairament, amb només uns pocs núvols cirrus, bona visibilitat i vents suaus.

El coet: Atlas V 401



Atlas V 401 Launch Vehicle

- L'Atles V 401 és part de la familia Atles V 400/500 família que és operada per United Launch Alliance.
- Atles coets V volen des de l'any 2002 i té una taxa d'èxit gairebé perfecte (només un vol ser un fracàs parcial).
- El vehicle s'opera des del
  - Complex de Llançament 41 a Cap Canaveral, Florida
  - Complex de Llançament 3-E a Vandenberg Air Force Base, Califòrnia.
- Atles V 401 és el més petit de la família de llançadors Atles V sense coets de combustible sòlid i una baina de càrrega útil de 4.2 metres.
- Els 401 pot llançar càrregues útils en a una varietat d'òrbites incloent
  - Òrbita terrestre baixa,
  - Òrbita de transferència geostacionària
  - Òrbita geostacionària.

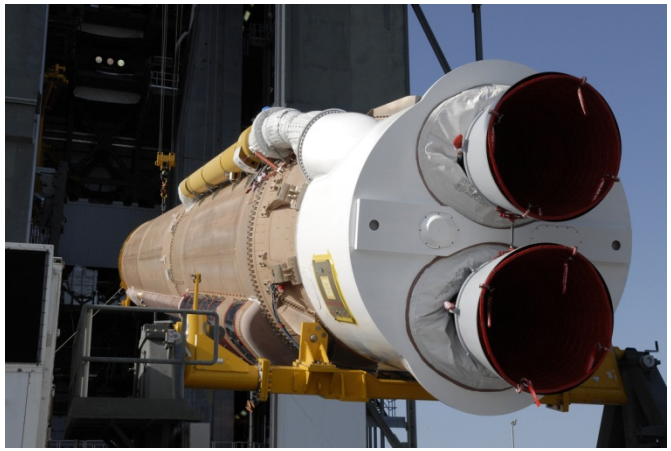
http://www.spaceflight101.com/atlas-v-401.html

El coet: Atlas V 401

- Height
  - 58.3m
- Diameter
  - 3.81m
- Launch Mass
  - 334,500kg
- Stage 1
  - Atlas Common Core Stage
- Boosters
  - None
- Stage 2
  - Centaur
- Mass to Low Earth Orbit
  - 10,470kg
- Mass to Geostationary Transfer Orbit
  - 4,750kg

Common Core Booster

- Inert Mass 21,054kg
- Diameter 3.81m
- Length 32.46m
- **Propellant** **Rocket Propellant-1 (Kerosene)**
- **Oxidizer** **Liquid Oxygen**
- Fuel&Oxidizer Mass **284,089kg**
- Guidance From Centaur
- Propulsion RD-180 Engine (2 Chambers)
- Type Staged Combustion
- Thrust at Sea Level 3,827kN
- Thrust (Vacuum) 4,152kN (933,369 lbf)
- Attitude Control Gimbaled Engine (8 Degrees)
- Throttle Capability 50-100%
- Burn Time 253 sec
- Tank Pressurization Helium
- Avionics Flight Control, Flight Termination Telemetry, Rate Gyros, Power
- Stage Separation 8 Retro Rockets

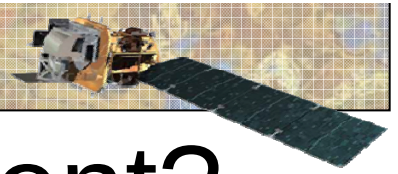


Centaur Upper Stage

• Diameter	3.05m
• Length	12.68m
• Inert Mass	2,243kg
• **Propellant**	**Liquid Hydrogen**
• **Oxidizer**	**Liquid Oxygen**
• Fuel&Oxidizer Mass	20,830kg
• Guidance	Inertial
• Thrust	99.2kN
• Burn Time	Variable
• Engine Start	Restartable
• Attitude control	4 27-N Thrusters
•	8 40-N Thrusters
• Propellant	Hydrazine

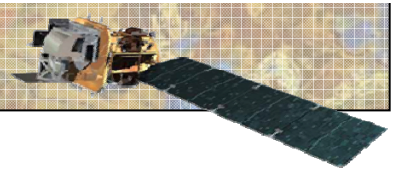
Payload Fairing

- Fairing — Aluminum Skin Stringer
- — Frame Clampshell
- Boattall — Aluminum Skin Stringer
- — Frame Clampshell
- Separation — Pyro Bolts
- — Spring Jettison Actuators
- Type — LPF
- Diameter — 4.2m
- Length — 12.0m
- Mass — 2,127kg



I si alguna cosa va malament?

- Un llançament depèn de l'èxit d'un ampli ventall de factors:
  - càrrega útil,
  - vehicle de llançament,
  - comunicacions,
  - plataforma,
  - meteorologia
  - i una bona sincronització.
- Els problemes amb qualsevol d'aquests factors pot potencialment resultar en reajustar la finestra de llançament. Un altre factor important és el "range" (seguiment per radar durant els llançaments, així com d'algunes de les dades i telemetria del vehicle durant el vol).
- Quan el llançament es retarda, o s'aplaça (SCRUBBED) durant el compte enrere, la naturalesa del problema determina el temps de retard. Els canvis d'horari són una part normal de l'activitat espacial i reflecteix les compromís per a la seguretat.



Programa

17:15 - *Connexió amb NASA-TV per a comentar el llançament*
Dr. Joan Masó (CREAF)

17:30-17:45 - *Benvinguda. L'observació de la Terra des de satèl·lits i de la missió Landsat.*
Dr. Xavier Pons (UAB).

17:45-18:00 - *Història de la missió Landsat.*
Sr. Òscar González (UAB) i Sr. Gerard Moré (CREAF).

18:00-18:15 - *Aplicacions 1. Els mapes d'usos del sòl.*
Sr. Vicenç Palà (ICC).

18:15-18:30 - *Aplicacions 2. Contribució als estudis de biodiversitat.*
Sra. Magda Pla (CTFC).

18:30-18:40 - *Aplicacions 3. La gestió de l'aigua en la innivació i l'agricultura.*
Dr. Pere Serra (UAB).

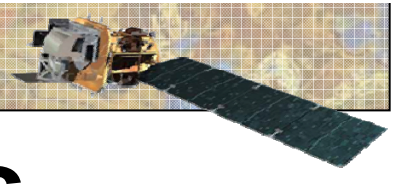
18:40-18:50 - *Aplicacions 4. Sensors tèrmics en aspectes biofísics: Evapotranspiració i sequera.*
Dr. Jordi Cristóbal (Univ. of Alaska Fairbanks) i Sra. Cristina Domingo (UAB).

18:50-19:20 - *Llançament del Landsat-8.*
Dr. Joan Masó (CREAF)

19:20-19:30 - *I ara què? Difusió i accés estandarditzats globalment i amb el SatCat.*
Dra. Alaitz Zabala (UAB).

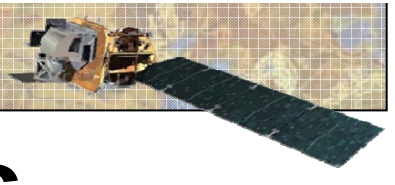
19:30 - *Torn obert de paraules. Cloenda*.
Dr. Xavier Pons (UAB).

Go LDCM !!!



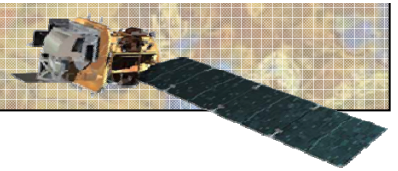
16:22h T-120 minutes and holding (30 minute hold)

- Launch Conductor receives reports on vehicle readiness for cryogenic tanking
- NASA Launch Manager polls team to proceed with tanking
- Launch Conductor holds a pre-test tanking briefing

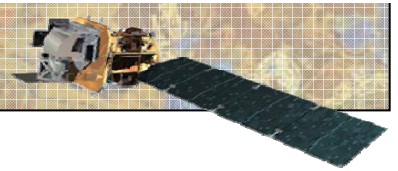


16:52h T-120 minutes and counting

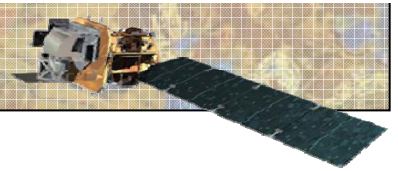
- Start chilldown procedures on Centaur upper stage's liquid oxygen storage tank
- Start chilldown procedures on Atlas V's liquid oxygen vault and Mobile Launcher Platform
- Start Centaur helium bottle charge to flight pressure
- Begin raising Atlas Pressure Vessels to flight levels
- Raise Atlas V RP-1 fuel tank to higher pressure



- 16:57h **T-115 minutes and counting**
  - Safe Arm Device (SAD) cycle test is performed
- 17:02h **T-110 minutes and counting**
  - Start Centaur liquid oxygen transfer line chilldown
- 17:09h **T-103 minutes and counting**
  - Start Centaur LO2 tanking
- 17:19h **T-93 minutes and counting**
  - Pressurize Centaur liquid hydrogen storage tank to chilldown level
- 17:22h **T-90 minutes and counting**
  - Start filling Atlas V with liquid oxygen
- 17:27h **T-85 minutes and counting**
  - Start Centaur liquid hydrogen transfer line chilldown
- 17:52h **T-60 minutes and counting**
  - Start Centaur engine chilldown



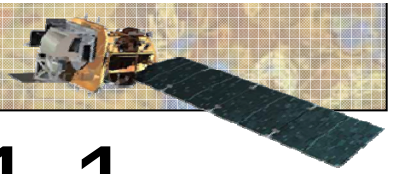
- 17:57h **T-55 minutes and counting**
  - Start flight control final preparations to raise hydraulic pressures
- 18:07h **T-45 minutes and counting**
  - Pressurize Main Engine Pneumatic System to flight pressure
- 18:36h **T-16 minutes and counting**
  - Initiate fuel fill sequence
- 18:42h **T-10 minutes and counting**
  - Weather briefing with Atlas Launch Weather Officer
- 18:47h **T-5 Minutes and counting**
  - Fuel fill sequence is complete
  - Water deluge system actuation pressure adjustment is performed
  - Atlas $L0_2$ at Flight level
  - Centaur $L0_2$ at Flight level
  - Centaur LH_2 at flight level



18:48h **T-4 minutes and holding (10 minute hold)**

– *NASA Advisory Manager* (NAM) and *NASA Launch Manager* (NLM) final launch polls
  - GO to continue countdown

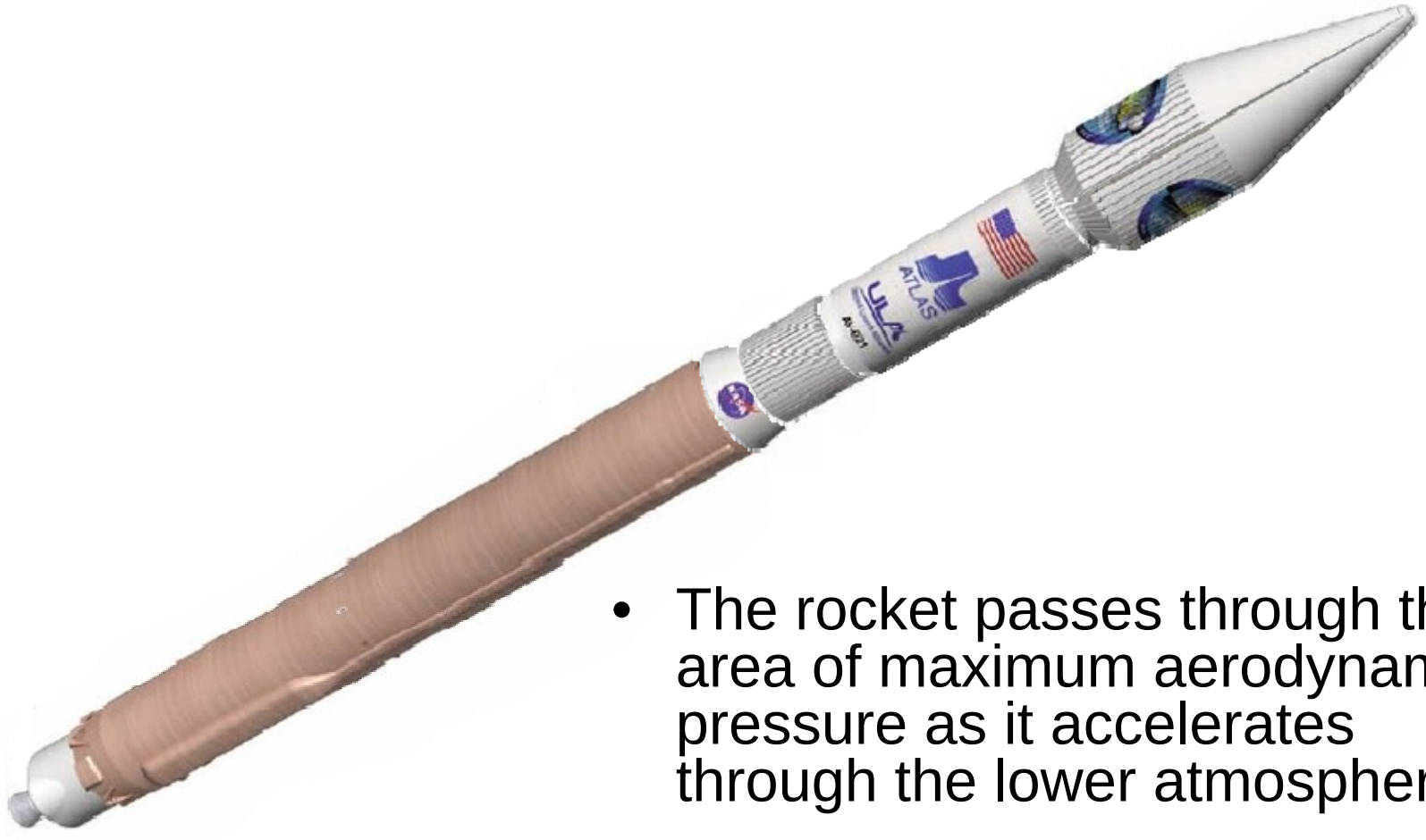
– Spacecraft transfers to internal power



T-0:00:02.7 T+0:00:01.1

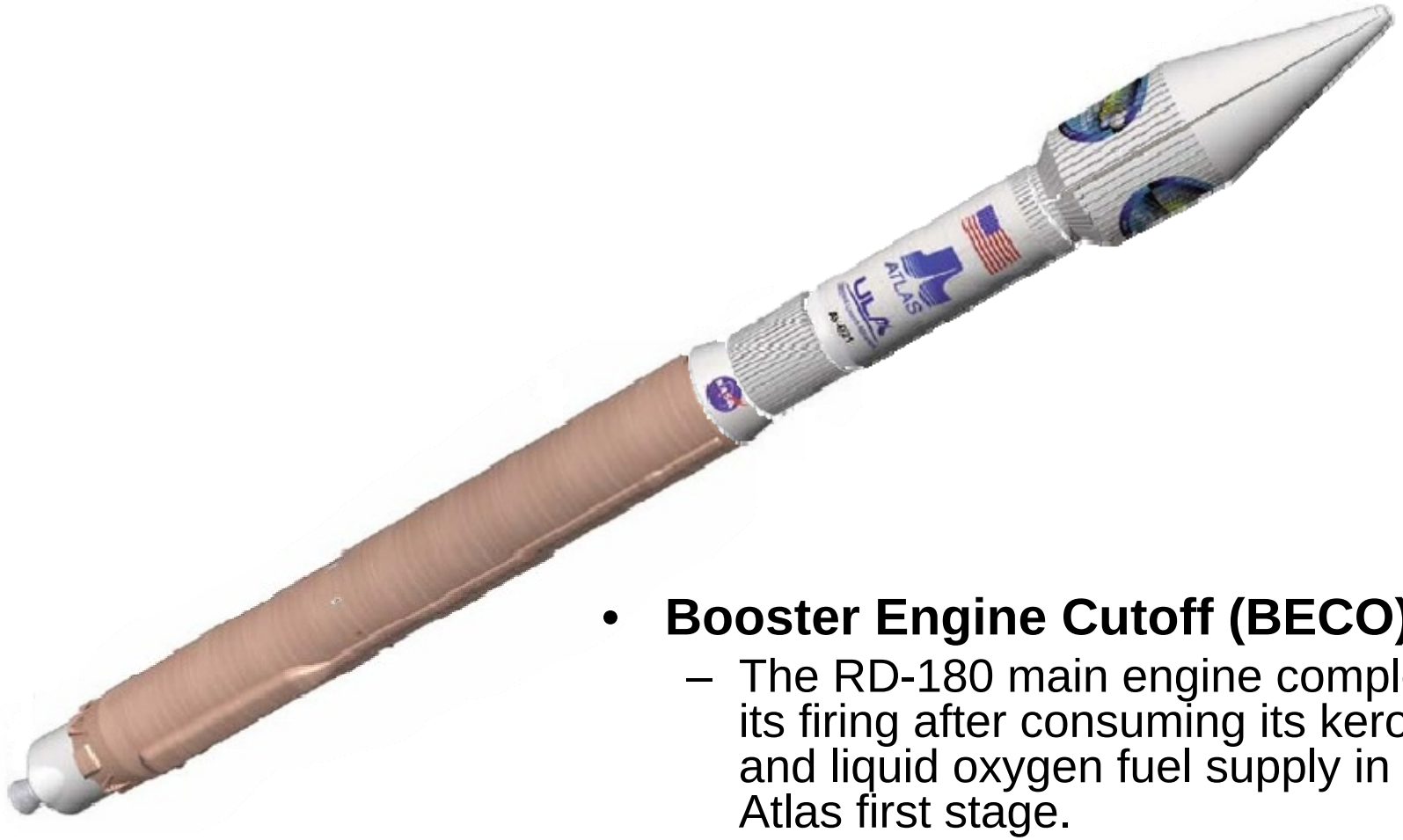
- Engine Start
  - The Russian-designed RD-180 main engine is ignited and undergoes checkout prior to launch.
- Liftoff
  - The Atlas 5 vehicle, designated AV-035, lifts off and begins a vertical rise away from Space Launch Complex 3 at Vandenberg Air Force Base, California.

T+0:01:27



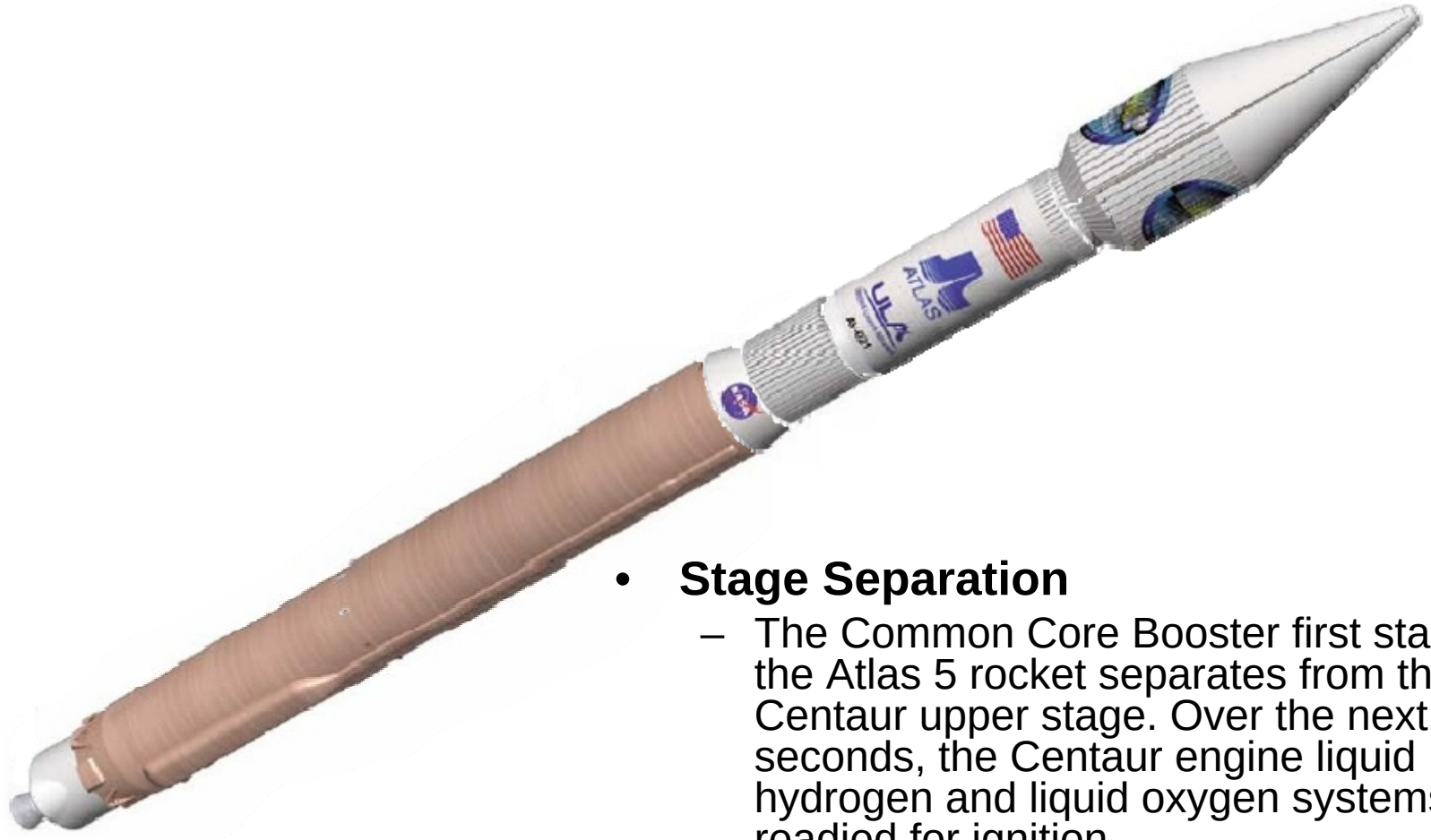
- The rocket passes through the area of maximum aerodynamic pressure as it accelerates through the lower atmosphere

T+0:04:02



- **Booster Engine Cutoff (BECO)**
  - The RD-180 main engine completes its firing after consuming its kerosene and liquid oxygen fuel supply in the Atlas first stage.

T+0:04:08



- **Stage Separation**
  - The Common Core Booster first stage of the Atlas 5 rocket separates from the Centaur upper stage. Over the next few seconds, the Centaur engine liquid hydrogen and liquid oxygen systems are readied for ignition.

T+0:04:18

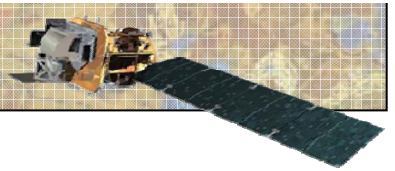
- **Centaur Ignition 1 (MES-1)**
  - The Centaur RL10 engine ignites for the longer of the two upper stage firings. This burn will inject the Centaur stage and LDCM spacecraft into a parking orbit.

T+0:04:26

- **Nose Cone Jettison**
  - The payload fairing that protected the LDCM spacecraft during the climb through the atmosphere is no longer needed and is separated.

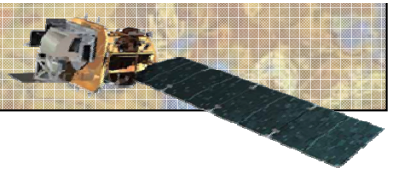
T+0:15:23

- **Centaur Cutoff 1 (MECO-1)**
  - The Centaur engine shuts down after arriving in a planned parking orbit. The vehicle enters a lengthy coast period lasting nearly 55 minutes before arriving at the required location in space for the second burn



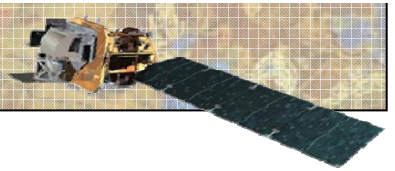
T+1:10:34

- **Centaur Ignition 2 (MES-2)**
  - The Centaur re-ignites to propel the payload into the desired Sun-synchronous polar orbit from the parking achieved earlier in the launch sequence.



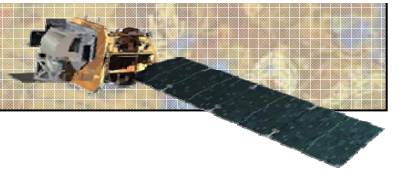
T+1:12:20

- **Centaur Cutoff 2 (MECO-2)**
  - At the conclusion of its second firing, the Centaur will have delivered the Landsat spacecraft into the targeted orbit with an apogee of 677 km, perigee of 660 km and inclination of 98.2 degrees.

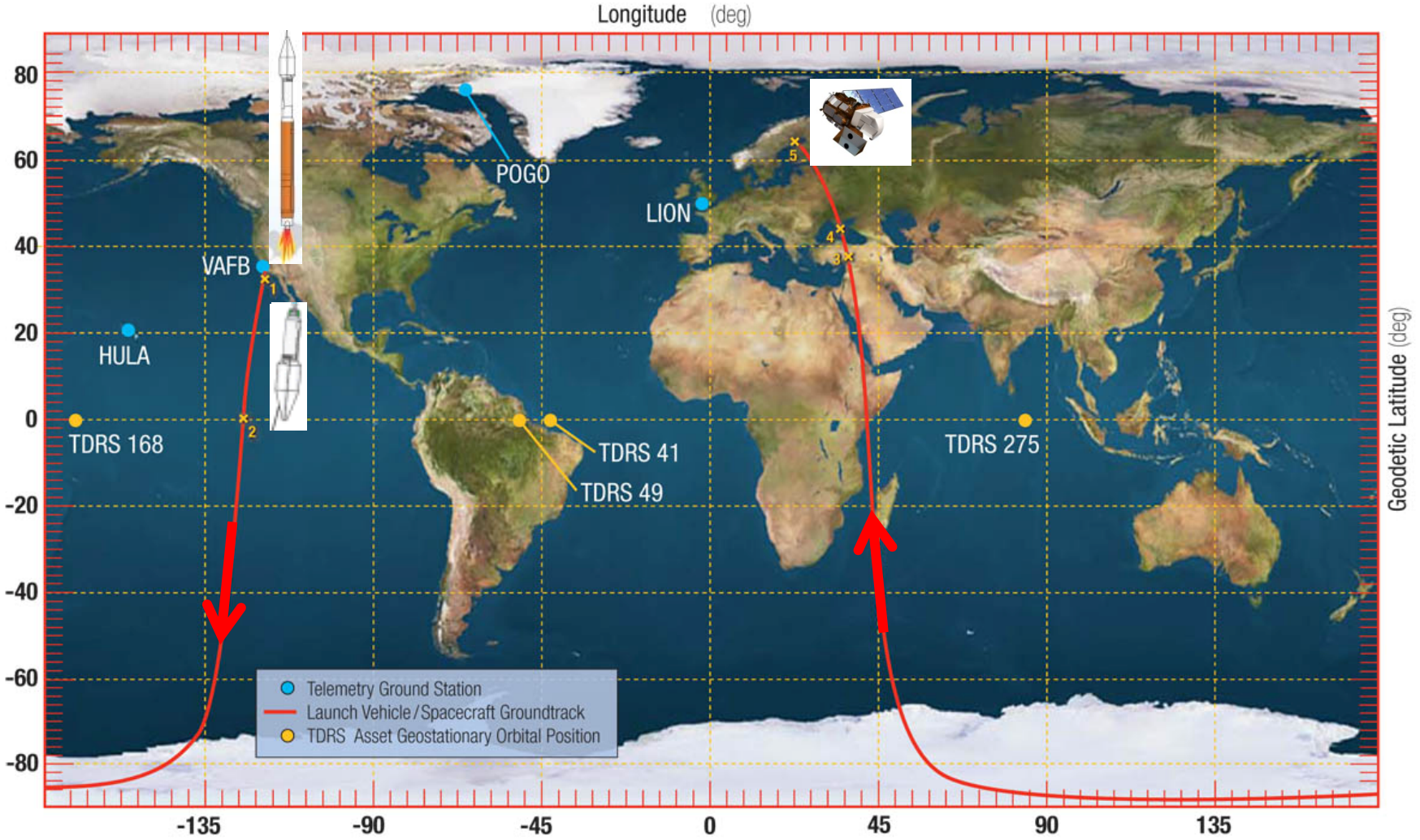


T+1:18:21

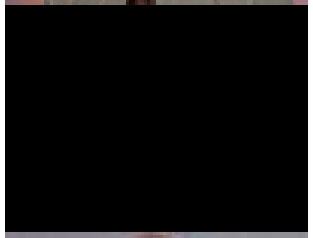
- **Spacecraft Separation**
  - The Landsat Data Continuity Mission spacecraft in collaboration between NASA and the U.S. Geological Survey is released into orbit from the Centaur upper stage to complete the AV-035 launch

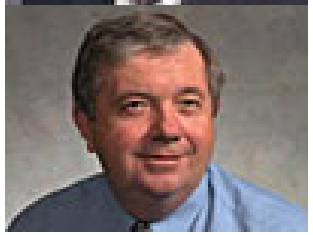


Atlas launch ground track

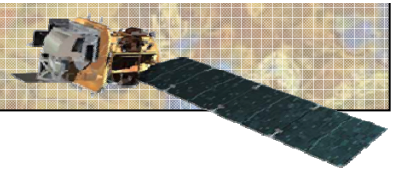


1 = MES-1 (0:04:18.2) | **2 =** MECO-1 (0:15:23.7) | **3 =** MES-2 (1:10:34.2)
4 = MECO-2 (1:12:19.9) | **5 =** LDCM Separation (01:18:20.9)



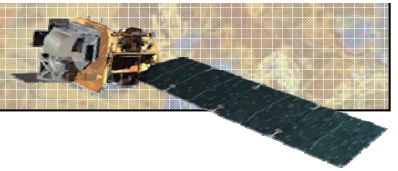


- Omar Baez, NASA Launch Manager (NLM)
  - Garanteix que el compte enrere i els processos de decisió se segueixen correctament. Pregunta (pulls) l'equip de llançament abans de passar la decisió de "go / no-go" al *mission manager*.
- Thomas Reinarts, NASA Chief Engineer (NASA CE)
  - És el responsable d'assessorar el *launch manager* sobre d'anàlisi del vehicle des d'un punt de vista d'enginyeria.
- Bruce E. Reid, Mission Manager (NASA MM)
  - Avalua els serveis de llançament i disponibilitat nau abans del llançament.
- Rick Boutin, Safety and Mission Assurance Manager (SMA)
  - Supervisa els requeriments de seguretat durant el compte enrere. S'assegura del compte enrere es correcta i serveix com l'integrador del vehicle de llançament.
- Joe Lackovich, NASA Advisory Manager (NAM)
  - Assessora per avaluar el procés de compte enrere i llançament



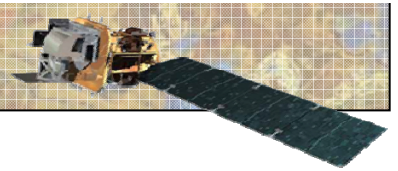
18:48-18:58h **T-4 minutes and holding (10 minute hold)**

- *NASA Advisory Manager* (NAM) and *NASA Launch Manager* (NLM) final launch polls
  - Launch Control (LC) you have permission to launch.
- Spacecraft transfers to internal power



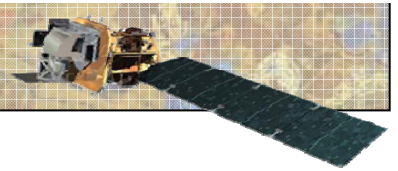
18:58h **T-4 minutes and counting**

- Hazardous gas monitoring is complete
- Automatic computer sequencer takes control for all critical events through liftoff
- Atlas first stage LO_2 replenishment is secured, allowing the tank to be pressurized for flight



18:59 **T-3 minutes and counting**

–Atlas tanks reach flight pressure



19:00h **T-2 minutes and counting**

- Atlas first stage and Centaur upper stage switch to internal power
- $L0_2$ and LH_2 topping for Centaur will stop in 10 seconds

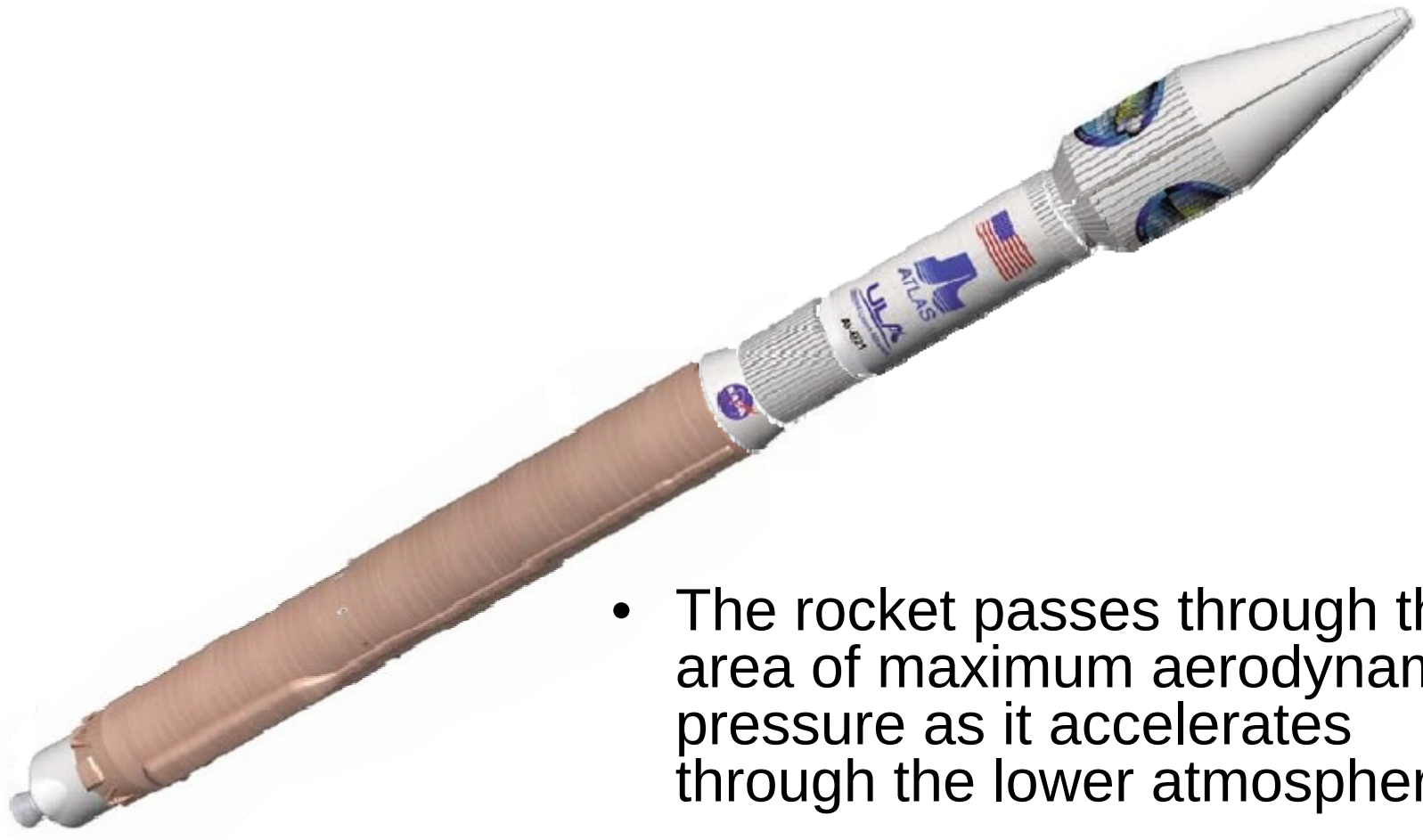
19:00:30 **T-90 seconds and counting**

– Launch control system is enabled

19:02h **T-0:00:02.7 T+0:00:01.1**

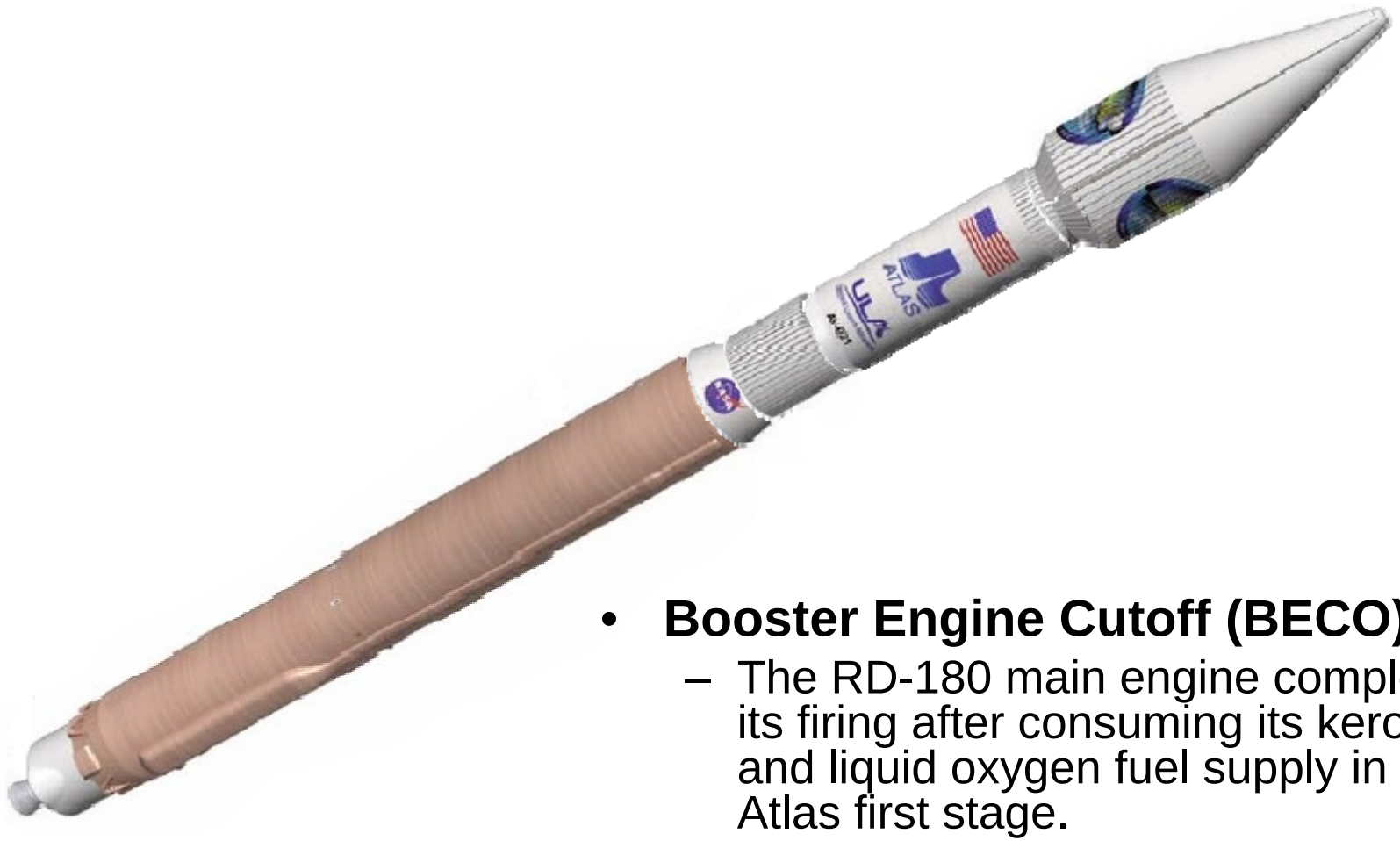
- Booster Engine Start (BES)
  - The Russian-designed RD-180 main engine is ignited and undergoes checkout prior to launch.
- Liftoff
  - The Atlas 5 vehicle, designated AV-035, lifts off and begins a vertical rise away from Space Launch Complex 3 at Vandenberg Air Force Base, California.

19:03:27h **T+0:01:27**



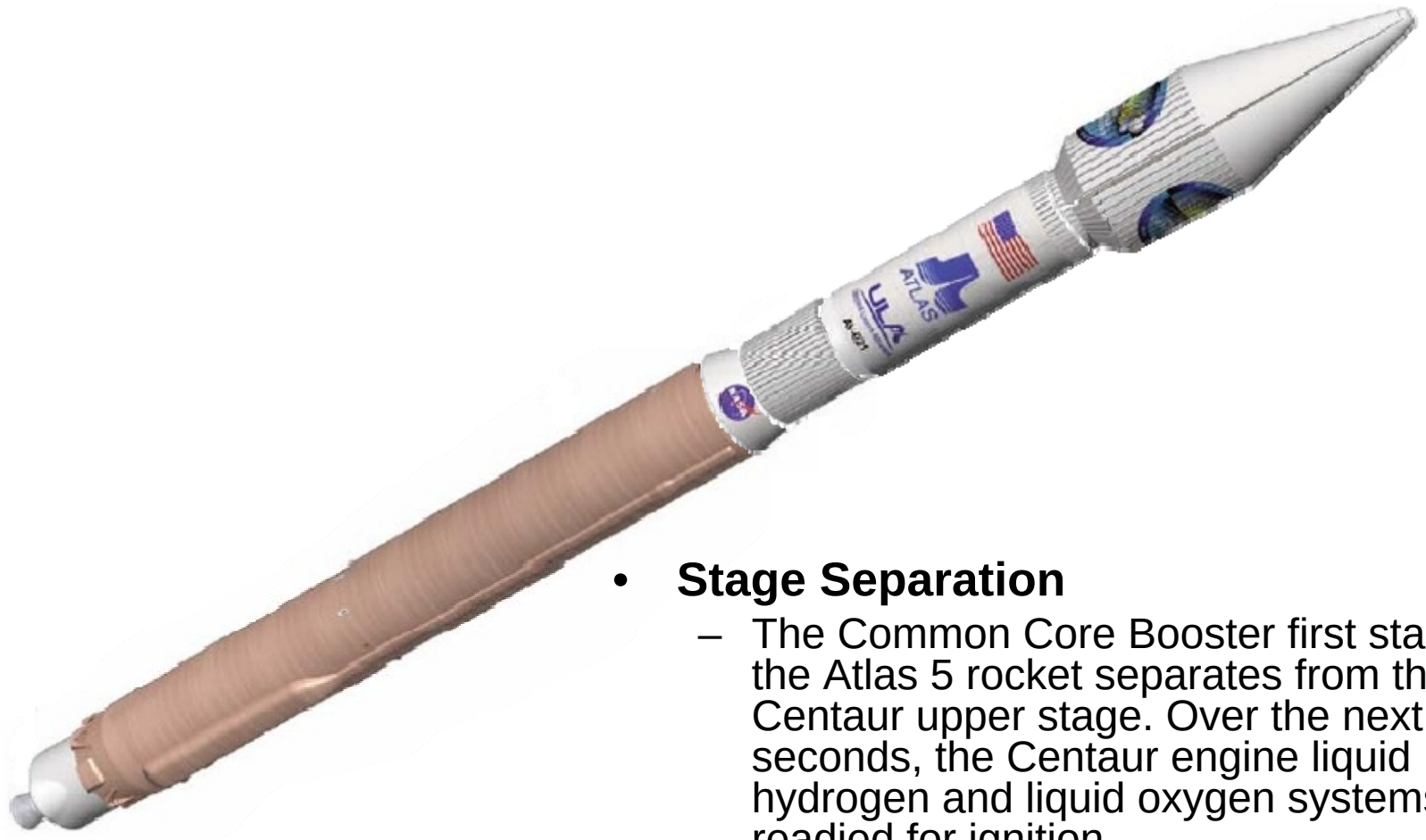
- The rocket passes through the area of maximum aerodynamic pressure as it accelerates through the lower atmosphere

19:06:02 **T+0:04:02**

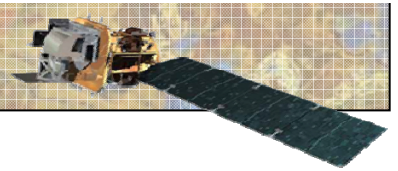


- **Booster Engine Cutoff (BECO)**
  - The RD-180 main engine completes its firing after consuming its kerosene and liquid oxygen fuel supply in the Atlas first stage.

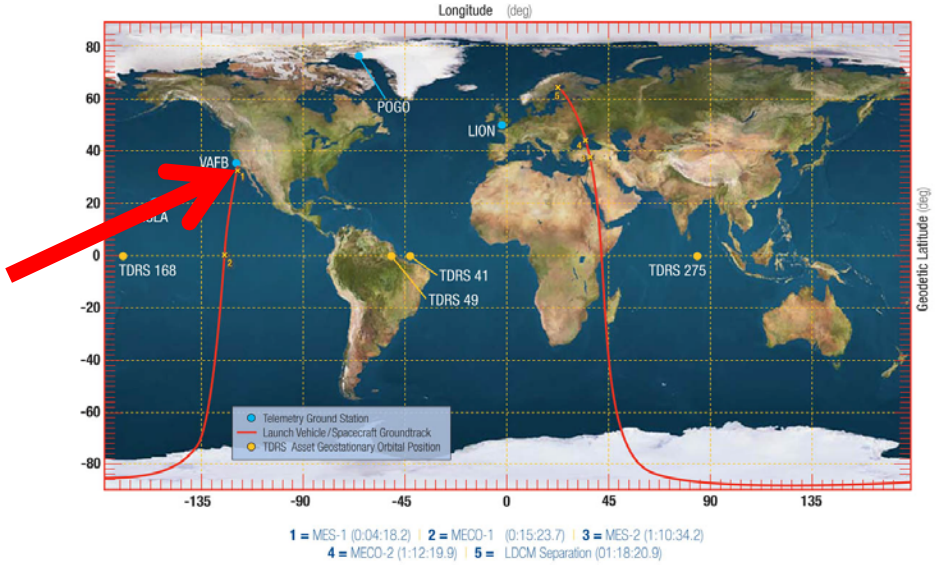
19:06:08h **T+0:04:08**



- **Stage Separation**
  - The Common Core Booster first stage of the Atlas 5 rocket separates from the Centaur upper stage. Over the next few seconds, the Centaur engine liquid hydrogen and liquid oxygen systems are readied for ignition.



19:06:18h **T+0:04:18**



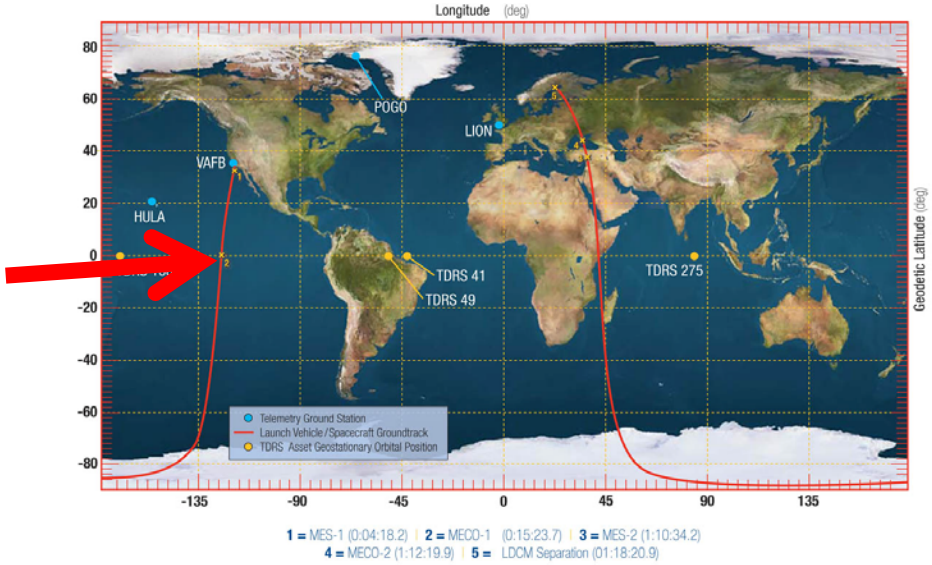
Centaur Ignition 1 (MES-1)

– The Centaur RL10 engine ignites for the longer of the two upper stage firings. This burn will inject the Centaur stage and LDCM spacecraft into a parking orbit.

19:06:26h **T+0:04:26**

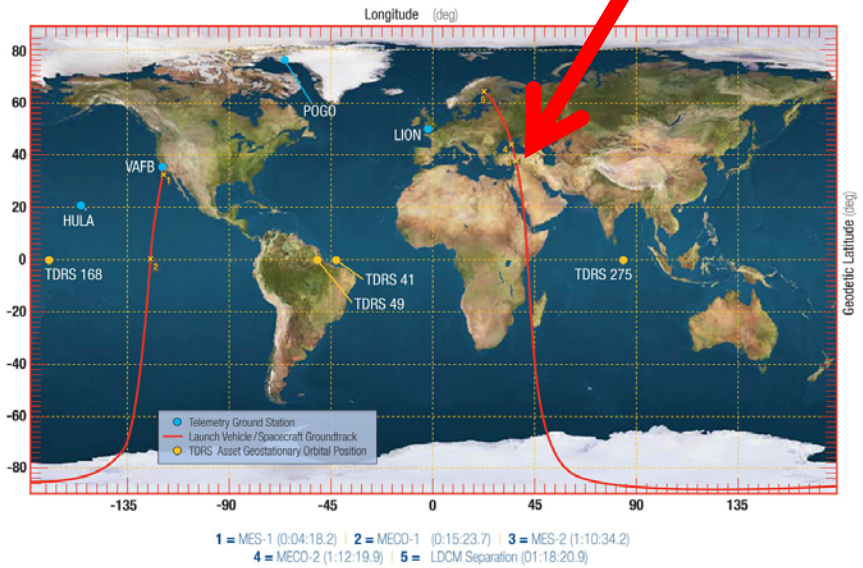
- **Nose Cone Jettison**
  - The payload fairing that protected the LDCM spacecraft during the climb through the atmosphere is no longer needed and is separated.

19:17:23h **T+0:15:23**

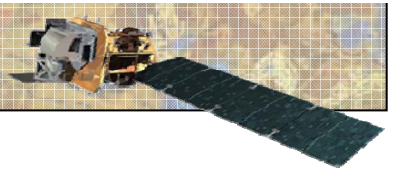


- **Centaur Cutoff 1 (MECO-1)**
  - The Centaur engine shuts down after arriving in a planned parking orbit. The vehicle enters a lengthy coast period lasting nearly 55 minutes before arriving at the required location in space for the second burn

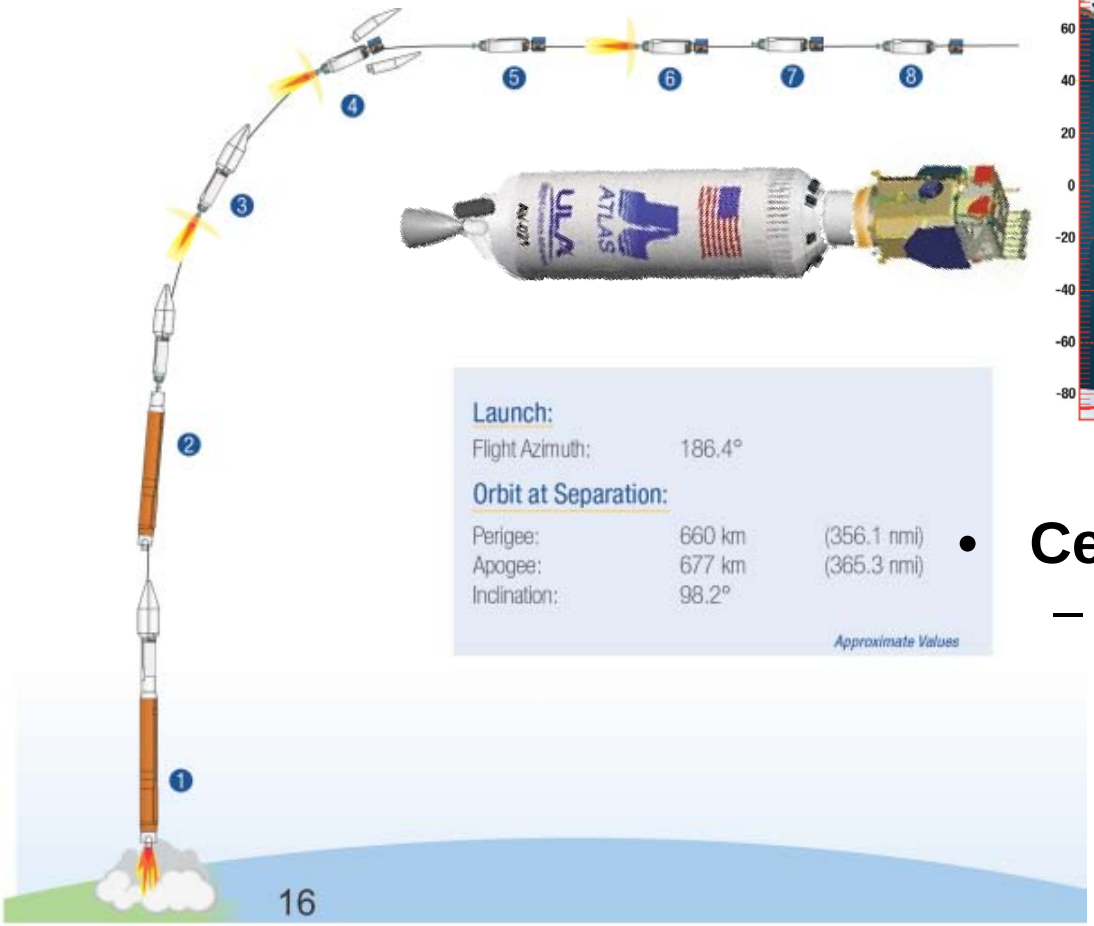
20:12:34h **T+1:10:34**



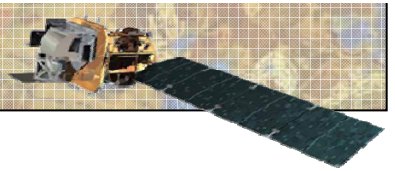
- **Centaur Ignition 2 (MES-2)**
  - The Centaur re-ignites to propel the payload into the desired Sun-synchronous polar orbit from the parking achieved earlier in the launch sequence.



20:14:20h **T+1:12:20**



- **Centaur Cutoff 2 (MECO-2)**
  - At the conclusion of its second firing, the Centaur will have delivered the Landsat spacecraft into the targeted orbit with an apogee of 677 km, perigee of 660 km and inclination of 98.2 degrees.



20:20:21h **T+1:18:21**

- **Spacecraft Separation**
  - The Landsat Data Continuity Mission spacecraft in collaboration between NASA and the U.S. Geological Survey is released into orbit from the Centaur upper stage to complete the AV-035 launch

Grumets Landsat-8 Launch party