"Fattah": Iran's new Hypersonic Missile

Technical Assessment

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New Iranian Hypersonic ballistic missile

- On June 6, 2023, Iran's IRGC unveiled the **FATTAH ballistic missile**. The missile is a hypersonic missile, with some unique characteristics.
- It was described as **hypersonic missile**, with a **range of 1,400 km** and a **speed of ~12 Mach**
- The missile's first stage is based (or identical) to the Khaibar Shekan missile, with a diameter of 100 cm.
- The RV has a solid rocket motor like the Arash-24 kick motor in use with satellite launchers. This motor has an electrical steerable nozzle.
- There are 4 steering fins on the RV for steering the missile during boost and reentry phases of the flight.

The Re-entry vehicle and its solid rocket motor

Configuration and dimensions

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- The missile's booster has an identical diameter as other Iranian missiles: Dezfull and Khaibar Shekan.
- The stabilized fins at the bottom of the booster are of THE SAME design as those in use with Khaibar Shekan missile.
- The RV was extended due to the solid rocket motor incorporated at its rear end.

Rendering by Nathan J. Hunt, used with permission

FATTAH Hypersonic missile: main characteristics

- Two stages, unique configuration.

- **Steering**:
  - 1st stage – Foreword aerodynamic fins.
  - 2nd – combined sustainer TVC and RV aerodynamic fins (the same as for the booster).
- Assessed dimension:
  - Body diameter – about 1 meter.
  - Length – about 15.3 m.
- **Weights:** Take off weight – Circa 12 tons, almost 9-ton propellants.
  - RV – 1 ton; Warhead 350 to 450 Kg.
- **Guidance and navigation**: INU and GNSS (GPS & GLONASS).

- Assessed CEP accuracy – 10 to 25 m

- Warhead - HE

FATTAH Hypersonic missile: general layout

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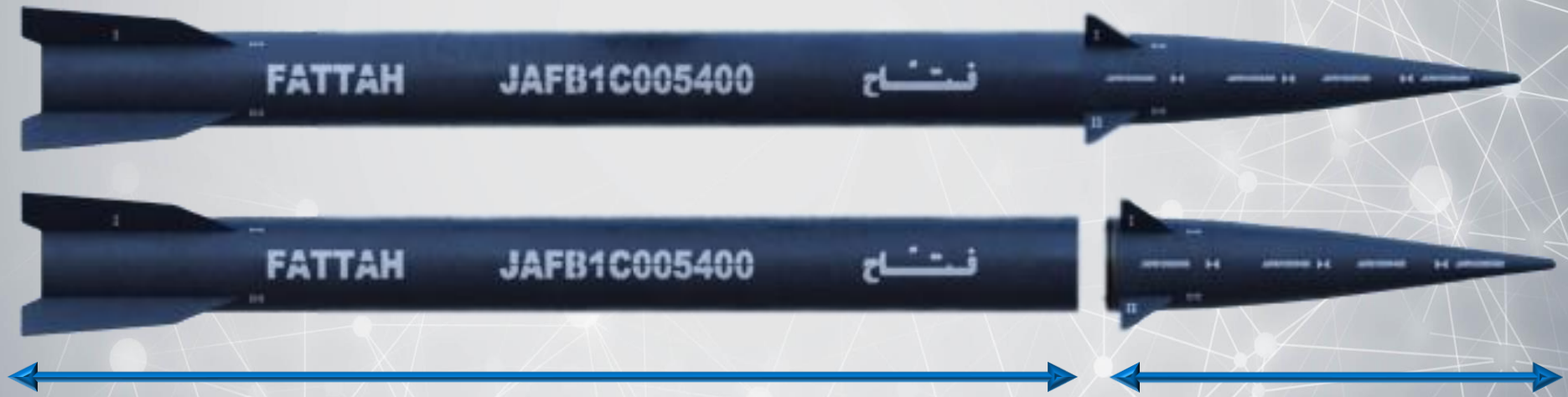

1st stage

Re-entry vehicle

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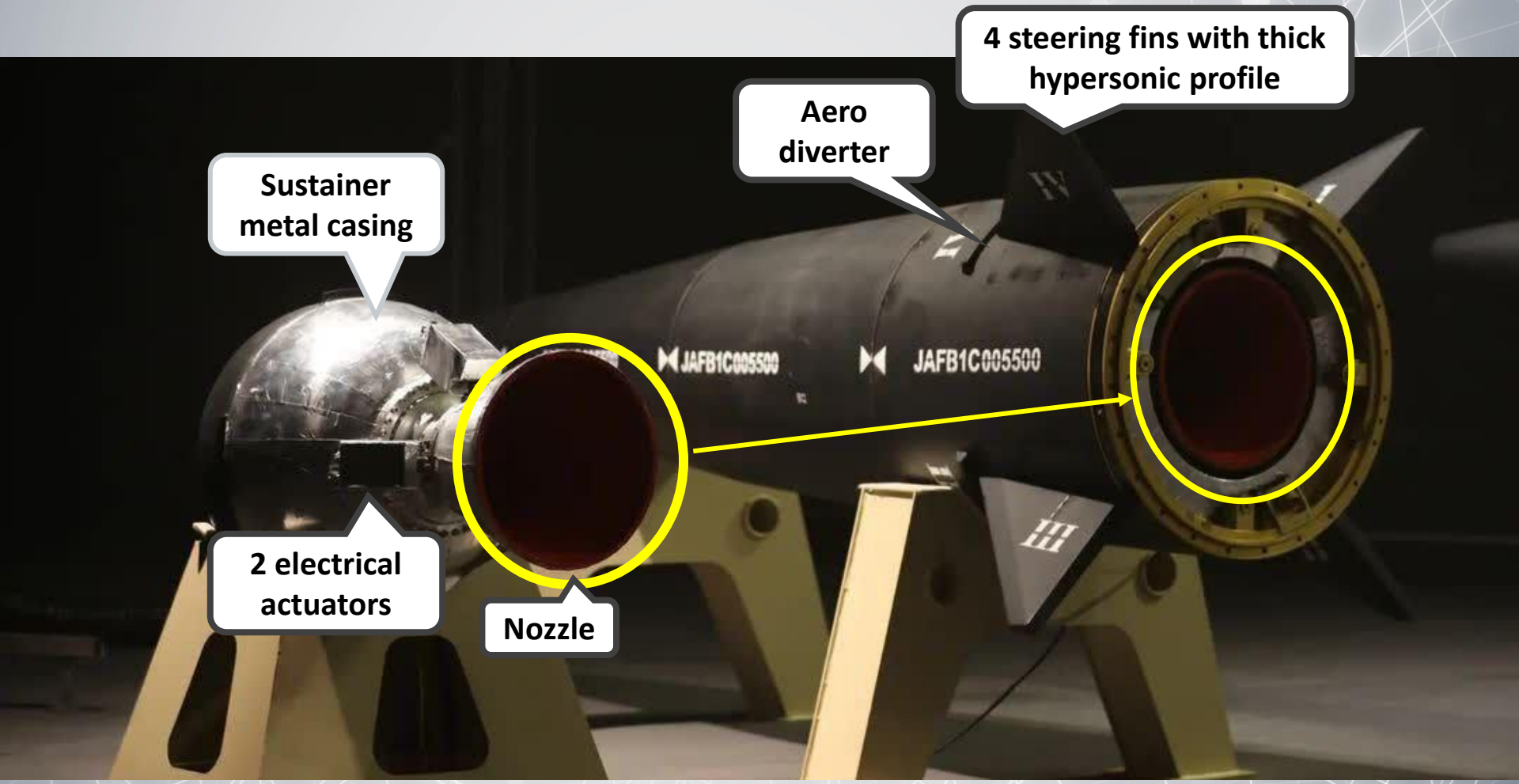
“Khaibar Shekan” – the basis for the booster of “Fattah”

The “Arrash 24” solid rocket motor and the complete RV

Rear view of the RV and the sustainer solid rocket motor



Iranian solid rocket motors for upper stages

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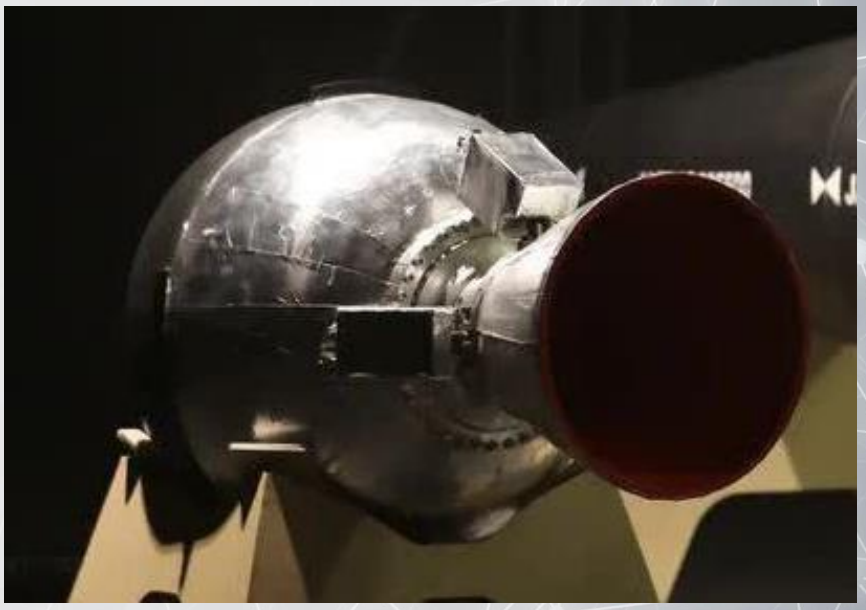
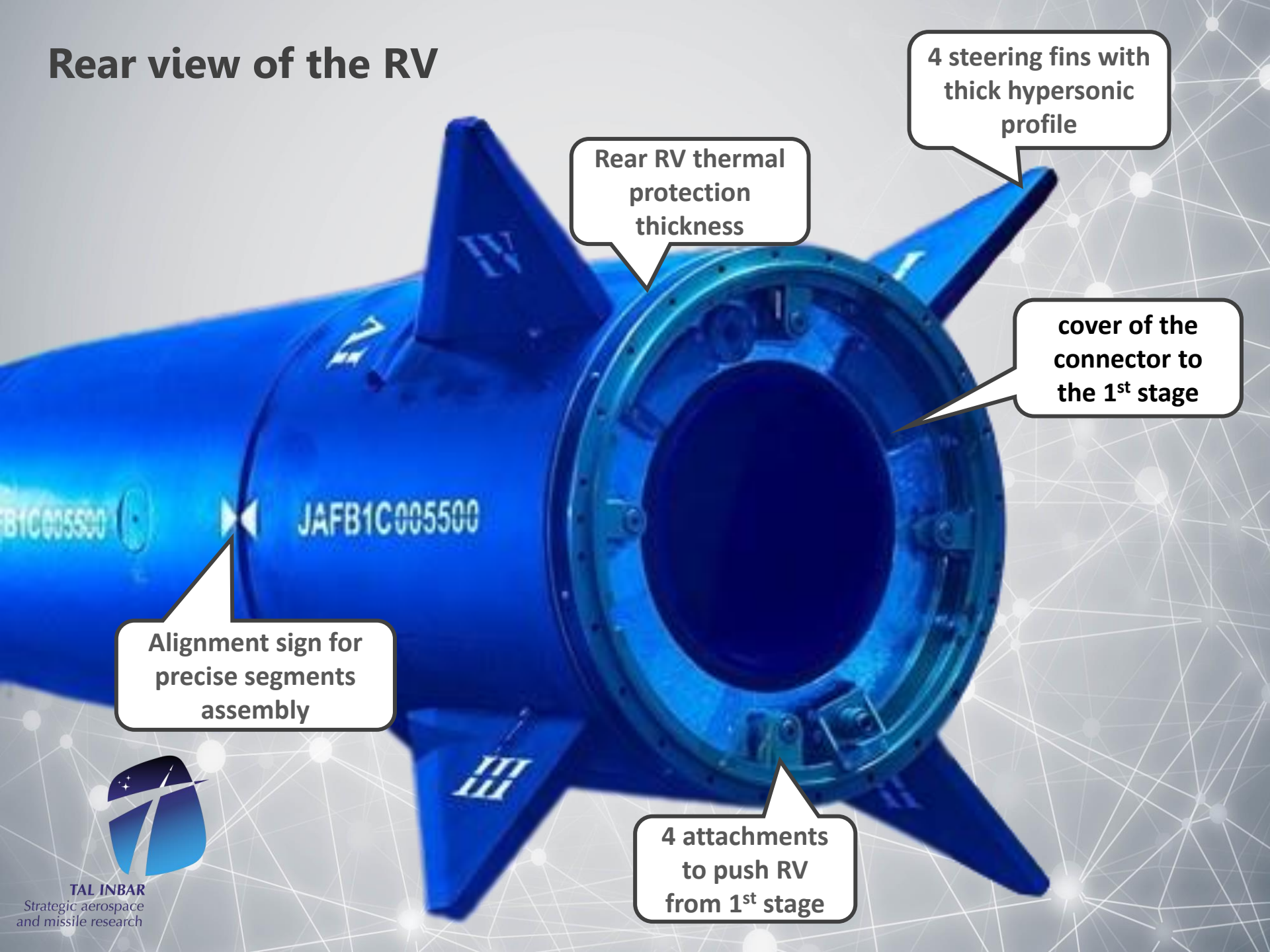
"Arash 24" solid rocket motor for space applications



solid rocket motor hypersonic missile RV. Note the steerable nozzle.

Rear view of the RV



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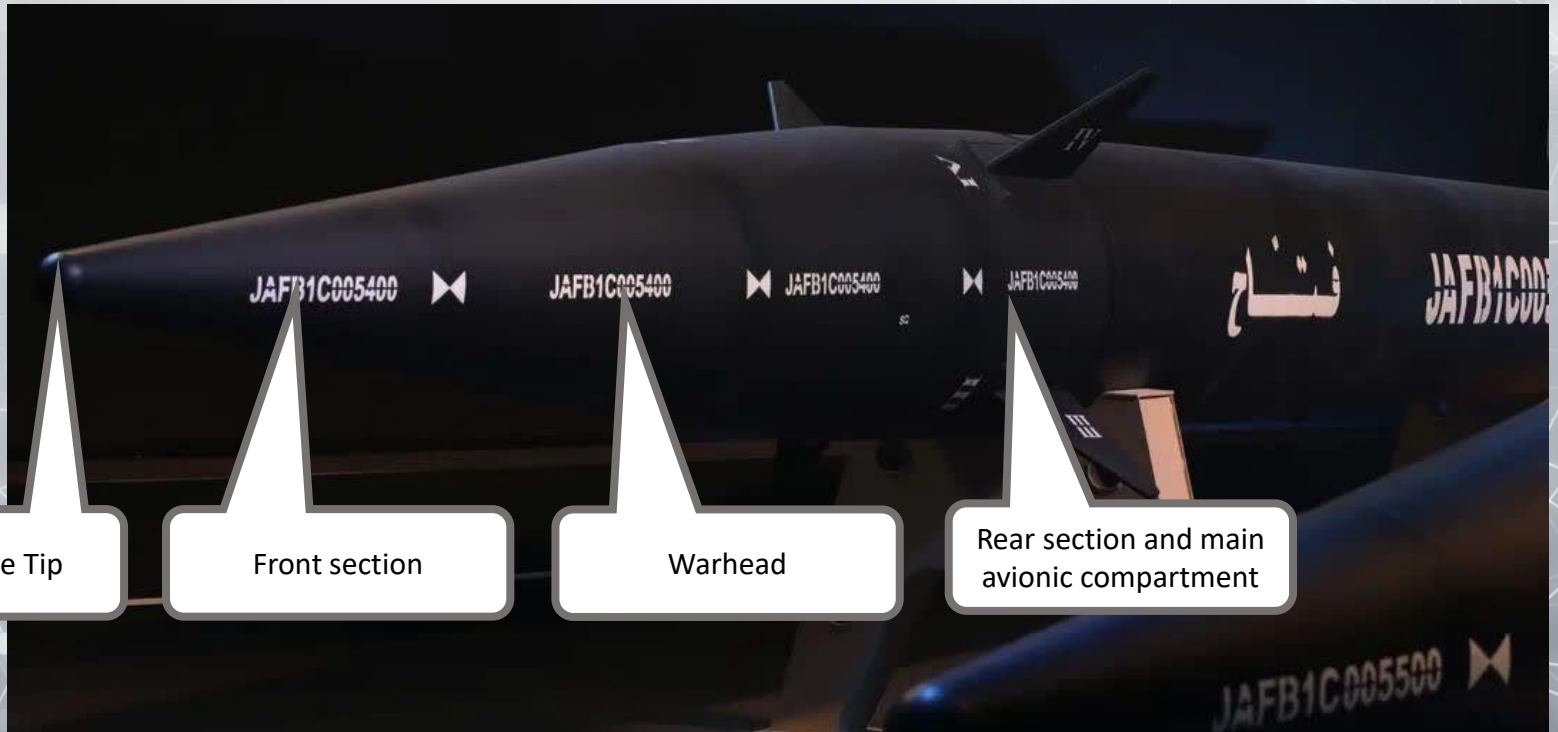
“Fattah” missile re-entry vehicle (RV)

- RV with 4 segments:
  - 1- Rear segment with 4 aerodynamic thick fins and rocket motor (sustainer) with flex nozzle.
  - 2 - Warhead section
  - 3 - Front section
  - 4 – Nose tip

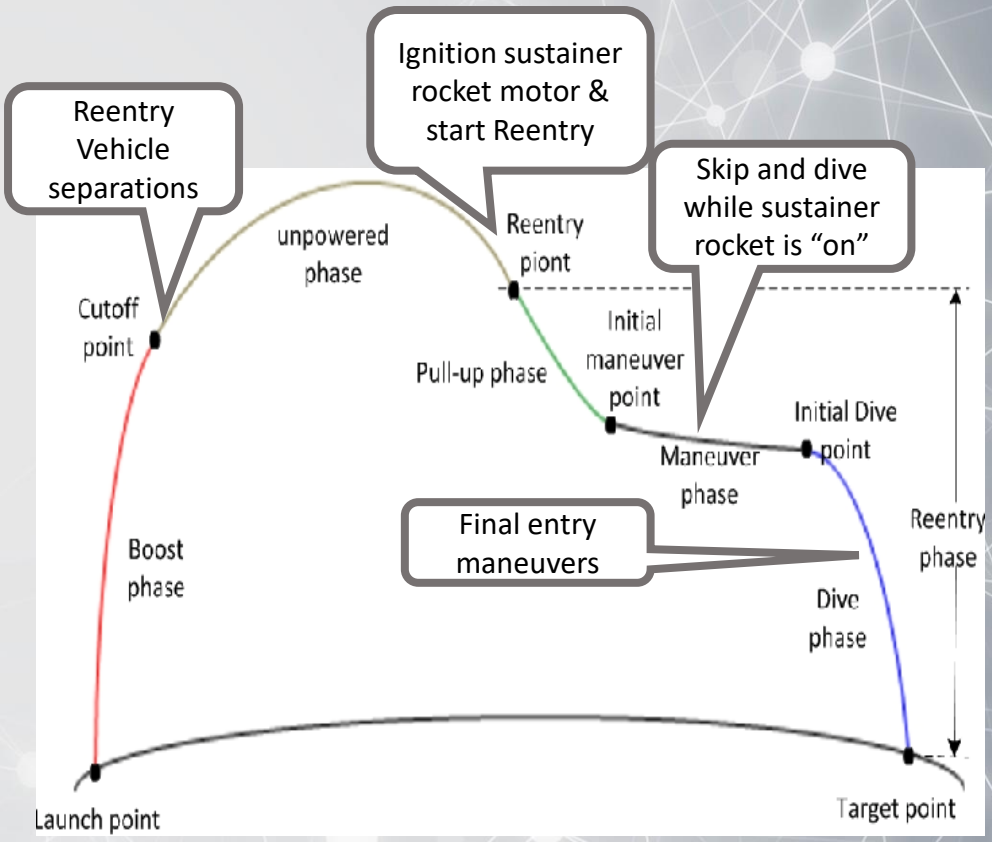


Flight profile (from official Iranian video)

Trajectory profile – phases of the missile's flight

(based on the official Iranian released video)

- **First phase:** boost by rocket motor, burnout, and separation of the RV from the first stage.
- **Second stage**: Ballistic flight (depressed), later - ignition of the sustainer located in the rear of the RV while out of the atmosphere. Then, performing 3 dimensional maneuvers, reentry into the atmosphere in a pull-up maneuver with the same 4 fins.
- **Third phase:** Pitch down maneuver towards target, with the 4 fins and (depends on range) the sustainer still burning up to the target in a preprogramed approach angle.




The missile during first stage of flight

A view from onboard camera

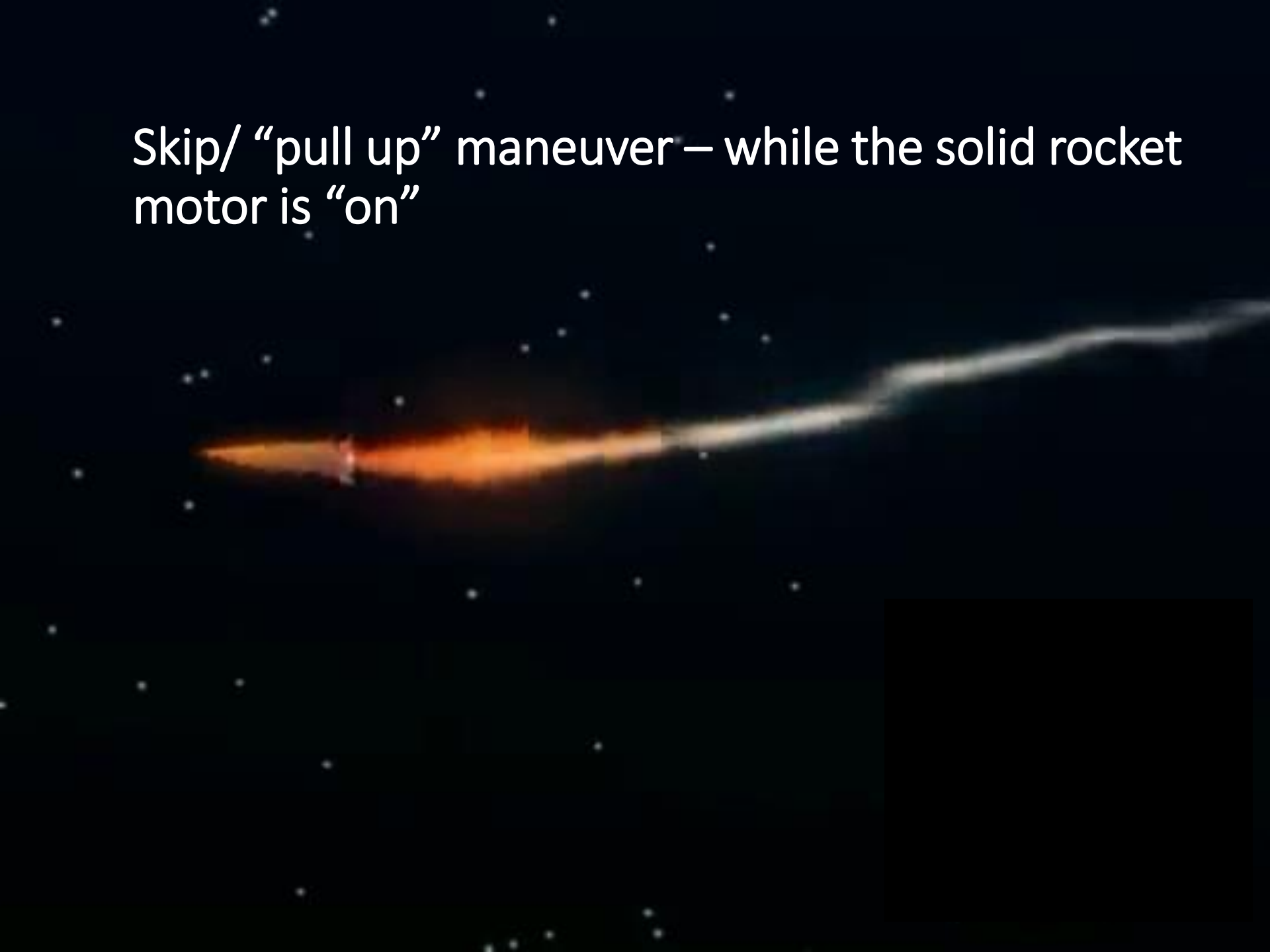
Separation of the RV from the booster (the first stage)

The booster pictured by onboard camera

Iranian video illustration of the heat load on the forward section of the RV and its fin's leading edge

While beginning reentry at shallow flight path, the missile ignites its sustainer motor at the rear end of the RV to regain some of its lost speed.

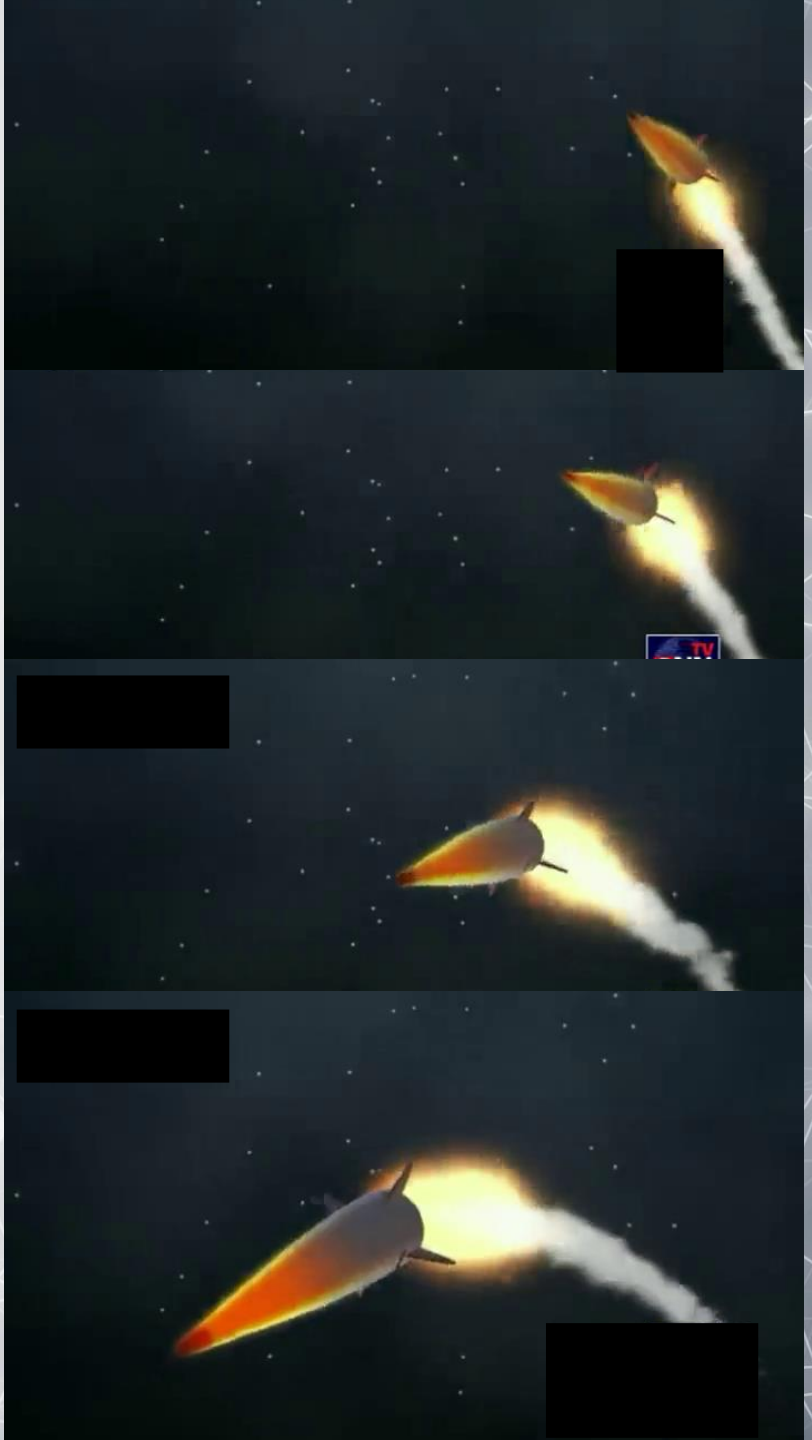
Skip/ “pull up” maneuver – while the solid rocket motor is “on”




Reentry to the atmosphere in a pull-down maneuver to achieve the required approach angle while hitting the target. Sustainer is “on”

Unique re-entry mode with the Solid rocket motor is on

- Long burn time of the sustainer (in the RV)
- Sustainer start burning out of the atmosphere and continue till near impact.
- Long burn rocket motor is effective in such an application.
- Flying at small gamma angle minimize gravity losses.



"Fattah" missile impact

- Approaching the target in a steep angle.
- Not significant wake – an indication for a supersonic speed only near impact.
- Precision - RV impact on the target.

"Fattah" missile impact & explosion

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“Fattah” RV design

- The Iranian are probably the first country in the world to implement a rocket motor into a hypersonic RV.
- On the other hand, the concept of utilizing small rocket motor in an RV is not new in the Iranian designs.
- Developing of such hypersonic, long-range, strike missile requires performing set of ground and flight tests. One might assume that they experienced some setbacks and failures along the development phase, although none were published.

"Fattah" missile potential impact on sensors arrays: the missile defense POV (1/2)

- Launch detection by US spaceborne assets – no change versus similar ballistic missile. However, those sensors cannot **provide anymore impact point prediction**.

- Throughout the entire flight phases, up to the impact, **there is no way to predict impact point**. Moreover, during the initial sustainer burn the final impact point deviations might exceeds 100's Km. (each **delta speed of 1 m/s is equivalent to about 1 Km deviation**). The Iranian show set of 3D maneuvers during this phase. This Iranian design might negate some western ballistic missile defense selective engagement strategies.

"Fattah" missile potential impact on sensors arrays: the missile defense POV (2/2)

- **Ballistic phase:**
  - Some assesses that "Fattah" missile will use **depressed trajectory**, so it will **limit ground radars and EO sensors range** due to LOS geometry.
  - High RCS and EO/IR signature due to the unique configuration, sustainer rocket and heat load.
  - Various tracking and TWS algorithms might requires adaptation to this non-ballistic behavior.

- **Pull up maneuver phase** – as the RV altitude might reach up to about 15 Km. **most sensors** (which are not close to this point) **might lose LOS to the RV target**.

- **Pull down maneuver** – potential **high g maneuvers** might **challenge tracking elements**.

Technical Summary

- **The Iranian R&D community demonstrated a real and unique hypersonic missile**. It is **not** a replica or copy of any other design.
- The Iranian succeeded to close most of their technological gap with Eastern and Western missile communities.
- **Iran is independent in those technologies and does not rely on external support from abroad** such as DPRK or Russia.
- The status of the program is not clear. Probably in-flight tests prior to initial deployment.
- This high-cost development program of hypersonic missile indicates 3 operational goals:
  - *The high priority for penetration through multi-tiers defense arrays in the region.*
  - *The importance of precision.*
  - *Long range – "significant stand-off"*

"Fattah" – Iranian hypersonic missile additional impacts

- Iran continue to advance in the state-of-the-art hypersonic technologies.
- The local missile industries infrastructure do not depend on external know-how.
- The message in the region is clear from 2 key aspects:
  - The claim to penetrate various missile defense arrays.
  - The rate of technical advance by the Iranian regime that threaten Middle-East status quo


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