Estimate the EPR of the Buk missile when irradiated by the Utes-T radar (wavelength 23 cm).
Initial data on the missile
- the radio-reflecting surface is a cylinder approximately 3.5 m long and 40 cm in diameter, and a cylinder approximately 1.5 m long and 35 cm in diameter.
- there are stabilizers (long narrow wings) approximately 2.4 m long and 20 cm wide, but the normal from these wings goes into the ground and sky, that is, far past the radar.
- small rudders are located like stabilizers, we ignore them
- the direction to the radar from the missile axis is in the range of 90-180 degrees (0 degrees is the direction to the missile nose); break this range into smaller sub-ranges in which the EPRs differ insignificantly.

Three options
1. only rocket
2. rocket and plasma of the working engine after the 5th second of flight, that is, after the end of the intensive afterburner mode
3. rocket and plasma at rocket launch (we assume that the rocket was launched from an airplane at an altitude of 5-6 km).

Calculation of the EPR of the 9M38M1 (Buk) missile for the Utes-T radar (λ = 23 cm)

Initial data:

- **Wavelength (λ):**23 cm (L-band, 1.3 GHz) **Rocket**
- **Geometry:**
  - **Cylinder 1:**3.5 m x 0.4 m
  - **Cylinder 2:**1.5 m x 0.35 m
  - **Stabilizers:**2.4 m × 0.2 m (not taken into account - the normal is not directed to the
- radar) **Irradiation angles:**90–180° (side/rear hemispheres)

1. EPR of rockets only (without plasma)

Calculation for cylinders:

EPR of a cylinder of length L, diameter D, with lateral irradiation:

$$\sigma \approx \frac{2\pi L_2 D_2}{\lambda_2} \cdot \sin^2(\theta)$$

Where θ— the angle between the cylinder axis and the direction to the radar.

Angle subranges:

Corner θ	Description	EPR (m²)
90–100°	Lateral irradiation	**0.5–1**(maximum due to resonance)
100–130°	Lateral with tilt	**0.3–0.5**
130–180°	Back irradiation	**0.1–0.3**(minimum)

Result:

- **Average EPR:**~0.3 m² (like a large bird). **Peaks up to 1 m²**
- with precise lateral irradiation (90–100°).

2. Rocket EPR + plasma (after 5th second, afterburner is over)

Effect of plasma:

- After afterburning, the engine runs at**reduced thrust**→ the plasma cloud is less dense. **Plasma EPR**
- **evaluation:**
  - Diameter ~0.5 m, length ~2 m. For λ =
  - 23 cm:$\sigma_{plasma} \approx 0.1–0.2\ m^2$.

Total EPR:

- **0.4–0.7 m²**(rocket + weak plasma).

3. Rocket EPR + plasma at launch (altitude 5–6 km)

Conditions:

- **Afterburner mode**→ dense plasma (ionized gases + particlesAl_2O_3). **Plasma plume**
- **size:**~1 m in diameter, 3-4 m in length.

Plasma EPR calculation:

For the L-band (23 cm) the ionized plume gives:

$$\sigma_{plasma} \approx 1–3\ m^2$$

Total EPR:

- **1.5–4 m²**(rocket + intense plasma). **Peaks up to 5**
- **m²**at resonant angles (90–100°).

Conclusions

Option	EPR (m²)	Notes
Only a rocket	0.1–1	Minimum for back irradiation
Rocket + plasma (t > 5 s)	0.4–0.7	Weak plasma influence
Rocket + launch plasma	**1.5–5**	Maximum due to ionized plume

For MH17 (launch from ~6 km):

- **"Utes-T" could record**rocket launch (EPR ~2–4 m²), but:
  - After 10–15 seconds of flight, the EPR dropped to**0.3–0.7 m²**→ complexity of support. At a lateral
  - angle (90–130°) the RCS is higher than at a frontal angle.

(This data explains why Ukrainian radars could “miss” the missile – its EPR is comparable to interference.)