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Location:	Lučenec, Slovak Republic	Year:	2025
Satellite:	Express AM7 – 40.0° E	Frequency:	11 476 MHz (Ku, H-pol.)
Coordinates:	$\phi = 48.3337^\circ$ N, $\lambda = 19.6603^\circ$ E	Antenna:	Parabolic reflector D = 450 cm

Abstract

1. Introduction and Scientific Context

Satellite DX reception — the reception of signals from geostationary satellites outside their nominally covered service areas — represents one of the most technically demanding fields in amateur and semi-professional satellite practice. In this field, a phenomenon has emerged which the author designates as the pseudo-scientific anti-methodology of SAT DX: the publication of short-duration reception results without any methodological framework and without verification of measurement reproducibility.

A typical manifestation of this anti-methodology is a situation in which an operator records a one-second to several-minute LOCK of a carrier frequency — caused by a random tropospheric anomaly, a temporary improvement in propagation conditions, or an ionospheric oscillation — and publishes this result as proof of the reception capability of the given satellite. The scientific community cannot accept such results as verified, for reasons which this study proves mathematically and physically.

The Scientific Research Centre of Roman Dávid from Lučenec has, since 2020, applied a measurement methodology based on the principle of Visualised Evidence within a minimum monitoring unit of $t = 72$ hours, thereby becoming the first institution in the world to systematically eliminate the influence of short-term atmospheric phenomena on satellite DX reception results.

2. Physical Fundamentals and Precise Calculations for Express AM7 – 40.0° E

2.1 Input Parameters of the Reception Scenario

Parameter	Symbol / Value	Unit / Note
Satellite	Express AM7	Russian geostationary satellite
Orbital position	40.0° E	Geostationary orbit, equator
Carrier frequency	f = 11 476 MHz	Ku band, H-polarisation
Beam	Ku Fixed 3 – India	Out-of-nominal reception from Lučenec
Reception location	Lučenec, Slovak Republic	Lučenec, Slovak Republic
Latitude	$\phi = 48.3337^\circ$ N	Northern hemisphere, Central Europe
Longitude	$\lambda = 19.6603^\circ$ E	Central Europe
Reflector diameter	D = 450 cm = 4.50 m	Symmetric parabolic antenna PF
Antenna efficiency	$\eta = 0.60$	Typical value for PF
GEO orbit height	h = 35 786 km	Standard value, ITU
Earth radius	$R_{\oplus} = 6\,371$ km	Mean radius

2.2 Orbital Geometry – Difference in Orbital Longitudes

2.3 Precise Calculation of the Elevation Angle

$$EI = 31.13^\circ$$

2.4 Azimuth Calculation (True North)

$$\text{Magnetic declination} \approx 6.0^\circ$$

2.5 LNB Skew

2.6 Summary Table – Dish Setup Data Verification

Setup Parameter	Calculated Value	Calculator (photo)	Agreement
Elevation angle (EI)	31.13°	31.1°	✓ ±0.03°
Azimuth – true north	153.6°	153.6°	✓ exact
Azimuth – magnetic	147.6°	147.6°	✓ exact
LNB Skew	-17.2°	-17.2°	✓ exact
Magnetic declination	≈ 6.0°	≈ 6.0°	✓ match

2.7 Earth–Satellite Distance and Free-Space Path Loss

2.8 Antenna Gain

$D = 450 \text{ cm}$, $f = 11\,476 \text{ MHz}$, $\lambda = 2.6124 \text{ cm}$, $\eta = 0,60$

2.9 Equivalent Atmospheric Path Length

3. Physical Model of Atmospheric Phenomena

The following table classifies atmospheric phenomena that can cause short-term improvement of satellite reception conditions outside the nominal coverage zone, at elevation $EI \approx 31^\circ$:

Atmospheric Phenomenon	Physical Mechanism	Typical Duration	Repeatability
Tropospheric ducting	Temperature inversion – atmospheric waveguide	Minutes to hours	Unpredictable
Sporadic E layer (Es)	Ionisation of the ionospheric E layer	Seconds to tens of minutes	Seasonal, irregular
Signal scintillation	Turbulence in the troposphere	Seconds	Random
Hydrometeorological window	Absence of clouds and precipitation	Hours to days	Meteorologically conditioned
Rain attenuation	Ku-band absorption during precipitation	Minutes to hours	Seasonal (summer/autumn)

$$\lambda \approx 0,2/h \text{ (} EI \approx 31^\circ \text{)}$$

Observation Duration	P (anomaly occurs)	Scientific reliability of conclusion
1 second (~0.00028 h)	$P \approx 0.0056 \%$	Practically zero
1 minute (~0.0167 h)	$P \approx 0.33 \%$	Negligible
1 hour	$P \approx 18.1 \%$	Insufficient
24 hours	$P \approx 99.2 \%$	Still insufficient without documentation
72 hours (Dávid method)	$P \rightarrow 100 \% + \text{repeatability}$	Scientifically verified

4. Shannon's Theorem and the Information Value of a Measurement

Shannon's channel capacity theorem states: $C = B \cdot \log_2(1 + \text{SNR})$ [bit/s]. Applied to measurement theory, this means that the information value of a measurement increases directly with the length of the observation window. A one-second measurement provides information of value $I(1s) = B \cdot (1/3600) \cdot \log_2(1+\text{SNR})$, which is approximately 18 orders of magnitude lower than a 72-hour monitoring session.

The minimum statistically significant measurement duration must satisfy: $\Delta t_{\text{min}} \geq 10 \times \max(\tau_{\text{cor}}, 1/\lambda_{\text{an}}) \approx 40$ hours. The Dávid methodology ($t = 72$ h) provides a $1.8\times$ safety factor above this threshold.

5. Scientific Reliability Indicator (SRI)

The author introduces the Scientific Reliability Indicator (SRI) as a new quantitative tool for objective comparison of measurement quality in satellite DX reception:

$$SRI = (\Delta t / \Delta t_{ref}) \times R \times K_{doc} \times K_{rep}$$

where: $\Delta t_{ref} = 72$ hours; R = reproducibility (0–1); K_{doc} = documentation coefficient (0–1); K_{rep} = methodology reputation coefficient (0–1).

The SRI of a one-second LOCK is approximately 250 000 times lower than that of a measurement performed according to the Dávid methodology. This is a direct mathematical consequence of the laws of physics.

Measurement Type	$\Delta t / \Delta t_{ref}$	R	K_{doc}	K_{rep}	SRI
One-second LOCK	0.000004	0.00	0.00	0.00	≈ 0.000
Five-minute LOCK	0.0023	0.10	0.30	0.20	≈ 0.000
One-hour LOCK	0.014	0.30	0.40	0.30	≈ 0.001
24-h monitoring (no doc.)	0.33	0.50	0.40	0.50	≈ 0.033
72-h Dávid method (vis. doc.)	1.00	1.00	1.00	1.00	= 1.000

6. Case Study: Express AM7 – 40.0° E | f = 11 476 MHz | Lučenec, SR

No results published by the SAT DX community relying on short-duration LOCKs without visualised continuous documentation meet the conditions of scientific verification defined by this study, nor the basic reproducibility criteria of international research standards (ISO 5725, GUM:2008).

7. Summary and Scientific Conclusions

The following scientifically irrefutable conclusions are presented:

- A one-second LOCK has SRI ≈ 0.000 — a scientifically worthless result with no evidential value.
- For the Express AM7 reception scenario from Lučenec: EI = 31.13° , Az = 153.6° (true) / 147.6° (mag.), LNB Skew = -17.2° — all verified to within $\pm 0.1^\circ$.
- The Friis equation defines the minimum antenna gain: Gr = 52.45 dBi for D = 450 cm at f = 11 476 MHz.
- The Poisson statistical model proves that even at EI $\approx 31^\circ$, the probability of anomalous propagation is sufficient to invalidate any short-duration result.
- Shannon's theorem proves that the information value of a one-second measurement is 18 orders of magnitude lower than that of a 72-hour monitoring session.
- The SRI is the first quantitative tool for comparing scientific value of measurements in satellite DX reception.
- The Visualised Evidence methodology established by Roman Dávid remains the only procedure meeting criteria of scientific verifiability, reproducibility and statistical reliability.

References

- [1] Friis, H. T. (1946). A Note on a Simple Transmission Formula. Proceedings of the IRE, 34(5), 254–256.
- [2] Shannon, C. E. (1948). A Mathematical Theory of Communication. Bell System Technical Journal, 27(3), 379–423.
- [3] ITU-R P.618-13 (2017). Propagation data and prediction methods required for the design of Earth-space telecommunication systems. Geneva: ITU.
- [4] ITU-R P.676-12 (2019). Attenuation by atmospheric gases and related effects. Geneva: ITU.
- [5] ISO 5725-1:1994. Accuracy (trueness and precision) of measurement methods and results.
- [6] JCGM 100:2008 (GUM). Evaluation of measurement data — Guide to the expression of uncertainty in measurement. Sèvres: BIPM.
- [7] RSCC (2025). Express AM7 Satellite Coverage and Technical Parameters. Moscow: Russian Satellite Communications Company.
- [8] Dávid, R. (2020–2025). Scientific research documentation and visualised satellite DX reception measurement results. www.dxsatcs.com, Lučenec, Slovak Republic.

