«Pētījumi satelītu signālu uztveršanas, moderno telekomunikāciju un mazo satelītu konstelāciju pakešdatu tīklu tehnoloģijās»
(Nr. L-KC-11-0006)

SATELLITE GROUND STATION POTENTIAL OF VIRAC RT-32 AND RT-16 ANTENNAS

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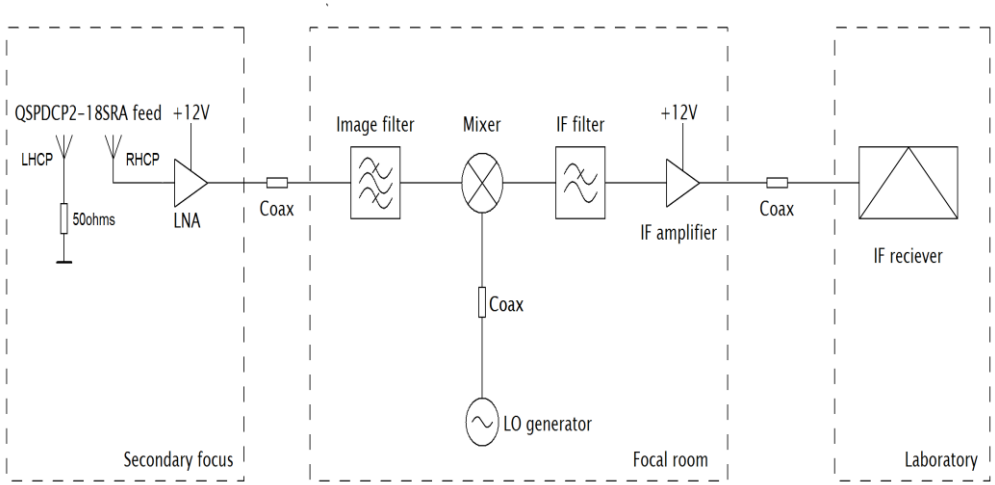
Aim of the work

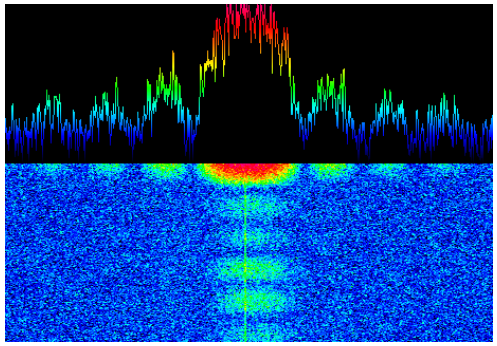
- Satellites becoming smaller, but the amount of data larger
- Main limitation of downlink data rate for small satellites – available onboard power
- Possible solution of this compromise - to increase sensitivity of ground station
- **Can VIRAC RT-32 and RT-16 function as ground station of small satellites?**

LEO satellite signal reception experiment

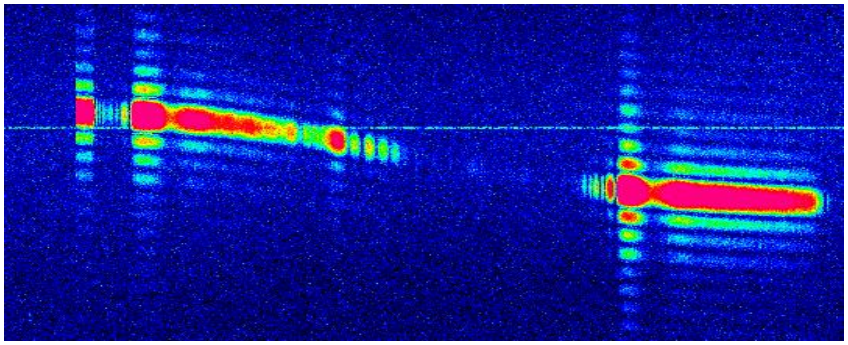
- S band frequncy downconverter was built for this purpose



Brite-Austria passing the beam of RT-32 (El: 12°):



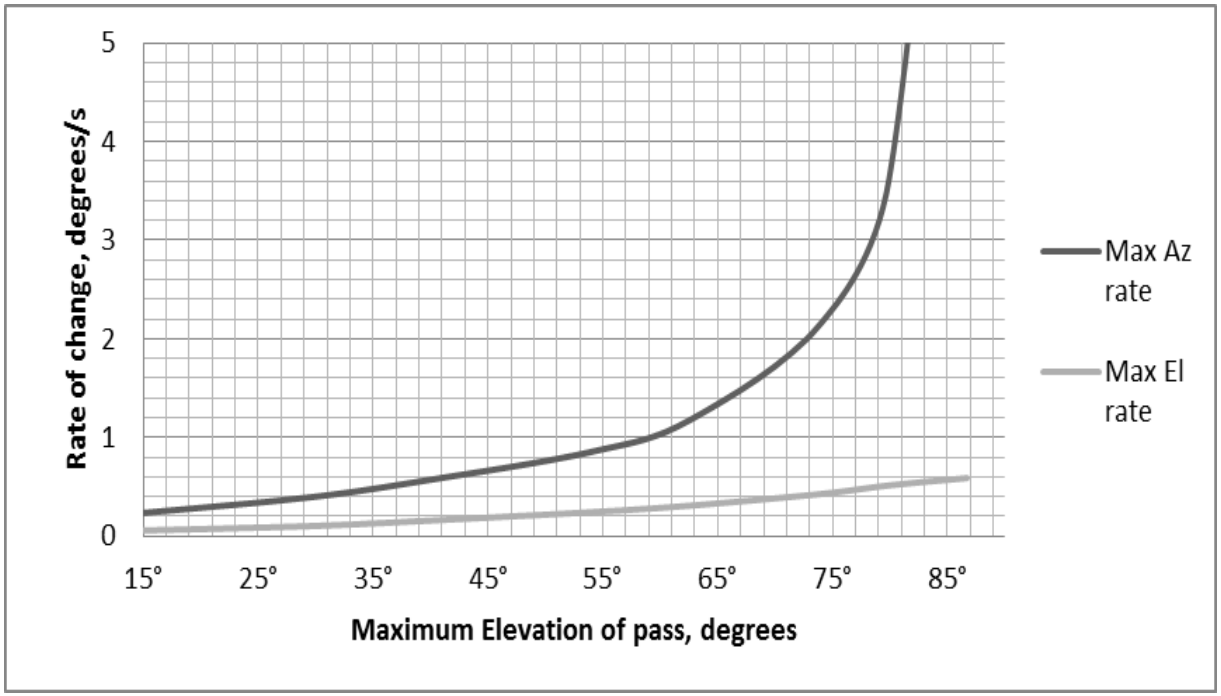
Brite-PL full pass received with RT-32 (Max El: 20°):



Performance of antenna steering system

- **Current performance:** 0.25 °/s for RT-16; 2 °/s for RT-32
- **After renovation:** >5 °/s for RT-16; >2.8 °/s for RT-32

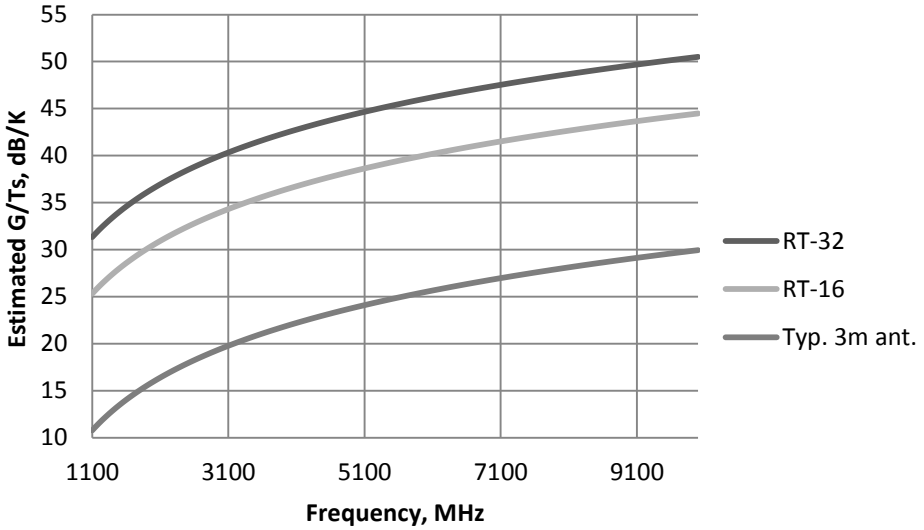
Rate of change of azimuth and elevation as function of maximum elevation of pass calculated for BRITE-PL LEO satellite (Altitude of orbit ≈700km):



Wideband cryogenic microwave receivers

- Frequency coverage: 4.5….8.8GHz with maximum system noise temperature of 16K

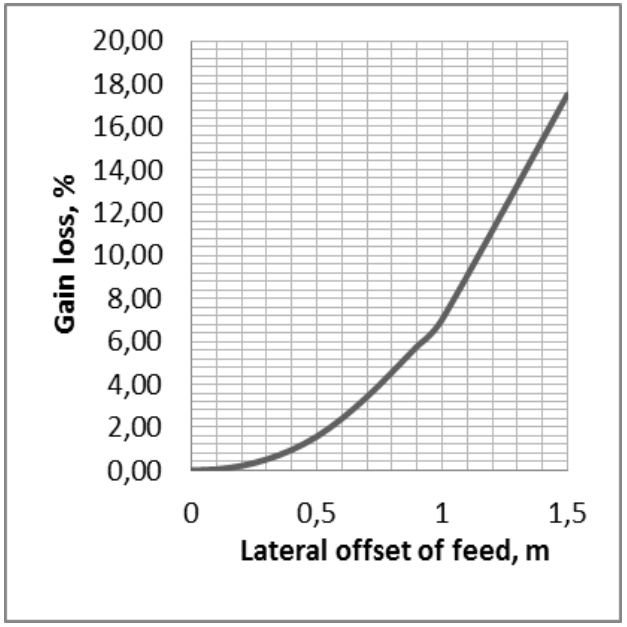
Estimated figure of merit of RT-32 and RT-16 reception systems (at least):

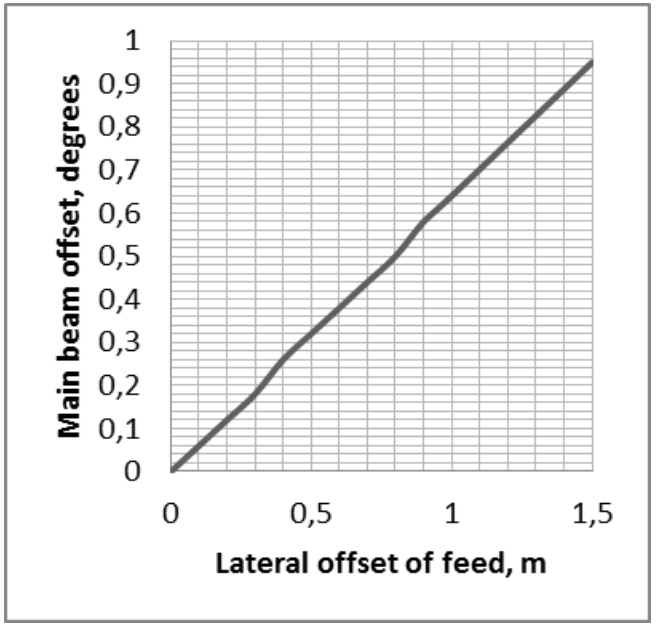


Possible integration of satellite base station functionality

- Offset additional feeds at secondary focus

Gain degradation and beam offset with lateral feed offset calculated for RT-32 at λ=13cm:





Ongoing reconstruction

- Restoration of RT-32 supporting structures and completely new surface for RT-16
- More accurate position sensors (at least 2.5’’ instead of current 20’’)
- New control and monitoring system with remote control, uninterruptable power systems

Main conclusions

- Convenient open loop tracking method based on TLE parameter orbital modeling can give reasonable accuracy for tracking LEO satellites with large diameter antennas.
- Large increase of figure of merit allows to increase error free data rate of power limited satellite downlink channel
- **RT-32 and RT-16 are capable to function as highly sensitive ground station for small satellites !**

Thank You for Your attention!

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