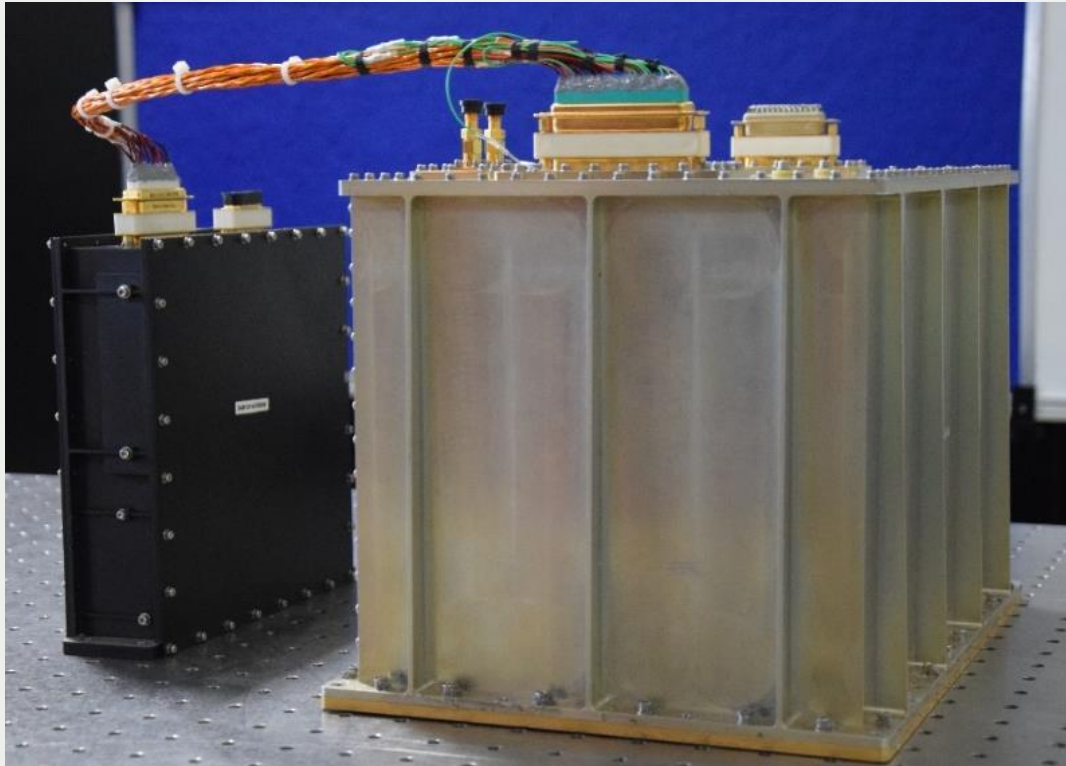




Performance of IRAFS on-board NVS-01 NavIC Satellite

*Atomic Clock Development Division
Space Applications Centre
Indian Space Research Organisation
Ahmedabad, India*

ISRO RAFS for Indian Navigation Program



IRAFS with EPC

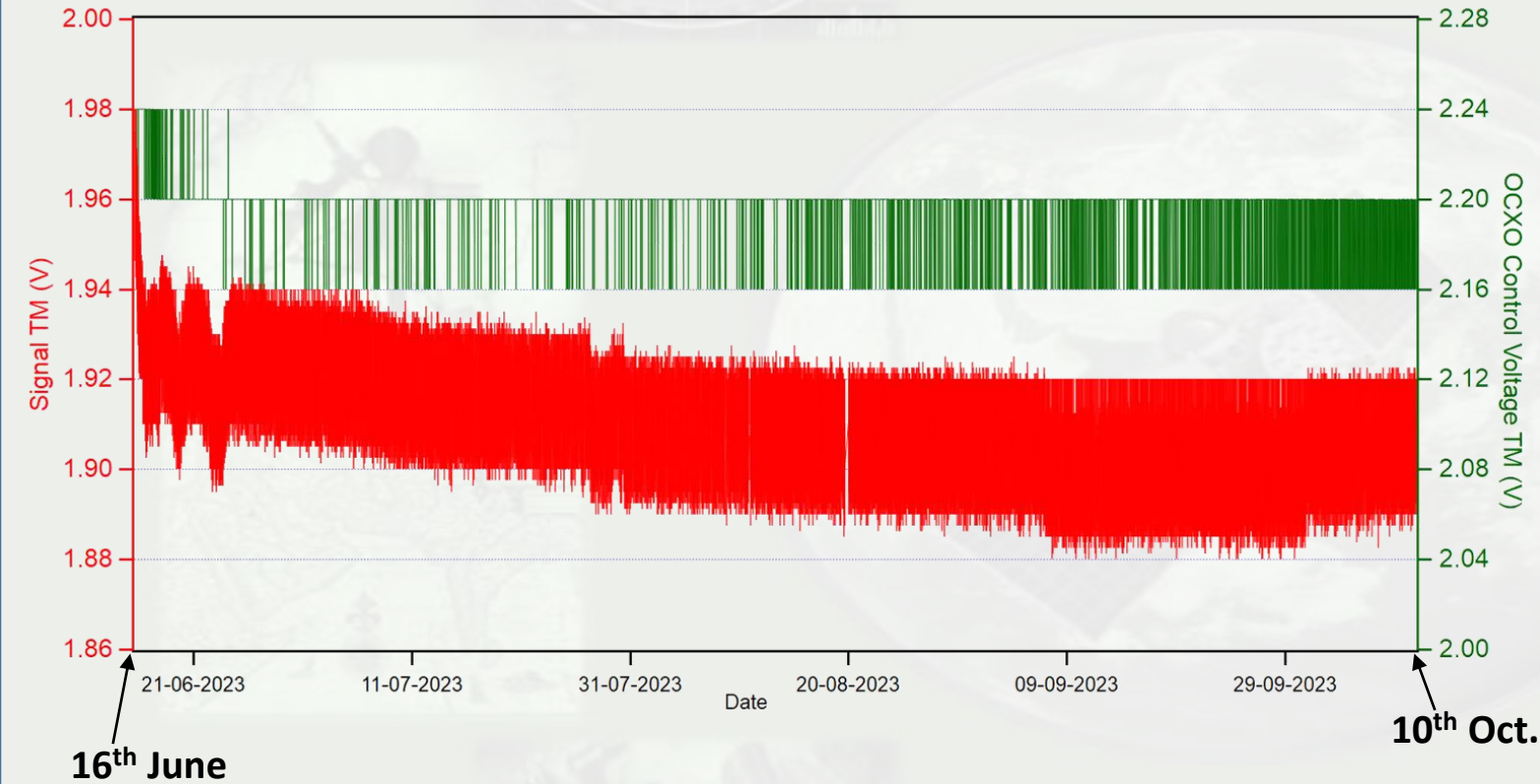
Development Status:

- RAFS is fully qualified
- First FM flown in NVS01/IRNSS1J satellite in May-2023
- In service since first week of July 2023. UERE specification of NVS01 achieved with IRAFS .

Highlights:

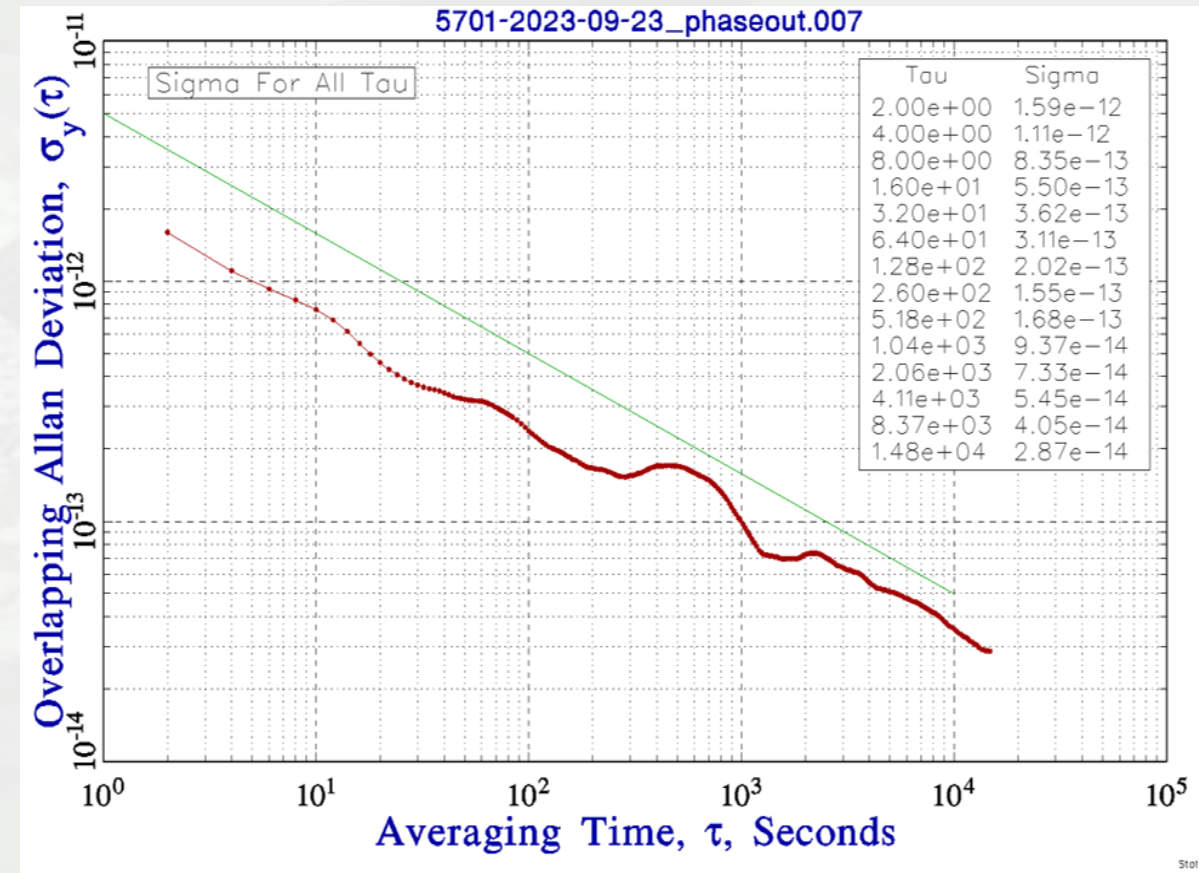
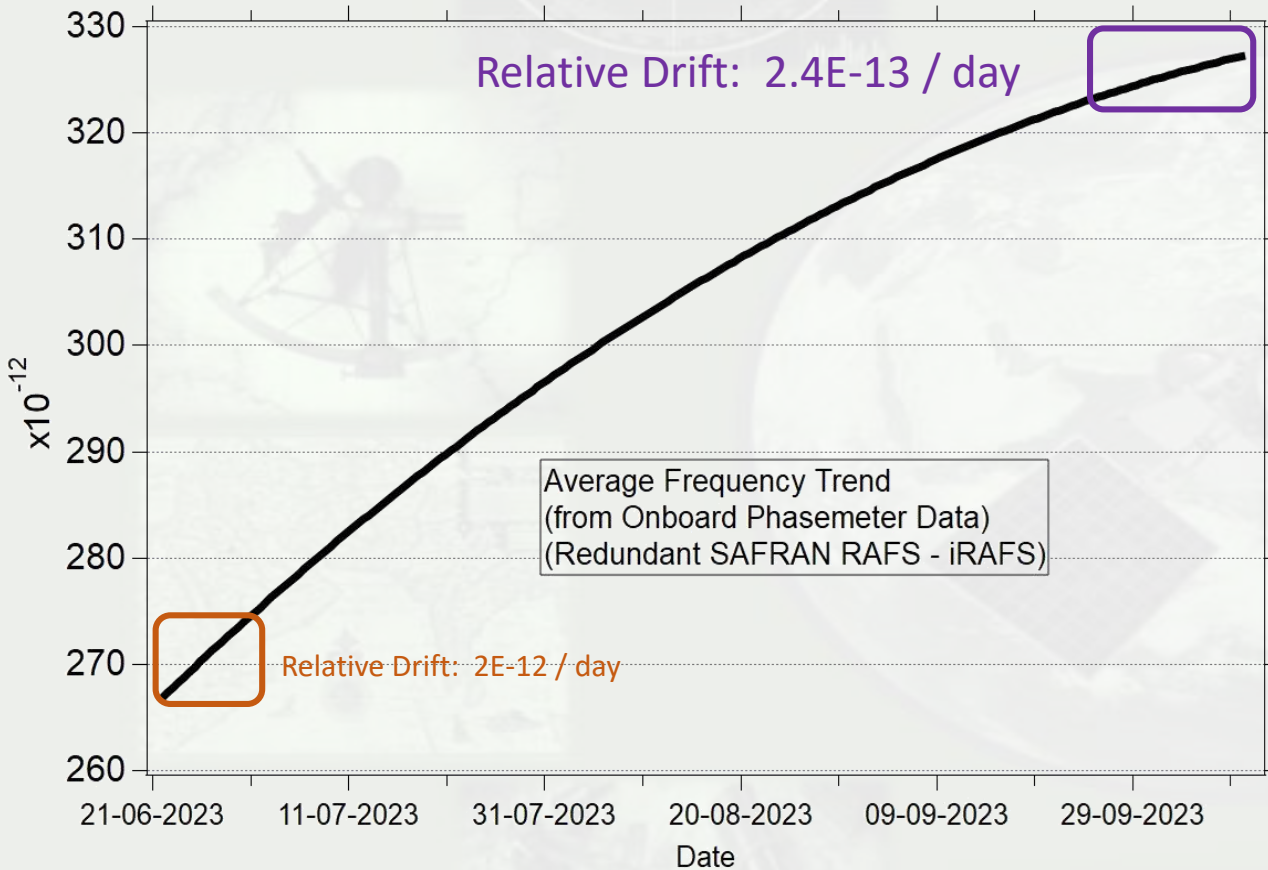
- Indigenous design and development at SAC-ISRO
- Physics Package: Lamp pumped with integrated filter cell, custom magnetic shields
- Digital Design for Lock-in Amplifier and Temperature Controller, DDS for tuning RF frequency
- Low phase noise OCXO with Multiplier based RF synthesizer

IRAFS On-board TM



TM	Ground T&E	On-board
LTM(V)	3.58 V	3.62 ± 0.00063 V
STM(V)	1.86 V	1.9 ± 0.00063 V
Lamp Current(V)	2.31 V	2.28 ± 0.04 V
OCXO(V)	2.22 V	2.18 ± 0.04 V

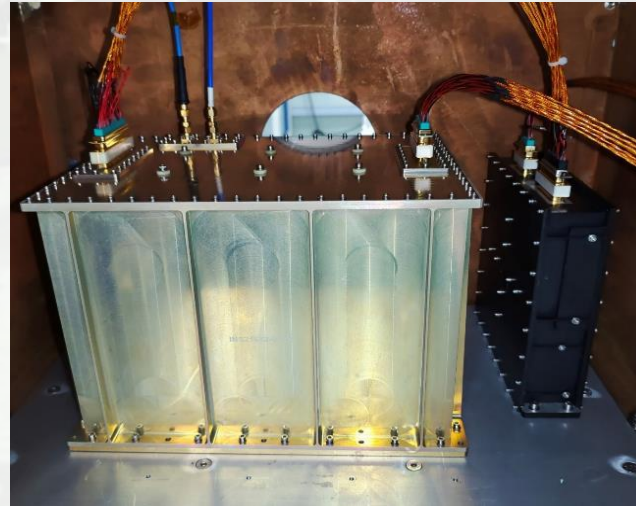
IRAFS On-board Frequency Stability



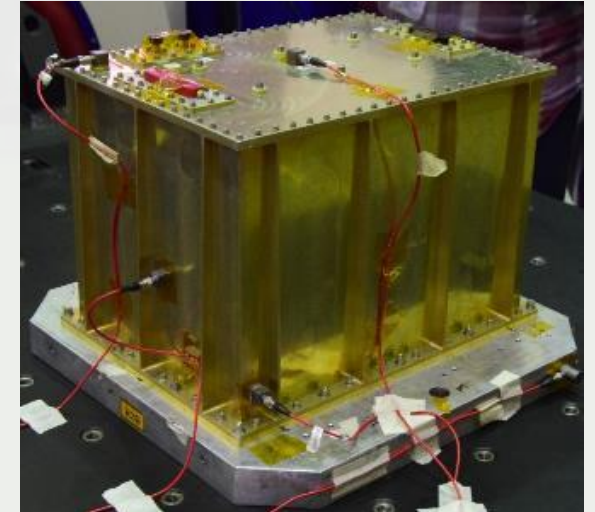
From Onboard Phasemeter Data (Redundant SAFRAN RAFS – IRAFS)

QM unit successfully qualified for space use

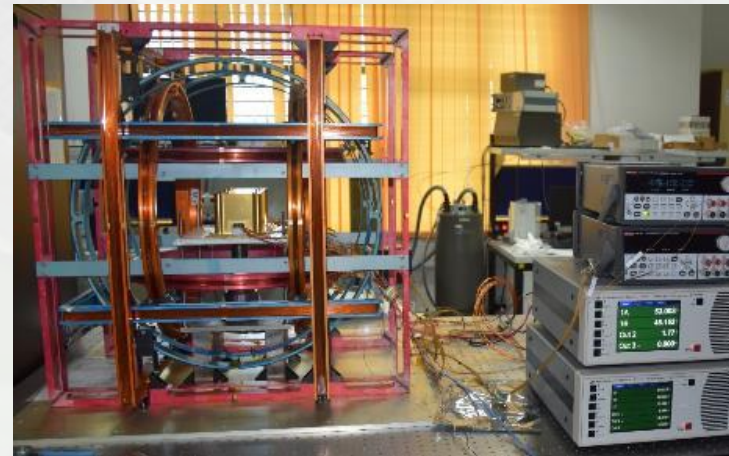
- Successfully completed qualification tests:
 - Bench Test (IBT)
 - 7-days burn-in Test
 - Hot and cold storage tests
 - Sine vibration tests
 - Random vibration tests
 - EMI / EMC test
 - Long-term thermovac test (6-weeks)
 - Life Test completed
 - Shock Test
- Demonstrated $<5e-14$ stability @ 10,000 sec.



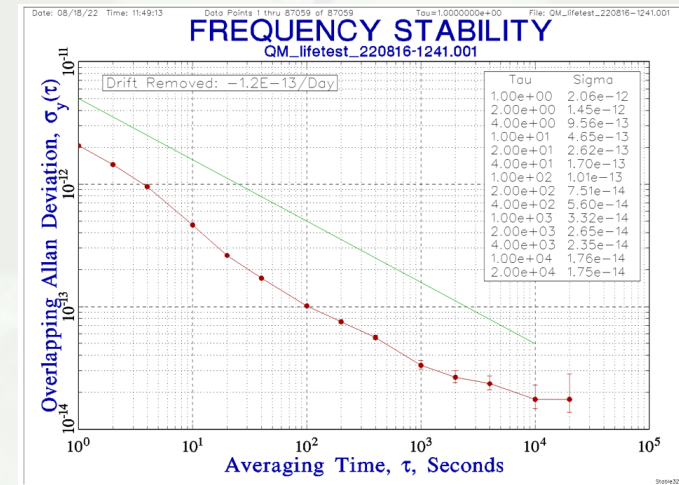
QM-IRAFS with EPC in TVAC chamber



QM-IRAFS under vibration tests



Magnetic sensitivity measurement



Conclusions / Key takeaways:

- First indigenous RAFS was flown on-board in NVS01 satellite.
- IRAFS is functioning satisfactorily on-board.

Thank You