Infleqtion

THALES

Quantum RF (QRF)

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Infleqtion

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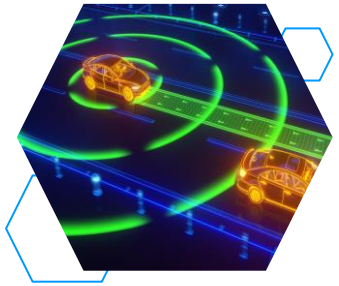
Rydberg Programs at Infleqtion

Rydberg-atom RF Sensors for Direction Finding and Geolocation (RADARS)



1st goal is to develop a cold Rydberg atom microwave direction finder at mm-Wave, with …
- …higher sensitivity than traditional systems
- …elimination of systematic effects, specifically: Doppler effects in hot atom sensors

2nd goal is to develop a hot Rydberg atom microwave direction finder at UHF, with …
- …higher sensitivity than traditional systems
- …sub-wavelength angle-of-arrival

Science of Atomic Vapors for New Technologies (SAVaNT)

Goals:
- Push sensitivity below blackbody radiation limit
- Control instantaneous bandwidth

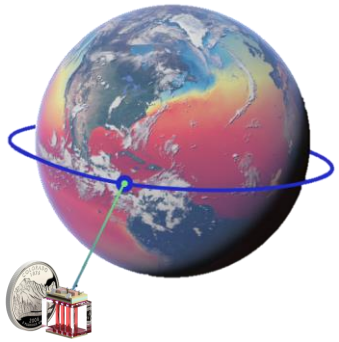
Scientific research-focused

Quantum Apertures (QA)

Goals:
- Demonstrate 10 MHz to 40 GHz
- Reduce aperture shape/size
- Detect & process commonly used waveforms

System development-focused

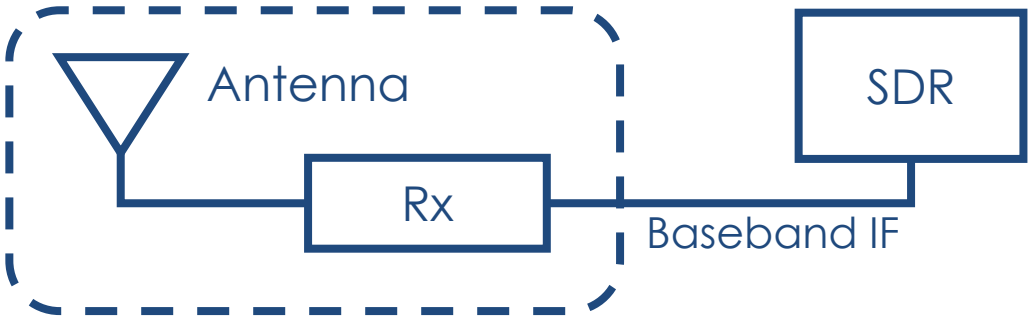
Quantum Atomic Rydberg Radiometer for Earth Measurements (QuARREM)

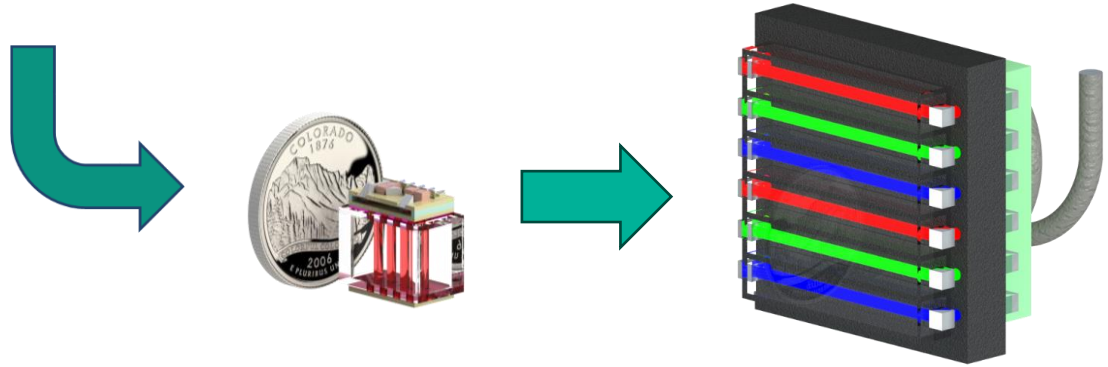


Goals:
- Demonstrate Rydberg V-band 'backend' receiver
- Compare QRF architectures to classical radiometry
- Develop testbenches and noise characterization techniques to facilitate measured comparisons
- Concept development around absolute calibration for in-measurement traceability chains

What is Quantum RF

Quantum RF (QRF):
Replaces RF antenna & analog Rx components





Integrated atomics, micro-optics & electro-magnetics in 1cm^3 vapor cell

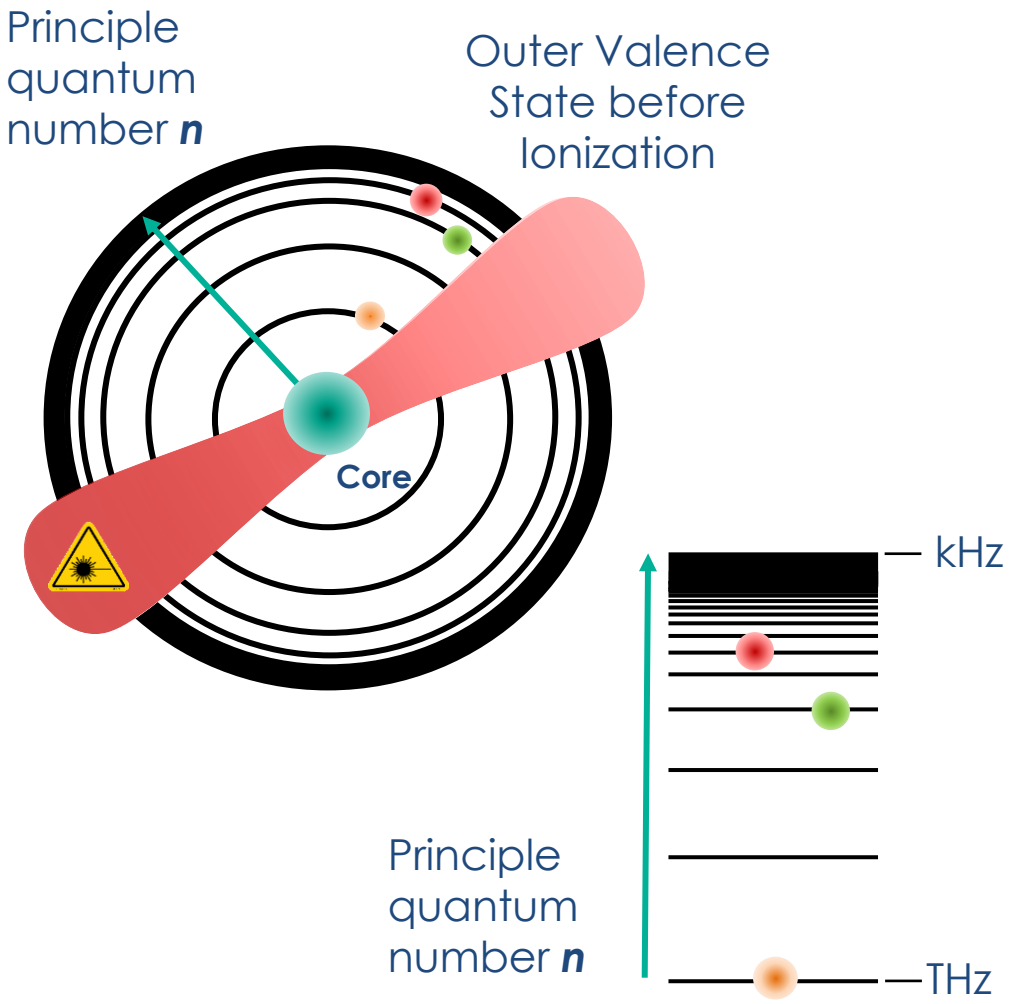
Unique Capabilities:

- Continuously **tunable** across a broad range of frequencies (.01 ~ 300 GHz)
- **Sensitive** down to blackbody rad limit
- Supports both **NB (kHz)** & **WB (10MHz+)** modes of operation
- Physically **small**, independent of frequency / wavelength
- **Resilient** to EMP & Radiation
- Simultaneously **replaces** multiple Rx systems with single multi-channel device

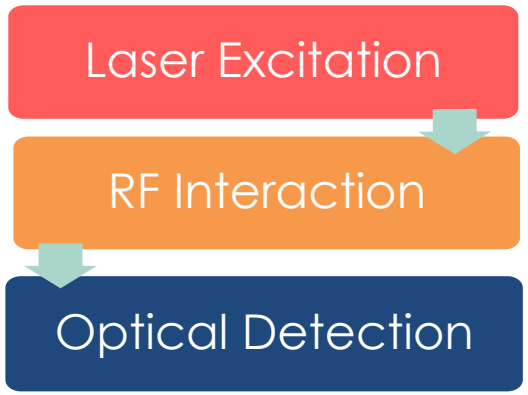
Convergence

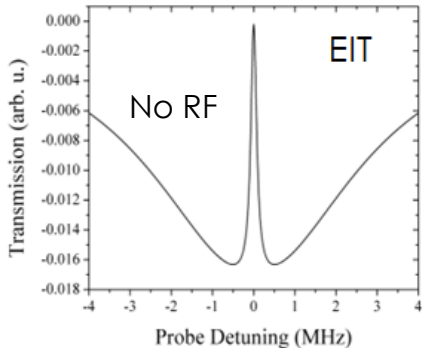
How does it work

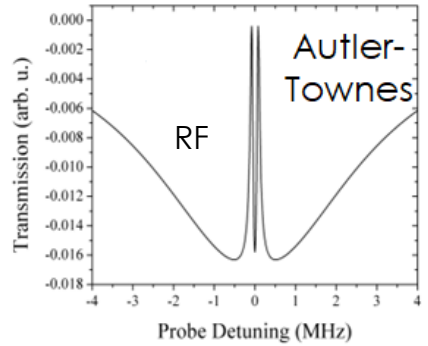
Rydberg Atom



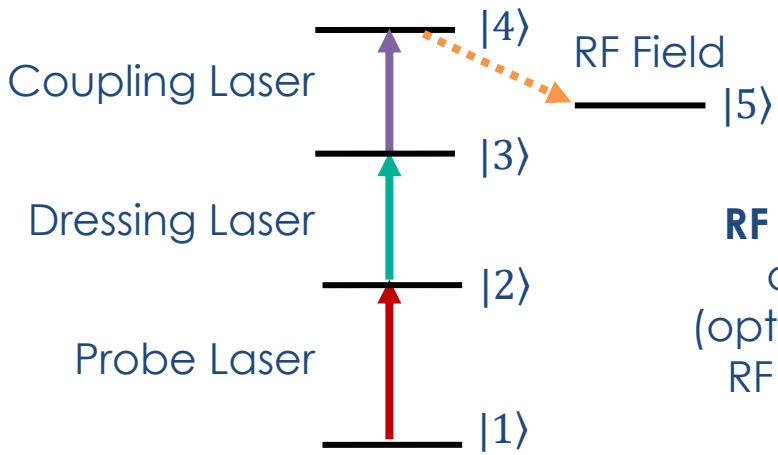
Rydberg Atom Receiver (Rx)







3-Photon Laser Excitation



RF signal is **transduced** onto probe beam (optical carrier), similar-to RF photonics, but with **no antenna**

Quantum RF Technology Roadmap

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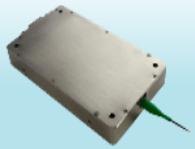
Laser/Control Unit

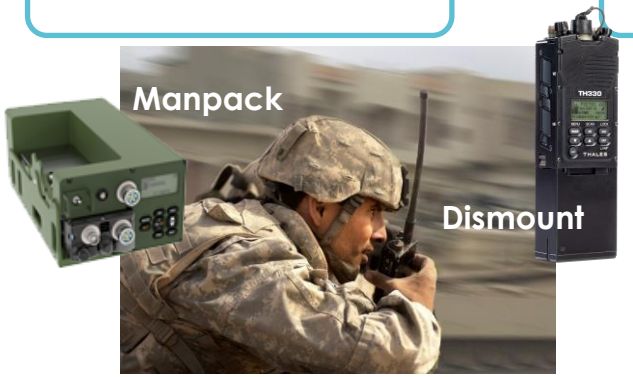


Apertures

Receive Only → Transmit/Receive

Today	2025	2028

Sensors



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Quantum RF Applications

Broad spectrum scanning with a single sensor using a QRF frontend

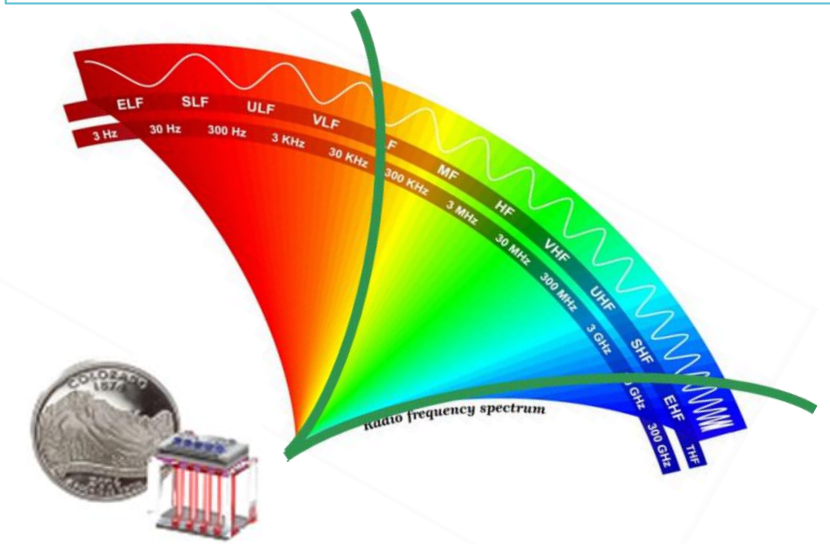
HF Communications leveraging smaller antennas and direct conversion to I/Q eliminates large RF components

Enhanced Cognitive Radio

- Spectrum agility far greater than currently available today
- Leverage Broad Spectrum Scanning to enhance spectrum awareness
- QRF inherently provides LPI/LPD

Tactical Communications

- Works with existing Legacy Channels (VULOS, SINCGARS, SATURN)
- Tactical MANET Networks



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