

Dicke-Switched microwave radiometry using Ettus USRP and GNU Radio

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Overview

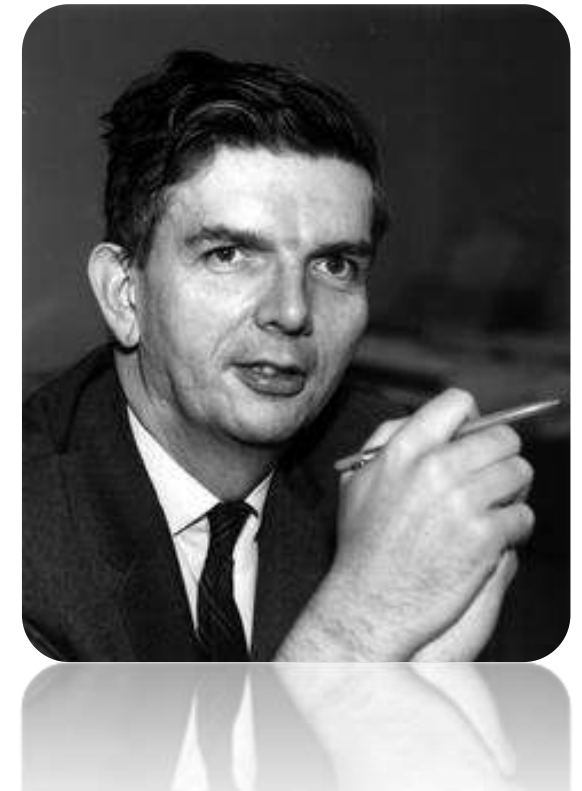
- Dicke-switching
- Aeronomy and Astronomy
- Software Defined Radio (SDR) platforms
 - i.e The Ettus Universal Software Radio Peripheral (USRP)
- GNU Radio
- A Dicke-Switched Fast Fourier Transform (FFT) back-end
- Measurements (O₃ and CO)
- Conclusion

Dicke-Switching

- Gain, atmospheric fluctuations
- Robert H. Dicke
- The Dicke Radiometer
- Load, sky and frequency switching

Applications

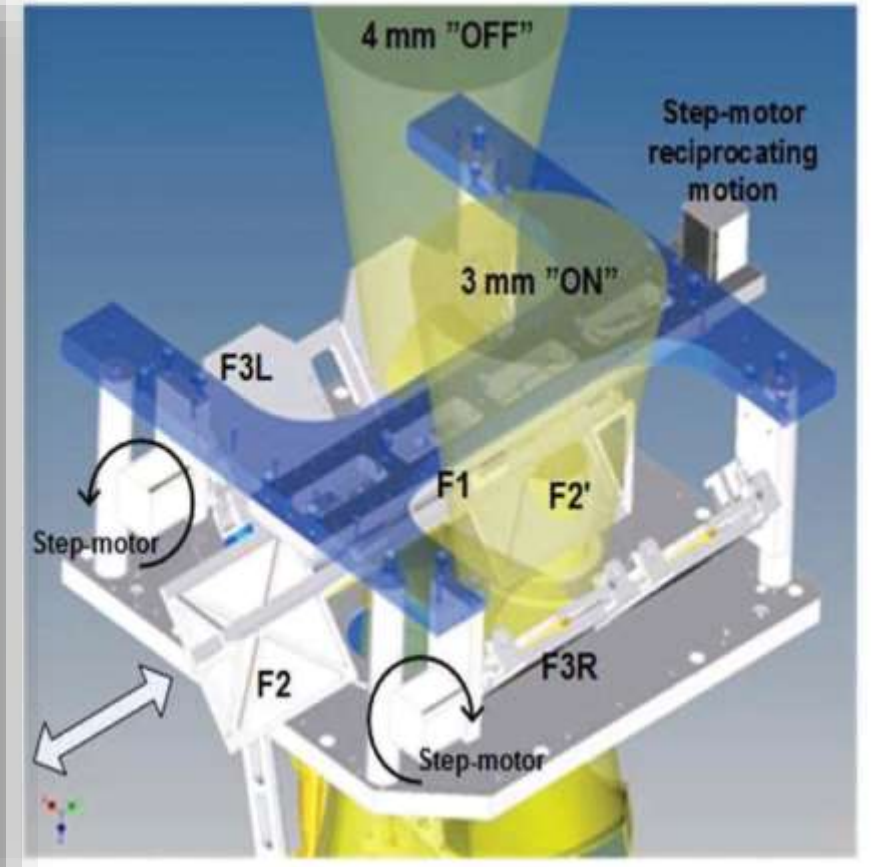
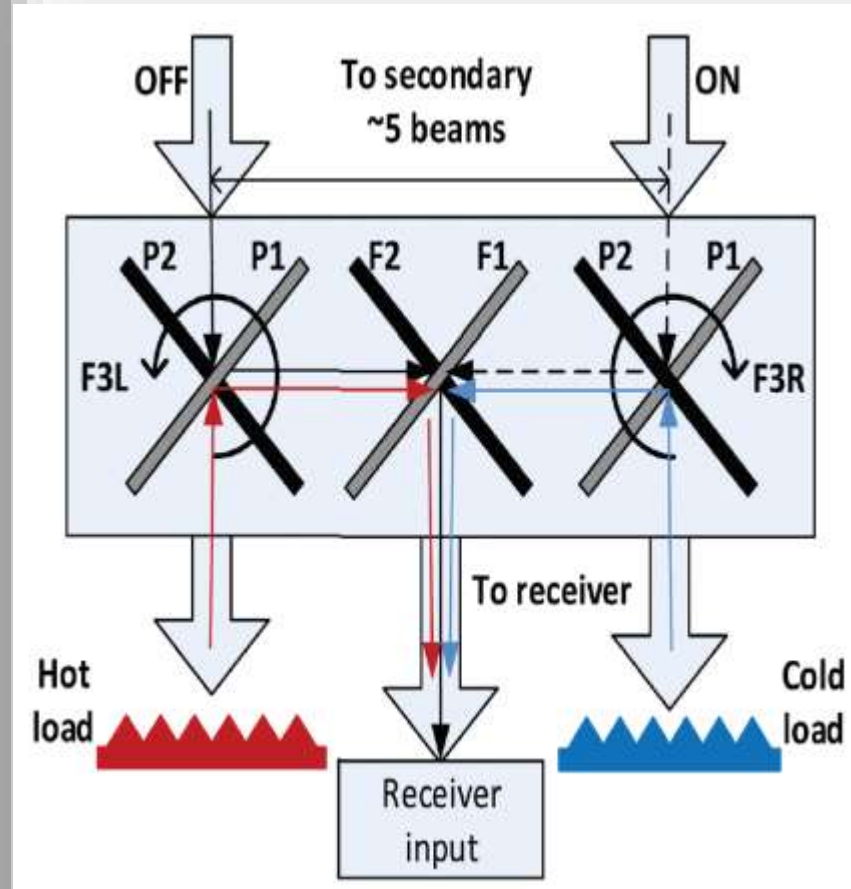
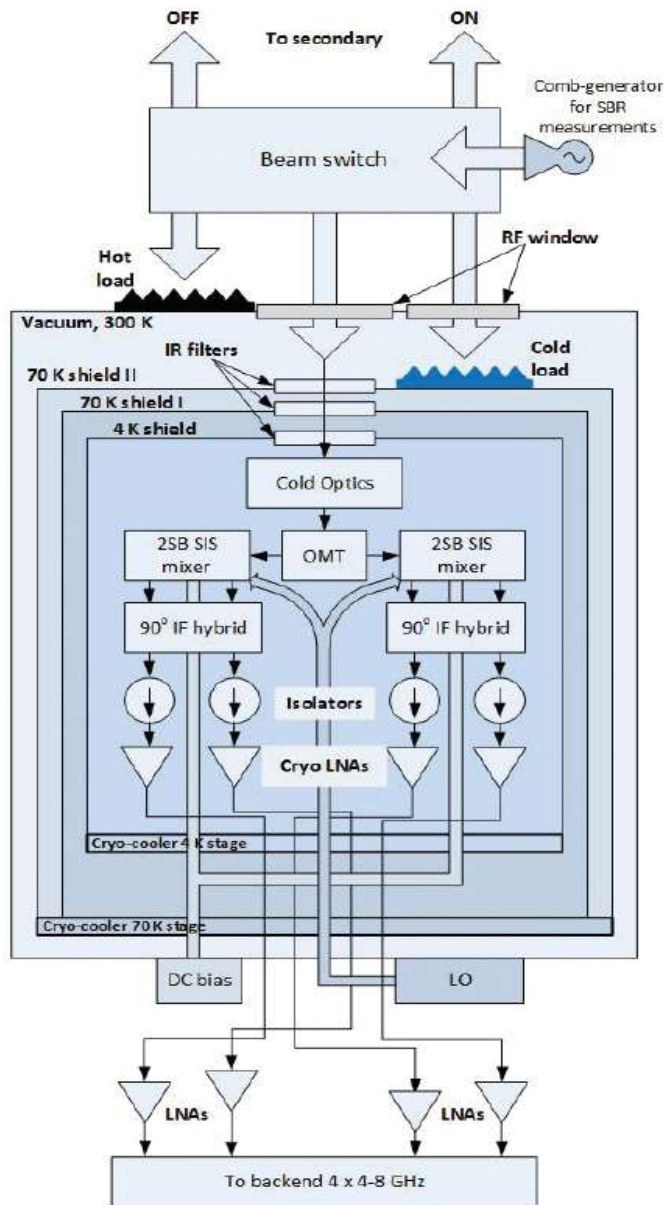
- Search for ExtraTerrestrial Intelligence (SETI)
- Interstellar medium
- Dark Matter/Energy
- Black holes
- Atmosphere







New Onsala 3mm band receiver



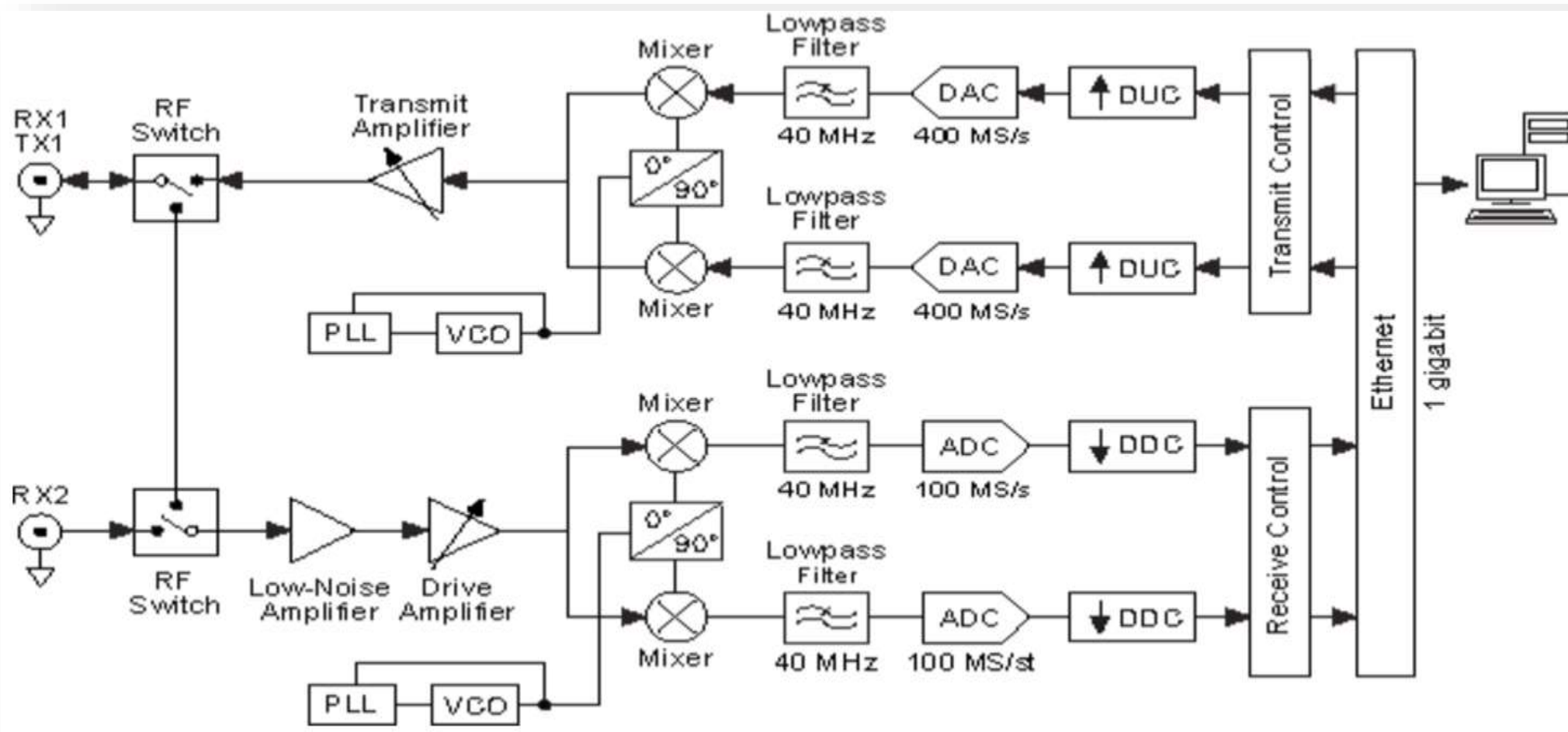
V. Belitsky, I. Lapkin et al

Software-defined radio (SDR)

- Implement radio in software
- Flexible
- Cost effective
- Simple
- The Ettus USRP



The Ettus USRP architecture

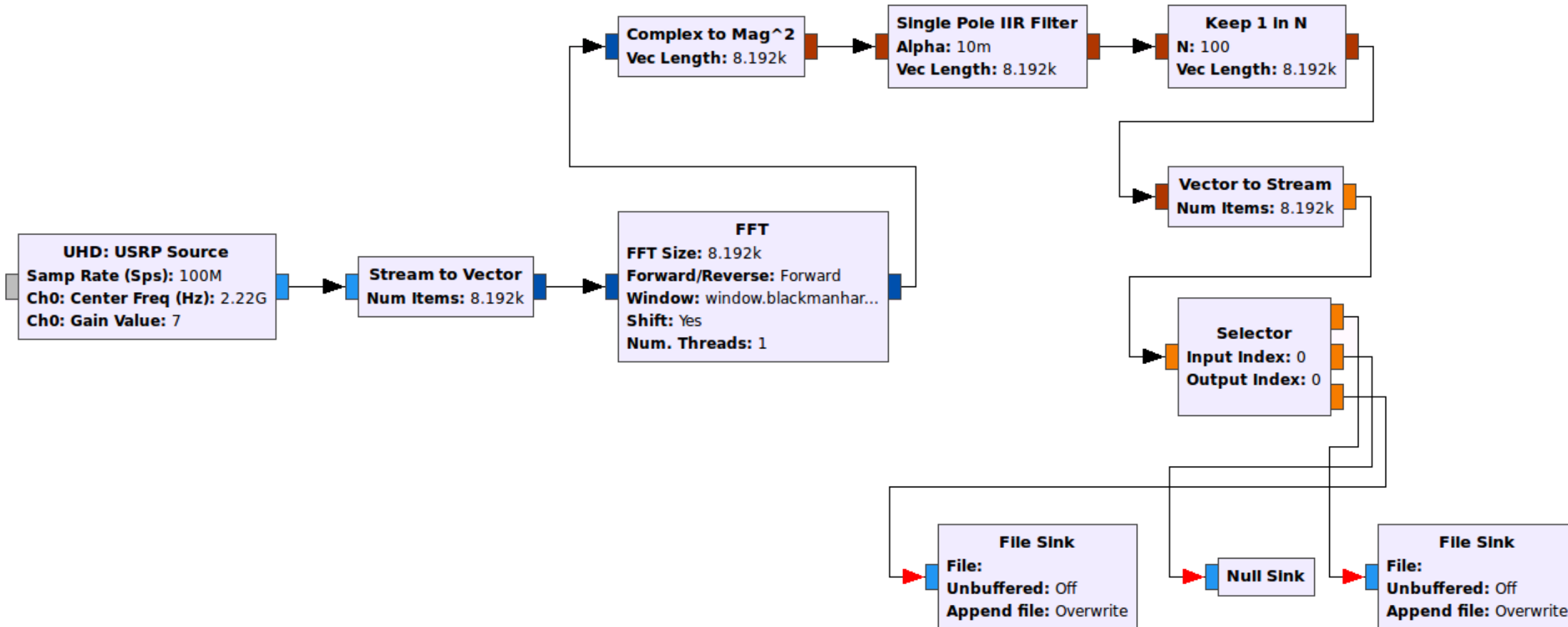




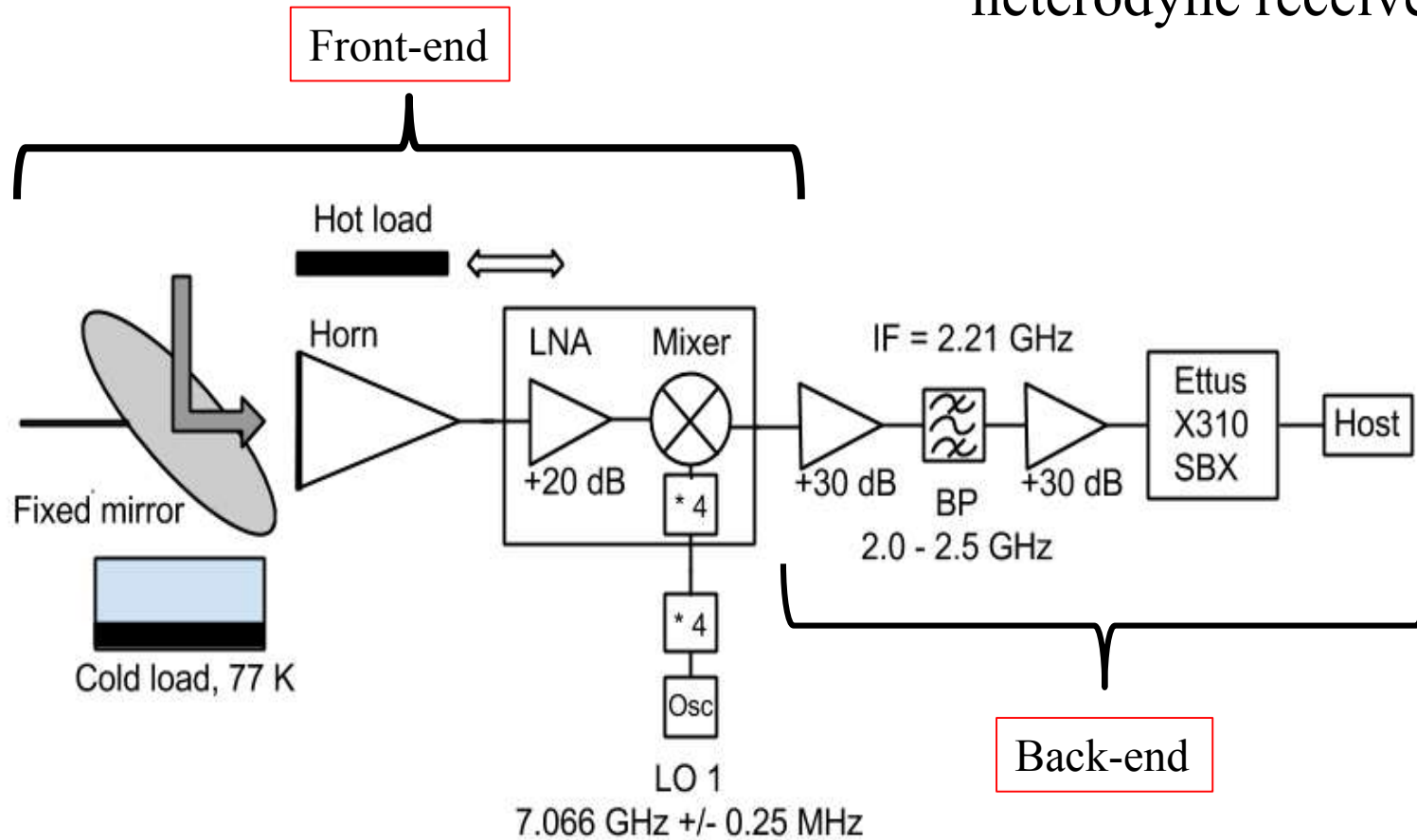
- Blocks designed in C++
- E.g. IIR-filter, FFT-calculations
- Linked through GRC, Python or C++
- Free and open source policy
- Great community



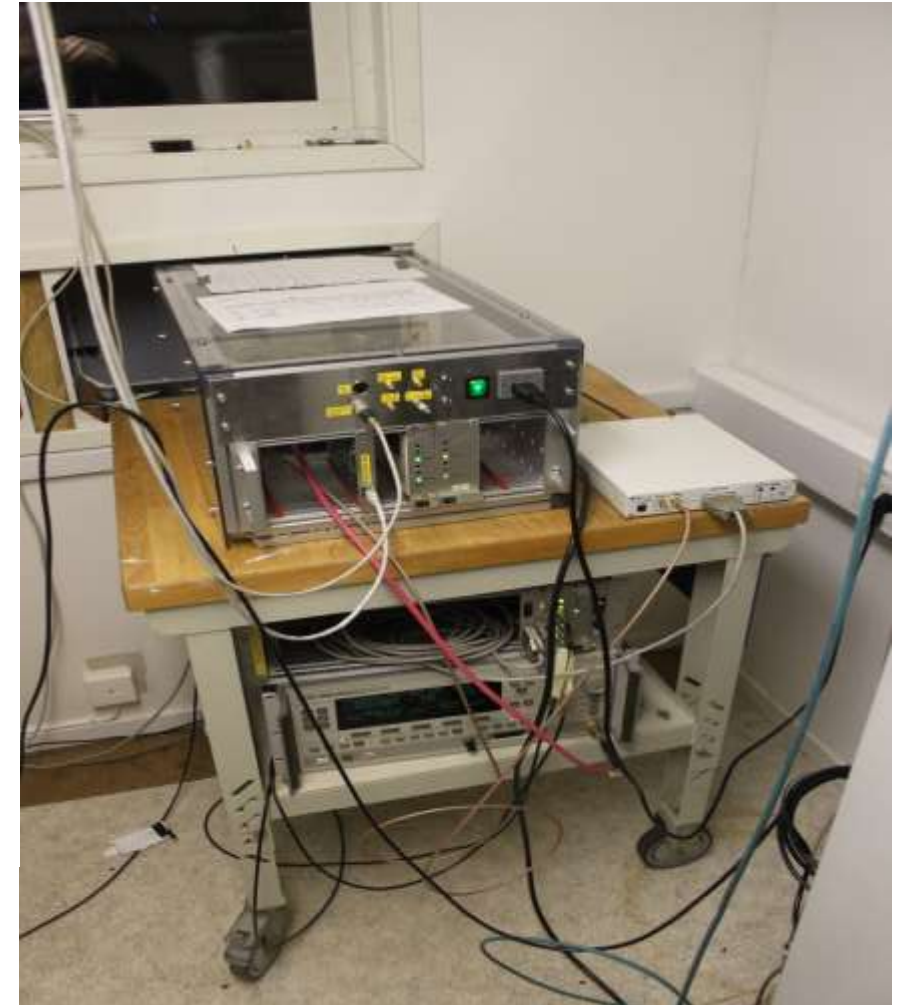
A Dicke-switched FFT spectrometer in GNU Radio



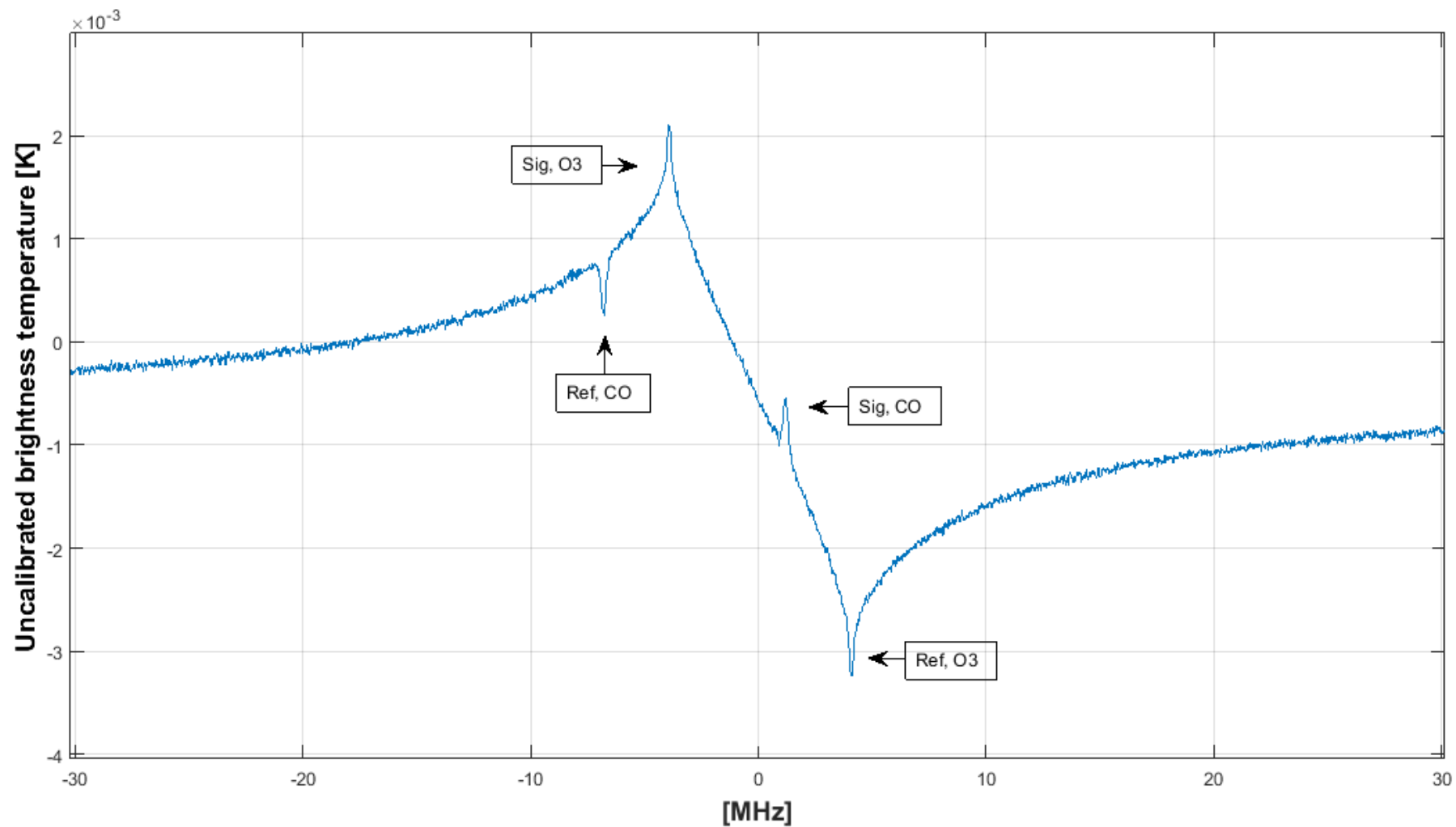
Measurements of frequency-switched O₃ and CO using a double side band heterodyne receiver



P.Forkman et al



Frequency-switched measurement of CO at 115.27 GHz and O3 at 110.84 GHz with Ettus USRP and GNU Radio as back-end spectrometer



Summary and conclusions

- Cheap, reliable high performing FFT spectrometer using SDR platforms and free software
- Easily integrated in new or existing systems
- Simple, cost effective, high performing
- A global network of ground based stations
- Atmospheric and interstellar measurements on a whole new scale!



