30 November 2021

2021 CCPR WG-SP

To: Maria Nadal, NIST, Chairperson for CCPR WG-SP

From: John Lehman, NIST

Subject: TG13, Optical fibre power responsivity (John Lehman)

The objectives of the CCPR-WG-SP Task Group 13 are:

* to discuss a pilot study on optical fibre power responsivity to improve calibration uncertainties;
* to create a questionnaire about a pilot study on optical fibre power responsivity for possible additional participants of such a pilot study;
* to organize and carry out a pilot comparison on optical fibre power responsivity using fibre-coupled cryogenic radiometer.

We report some activity and technical progress. There has been exchange of information among CENAM and CMI and NIST. We continue to learn from the challenges of fibre-based measurements requiring low uncertainty.

Mr. Zeus Efrain Gutierrez of CENAM spent six months at NIST-Boulder undertaking fibre connector, fibre switching, and other studies relevant to uncertainty of the optical fibre coupled radiometer.

A cryogenic radiometer optimized for fiber coupling has been designed and built and reproduced. The radiometer works well (1 µK thermal stability and 0.1 % accuracy (k=2)). Experience so far informs us that the fibre-connector challenges should not be underestimated, particularly for single photon detectors and quantum networks requiring extremely high coupling efficiency, low loss, and high repeatability. You might say that the radiometer is sufficiently accurate to reveal fiber-coupling issues over inadequacy of other detection methods.

Some topics worthy of further consideration:

* Polarisation and PM fibre
* Fibre bending and temperature dependence
* Beam splitter and/or switching ratios
* 1550 nm wavelength to achieve 0.1 % repeatability
* Free space comparisons ongoing at CENAM

Intercomparison has been initiated with calibration of two fibre-trap detectors calibrated at NIST and headed to CENAM.

The fiber switching scheme is implemented with METAS-assembled fibre switching unit.

