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STANDARDS INTERCOMPARISONS IN THE FIELD OF FIBRE OPTICS WITH VNIIOFI PARTICIPATION

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Abstract — Activity of VNIIOFI (Russian National Metrological Institute for optical measurements) on standards comparisons in the field of fibre optics is considered. The basic results of intercomparisons in this field which have been made in the frame of some international projects are described.

Keywords: comparison, fibre-optics, average power, chromatic dispersion.

1. INTRODUCTION

Some reference standards in the field of fibre optics have been designed at VNIIOFI [1]. For providing measurements results unity in this field and their correctness VNIIOFI takes part in several projects on standards intercomparisons with leading national metrological institutes (NMI).

Basic parameters for these works were average optical power for fibre optics (or fibre optic power responsivity) and chromatic dispersion of optical fiber. In this report the main results of intercomparisons are described.

2. INTERCOMPARISONS RESULTS

The VNIIOFI works on intercomparisons began from the 90-th period. In 1999 the bilateral comparison on average power for fibre optics with NIST, U.S.A., took place. It was carried out using VNIIOFI reference calorimetric detector with electrical substitution as artifact. The view of the detector is shown in figure 1.

Fig. 1. Reference calorimetric detector

Although the comparison had not official status the results were quite good - the difference between NIST and VNIIOFI values was less than 0, 4 % [2]. The results are presented in the table 1.

Table 1 Results of NIST/VNIIOFI comparison on average power.

Source Wavelength, nm	Number of measure-ments	Relation NIST/VNIIOFI	RMS,%	NIST Expanded uncertainty
1308	9	0,9958	0,10	± 0,65
1543	5	0,9977	0,15	± 0,65

The similar bilateral comparison with the same artifact was carried out in 2001 with PTB, Germany.

After approving of some reference primary standards [1] designed at VNIIOFI we began the works on official supplementary intercomparisons. In 2009 VNIIOFI was included in the APMP Project PR-S2 (Pilot KRISS, Korean Republic, 9 participants) on fiber optic power responsivity supplementary comparisons. The KRISS photometer was used as artifact. The differences (degree of equivalence) for VNIIOFI values for wavelength 1310 nm and 1550 nm were about 0, 2 %. The results are presented in figures 2 and 3.

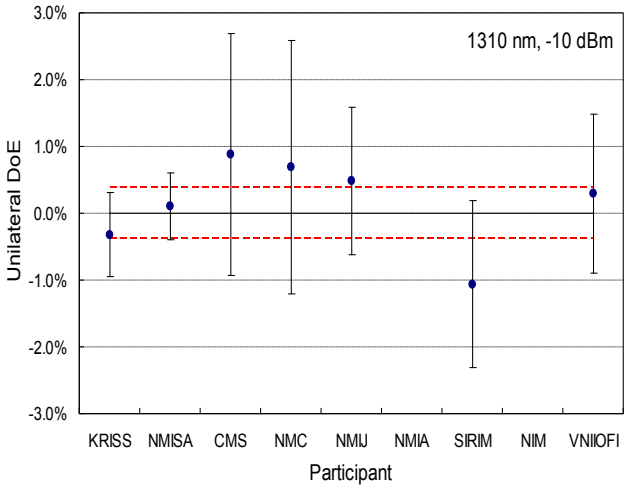

Fig. 2. PR-S2 Comparison results of for 1310 nm

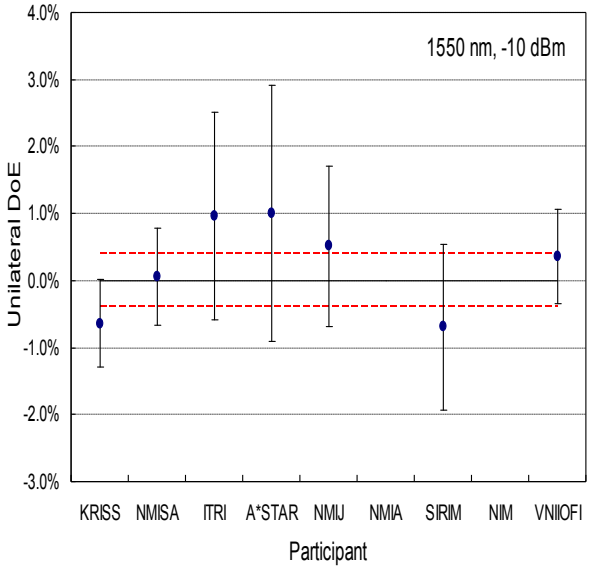

Fig. 3. PR-S2 Comparison results for 1550 nm

The publication of final report on the PR-S2 project is in process.

At the same time from 2012 supplementary comparisons on fiber optic power responsivity in the frame of COOMET Project PR-S6 started. The participants of the project became PTB, Germany, Belgim, Belarus and VNIIOFI, Russia. The pilot of the Project was VNIIOFI. VNIIOFI reference photometer was used as artifact. The view of the artifact is shown in figure 4. To avoid the influence of input radiation geometrical inhomogenity the photometrical sphere was used in the photometer. As the registration instrument the Keithly picoammeter was used.

Fig. 4. VNIIOFI reference photometer

The results of this comparison for two wavelengths are shown in figures 5 and 6 [3].

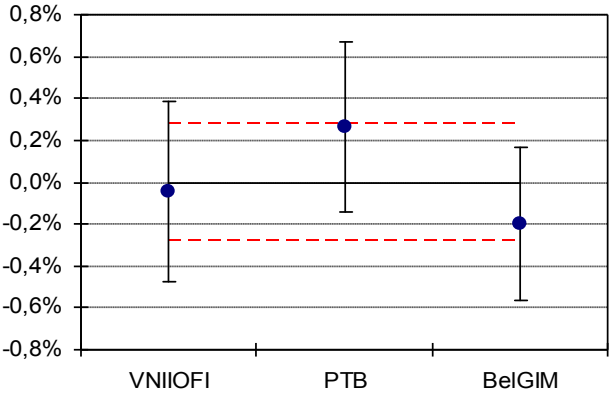

Fig. 5. PR-S6 Comparison results of for 1310 nm

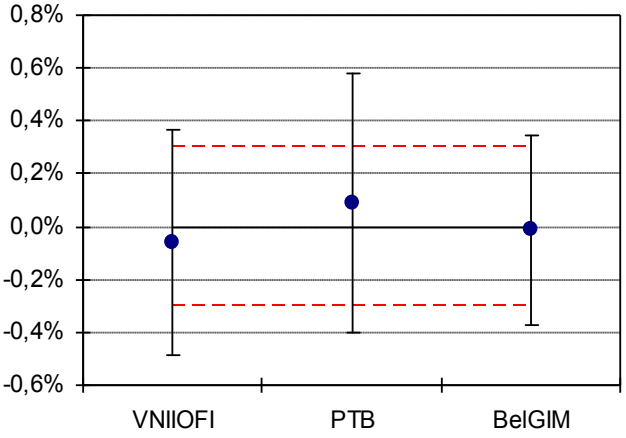

Fig. 6. PR-S6 Comparison results for 1550 nm

We can see that the differences for all 3 participants for wavelength 1310 nm and 1550 nm were about 0, 3 %. The results of these comparisons can be used for including in CMC tables.

The both project small differences for VNIIOFI results confirm the correctness of optical power unit reproduction.

To provide measurement unity and to confirm the characteristics of primary standard of chromatic dispersion in optical fiber designed at VNIIOFI [1], the comparison works on chromatic dispersion started in 2010. The bilateral supplementary comparisons with METAS, Switzerland have been carried out in the frame of EURAMET Project PR-S3 (pilot - METAS). VNIIOFI reference standards on the base of two types of thermostabilized optical fiber G 652 and G 653 were used as artifacts. Design of the artifacts is shown in figure 7.

Fig. 7. Reference fiber for Project PR-S3

This project was the prolongation of previous project of 7 national metrological institutes including METAS and NIST. The results analysis showed that the deviations from reference level are less than 0,2 ps/nm when expanded uncertainty of comparison results is about 0,64 ps/nm [4]. It confirms VNIIOFI standard parameters.

3. FUTURE WORKS ON COMPARISONS

Nowadays VNIIOFI takes part in new comparison on fiber length which has been started in the frame of the project APMP.PR-S8. The pilot of the project is KRISS; there are 9 NMI participate in the project. The comparison will be based on the optical fibre artifacts from KRISS and METAS. It will be carried out using time delay of signal in optical fiber measurement results.

Besides some discussions take place among several NMI about the opportunity of comparisons on polarization mode in optical fiber and on wavelength unit (for spectrum analyzers calibration tasks).

4. CONCLUSIONS

The works on bilateral and supplementary intercomparisons where VNIIOFI took part gave good results and confirmed correctness of its measurement results of such parameters as fiber optics average power and chromatic dispersion. It helps to provide harmonization between different NMI measurement results.

The future works are directed to providing the measurement unity on other units in this field.

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