

# Minimizing Uncertainty for Traceable Fluorescence Measurements –

## The BAM Reference Fluorometer

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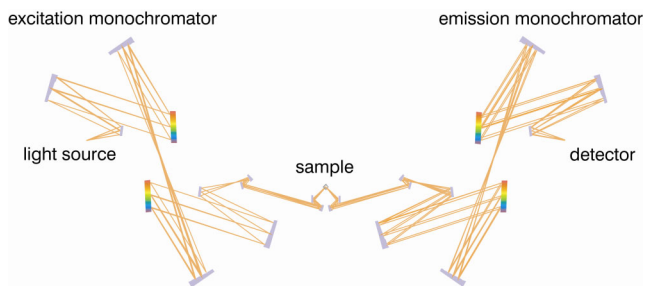
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### Introduction

Providing fluorescence emission spectra traceable to the units of spectral responsivity and spectral radiance with minimized uncertainties is currently limited by two factors: The uncertainty of the available transfer standards and the uncertainty of the measurement process itself.

### A Reference Fluorometer

Here the requirements on a reference fluorometer enabling measurements with lowest possible uncertainty, its design, its simulation and its realization are presented. The fluorometer is designed with minimized chromatic and geometrical aberrations. To realize an efficient reduction of stray light and subtractive dispersion, a double monochromator design was necessary. The basic element is a so called U-type Czerny-Turner single monochromator featuring off-axis paraboloids and an entrance and exit slit virtually at the same place. Thereby spherical aberration, coma, and astigmatism are effectively reduced. The employed special double monochromator design further cancels out the remaining aberrations of the single monochromator. The design of the whole spectrometer was optimized and subsequently toleranced with a ray-tracing program.



**Figure 1.** The optimized geometry of the reference fluorometer

### Transfer Standards

To minimize calibration uncertainties due to the applied transfer standards, the reference fluorometer is exclusively traceable to the unit of spectral responsivity provided in Germany by a cryogenic radiometer at PTB. This is realized via trap detectors as radiometric transfer standards with the smallest possible uncertainty. Here trap detectors of common design are employed, but specially calibrated for a divergent light bundle according to their application.

### Absolute Measurements

Based on this instrument with its achromatic design and precisely known numerical apertures the determination of absolute fluorescence spectra will be addressed.

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### References

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