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New detection systems for UV solar reference scanning spectroradiometers

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Current state of the art for UV solar reference spectroradiometers, based on double-grating scanning monochromator configuration reaches a total uncertainty of 5% which adversely affects long term analysis of atmospheric changes. A significant contribution to this uncertainty is mainly due to the nonlinearity and quantum efficiency stability of the photomultiplier tubes (PMT) typically used to satisfy the demanding constraints in terms of sensitivity and dynamic range required by solar UV scanning spectroradiometers. In fact for some PMT's the quantum efficiency alone can change in the order of some percent during one day.

In order to reduce the total uncertainty of UV solar reference spectroradiometers an integrated solid state detection system (SSDS) composed by a solid state detector in conjunction with optimized low noise and high sensitive readout electronics is being developed. The challenge is to measure level of spectral irradiance as low as 10^{-14} W cm^{-2} .nm^{-1} with an integration time of 1 second and with a dynamic range of 6 orders of magnitude with a total uncertainty as low as 1%.

Different semiconductor materials are studied and characterized from the perspective of the conversion of photons into electrical charges with the goal of high efficiency in the UV spectral region and low thermal charge generation,both of which are crucial to measure irradiance levels required by UV solar reference spectroradiometers. High sensitive and low noise readout electronics are being developed and fully characterized to optimize the conversion of the charge generated by the solid state detector to a measurable output voltage in terms of current to voltage conversion factor, noise floor and linearity.

This study presents the preliminary performance results of the first set of SSDS prototypes based on:
• Si commercially available detectors
• SiC detectors
• Interdigitated ZnO detectors on sapphire substrates developed by the consortium.

Their potential beneficial impact on existing reference scanning spectroradiometers (QASUME) performances is presented.