ELECTRIC QUADRUPOLE TRANSITIONS IN THE $a^1\Delta_g \leftarrow X^3\Sigma_g^-$ BAND OF OXYGEN: A CASE STUDY

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Electric quadrupole transitions in the $a^1\Delta_g \leftarrow X^3\Sigma_g^-$ band of $^{16}O_2$ are reported for the first time. They were first detected in atmospheric solar spectra acquired with a ground based Fourier transform spectrometer (FTS) in Park Falls, WI. Subsequently high-sensitivity Continuous Wave-Cavity Ring Down Spectroscopy (CW-CRDS) experiments were carried out at Grenoble University in the 7717-7917 cm^{-1} region in order to provide quantitative intensity information for these transitions. Experimental intensities of the ΔJ=±2 transition were used as input data for calculation of the complete list of electric quadrupole transitions with ΔJ=±2, ±1 and 0. The calculation was carried out for the intermediate coupling case and assuming that these transitions are possible only through mixing of the Ω=0 component of the ground electronic state and $b^1\Sigma_g^+$ state induced by spin-orbit coupling. The calculated line list agrees well with experimental measurements and was used to improve the residuals of the fitted atmospheric spectrum. Emission probability for the electric quadrupole band was determined to be (1.02±0.10)×10^{-6} s^{-1}.