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POLARISATION OF AURORAL LINE EMISSIONS ON EARTH: A REVIEW

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In the last 10 years, a lot of efforts have been devoted to measure and model the polarization of the auroral red emission line at 630 nm. This polarization arises due to impact of thermospheric oxygen atoms with magnetospheric precipitating electrons collimated along the geomagnetic field lines and is due to an imbalance between unresolved Zeeman sublevels (Bommier et al., 2011). The theoretical level of polarization can reach $\sim 17\,\%$ but measurements with a steerable photo-polarimeter (SPP) show that the red line emission is polarized only at a level of a few percent (e.g. Lilensten et al., 2008, Barthlemy et al., 2011). The reason is most probably that the polarization is diluted by many competing production mechanisms of the red emission line that are mostly isotropic and therefore do not produce polarization. Also the distribution of pitch-angle of precipitating electrons obviously plays a role as well. In Lilensten et al. (2015), a theory was developed to combine the electron impact theory of Bommier et al. (2011) and an electron transport code called transsolo. This theory enables to compute the distribution of the Degree of Linear Polarisation (DoLP) as a function of height if the flux of precipitating electrons is provided as input as function of the energy and pitch-angle.

The next logical step is then to check whether other auroral emission lines could also be polarized by impact with precipitating electrons. The most intense auroral emission line, the green line at 577.7 nm, cannot be polarized by electron impact because the upper state of the transition has a total kinetic moment J = 0 and therefore has no Zeeman sublevels. Therefore the most promising candidate to display polarization is the third most intense auroral emission line which is the blue line at 427.8 nm and is due to N2+ 1NG. This line/band is created by electron impact only. In order to continue investigating this field, BIRA-IASB (Royal Belgian Institute for Space Aeronomy) and University of Grenoble have partnered to build a spectropolarimeter able to measure the polarization of the full auroral spectrum between 400 and 700 nm. Results for the blue line obtained with this instrument during campaigns carried out in Skibotn, Norway, will be presented. Due to limitations with the experimental concept, very long integration times were needed to obtain adequate S/N ratios. Plans to improve this instrument will be discussed.

Finally, the theory of the red auroral emission line indicates that the Angle of Linear Polarisation (AoLP) should be more or less aligned with the local geomagnetic field.

This would then open the possibility to map for the first time how geomagnetic field lines become twisted when strong geomagnetic storms or substorms occur. We will present an attempt to do that, made by the University of Leiden in collaboration with BIRA-IASB, by building a prototype of an imaging polarimeter using 2 commercial cameras equipped with fixed polarizers tilted at 0 and 90 degrees and using RGB images to estimate the polarisation of respectively the 630.0, 557.7 and 427.8 nm emissions.

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