



Short Visit Grant or Exchange Visit Grant

(please tick the relevant box)

Scientific Report

Scientific report (one single document in WORD or PDF file) should be submitted online within one month of the event. It should not exceed eight A4 pages.

Proposal Title: Investigation of TGF photon propagation between source region and satellite altitude

Application Reference N°: 4325

1) Purpose of the visit

The purpose of the visit was to share knowledge on bremsstrahlung cross-sections, photon source and propagation for terrestrial gamma-ray flashes (TGFs) research. DTU Space and Birkeland Center for Space Science had been studying bremsstrahlung event using different bremsstrahlung cross-sections approaches. It was proposed to compare these two cross-sections and to study the potential effect on the TGFs spectrum. It was also targeted to compare the photon source distribution using different approaches looking at the ratio between electron avalanche and photon population.

The second aim is to include atmospheric photon interaction in the study of the characterisation of the source parameters sharing source region characterisation from DTU Space and atmospheric photon propagation understanding from the Birkeland Center for Space Science.

DTU Space had newly developed relativistic Monte Carlo simulation to study influences of the discharge dynamics and effects on the atmosphere. They had characterised in particular the photon source distribution as a function of the source region parameters. Birkeland Center for Space Science had been working with TGFs photon atmospheric interactions. They had characterised in particular the observed TGF spectrum as a function of assumptions on the source emission cone angle and photon energy distribution function. The objective was to propagate source photon data modelled by DTU space simulations using propagation simulation developed at the Birkeland Center for Space Science in order to observe TGF spectrum from DTUSpace data.

2) Description of the work carried out during the visit

We first focused on the comparison of two different bremsstrahlung cross-sections.

DTU Space used the single differential cross-sections (in photon energy) in their model simulations. The cross-sections were tabulated in literature using partial wave equation for incident electron energy up to 2 MeV and Bethe – Heitler cross-section including Coulomb and screening corrections for incident electron energy 50 MeV and above. The bremsstrahlung cross-sections between these two incident electron energy levels were interpolated, as there were no valid cross-sections in that range.

Birkeland Center for Space Science had been studying double differential cross-sections (in angle relative to the incident electron) to get the single cross-sections. The cross-section calculations are based on the Sommerfeldt-Maue wave function including the Coulomb and screening corrections, as described in literature.

The comparison of these two cross-sections was focused on 2 – 50 MeV energy range to check validity of the tabulated cross-sections in the literature and understand physics of the cross-sections in that energy range.

The ratios between electron avalanche number and photon population number for different applied electric fields were studied using the model developed by DTU Space. These results were also compared with the results from Geant4 electron – photon propagation code.

The photon propagation of the source photon data characterised by DTU Space was performed using propagation simulation developed by the Birkeland Center for Space Science to obtain a dataset of TGF spectrum.

3) Description of the main results obtained

Pre-results of the two different bremsstrahlung cross-sections have shown that the cross-sections developed by Birkeland Center for Space Science agree with the tabulated cross-sections used by DTU Space from the literature in the interesting energy range. As the tabulated cross-sections are easy to implement into simulations codes, we concluded that the usage of tabulated cross-sections are robust being valid in the 2 – 50 MeV energy range.

The comparison results of the ratios between electron number and photon number in different background electric fields have shown the influence of applied electric field. The electron avalanche grows faster than the photon population in the stronger fields yielding higher ratios in these fields.

Pre-results of the photon propagation showed that the detected TGFs by satellites need at least 100 keV or above source photon spectrum at the source altitudes (around 15 km or below) because of high attenuation of the photons at these altitudes. We could not see any effects of the electric field on the photon spectrum at the satellite altitudes.

4) Future collaboration with host institution (if applicable)

DTU Space would like to continue to work and collaborate with Birkeland Center for Space Science in the study of bremsstrahlung event and propagation source photon data, which will also be important for the future satellite missions ASIM and TARANIS.

- 5) **Projected publications / articles resulting or to result from the grant (*ESF must be acknowledged in publications resulting from the grantee's work in relation with the grant*)**

We have started to write one article on 'Effects of bremsstrahlung cross sections on TGF properties'.

We also projected to write another paper on the propagation source photon data.

- 6) **Other comments (if any)**

Ikke gyldig til rejse

Rejsekvittering

Bookingreference : 24TBGA

Købsoversigt

Sidst genereret 04 jun. 2013

Produktbeskrivelse	Moms (DKK)	I alt (DKK)
København - Bergen LowFare DY969 København - Bergen - 04 aug. 2013 17:00 CINAR/DENIZ(328-7111982512)	0.00 (0%)	849.00
Bergen - København LowFare DY968 Bergen - København - 01 sep. 2013 20:30 CINAR/DENIZ(328-7111982513)	0.00 (0%)	405.00
2 x Forudbetalt indchecket bagage (69 DKK)	0.00 (0%)	138.00
Beløb i alt	0.00	1392.00

Moms	Moms i alt (DKK)
Moms i alt 0%	0.00

Betingelser og vilkår

Betalingsform	MASTERCARD*****4262
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Tak, fordi du flyver Norwegian