

2017年6月6日

## ㈱早川地震電磁気研究所主催「電磁気セミナー」の開催案内

電気通信大学発ベンチャー㈱早川地震電磁気研究所は「電波、環境」をキーワードに色々な活動をしています。今回は、二人の若い教授による共同セミナーを開催します。一人目はロシアの若手教授で、雷物理の最も基本的で未解明な雷の initiation をフラクタルの概念にて説明しようとするものです。二人目はギリシャの若手で、地震前兆の超低周波放射が真に地震の前兆なの否かを、破壊現象に対する臨界解析 (Natural time, fractal 解析) により解明しようとするものである。若い先生による挑戦的取り組みを御紹介します。教官のみならず、多くの学生さんもお参加いただければ幸いです。

### 記

日時：2017年6月19日(月) 14:00-16:30

場所：電気通信大学 UEC アライアンスセンター1階 100周年記念ホール

URL: <http://www.uec.ac.jp/facilities/exchange/alliance/>

講演：

(1) Prof. Dima IUDIN (Institute of Applied Physics, Russian Academy of Sciences, Nizhny Novgorod, Russia) (14:00-15:00)

Title: A new hypothetical scenario of lightning initiation

Abstract:

It is common knowledge that observations of thundercloud electric fields have consistently yielded a peak value that is an order of magnitude weaker than the dielectric strength of air. The goal of the paper is to promote a new lightning initiation scenario which involves two basic stages. The first stage is associated with the generation of the highly conductive regions that we name elevated-conductivity areas. These elevated-conductivity areas appear due to collective stochastic electric field of charged hydrometeors. Above-critical bursts of the stochastic field provide the survival of the free electrons in conditions when the RMS level of the stochastic field is significantly less than the air electric strength. One may consider the elevated-conductivity areas appearance as a nonequilibrium kinetic transition provided by an external driving, the intensity of which is equal to the product of hydrometeor concentration and the variance of their charge magnitude. The considered kinetic transition has several characteristic features that distinguish it from other mechanisms of lightning initiation. First, due to interaction of electron and ion components the dynamic implementation of this transition is stretched in time interval, which

significantly exceeds the development time of ordinary spark discharge. In this case the rapid attachment of electrons is balanced by the processes of their liberation during negative ions destruction. Secondly, ions drift in stochastic electric field plays a significant role in the transition kinetics. From a formal mathematical point of view, this stochastic drift is indistinguishable from advection of a scalar impurity in a turbulent flow. It is shown that the effectiveness of "advective mixing" for a few degree surpasses the efficiency of conventional diffusion. Third, noise-induced stepwise growth in the density of ions and free electrons is limited to spatial - temporal clusters that have a fractal structure and covering, therefore, a very small proportion of the actual space-time area. As a result in the considered gradual transition the average conductivity of the medium does not significantly change. Thus, the considered kinetic transition can be interpreted as the emergence of a strongly inhomogeneous random mixture of highly conductive areas with poorly conducting, almost dielectric regions. On the second stage of the scenario we reduce the consideration of lightning initiation to the dielectric breakdown problem in random conductor-insulator composites. The sensitivity of the dielectric breakdown field on the conductor fraction in the media is caused by the formation of conductive percolation clusters which act as equipotential for an applied quasi-static electric field. Moreover, on the scenario second stage the process of ionization in the elevated-conductivity areas is determined by the sum of the external field with an induced field of plasma spots. For a given applied field, a larger and larger local field is concentrated across the space between relatively large conductive clusters. The breakdown field is inversely proportional to the linear dimension of the largest conductive cluster. Since the size of the clusters diverges as the volume fraction of conductor tends to the percolation threshold value, the breakdown field tends to zero in this limit. In addition, the average breakdown electric field decreases logarithmically with the linear dimension of the system when the volume fraction of good conductor is below the percolation threshold. The proposed two stage scenario of the lightning discharge initiation provides both amplification of the local electric field in a thundercloud, and self-consistent support of the discharge process under the conditions when the free electrons attachment dominates over their production in ionization process.

(2) Prof. Stelios POTIRAKIS (Piraeus University of Applied Sciences, Athens, Greece)  
(15:10-16:10)

Title: "The quest for credible earthquake precursors: the case of fracture-induced electromagnetic emissions"

Abstract:

Scale invariance of fracture and faulting processes is the basic background for seeking similarities, dynamical analogies and common characteristics between the fracture phenomena happening at the laboratory and the geophysical scale, although these are phenomena developing in clearly distant scales, both in space and time. The hypothesis that the fracture-induced electromagnetic (EM) emissions, which emerge from a few days up to a few hours before the main seismic shock occurrence, permit a real time monitoring of the damage process during the last stages of earthquake (EQ) preparation, as it happens at the laboratory scale, is examined. Since 1994, a remote observation stations network has been developed in Greece for the recording of the pre-seismic EM variations at the MHz and kHz bands. Linking the obtained EM observations with corresponding distinctive last stages of the fracture / EQ preparation is of crucial importance in understanding them. Based on a multidisciplinary analysis, a four-stage model of EQ dynamics by means of precursory EM emissions has been proposed, while certain “puzzling features” which are consistently observed in EM precursors and have been used as evidence for questioning their credibility have been explained. Features characterizing the preseismic EM emissions during the different stages of this model have also been sought in the observables of different complex systems revealing striking dynamical analogies between the EQ generation and other extreme phenomena.

問い合わせ :

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