UNEXPECTED FEATURES OF SELF-DISCHARGE IGNITION IN CROSSED ELECTRIC AND MAGNETIC FIELDS [[1]](#footnote-1)\*)

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The understanding that the flow of ions leaving the self-discharge zone in crossed electric and magnetic fields (*E*×*B* discharge) can be an indicator of the ignition process – the appearance of electrons and plasma in the anode-cathode gap of an thruster with an anode layer (TAL), led to an experiment to measure the ignition voltage *Uig* (anode-cathode TAL) and the radial component of the magnetic field induction at the TAL cathode *BrKig* in the moment of the signal appearance on the ion collector. An additional advantage of “ion tracking” was the ability to explicitly show that the self-sustaining discharge does extend to the entire anode-cathode gap, since ions with energies of 50 eV ≤ *Wi* ≤ *eUA* come to the ion collector, which was an element of the energy analyzer with a retarding potential (RFA) at the time of ignition (*UA* is the potential of the anode). As a result, 2 stationary modes of the *E*×*B* discharge were detected, starting each of them with the ignition moments – a sharp increase in the discharge current from 0 (neutral gas) to *I*1 (point *B* in Fig. 1a) and from *I*1 (stationary mode of abnormal glow discharge) to *I*2 (point *D* in Fig. 1a). Two current jumps “in the glow discharge mode” and in the glow discharge mode are the fundamental difference between a *E*×*B* discharge and a discharge without a magnetic field. You can build the following line of generation of *E*×*B* discharge: mode I of the anomalous glow discharge – mode II of the anomalous glow discharge – arc discharge.

Fig. 1. Ignition curve *E*×*B* discharge: *dURFA*/*dt* = (2 V)/(30 mс); *a*) neon; gas inlet rate *qNe* = 80 sccm, *Uig* = 1150 V, *ВrKig.*I = 1477 G, *ВrKig.*II = 2145 G; *b*) argon, 5 sccm, *Uig* = 1044 V, *ВrKig.*I = 1427 G, *ВrKig.*II = 1625 G.

Working on mixtures of inert gases, it was impossible to ignore experiments with “Penning pairs” – in our case, mixtures of neon with argon or krypton, in which the excitation potential of neon into a metastable state is about 16.7 eV, which exceeds the ionization potentials of argon (15.7 eV) and krypton (14 eV). The natural, “according to Penning”, behavior of the ignition curve *Big*(*rK*) = *f*(*q*) – reduction of the energy input from the electromagnetic field required for the ignition of the discharge – was observed when argon or krypton was added to neon as an impurity. However, if neon was an additive to argon or krypton, the ignition induction increased to *qNe* ≈ 30 sccm and then monotonically decreased, not reaching the starting value at *qNe* ≤ 90 sccm; the Penning effect (explicitly) did not work here. The difference in the behavior of Penning pairs when their role in the pair changes – the main gas or impurity – we explain the varying degree of influence of the discharge on the distribution of potential in the cathode region.

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/Lt/ru/FU-Strokin.docx) [↑](#footnote-ref-1)