Spacecraft Intercosmos-Bulgaria-1300

I.M. Podgorny

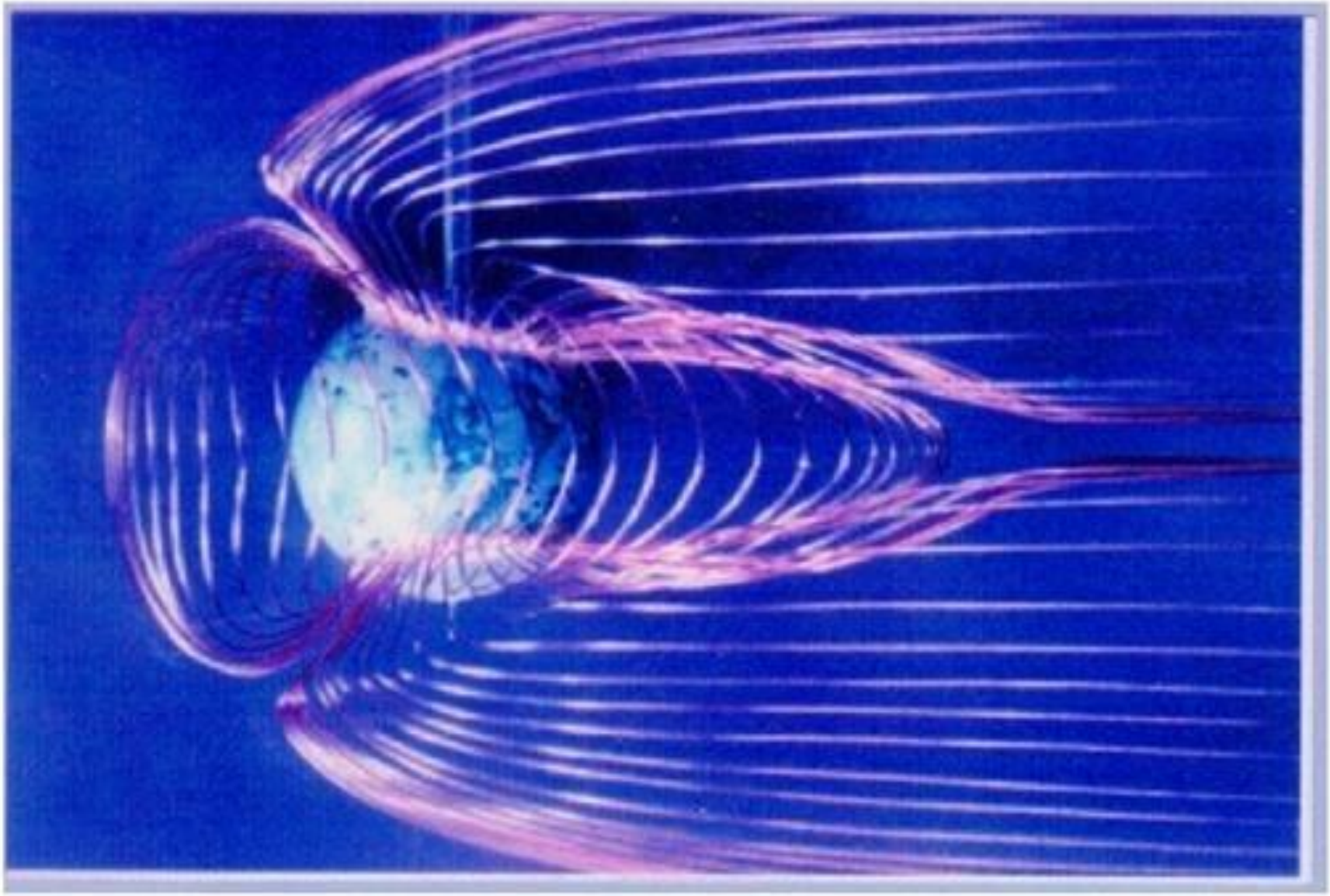
Institute of Astronomy RAS, Moscow, Russia

The Soviet-Bulgarian spacecraft IKB-1300 was launched in 1981, August 8 on a polar circular orbit with the altitude of 900 km [1]. The idea to put forward the magnetospheric spacecraft belongs to **prof. K.B. Serafimov**. All 12 scientific instruments were developed in Bulgaria with assistance of Soviet scientist and engineers from Space Research Institute of Russian Academy of Science. The spacecraft was built on the base of Meteor satellite under the guidance of outstanding Soviet aircraft designers **A.G. Iosifjan and V.I. Adasko**. Three-axis stabilization supplied unique possibility of comfortable measurements of three components of the electric and magnetic fields, and the plasma velocity. Three perpendicular rods 7.5 m are used for electric field measurement sensors. X - axis is directed along the spacecraft velocity; Z - axis is directed upward normal to the Earth surface. The fluxes of fast electrons, the electron spectrum, and atmosphere luminosity in several spectral lines are also measured. The measured value of the electric field component perpendicular to the Earth magnetic field is controlled by plasma drift velocity measurements in XY-plane.

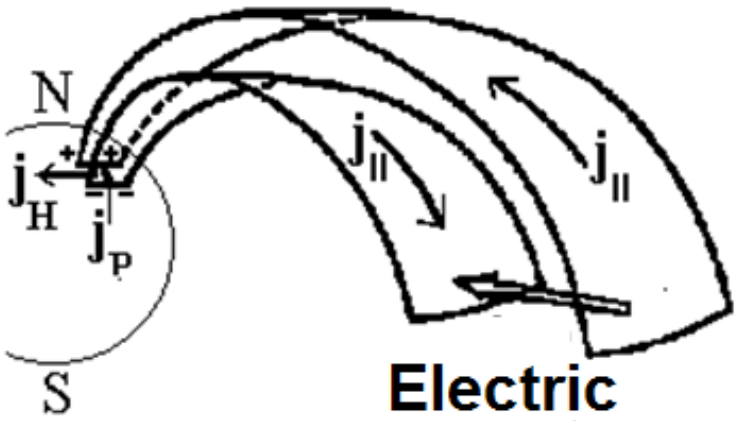
The first publicatin:

Serafimov K. B., Kutiev I., Chapkunov S., Gogoshev M., Bochev A., Dachev Ts., Ivanov I., Adasko V., Balebanov V. M., Josifjan A., Podgorny, I. M. Sherimetjevsky. New complex for ionosphere and magnetosphere investigation (Intercosmos-Bulgaria-1300). Proc. of 32 IAF-81-212. 1981.).

Earth magnetosphere laboratory simulation, 1976.

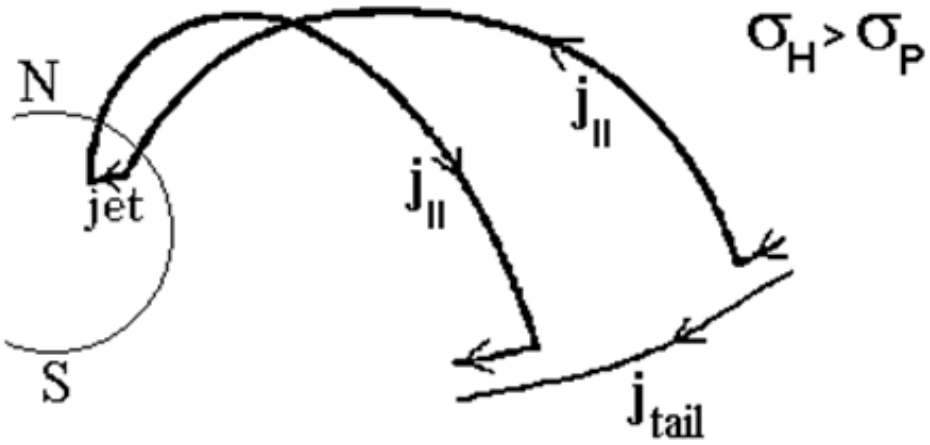


Bostrom 1964



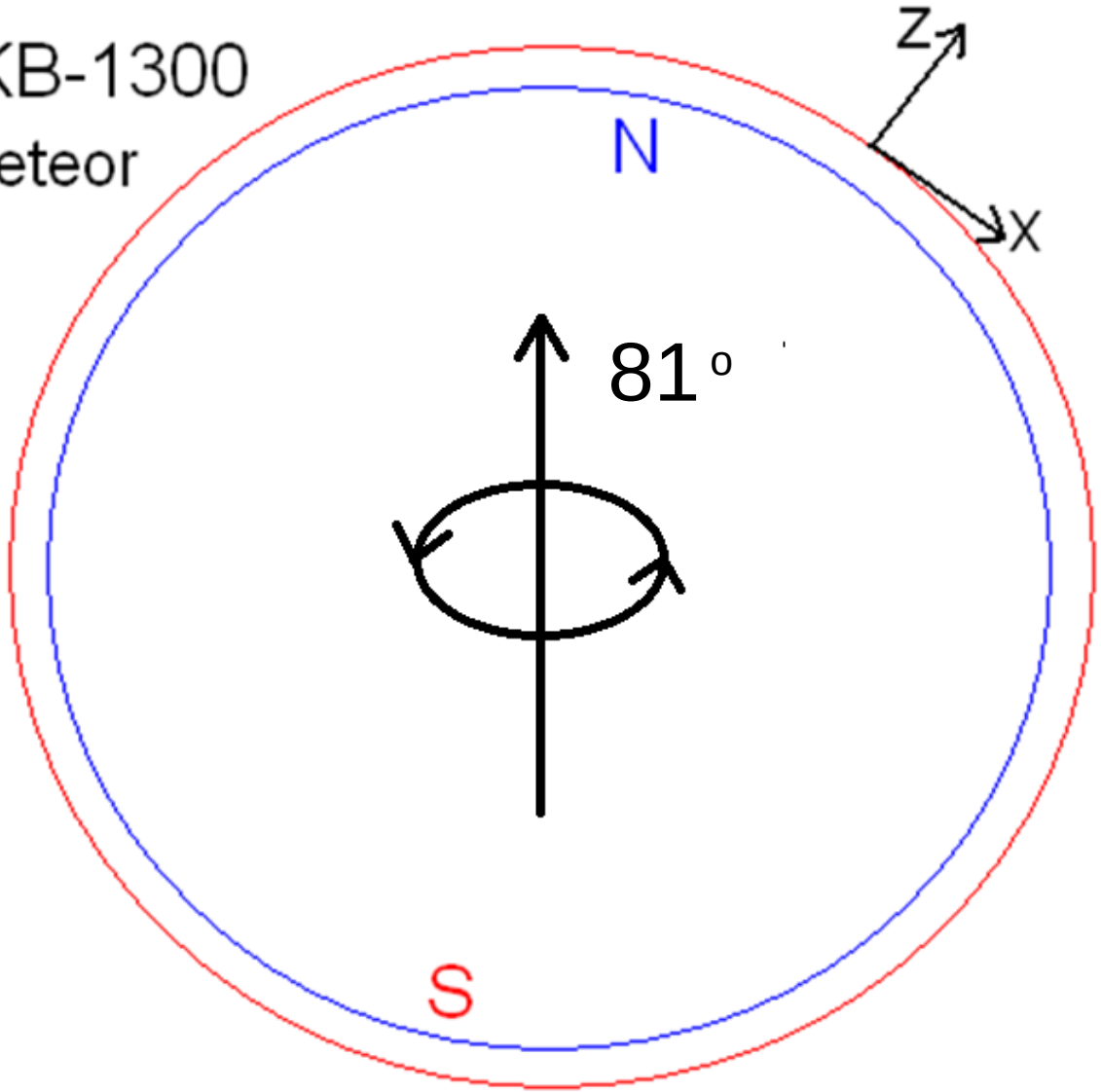
Electric generator

Electrojet is the Hall current



IKB-1300

Meteor



Three-axis stabilization

h=900 km

B_x, B_y, B_z .

E_x, E_y, E_z .

V_x

Electron flux

Emission

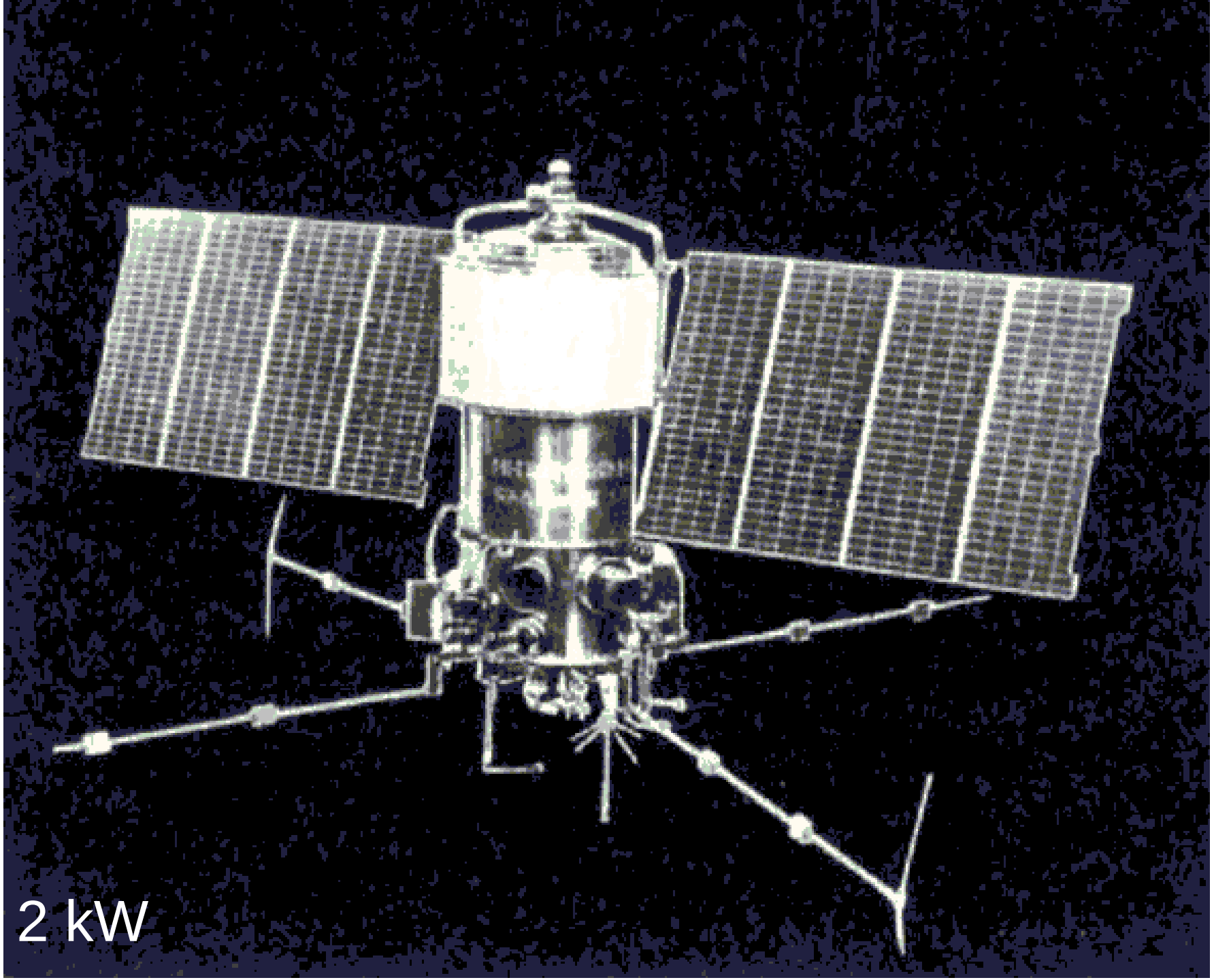
T_e

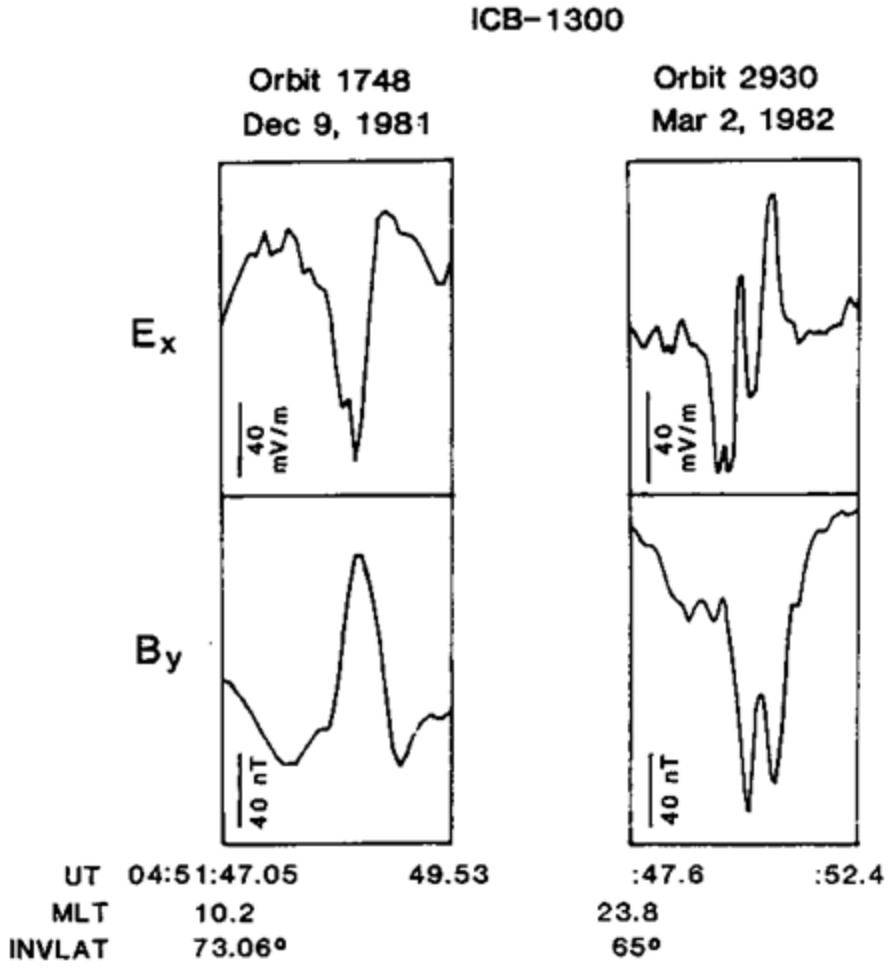
Ion compsition

Neutrons

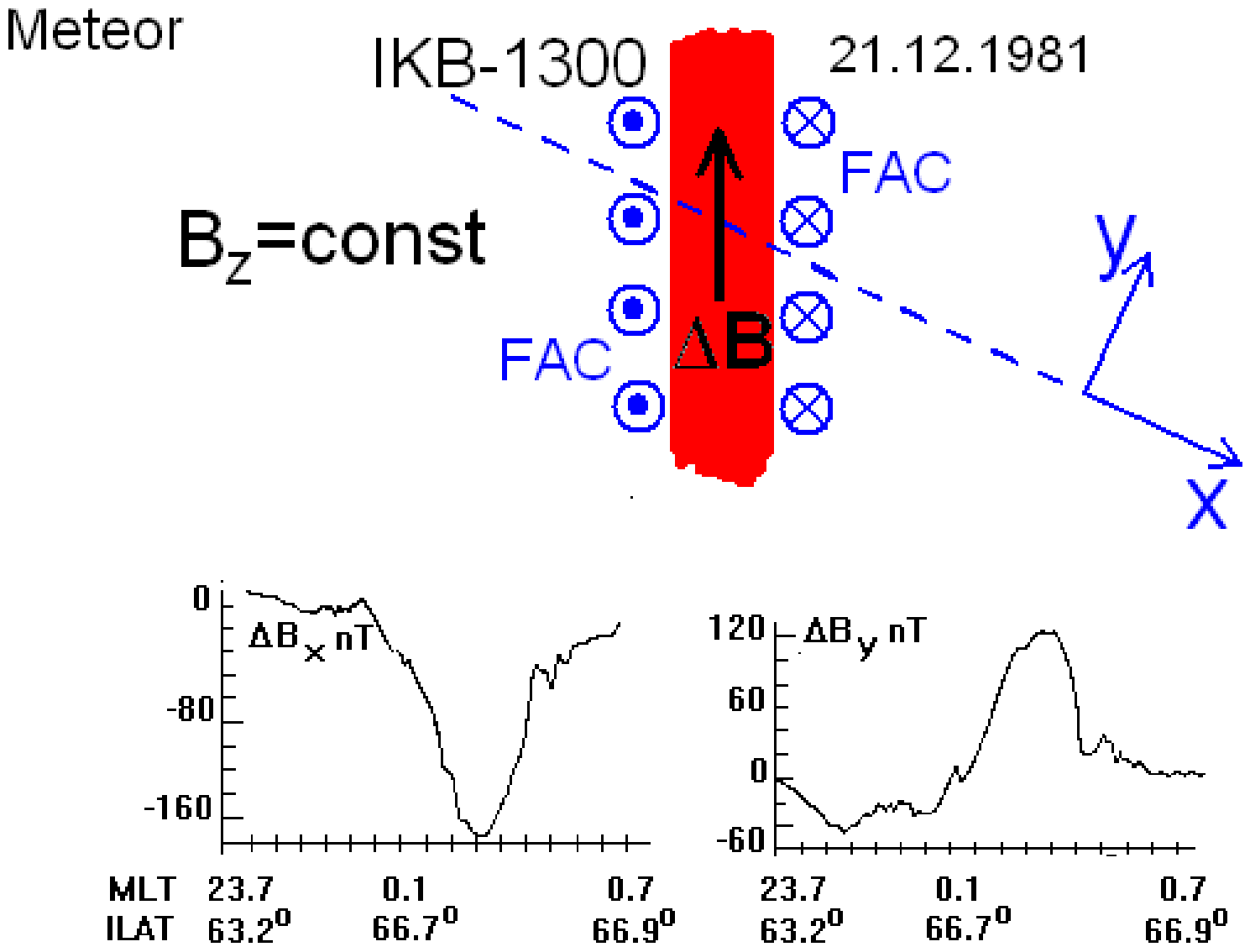
1500 kg T=101 min

VOSTOK -2M
1981

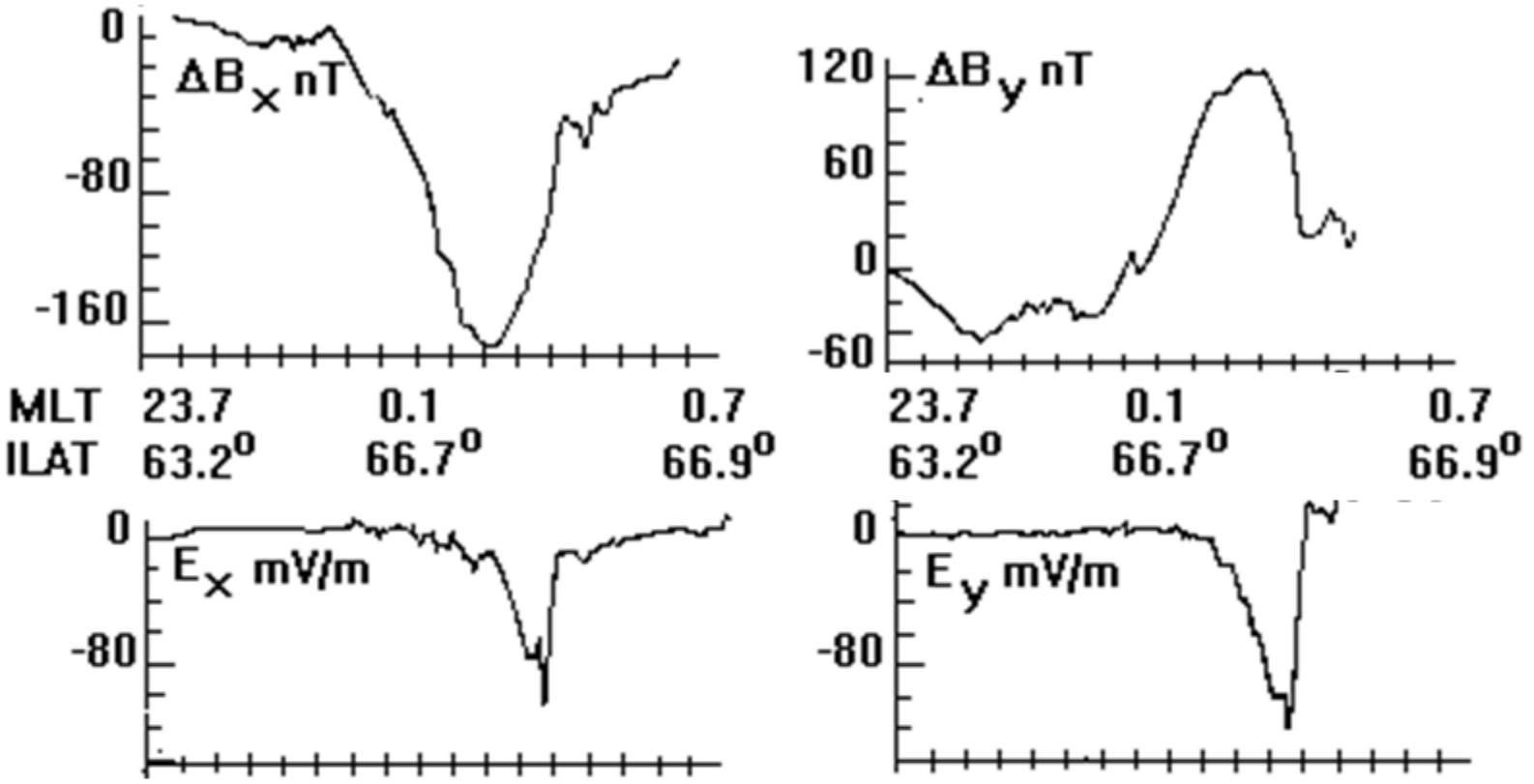

2 kW



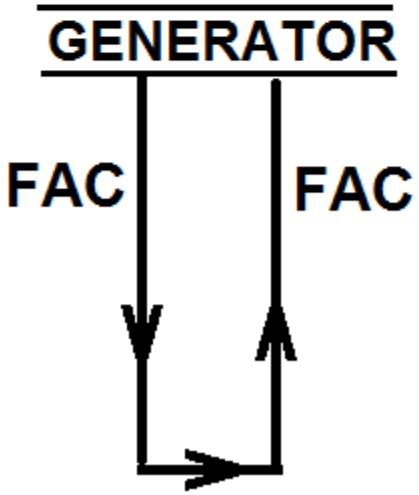
In the case Dec 9,1981 $\Delta B \perp \Delta E$, as it should be in oblique Alfven wave. Apparently the recorded disturbance is the Alfven type structure.

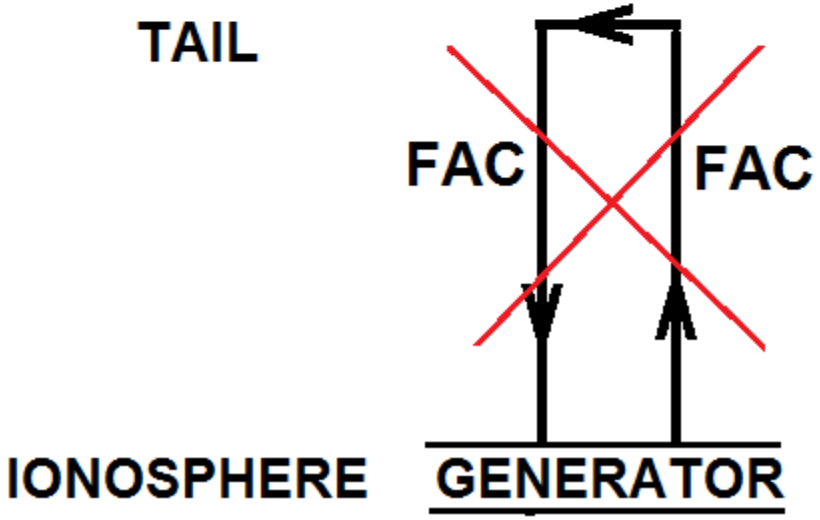


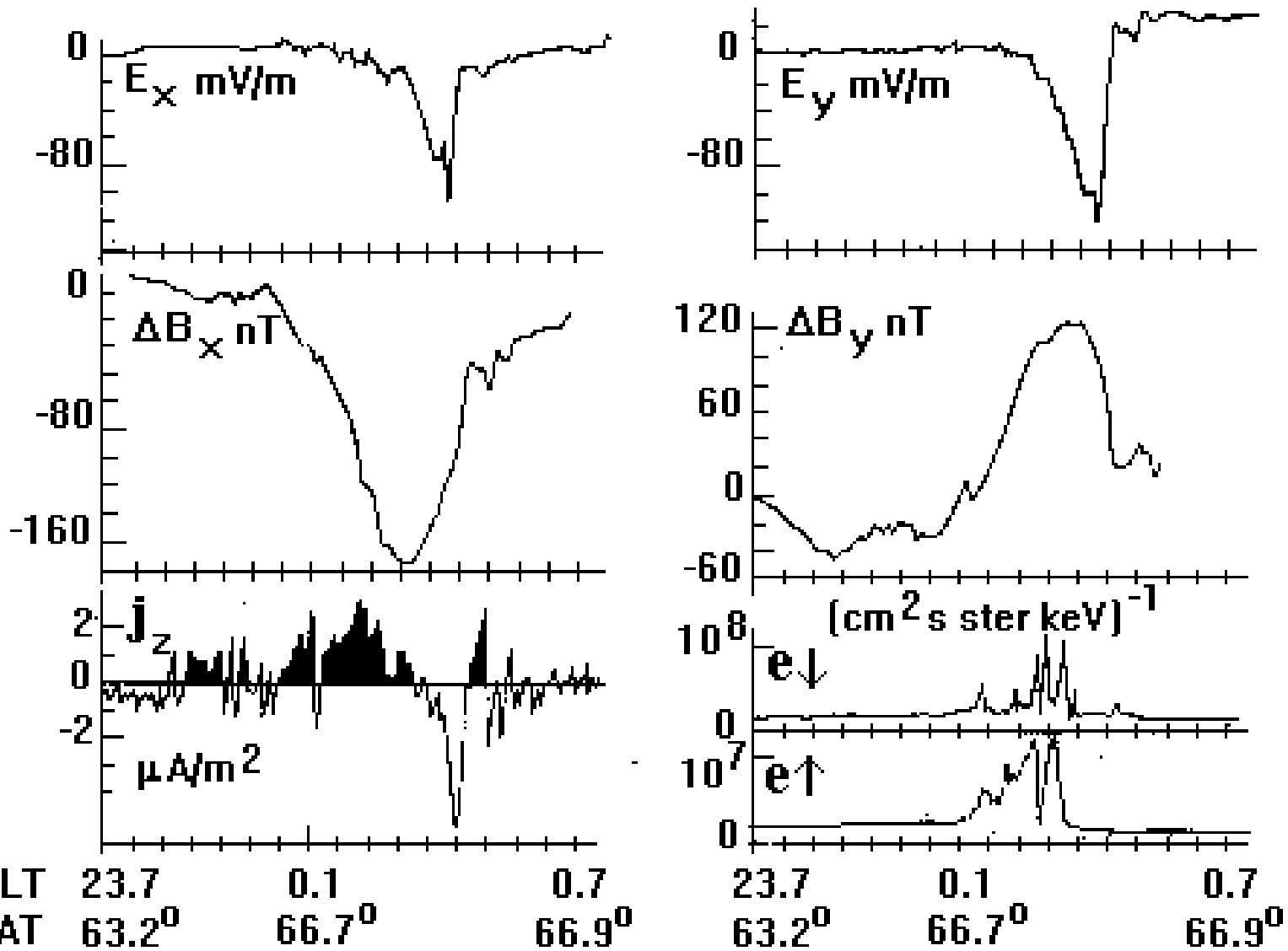
During the substorm (~300 nT), registered by IZMIRAN stations, IKB -1300 spacecraft was on the night side over auroral electrojet.



Two Possibility:



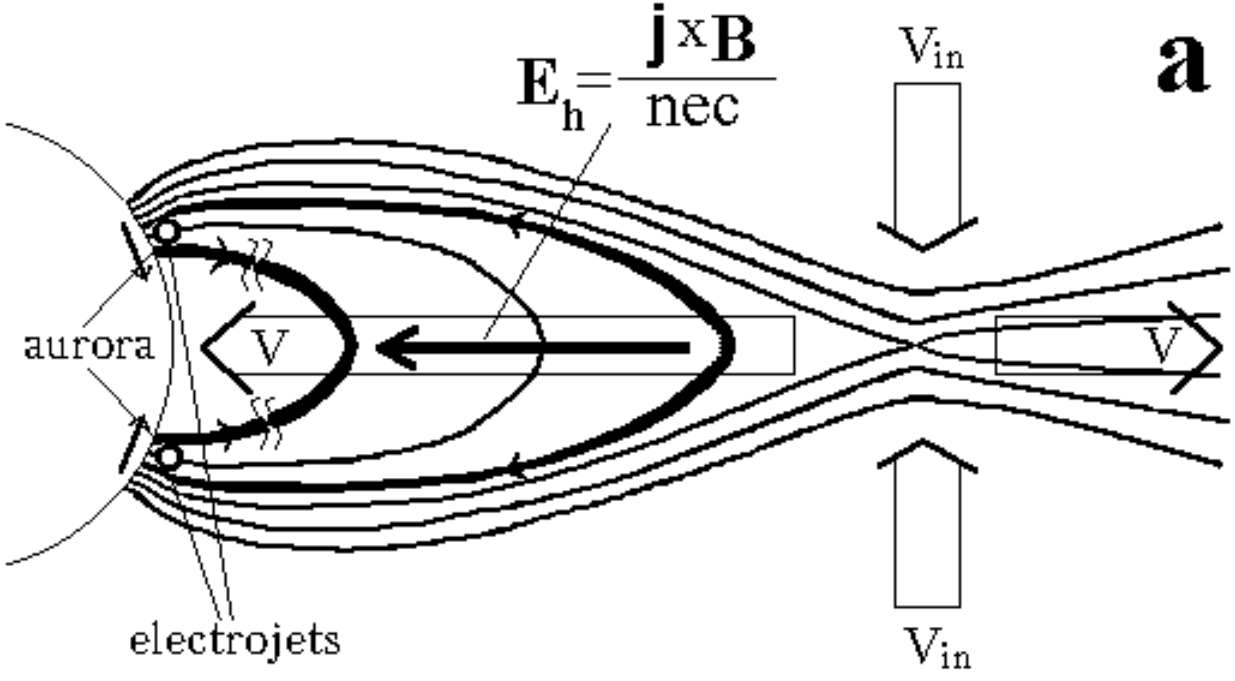




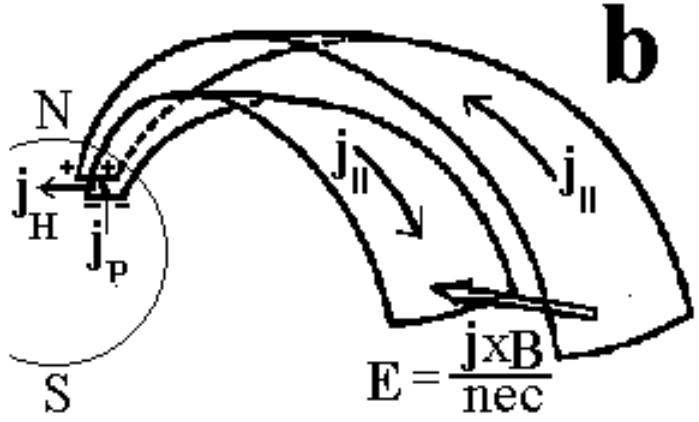
FAC crossing at night side during substorm ~50°

FAC connection in ionosphere, generation in tail.

E_x is displaced. $E_z \sim 0$. $B_z \sim$ const.



FAC magnetic lines are connected with the tail. They are produced by Earthward electric field in the current sheet.
The Erthward electric field is also responsible for auroral jet appearance.
The Hall electric field is revealed in laboratory simulation.



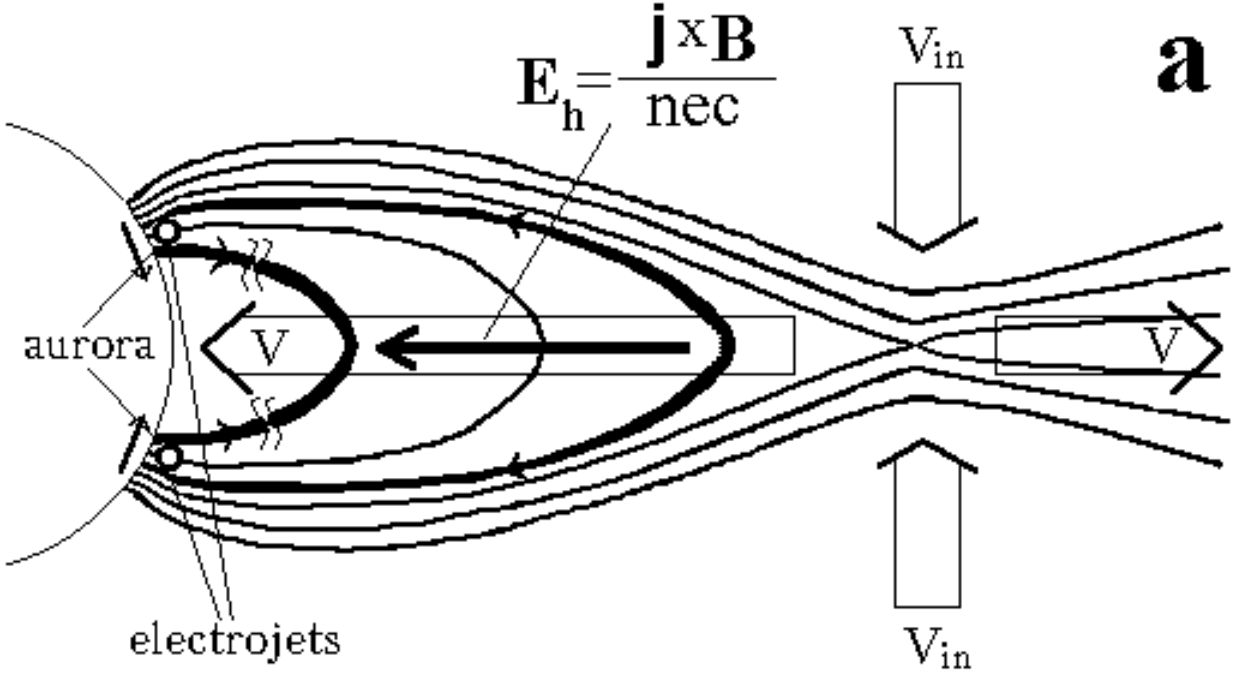
Electrojet is the Hall current $j \perp B$ $\sigma_H > \sigma_P$

$J_H = \Sigma_H E \sim 2\ 10^4$ A

$$\mathbf{j} = \sigma[\mathbf{E} + \mathbf{V}\times\mathbf{B}/c - \mathbf{j}\times\mathbf{B}/nec + \nabla p_e/\mathbf{ne}]$$

The tail current density increasing during a substorm. Current sheet thickness decreases up to ~ $0.1R_E$. $\mathbf{j}\times\mathbf{B}/c$ force increases and produces accelerated plasma injection in the Earth magnetosphere. The Hall electric field $\mathbf{j}\times\mathbf{B}/nec$ also increases, if the current in CS is transferred by electron. B_t =20 nT, B_n ~ 2 nT in the tail CS, n ~ 0.2 cm^{-3}, and the potential drop at distance L = $10R_E$ can be estimated as

$$B_tB_n/(2\pi\delta ne)L \sim 50 \text{ kV}$$



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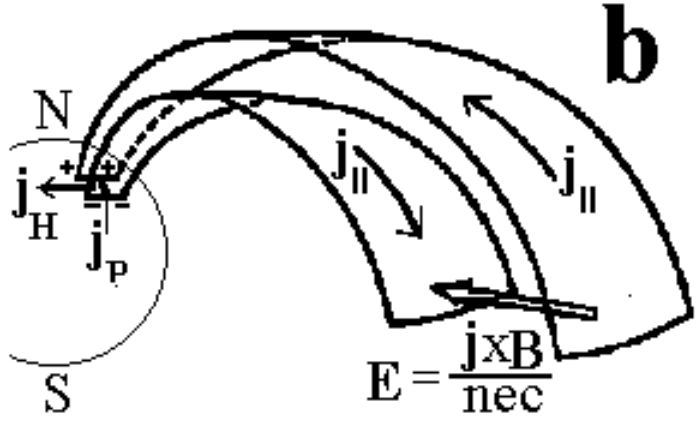

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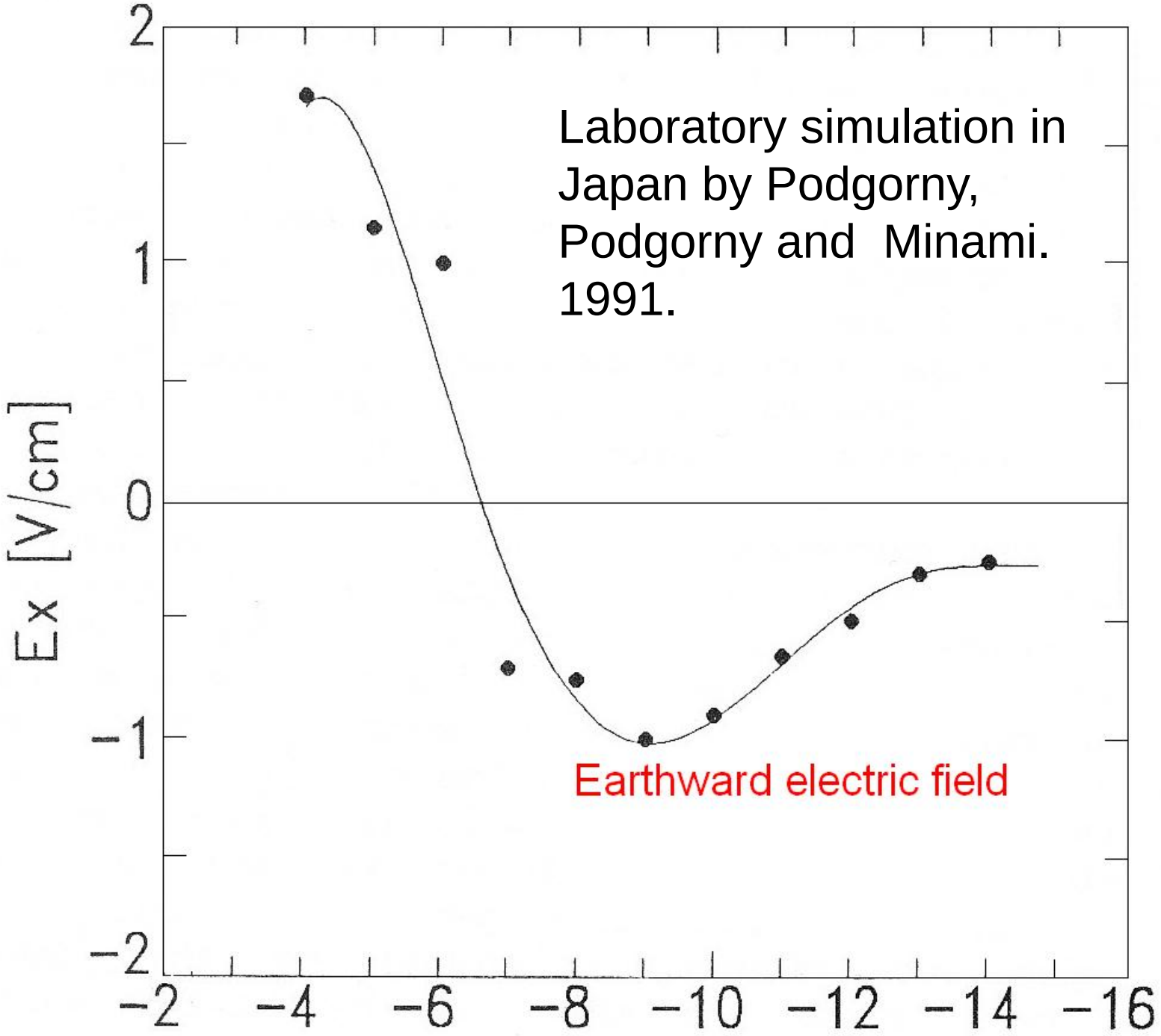
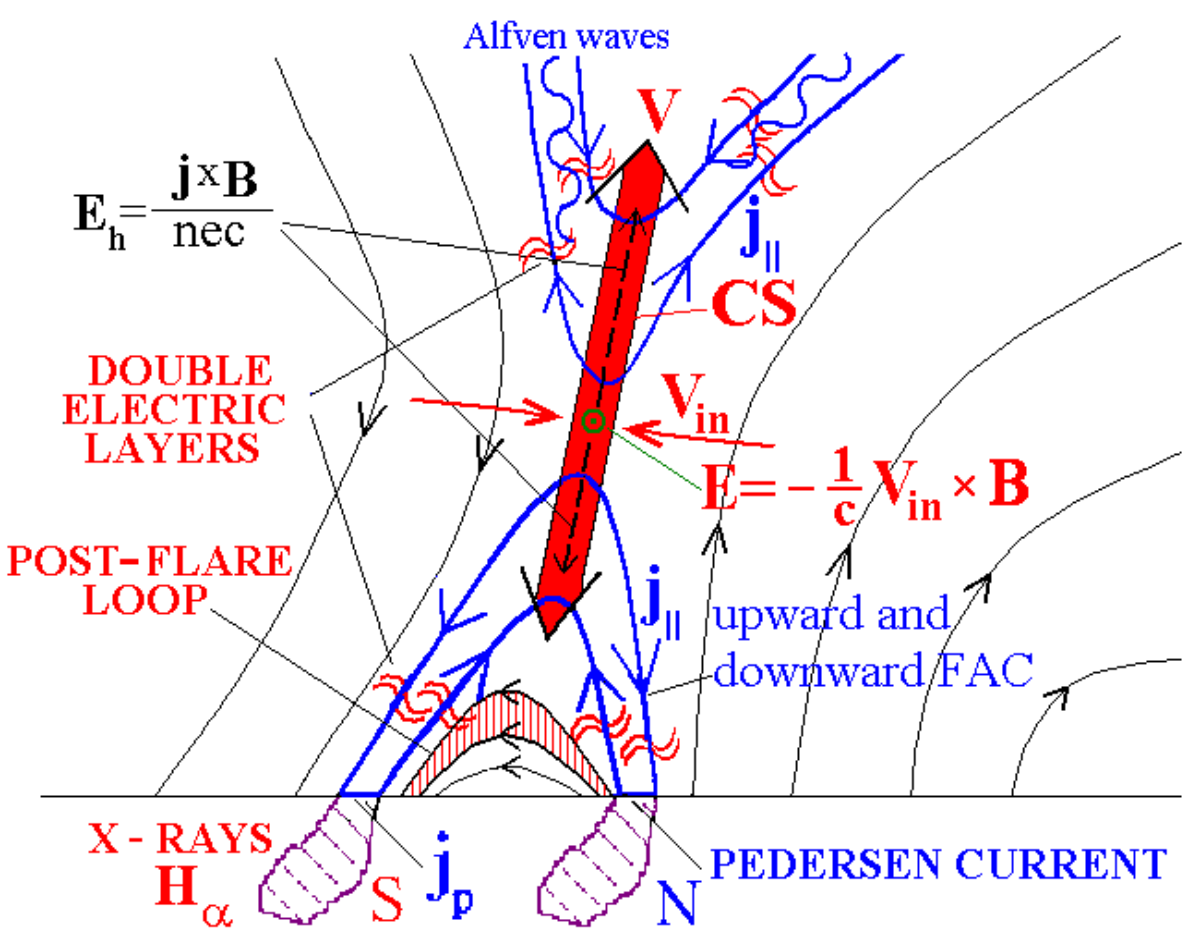
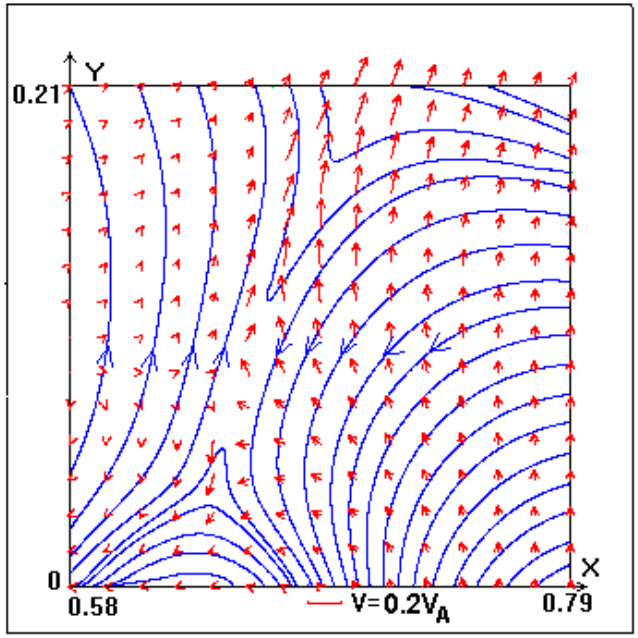

Laboratory simulation in Japan by Podgorny, Podgorny and Minami. 1991.
Earthward electric field
Ex [V/cm]
2
1
0
−1
−2
−2
−4
−6
−8
−10
−12
−14
−16



Electrons accelerated in FAC produce hard X-ray.



Results of current sheet creation in numerical MHD simulation. A sheet appears above an active region in the preflare state. Plasma inflows into a current sheet. Iside the sheet plasma acceleration takes place by $\mathbf{j} \times \mathbf{B}$ force producing CME.

БЛАГОДАРЯ !

Thank You