

ON ELECTROMAGNETIC RADIATION IN THE ATMOSPHERE OF THE EXCESS NEGATIVE CHARGE IN THE NUCLEAR- ELECTROMAGNETIC CASCADE

(and related topics)

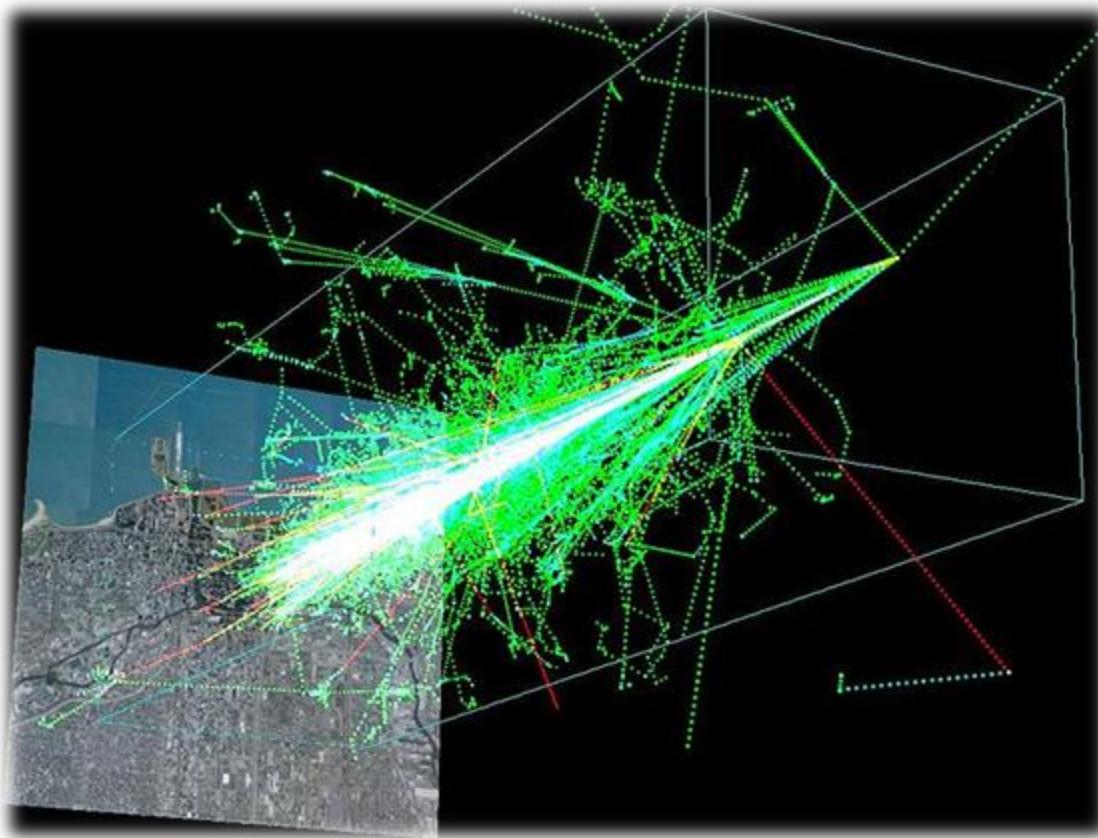
V.S. Malyshevsky, G.V. Fomin

Southern Federal University, 344090, Rostov-on-Don, Russia

E-mail address: vsmalyshevsky@sfedu.ru

G.A. Askariyn. Sov. Phys. JETP, v.41, 616 (1961).

The excess negative charge electron-photon shower and coherent radio emission from it



L. Desorgher, E.O. Flückiger, M. Gurtner, *et. al.*,
Int. J. Mod. Phys. A **20**, 6802 (2005).

PLANETOCOSMICS: Geant4 application for simulating the interaction of cosmic rays with the Earth, Mars and Mercury.

The slide features a title 'PlanetoCosmics' with a logo of a tree and the word 'QinetiQ' below it. The main text reads 'Geant4 simulation of Cosmic Rays in planetary Atmo- / Magneto- spheres'. It includes a small image of Earth's magnetic field and atmosphere, a 3D simulation of particle tracks, and a 2D energy deposition plot. The bottom left contains conference information and author details, while the bottom right shows a Geant4 visualization of particle interactions.

PlanetoCosmics
Geant4 simulation of Cosmic Rays
in planetary Atmo- / Magneto- spheres

■ Laurent Desorgher, University of Bern
<http://real.space.qinetiq.com/septimess/m>

28th International Cosmic Ray Conference 4277

Geant4 Simulation of the Propagation of Cosmic Rays through the Earth's Atmosphere

L. Desorgher, E. O. Flückiger, M. R. Moser, and R. Büttikofer
Physikalisches Institut, University of Bern, CH-3012 Bern, Switzerland

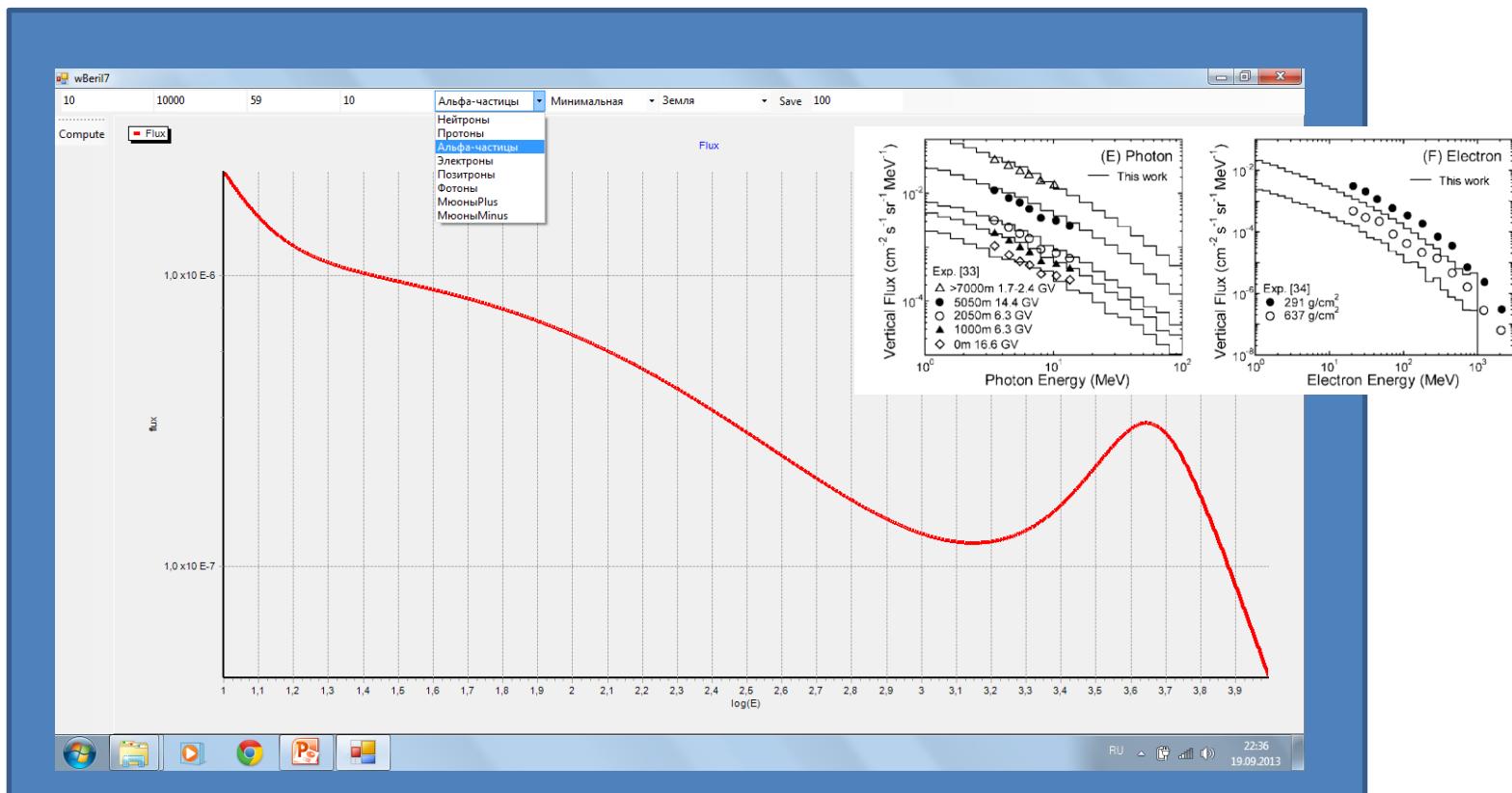
esa

Giovanni Santin - Geant4 in Space - Geant4 '07, Hebden Bridge, Sep 2007

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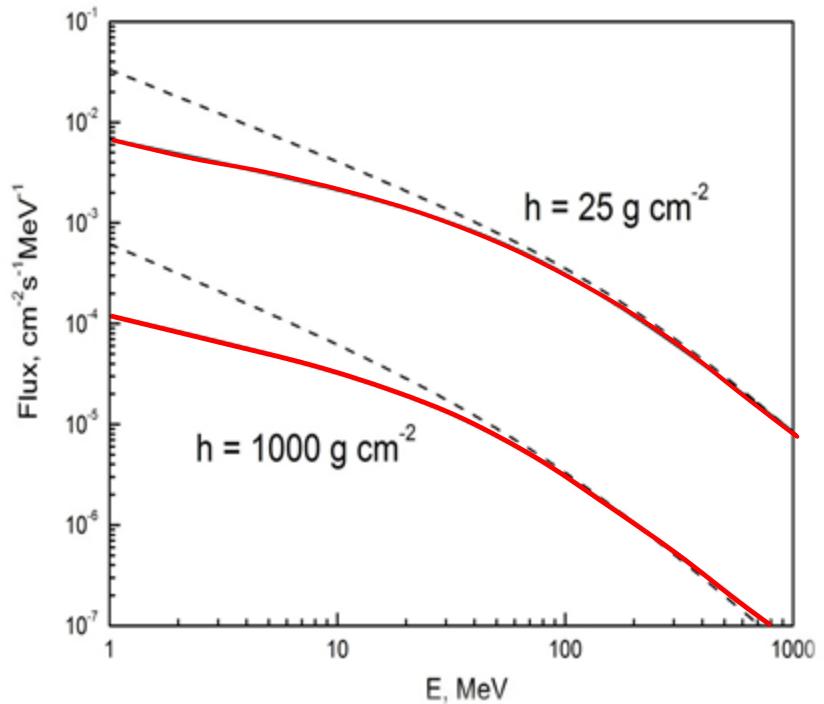
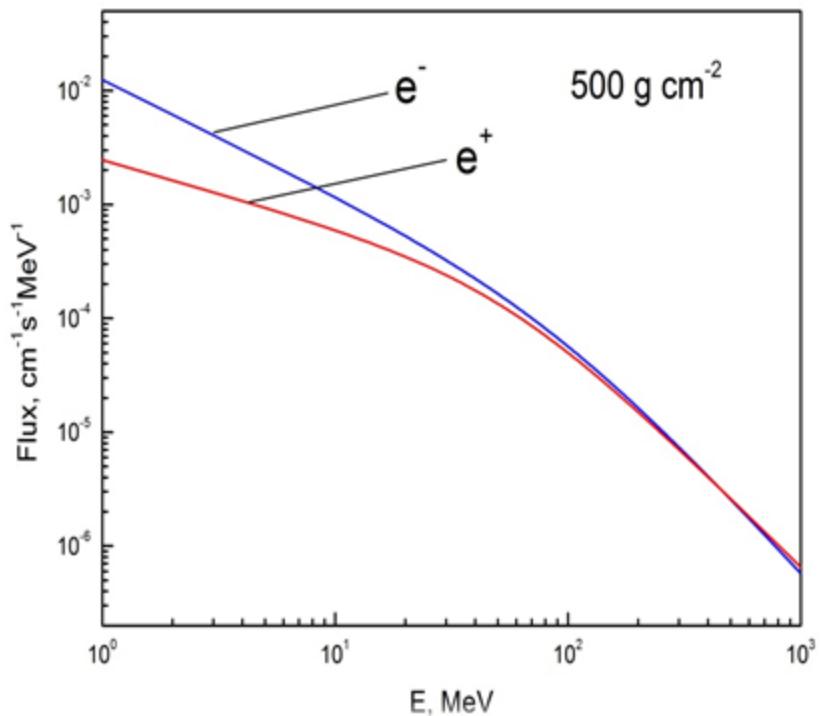
Tatsuhiko Sato, Hiroshi Yasuda, Koji Niita, *et.al.*,
Radiation Research **170**, 244 (2008).

Development of PARMA: PHITS-based analytical radiation model in the atmosphere

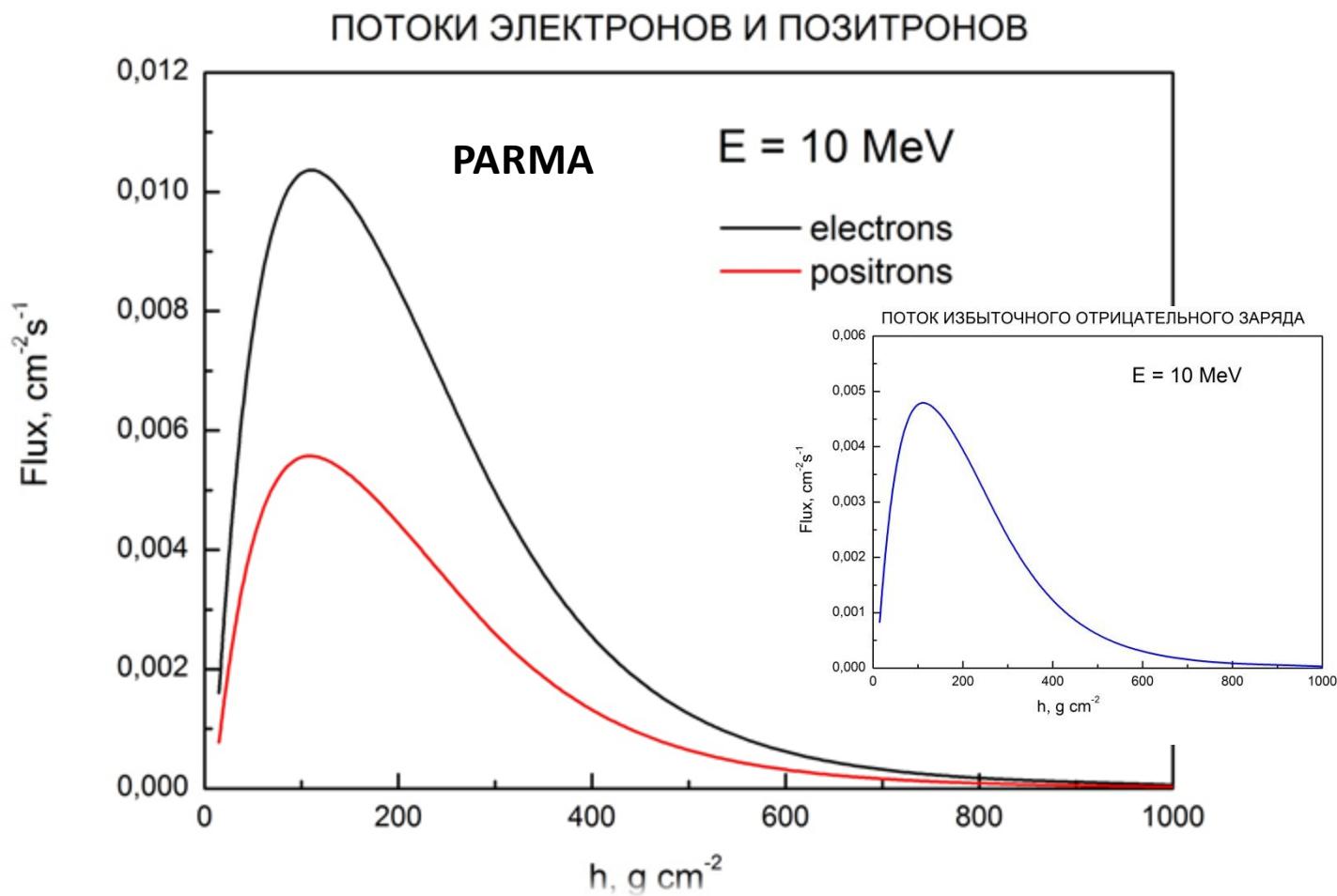


The flux density of electrons and positrons

PARMA



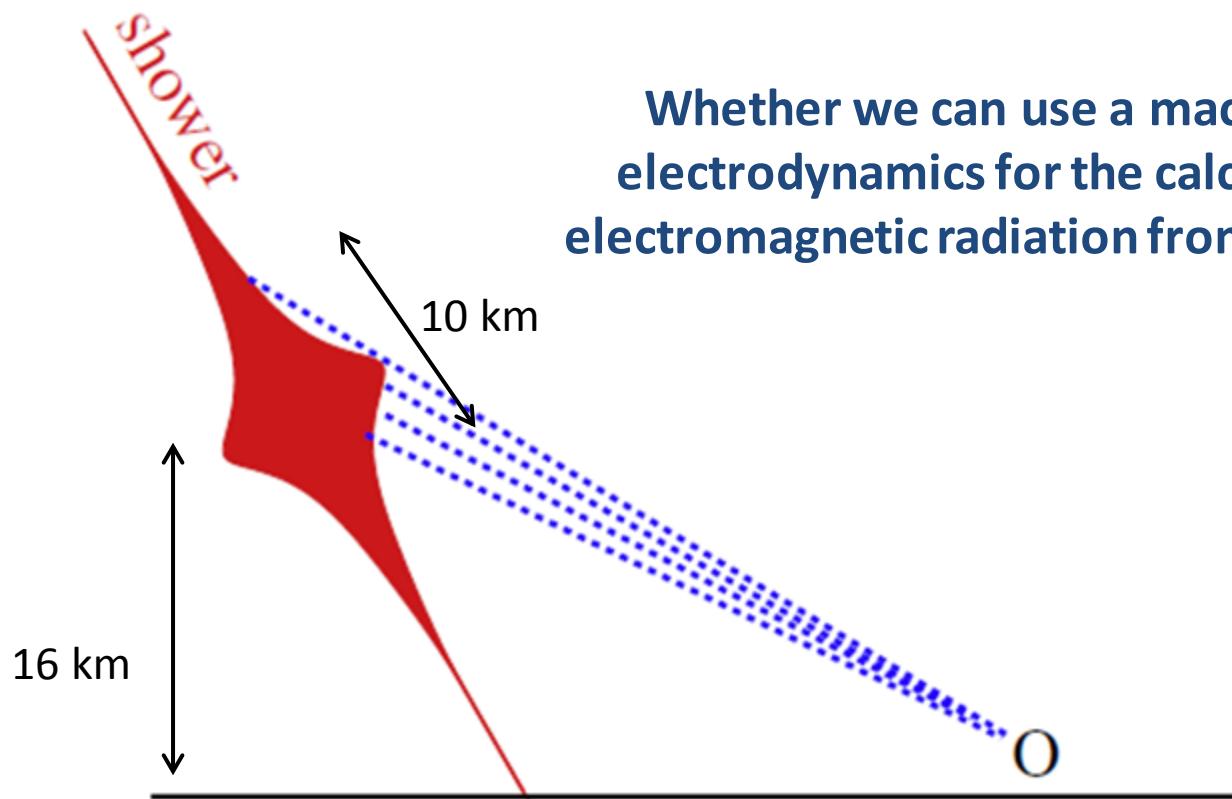
The flux density of electrons and positrons depending on the depth of the atmosphere



A realistic treatment of geomagnetic Cherenkov radiation from cosmic ray air showers

Klaus Werner, Krijn D. de Vries , Olaf Scholten
Astroparticle Physics **37** (2012) 5–16

Whether we can use a macroscopic electrodynamics for the calculation of electromagnetic radiation from a shower ?



33-nd International Cosmic Ray Conference, Rio De Janeiro 2013

The EVA code: Macroscopic modeling of radio emission from air showers

Krijn D. De Vries¹, Olaf Scholten², Klaus Werner³,

1 - *Vrije Universiteit Brussel (VUB), dienst ELEM, Pleinlaan 2, B-1050 Brussels, Belgium*

2 - *Kernfysisch Versneller Instituut, University of Groningen, 9747 AA, Groningen, The Netherlands*

3 - *SUBATECH, University of Nantes – IN2P3/CNRS– EMN, Nantes, France*

arXiv:1107.1189v2 [astro-ph.HE] 16 Apr 2012

Monte Carlo simulations of radio pulses in atmospheric showers using ZHAireS

Jaime Alvarez-Muniz¹, Washington R. ², Carvalho Jr.,¹ Enrique Zas¹

1 - *Dept. de Física de Partículas & Instituto Galego de Física de Altas Enerxías,*

2 - *Universidade de Santiago de Compostela, 15782 Santiago de Compostela, Spain*

ЯДЕРНАЯ ФИЗИКА, 2010, том 73, №7, с. 1231–1242

**Радиоизлучение широких атмосферных ливней
как метод регистрации космических лучей**

Н. Н. Калмыков, А. А. Константинов, Р. Энгель

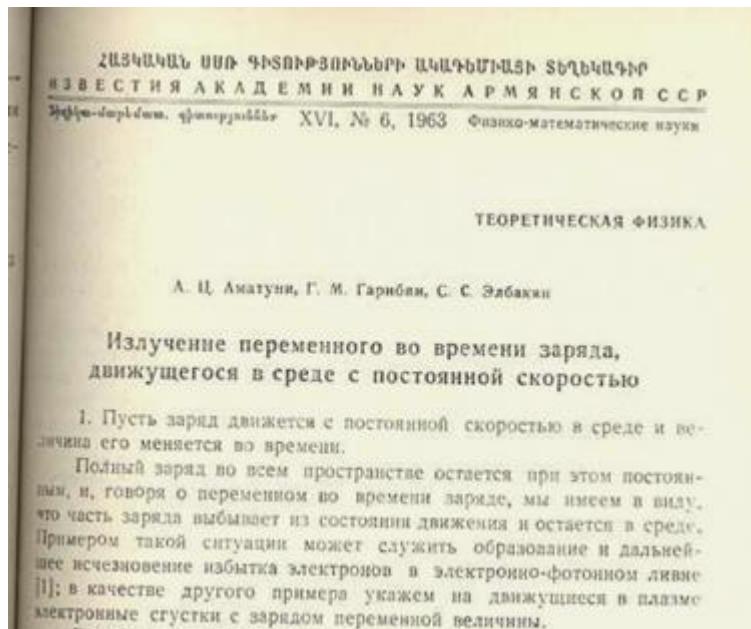
Научно-исследовательский институт ядерной физики Московского
государственного университета, Россия

Justice must be restored !

Аматуни А.Ц., Гарифян Г.М., Элбакян С.С. //
Известия Академии наук Армянской ССР.
1963. Т. XVI. №6. С. 101-112.

**Излучение переменного во времени заряда движущегося
в среде с постоянной скоростью**

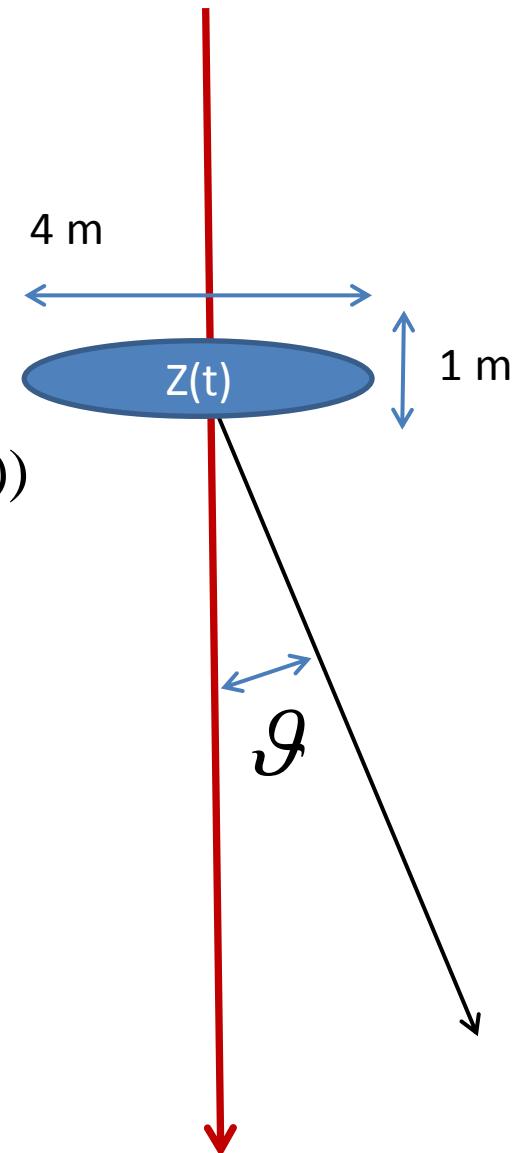
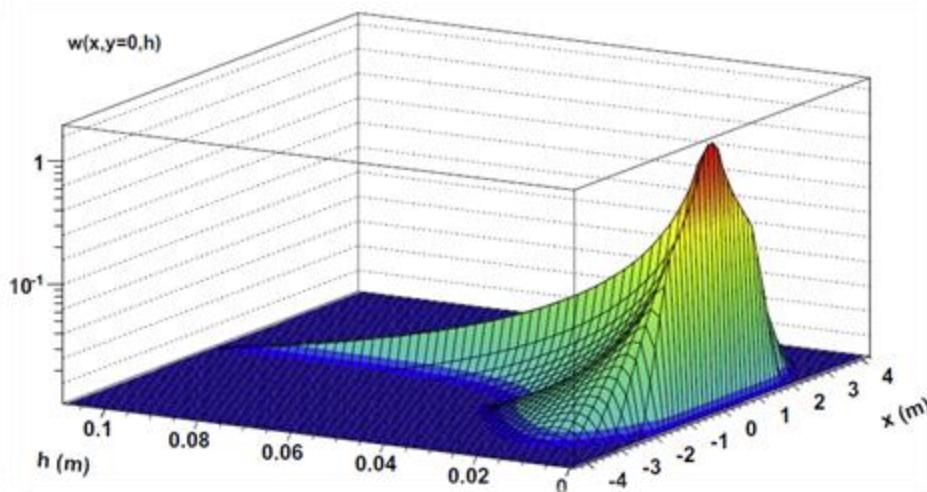
**The radiation of a time-varying charge moving
in a medium with a constant speed**



Point-like approximation

Аматуни А.Ц., Гариян Г.М., Элбакян С.С. Известия Академии наук
Армянской ССР. 1963. Т. XVI. №6. С. 101-112.

$$\mathbf{j}(\mathbf{r}, t) = eZ(t)\mathbf{v}(t)\delta(\mathbf{r} - \mathbf{r}(t))$$
$$\rho(\mathbf{r}, t) = eZ(t)\delta[\mathbf{r} - \mathbf{r}(t)] - e \int_{-\infty}^t dt Z'(t)\delta(\mathbf{r} - \mathbf{r}(t))$$
$$\partial\rho(\mathbf{r}, t)/\partial t + \text{div}\mathbf{j}(\mathbf{r}, t) = 0$$

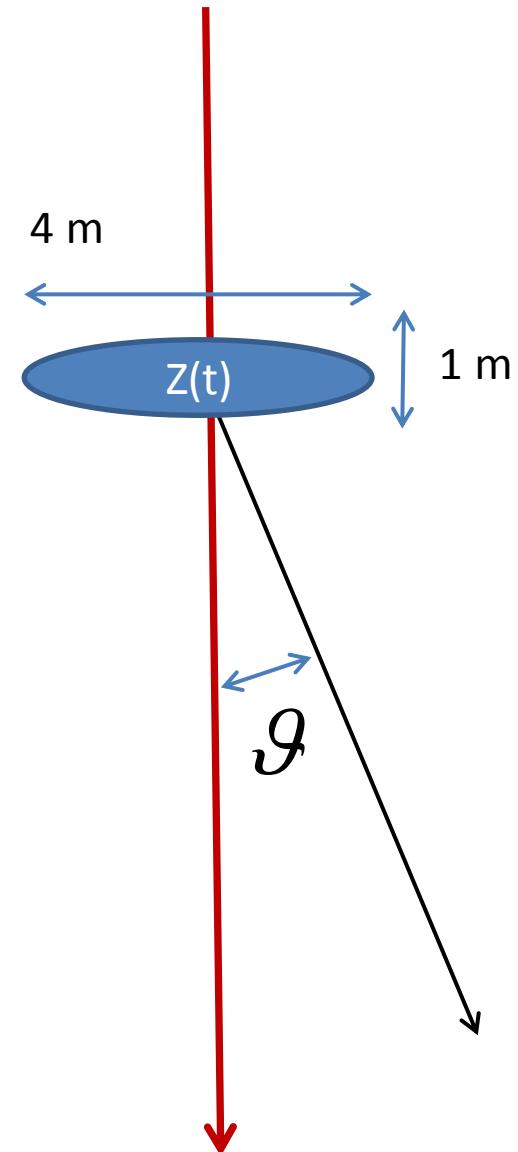
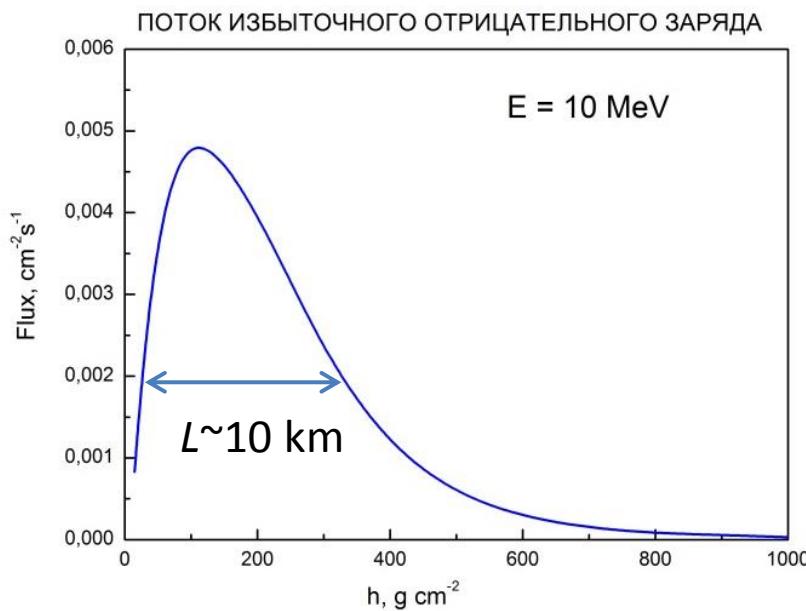


Point-like approximation

Аматуни А.Ц., Гарибян Г.М., Элбакян С.С. Известия Академии наук
Армянской ССР. 1963. Т. XVI. №6. С. 101-112.

$$Z(t) = Z \exp(-\omega_0^2 t^2)$$

$$\omega_0 \approx 2\pi c / L$$



Condition of the Point-like approximation

Аматуни А.Ц., Гарифян Г.М., Элбакян С.С. Известия Академии наук
Армянской ССР. 1963. Т. XVI. №6. С. 101-112.

Longitudinal "point"

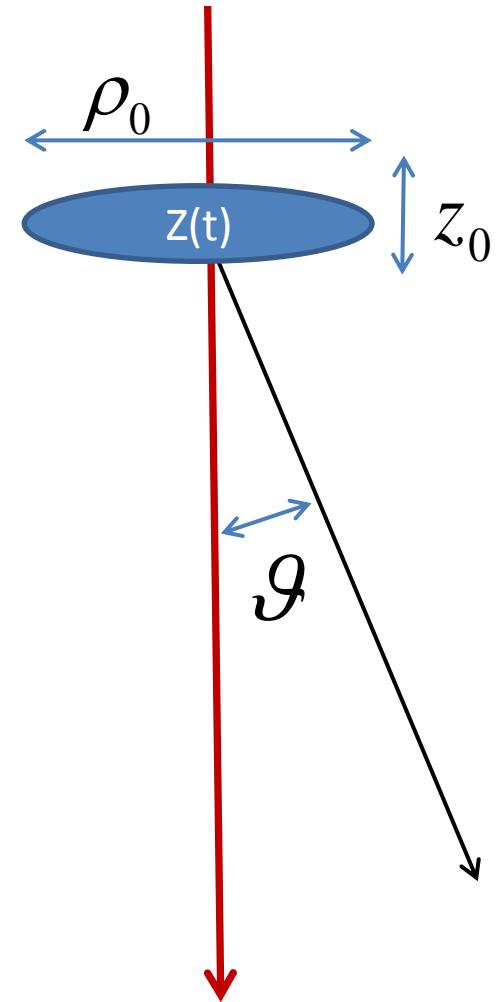
$$z_0 \frac{\omega}{c} \sqrt{\epsilon} \cos \vartheta \ll 1$$

Transverse "point"

$$\rho_0 \frac{\omega}{c} \sqrt{\epsilon} \sin \vartheta \ll 1$$

$$\frac{d^2W}{d\omega d\Omega} \sim Z^2$$

If $\vartheta = 45^\circ$ $\omega \ll 200 \text{ MHz}$



Аматуни А.Ц., Гарифян Г.М., Элбакян С.С. Известия Академии наук
Армянской ССР. 1963. Т. XVI. №6. С. 101-112.

Instead of the conclusion for young colleges

*If you start to solve some problem look carefully
around previous results.*

*May by 20 or 30 years ago Armenian physicist
already have solve it.*

Thank you for your attention !