The Cutoff calculator program **Cutoff** http://crsv.izmiran.ru/cutoff calculates the rigidity of geomagnetic cutoff for a given date (1900-2015, extrapolation to 2050) and at a given geographic point. From a given height, antiprotons of various rigidity are launched at a certain zenith and azimuth angle, and trajectories can be traced. If the particle emerges from the magnetosphere, the rigidity is allowed, if it returns to the ground or turns too long (the duration of the flight is set), the rigidity is forbidden. The program can consider trajectories in one of the given models of the magnetosphere: **диполь**, **IGRF**, Tsyganenko **IGRF+T89**, **IGRF+T96**, **IGRF+T02**. The result of this program - the lower, upper and effective values of the rigidity of the geomagnetic cutoff and the penumbra, for example, for the model IGRF- looks like following:

Cutoff rigidities: lower 1.765 upper 2.416 effective 2.185

Test checking of the calculator.

To test the calculator, you can get test results for test values of model parameters based on the following table.

For 01.07.2017 00:00:00 and Geographic coordinatres(latitude, longitude) - (55.00, 40.00)
Vertical angle - 0.00 and Azimutal angle - 0.00

Model	Parametrs					Result			
						Cutoff rigidities, GV			Calculation time, sec
	Kp	P_{sw}(nPa), Solar wind dynamic pressure	D_{st}-index (nT)	IMF B_y and IMF B_z, nT	G_1 and G_2	lower	upper	effective	
Dipole						2.337	2.737	2.498	6
IGRF						1.765	2.416	2.185	37
IGRF+T89	4					1.582	2.190	1.922	28
IGRF+T96		2	-50.0	0 and 5		1.518	2.156	1.906	1188
IGRF+T02		2	-50.0	0 and 5	6 and 10	1.649	2.234	1.947	3964

rigidity lower and upper limit (GV): 0.0 – 3.0
step 0.001 GV, Maximum time of flight - 180.00 s.

Remembering.

1) After selecting a model, the calculator prompts you to specify the required set of parameters.
2) The older the model of Tsyganenko, the more time is required for calculations. Especially it concerns models T96 and T02. To speed up the counting time, it is recommended that you carefully select the values of rigidity lower and upper limit. So when selecting Rmin = 0 and Rmax = 3 GV, the counting time for the IGRF + T02 model is 3964 seconds. When specifying this range, Rmin = 1.3 and Rmax = 2.6 GV, the counting time for the model is 1200 seconds. If it necessary to use the older models of Tsyganenko (T96 and T02), it is recommended to estimate the Rmin and Rmax by the IGRF model and use these values in the future.
3) The integration step is selected as high - 0.001 GV. Usually limited to an integration step of 0.01 GV or less, which allows to speed up the calculator work by an order of magnitude. For the IGRF + T02 model at a step of 0.01 GV, the counting time is less than 2 min instead of 1200 s.

4) Parameters of the magnetosphere Kp, Dst and parameters of the interplanetary medium Psw, Dst, IMF By, IMF Bz are determined experimentally, and the parameters G1, G2 and G3 are estimated by the algorithm described in Description_CutOff.doc in ftp://crsb.izmiran.ru/MagEffect (See guide.pdf).

Other calculators of the geomagnetic cutoff rigidity.

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2) Boschini M.J., Della T.S., Gervasi M., Grandi D., Rancoita P. G. ,Bobik P., Kudela K. // Cutoff rigidity online Calculator, model T96, T05. E-pub. 2014. http://www.geomagsphere.org. Online Internet project is based only on the more complex models of the magnetosphere (Tsyganenko T96 and T05) with automatic attraction parameters of the interplanetary medium, necessary for the magnetosphere model, which is a very useful option.

Literature.

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3) Гвоздевский Б.Б., Белов А.В., Гущина Р.Т., Ерошенко Е.А., Кобелев П.Г., Янке В.Г. Долгопериодные изменения вертикальных жесткостей геомагнитного обрезания за весь период мониторинга космических лучей // "Physics of Auroral Phenomena" Proc. XL Annual Seminar, Apatity, pp. 89-93, 2017 |pdf|

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5) Гвоздевский Б.Б., Белов А.В., Гущина Р.Т., Ерошенко Е.А., Кобелев П.Г., Янке В.Г. Долгопериодные изменения вертикальных жесткостей геомагнитного обрезания космических лучей // Ядерная физика и инжиниринг. Т.8, No 4, p.1-9. 2017. doi: 10.1134/S2079562917040133. |pdf|