

FLUKA Standard Output and Plotting

Beginners' FLUKA Course

The FLUKA Standard Output

• FLUKA provides a standard output file that contains plenty of useful information:

(fortran unit 11, *inp###.*out from rfluka)

It must be checked at least once when setting up a simulation and always in case of doubts/crashes
 (together with inp###.err and inp###.log files)

 Let's have a look to ex_3001.out (editor or flair output viewer: Process – Files – select ex_3001.out (a), or fless ex_3001.out)

Input echo

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ex3001.out	same order a	is they d		berteu i		nput i	IC		
License/version Input Echo Nuclear Data Mulmix Output	****** Next control card *		0.000	0.000	0.000	0.000	0.000	0.000	*
	FLUKA Course Exercise								
- Media Parameters	* use :	names everywher	e and free	format for ge	ometry				* *
- Fluka Particles Beam Properties	***** Next control card *	**** DEFAULTS	0.000	0.000	0.000	0.000	0.000	0.000	NEW-DEFA
Particle Thresholds Particle Thresholds Termination Condition: Mult. Coulomb Scatterii EM Showers Particle Importances Scoring Material Preparties	* beam * Geom * Geom * Mate	definitions etry ials definition	a						* * * *
Regions Summary Regions Summary Initialization Time Output During Transpc Events by Region	* * * *		-						* * *
Ha Scattering Statistics ⊕⊖ Run Summary	***** Next control card *	*** BEAM	-3.500	-8.2425E-02	-1.700	0.000	0.000	1.000	PROTON
	**** Density scaling fact	ors start at lo	cation	1 and end :	at 4000	(I*4 addr.) -	****		
	***** Next control card *	**** BEAMPOS	0.000	0.000	-0.1000	0.000	0.000	0.000	
	***** Next control card * 1	**** GEOBEGIN	0.000	0.000	0.000	0.000	0.000	0.000	COMBNAME

TITLE is the first to appear, then all comment cards are listed together, followed by the beam related cards, etc...

Input echo – *Geometry output*

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Edit Moon

X FileViewer: ex3001.out

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E License/version							
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⊢ Body data	Body n. I SPH	BLK ROT. 0 000000	U	0 000000	10000 00		
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🗕 Media Parameters	Body n. 7 XYP	T2seq Rot.	0	I UIIUWEU	by the get	mea y outp	
HB EMF-FLUKA	5.140000	-		no dino et o			
- Fluka Particles				reairected	a (see GEC	BEGIN Card).
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Particle Thresholds				Echo of	the comp	nands is n	resented L
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Body data	Region n. I BLK	HULE _9		names			
egion data	Region n. 2 TAR	GS1					
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B Nuclear Data	Region n. 3 TAR	.GS2					
B Mulmix Output	Begiop n 4 TAB	-6 /					
Bequested Products/Der	3	-7 5					
Hi Neutron Data	Region n. 5 INA	IR					
H dp/dx	OR 2	-3					
🗕 🔁 Blank Common	0R 2 0B 2	-5					
🕂 🖻 Media Parameters	1 OPTION O WAS USED IN	CALCULATING VOLUME	S, FOR	5 REGIONS			
H EMF-FLUKA	3: INPUT VOLUMES, ANYI	HING ELSE: VOLUMES	= 1.0				
Ha Fluka Particles							
Ha Beam Properties	VOLUMES (CM*	*3)					
Particle Inresholds Darmination Conditions	1 REG 1	2 3		4 5			
B Mult, Coulomb Scatterior	VOLUME 1.000E+00 1	.000E+00 1.000E+0	0 1.0	00E+00 1.000E+00			
B FM Showers	*	witch on to debug t	hie ceo	metru			*
- Particle Importances	• • • • • • • • • • • • • • • • • • •	wrech on co debuy t	ans yeu	weery			
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Nuclear data [1/3]

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X FileViewer: ex4001.out

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9685549

9688309

9688310 9819257

9861545

9916600

10219521

9634777

Edit View File

aex4001.out *** Reading evaporation and nuclear data from unit: 14 License/version **** Nuclear data file for Fluka9x-20xy **** Nuclear Data Mulmix Output File version: 2011.1 Requested Products/Decay Copyright (C) 1990-2011 by Alfredo Ferrari & Paola Sala - Neutron Data -🛅 dp/dx -🛅 Blank Common *** Evaporation: using NNDC (1996) data *** Starting location in blank common of LVL data: Media Parameters Last location in blank common of LVL data: EMF-FLUKA
 EMF-FLUKA
 Fluka Particles Starting location in blank common of CE data: 9634778 Beam Properties Last location in blank common of CE data: -🗋 Particle Thresholds 🖹 Termination Conditions Starting location in blank common of alpha data: 9685550 Last location in blank common of alpha data: - Mult. Coulomb Scattering - EM Showers - Particle Importances Starting location in blank common of gamma data: Last location in blank common of gamma data: 🕀 🧰 Scoring - Material Properties Starting location in blank common of beta data: 9819258 - 🖹 Regions Summary - 🖹 Initialization Time Last location in blank common of beta data: Starting location in blank common of GDR data: 9861546 Output During Transport
 Events by Region Last location in blank common of GDR data: - Scattering Statistics Starting location in blank common of (q, x) data: 9916601 🗄 🤐 Run Summary Last location in blank common of (q,x) data: **** RIPL2/Ign. self-cons. T=0 N,Z-dep. level density used **** RIPL-2 / Ignyatuk level density en. dep. used **** with Moller, Nix self-cons set of parameters for T=oo **** **** Original Gilbert/Cameron pairing energy used **** Maximum Fermi momentum 💠 : 0.268371314 GeV/c **** **** Maximum Fermi energy

**** 0.0376013778 GeV **** Average Fermi energy **** 0.022676846 GeV **** Average binding energy 0.00768006314 GeV **** **** Nuclear well depth 0.04528144 GeV **** Excess mass for 11-B 0.00866803993 GeV **** information about the basic nuclear data file used

Some memory allocation details

Nuclear data [2/3]

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🔄 ex4001

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🗄 🥌 Run

X FileViewer: ex4001.out

<u>File E</u>dit ⊻iew

∎ex4001.out –Bi License/version	**** Atomic	mass	for 40-Ca :	37.224926 GeV **	* * *
Input Echo	**** Nuclea	r mass	for 40-Ca :	37.2147255 GeV	****
- 📑 Nuclear Data - 🗄 Mulmix Output	**** Excess	mass	for 55-Fe :	-0.0574751087 GeV	****
Requested Products/Decay Neutron Data	**** Camero	о г т	for 55-Fe	-0 0595041849 GeV	****
- dp/dx	tttt Orn El	E	for EE Wo	0.0590041049 000	++++
–🖹 Blank Common –🖹 Media Parameters		. <u>с</u> . ш.	101 55-10 :	-0.050000023 Gev	
– EMF-FLUKA	**** My.&Sw	. E. m.	for 55-Fe :	-U.U575U32495 GeV	****
-B Beam Properties	**** Atomic	mass	for 55-Fe :	51.1747131 GeV	****
Particle Thresholds Particle Conditions	**** Nuclea	r mass	for 55-Fe :	51.1614609 GeV	****
- Mult. Coulomb Scattering	**** Excess	mass	for $56-Fe$:	-0.0606013089 GeV	****
-B EM Showers -B Particle Importances	**** Camero	n E. m.	for 56-Fe :	-0.0623576604 GeV	****
	**** Cam.El	. E. m.	for 56-Fe :	-0.0608849637 GeV	****
-B Regions Summary	**** My.&Sw	. E. m.	for 56-Fe :	-0.0604862086 GeV	****
Initialization Time Output During Transport	**** Atomic	mass	for 56-Fe :	52.1030807 GeV	****
- Events by Region	**** Nuclea	r mass	for 56-Fe :	52.0898285 Ge V	****
Scattering Statistics Summary	**** Fyraco		for 107-Ag	_0 088405250 Cev	****
Contrain Community	AAAA O	mass	for 107 hg.	0.000403239 860	
	**** Camero	n Ľ. m.	for IU/-Ag:	-0.0891378522 GeV	****
	**** Cam.El	. E. m.	for 107-Ag:	–0.0886852369 GeV	****
	**** My.&Sw	. E. m.	for 107-Ag:	-0.0882571116 GeV	****
	**** Atomic	mass	for 107-Ag:	99.5814896 GeV	****
	**** Nuclea	r mass	for 107-Ag:	99.5576096 GeV	****
	**** Excess	mass	for 132-Xe:	-0.0892794058 GeV	****
	**** Camero	n E. m.	for 132-Xe:	-0.0898088515 GeV	****
	**** Cam.El	. E. m.	for 132-Xe:	-0.0892864987 GeV	****
	**** My.&Sw	. E. m.	for 132-Xe:	-0.0894251093 GeV	****

Nuclear data used in the program

Nuclear data [3/3]

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X FileViewer: ex4001.out

<u>File Edit View</u>

nex4001.out ⊢⊡ License/version	**** My.&Sw. E. m. for 235-U : 0.0413222089 GeV ****	
	**** Atomic mass for 235-U : 218.942078 GeV ****	
Hin Mulmix Output	++++ Muclear mass for 025-M . 010 005767 0eW ++++	
Requested Products/Decay	Nuclear mass for 233-0 : 210.095707 GeV	
Handright Hata	**** Excess mass for 238-U : 0.0473045185 GeV ****	
Blank Common	**** Cameron E. m. for 238-U : 0.0524553321 GeV ****	
Ha Media Parameters	**** Cam.El. E. m. for 238-U : 0.0481762439 GeV ****	
Fluka Particles	**** My.&Sw. E. m. for 238-U : 0.0473943055 GeV ****	
Higher Beam Properties	**** Atomic mass for 238-U · 221 74295 GeV ****	
Termination Conditions		
Hand Mult. Coulomb Scattering	**** Nuclear mass for 236-0 : 221.696655 GeV ****	٦
Particle Importances	**** Evaporation from residual nucleus activated **** **** Deexcitation gamma production activated ****	L
	**** Evaporated "heavies" transport activated ****	L
Haterial Properties	**** High Energy fission requested & activated **** **** Fermi Break Up requested & activated ****	L
- Initialization Time		-
Hand Output During Transport	**** Neutrino generators initialized F T T ****	
Scattering Statistics		
Head Run Summary	*** Neutrino xsec file header · Neutrino Xsec file from ***	
	*** Neutrino xsec file generated on: DATE: 9/10/ 8, TIME: 19:48:1 ***	
	Minimum kinetic energy for BME : 1.0000E-03 (GeV/n)	
	Overall minimum kinetic energy for ion nuclear interactions: 1.0000E-03 (GeV/n)	
	*** Material WATER (# 26 automatically guessed by FLUKA, please check its correctness ***	
	*** Material AIR (# 27 automatically guessed by FLUKA, please check its correctness ***	
	**** Fluorescence data successfully retrieved from unit 13 ****	
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Material properties

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X FileViewer: ex4001.out

<u>File E</u>dit <u>V</u>iew

∃⊖ 3 e x4001.out	**** Subroutine Mulmix: medium n. 🤉	26 ****	
T-B License/version			Matarial proportion
+ Minnut Echo	Number of elements = 2, Density=	1.000000 (g/cm**3)	Material properties,
La Nuclear Data	OIZ Pa	F_i Rho_i	
-B Mulmix Output	Index Atomic Atomic Number Weight	Proportion Proportion	multiple scattering
Requested Products/Decays	Walder wergne	by Malaber by weight	
Ha Neutron Data	1 1.00000 1.00794	0.666667 0.111898	parameters
Handrax	2 8.00000 15.9994	0.3333333 0.888102	
Biank Common	ZTILDE, AE103, BLCCRA= 7.78788E+00	2.51981E+00 1.08102E-02	
- EMF-FLUKA	++++ Warning Least equare fit for	bloors failed to keep war wel Pl	and are holder 1% ++++
🗕 Fluka Particles	**** Max. error is 1.1 %. for beta	2 = 0.00358 ****	CCE EII. DEIDW 1% ^^^^
Beam Properties			
Particle Thresholds		0 E1001E.00 1 0762EE 00	This warning is normal!
B Mult, Coulomb Scattering	BLCC, XCC, TFFLUO, XROFLU= 6. 33212E+03	3 7.58200E-04 1.05734E-03 4.2	7023E-05
B EM Showers	BLCCE, XCCE, TFEMFO, XROEMF= 7.52263E+	03 8.13614E-01 2.65915E-03 8.	.90013E-02
Elvi Siluweis	Particle n.: -6 Ecutm (prim. & sec	c.) = 3.747 GeV 3.747 Ge	eV, Hthnsz = 1.0000E+30 GeV
	Particle n.: -5 Ecutm (prim. & sec	c.) = 2.828 GeV 2.828 Ge	eV, Hthnsz = 1.0000E+30 GeV
파 Scoring	Particle n.: -4 Ecutm (prim. & sec	c.) = 2.829 GeV 2.829 Ge	eV, Hthnsz = 1.0000E+30 GeV
Haterial Properties	Particle n.: -3 Ecutm (prim. & sec	c.) = 1.896 GeV 1.896 Ge	eV, Hthnsz = 1.0000E+30 GeV
Begions Summary	Particle n.: 1 Ecutm (prim. & sec	c.) = 0.9583 GeV 0.9583 Ge	eV, Hthnsz = 1.0000E+30 GeV
H Initialization Time	Particle n.: 2 Ecutm (prim. & sec	c.) = 0.9583 GeV 0.9583 Ge	eV, Hthnsz = 1.0000E+30 GeV
Output During Transport	Particle n.: 3 Ecutm (prim. & sec	c.) = 2.0511E-02 GeV 2.0511E-02 Ge	eV, Hthnsz = 1.0000E+30 GeV
B Events by Pagion	Particle n.: 4 Ecutm (prim. & sec	c.) = 2.0511E-02 GeV 2.0511E-02 Ge	eV, Hthnsz = 1.0000E+30 GeV
	Particle n.: 10 Ecutm (prim. & sec	c.) = 0.1257 GeV 0.1257 Ge	eV, Hthnsz = 1.0000E+30 GeV
	Particle n.: 11 Ecutm (prim. & sec	c.) = 0.1257 GeV 0.1257 Ge	eV, Hthnsz = 1.0000E+30 GeV
🗄 😂 Run Summary	Particle n.: 13 Ecutm (prim. & sec) = 0.1596 GeV 0.1596 Ge	eV, Hthnsz = 1.0000E+30 GeV
-	Particle n.: 14 Ecutm (prim. & sec	x.) = 0.1596 GeV 0.1596 Ge	eV, Hthnsz = 1.0000E+30 GeV
	Particle n.: 15 Ecutm (prim. & sec	x.) = 0.5136 GeV 0.5136 Ge	eV, Hthnsz = 1.0000E+30 GeV
	Particle n.: 16 Ecutm (prim. & sec) = 0.5136 GeV 0.5136 Ge	eV, Hthnsz = 1.0000E+30 GeV
	Particle n.: 20 Ecutm (prim. & sec	c.) = 1.217 GeV 1.217 Ge	eV, Hthnsz = 1.0000E+30 GeV
	Particle n.: 21 Ecutm (prim. & sec	c.) = 1.209 GeV 1.209 Ge	eV, Hthnsz = 1.0000E+30 GeV
	Particle n.: 31 Ecutm (prim. & sec	≿.) = 1.209 GeV 1.209 Ge	eV, Hthnsz = 1.0000E+30 GeV
	Particle n.: 33 Ecutm (prim. & sec	z.) = 1.217 GeV 1.217 Ge	eV. Hthnsz = 1.0000E+30 GeV
	Particle n.: 36 Ecutm (prim. & sec	c.) = 1.341 GeV 1.341 Ge	eV. Hthmsz = 1.0000E+30 GeV
	Particle n.: 37 Ecutm (prim. & sec	c.) = 1.341 GeV 1.341 Ge	V. Hthmsz = 1.0000E+30 GeV
	Particle n.: 38 Ecutm (prim. & sec	c.) = 1.692 GeV 1.692 Ge	eV. Hthmsz = 1.0000E+30 GeV
	Particle n : 39 Ecutm (prim & sec	(1) = 1.692 GeV 1.692 GeV	V. Hthmsz = 1.0000E+30 GeV
	Particle n : 41 Ecutm (prim & sec	() = 1.797 GeV 1.797 G	AV. Hthmsz = 1 0000E+30 GeV
	Particle n · 42 Ecutm (prim & sec	(1) = 1.797 GeV 1.797 G	AV. Hthmsz = 1 0000E+30 GeV
	Particle n · 45 Foutm (prim & sec	(x) = 1.889 GeV 1.889 G	AV. Hthmsz = 1 0000F+30 GeV
	Particlen : 46 Foutm (prim & sec	$(x_{1}) = 1.889$ GeV 1.889 GeV	$W = H^{+}h^{-}h^{-}r = 1.0000E^{+}30 \text{ GeV}$
	Particle n · 40 Foutm (prim & sec	(-1.00) (-1.00) (-1.00) (-1.00)	$W = H^{+}h^{-}h^{-} = 1.0000E^{+}30 \text{ GeV}$
	Particle n · 50 Foutm (prim & sec	$(x_1) = 1.000 0.00 1.000 0.000$	$W = H^{+}h^{-}h^{-} = 1 0000E^{+}30 \text{ GeV}$
	Particle n · 51 Foutm (prim & sec	(-2.305) (-305)	$W = H^{+}h^{-}h^{-} - 1 = 0 = 0 = 0 = 0 = 0$
	Tarcicie II. JI Beach (Prim. & Sec		5*, namoz = 1.0000±+30.00v

Radiation Decay

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X FileViewer: ex4001.out

<u>File E</u>dit <u>V</u>iew

at location 10219522 and end at 10242872 (I*4 addr.) **** 🗟 ex4001.out **** Isotope tabulation data start License/version info on the decay No radioactive products/decays requested - Nuclear Data - Mulmix Output radiation options Requested Products/Decays 🗄 Neutron Data -🛅 dp/dx -🛅 Blank Common Flags for applying biasing to prompt and/or decay radiation: Hadr/muon Low en. Neut. EM Prompt/Decay Prompt/Decay Prompt/Decay Media Parameters Radiation biasing Inter./decay length: T F T F т F EMF-FLUKA
 EMF-FLUKA
 Fluka Particles Leading Particle F т F т F т Importance and WW т F т F т F Beam Properties
 Particle Thresholds
 Termination Conditions Mult. Coulomb Scattering
 EM Showers
 Particle Importances EM transport threshold multipliers: prompt 1.00E+00 decay 1.00E+00 🗄 🦲 Scoring Material Properties
 Regions Summary
 Initialization Time Output During Transport
 Events by Region
 Scattering Statistics 🗄 🤐 Run Summary .

Neutron data

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X FileViewer: ex4001.out

<u>File E</u>dit <u>V</u>iew

ex4001.out	Group cross sections storage starts at 10352413 Last location used for group xsecs 11784019							
 Input Echo Nuclear Data Mulmix Output Requested Products/Decays Neutron Data dp/dx Blank Common Media Parameters EMF-FLUKA Fluka Particles Beam Properties Particle Thresholds Termination Conditions Mult. Coulomb Scattering EM Showers Particle Importances 	Panini indepe Number of primar Number of primar Number of second Number of second Number of neutro Total xsec table Loc. of within g Number of media Number of media Number of discre 1 *** Fluka low e correspondi	*** Val ndent Xsec y groups y downscat ary groups ary downsc: n+gamma gr length roup (g->g read oefficient: te angles nergy group ng to an en	ues read from 260 ters 260 rs 30 atters 42 oups 302 0 xsec 34 269 s 6 3 p transport th nergy threshol	the cross sec L (if reshold: 261 d of: 1.000011	tion file *** OW-ENERGY CORRESPOND OW ENERGY the LOW-	neutron dence I neutron NEUT ca	info, m More inf cross se ard is sp	aterial o on ection ecified
Material Properties	1 *** Fluka to lo und ***	w en. xsec	material corr	espondence: p:	rinted atomic den:	sities are mea	ningless when	. used in a compo
Initialization Time Output During Transport Events by Beging	Fluka medium number	Name	Xsec medium number	atomic densi (at/(cm barn)	ty Id. 1))	Id. 2	Id. 3	
Scattering Statistics	1	BLCKHOLE	0	0.0000E+0	0 0	0	0	
±r⊜i ∩un Suninary	2	VACUUM	1000	0.0000E+0	0 0	0	0	
	3	HYDROGEN	1	0.0000E+0	0 1	-2	296	
	6	CARBON	2	0.0000E+0	0 6	-2	296	
	7	NITROGEN	3	0.0000E+0	0 7	-2	296	
	8	OXYGEN	4	0.0000E+0	0 8	16	296	
	10	ALUMINUM	5	6.0240E-0	2 13	27	296	
	17	LEAD	7	3.2988E-0	2 82	-2	296	
	20	ARGON	6	0.0000E+0	0 18	-2	296	

Material Parameters – *dp/dx*

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X FileViewer: ex4001.out

<u>File E</u>dit <u>V</u>iew



Material parameters – *Transport thresholds*

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X FileViewer: ex4001.out

<u>File E</u>dit <u>V</u>iew

🗟 ex4001.out 1 Quantities/Biasing associated with each media: License/version - Nuclear Data - Mulmix Output WATER Rho = 1.00000 q/cm**3 Rlc= 36.0830 CM Requested Products/Decays
 Neutron Data 1.51100 11737.8 Ae = MeV Ue = MeV 0.333333 11737.3 Ap = MeV Up = MeV -🛅 dp/dx -🛅 Blank Common dÊ/dx fluctuations activated for this medium, level 1 below the threshold for explicit secondary electron production (up to 2I discrete levels, up to 2 K-edges) 🖹 Media Parameters -🛅 EMF-FLUKA -🖺 Fluka Particles ALUMINUM Rho = 2.69900 g/cm**3 Rlc= 8.89633 CM - Beam Properties - Particle Thresholds - Termination Conditions Ae = 1.51100 MeV Ue = 11737.8 MeV 0.333333 11737 3 Ap = MeV Up = MeV dE/dx fluctuations activated for this medium, level 1 production threshold for - Mult. Coulomb Scattering - EM Showers - Particle Importances below the threshold for explicit secondary electron production (up to 2I discrete levels, up to 2 K-edges) e[±] in MeV (total energy, LEAD 🗄 🦲 Scoring Rho = 11.3500 q/cm**3 Rlc= 0.561207 CM Material Properties
 Regions Summary
 Initialization Time not only kinetic) 1.51100 11737.8le₹ Ae = MeV Ue = 11737.3 0.333333 MeV MeV Ap = Up = dE/dx fluctuations activated for this medium, level 1 Output During Transport
 Events by Region
 Scattering Statistics below the threshold for explicit secondary electron production upper limit for e^{\pm} in MeV (up to 2I discrete levels, up to 🕺 K-edges) AIR 🗄 🤐 Run Summary . Rh zoom Ae ALUMINUM Ap dE q/cm**3 2.69900 Rlc= 8.89633 Rho. CM bel 1.51100 MeV Ue = 11737.8 MeV Ae = (up Ap = 0.333333 MeV Up = 11737.3MeV dE/dx fluctuations activated for this medium, level 1 below the threshold for explicit secondary electron production 2I discrete levels, up to 2 K-edges) (up to same for photons 12

Material parameters – *EMF-FLUKA*

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X FileViewer: ex4001.out

<u>File E</u>dit <u>V</u>iew



FLUKA Particles

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File

Edit View

exhaustive list of **FLUKA** particles

🕞 ex4001.out License/version 🗄 🕼 Input Echo - Nuclear Data - Mulmix Output - Requested Products/Decar -🗋 Neutron Data -🛅 dp/dx -🛅 Blank Common 🖹 Media Parameters -🗋 EMF-FLUKA E Fluka Particles Beam Properties - Particle Thresholds - Termination Conditions -🛅 Mult. Coulomb Scattering - EM Showers - Particle Importances 🗄 🦲 Scoring Material Properties
 Regions Summary
 Initialization Time Output During Transport
 Events by Region
 Scattering Statistics 🗄 🧐 Run Summary

=== Output before the actual run - Particle properties: ===

=== Transportable Fluka particles: ===

ys	Particle	Number	Mass (GeV/c**2)	Mean Life (s)	Charge	Baryon number	Discard Flag(=1)	Decay Flag	PDG id
	4-HELIUM	-6	3.7273803	1.000E+18	2	4	0	1	9999
	3-HELIUM	-5	2.8083922	1.000E+18	2	3	0	1	9999
	TRITON	-4	2.8089218	1.000E+18	1	3	0	1	9999
	DEUTERON	-3	1.8756134	1.000E+18	1	2	0	1	9999
	HEAVYION	-2	0.0000000	1.000E+18	0	0	0	1	9999
	OPTIPHOT	-1	0.0000000	1.000E+18	0	0	0	1	9999
	RAY	0	0.0000000	0.00	0	0	0	1	9999
	PROTON	1	0.9382723	1.000E+18	1	1	0	1	2212
	APROTON	2	0.9382723	1.000E+18	-1	-1	0	1	-2212
	ELECTRON	3	0.0005110	1.000E+18	-1	0	0	1	11
	POSITRON	4	0.0005110	1.000E+18	1	0	0	1	-11
	NEUTRIE	5	0.0000000	1.000E+18	0	0	1	1	12
	ANEUTRIE	6	0.0000000	1.000E+18	0	0	1	1	-12
	PHOTON	7	0.0000000	1.000E+18	0	0	0	1	22
	NEUTRON	8	0.9395656	889.	0	1	0	1	2112
	ANEUTRON	9	0.9395656	889.	0	-1	0	1	-2112
	MUON+	10	0.1056584	2.197E-06	1	0	0	1	-13
	MUON-	11	0.1056584	2.197E-06	-1	0	0	1	13

... continues on your screen!

...and many more

=== Generalised particles (201-233) (for scoring): ===

Generalised particle	Number
ALL-PART	201
ALL-CHAR	202
ALL-NEUT	203
ALL-NEGA	204
ALL-POSI	205
NUCLEONS	206
NUC&PI+-	207
ENERGY	208
PIONS+-	209
BEAMPART	210
EM-ENRGY	211
MUONS	212
E+&E-	213
AP&AN	214

Input interpreted summary – *Beam*

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X FileViewer: ex4001.out

<u>File E</u>dit <u>V</u>iew

🖯 aex4001.out === Output before the actual run - Beam properties === License/version 🗄 🕼 Input Echo - Nuclear Data - Mulmix Output Fluka incident beam properties: Requested Products/Decays
 Requested Products/Decays
 Neutron Data
 dp/dx
 Blank Common Beam particle: PROTON Id: 1 (Fluka) 2212 (PDG) Charge: 1 Baryon n.: 1 (GeV/c^2) Mean life: 1.0000E+18 (s) Weight: 1.000 Mass: 0.9383 4.337961 (GeV/c) Average beam momentum Average beam kinetic energy: 3.500000 (GeV) - Media Parameters Momentum deviation at FWHM (gaussian): 0.0824250 (GeV/c) - EMF-FLUKA - Fluka Particles Beam hit position 0.00000000 0.00000000 -0.100000000CM Beam direction cosines: 0.00000000 0.00000000 1.00000000 Beam Properties Beam spot FWHM X-width (Rectangular): 0.0000 CM - Particle Thresholds - Termination Conditions Beam spot FWHM Y-width (Rectangular): 0.0000 CM Beam FWHM angular divergence (Gaussian): 1.7000 (mrad) - Mult. Coulomb Scattering (Spatial distribution, polarization, and angular direction and distribution - EM Showers - Particle Importances are given in the beam frame of reference) Beam reference frame (world coordinates): 🗄 🦲 Scoring Beam X axis: 1.00000000 0.00000000 0.00000000 Material Properties
 Regions Summary
 Initialization Time 0.00000000 1.00000000 0.00000000 Beam Y axis: 0.00000000 0.00000000 1.00000000 Beam Z axis: Output During Transport
 Events by Region
 Scattering Statistics The nominal beam position belongs to region: 5(INAIR lattice cell: 0(🗄 🤐 Run Summary . Check where the beam is starting

Input interpreted summary – *Thresholds*

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X FileViewer: ex4001.out

<u>File E</u>dit <u>V</u>iew

🖯 aex4001.out === Particle transport thresholds: License/version Global cut-off kinetic energy for particle transport: 1.000E-02 GeV 🗄 🕼 Input Echo The cut-off kinetic energy is superseded by individual particle thresholds if set - Nuclear Data - Mulmix Output - Requested Products/Decays Cut-off kinetic energy for 4-HELIUM transport: 1.000E-02 GeV -🖹 Neutron Data -🛅 dp/dx -🖺 Blank Common Cut-off kinetic energy for 3-HELIUM transport: 1.000E-02 GeV Cut-off kinetic energy for TRITON transport: 1.000E-02 GeV - Media Parameters EMF-FLUKA
 EMF-FLUKA
 Fluka Particles Cut-off kinetic energy for DEUTERON transport: 1.000E-02 GeV Beam Properties Cut-off kinetic energy for PROTON transport: 1.000E-02 GeV Particle Thresholds Termination Conditions Cut-off kinetic energy for APROTON transport: 1.000E-02 GeV - Mult. Coulomb Scattering - EM Showers Cut-off kinetic energy for ELECTRON transport defined in the Emfcut card - Particle Importances Cut-off kinetic energy for POSITRON transport defined in the Emfcut card 🗄 🦲 Scoring Material Properties
 Begions Summary
 Initialization Time Cut-off kinetic energy for NEUTRIE transport: 0.000E+00 GeV Cut-off kinetic energy for ANEUTRIE transport: 0.000E+00 GeV - Output During Transport - Events by Region Cut-off kinetic energy for PHOTON transport defined in the Emfcut card - Scattering Statistics Cut-off kinetic energy for NEUTRON transport: 1.000E-14 GeV 🗄 🤐 Run Summary Cut-off kinetic energy for ANEUTRON transport: 1.000E-05 GeV Cut-off kinetic energy for MUON+ transport: 1.000E-02 GeV Cut-off kinetic energy for MUONtransport: 1.000E-02 GeV Cut-off kinetic energy for KAONLONG transport: 1.000E-02 GeV Cut-off kinetic energy for PION+ transport: 1.000E-02 GeV Cut-off kinetic energy for PIONtransport: 1.000E-02 GeV Cut-off kinetic energy for KAON+ transport: 1.000E-02 GeV Cut-off kinetic energy for KAONtransport: 1.000E-02 GeV Cut-off kinetic energy for LAMBDA transport: 1.000E-02 GeV

Input interpreted summary – TC, MCS, EM

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X FileViewer: ex4001.out

<u>File E</u>dit <u>V</u>iew

🕞 ex4001.out === Termination conditions: === License/version Maximum cpu-time allocated for this run: 10000000000000000.00 sec 🗄 🕼 Input Echo - Nuclear Data - Mulmix Output Minimum cpu-time reserved for output: 10000.00 sec Maximum number of beam particles to be followed: 1000 Maximum number of stars to be generated: infinite EMF-FLUKA
 EMF-FLUKA
 Fluka Particles
 Beam Properties
 Particle Thresholds
 Committee Thresholds === Multiple Coulomb scattering: === Moliere Coulomb scattering for primaries: 🚽 т Moliere Coulomb scattering for secondaries: T Termination Conditions 🖹 Mult. Coulomb Scattering Hadrons/muons: EM Showers Flag for MCS check with boundary normals: F Particle Importances Flag for Coulomb single scattering(s) at boundaries: F (# of Coulomb single scattering(s) at boundaries: 🗄 🦲 Scoring 1) - Material Properties - Regions Summary - Initialization Time Flag for single scatterings below min. (Moliere) energy: F Output During Transport
 Events by Region
 Scattering Statistics === Electromagnetic Showers: === 🗄 🤐 Run Summary EM showers are treated by the EMF (A.Fasso`, A.Ferrari, P.R. Sala) code Electrons/positrons: Flag for MCS check with boundary normals: F Flag for Coulomb single scattering(s) at boundaries: F (# of Coulomb single scattering(s) at boundaries: 1) Flag for single scatterings below min. (Moliere) energy: F



Materials – *Scattering lengths*

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X FileViewer: ex4001.out

<u>File E</u>dit <u>V</u>iew

🕞 ex4001 out	Material o	omnositions							I
	Materiar t	omposicions							P
Input Echo Input Echo Mulmix Output Requested Products/Decays Neutron Data Data	Material Number&Name	Atomic Number	Atomic Weight	Density	Inelastic Scattering Length for PROTON at Beam energy	Elastic Scattering Length for PROTON at Beam energy	Radiation Length	Inelastic Scattering Length for neutrons at Threshold Momentum	
-Blank Common				g/cm**3	cm	cm	cm	cm	
 Media Parameters EMF-FLUKA Fluka Particles Beam Properties Particle Thresholds Termination Conditions Mult. Coulomb Scattering EM Showers Particle Importances Scoring Material Properties Regions Summary Initialization Time Output During Transport Events by Region Scattering Statistics Run Summary 	Data reparticle particle the BEA 10 ALONINON 11 IRON 12 COPPER 13 SILVER 14 SILICON 15 GOLD 16 MERCURY 17 LEAD 18 TANTALUM 19 SODIUM 20 ARGON 21 CALCIUM 22 TIN 23 TUNGSTEN 24 TITANIUM 25 NICKEL 26 WATER Material HYDROGEN 0XYGEN	elated to type s A Card 25,00 29,00 47,00 14,00 79,00 82,00 73,00 11,00 18,00 20,00 73,00 11,00 18,00 22,00 73,00 11,00 18,00 22,00 74,00 22,00 28,00 3,333 Number	D the beam specified in 14 01 16 00 24 30 55 84 63 55 107.9 28.09 197.0 200.6 207.2 180.9 22.99 39.95 40.08 118.7 183.8 47.87 58.69 6.005 Atom content 0.66667 0.33333	000 000 3370E-04 1660E-03 848 000 1170E-02 1330E-02 740 2.699 7.874 8.960 10.50 2.329 19.32 13.55 11.35 16.65 0.9710 0.1660E-02 1.550 7.310 19.30 4.540 8.902 1.000 Partial Dens 0.11190 0.88810	0.1000E+31 0.7040E+06 0.3506E+06 39.41 39.52 0.7054E+05 0.6438E+05 55.31 36.71 15.55 13.97 14.12 43.04 9.239 13.25 15.97 10.44 97.58 0.6692E+05 71.73 20.91 9.055 25.79 13.87 81.49 sitie	$\begin{array}{c} 0.\ 1000E+31\\ 0.\ 1000E+31\\ 0.\ 1000E+31\\ 0.\ 1418E+07\\ 0.\ 6310E+07\\ 77.\ 65\\ 110.\ 5\\ 0.\ 1872E+06\\ 0.\ 1624E+06\\ 117.\ 7\\ 75.\ 04\\ 25.\ 41\\ 23.\ 26\\ 21.\ 47\\ 86.\ 54\\ 13.\ 14\\ 18.\ 79\\ 22.\ 54\\ 13.\ 14\\ 18.\ 79\\ 22.\ 54\\ 15.\ 03\\ 212.\ 4\\ 0.\ 1186E+06\\ 127\ 1\\ \hline Compo\\ interpretoto to the second sec$	0.1000E+31 0.7532E+06 0.5682E+06 35.28 21.35 0.2574E+05 0.2574E+05 14.39 8.896 1.757 1.436 0.8543 9.370 0.3344 0.4752 0.5612 0.4094 28.56 0.1178E+05 10.42 und	$\begin{array}{c} 0.\ 1000E+31\\ 0.\ 1000E+31\\ 0.\ 8508E+09\\ 0.\ 6024E+34\\ 17.\ 26\\ 18.\ 23\\ 0.\ 3319E+05\\ 0.\ 3013E+05\\ 26.\ 58\\ 17.\ 24\\ 9.\ 128\\ 8.\ 423\\ 10.\ 59\\ 20.\ 38\\ 7.\ 012\\ 9.\ 852\\ 12.\ 03\\ 7.\ 390\\ 47.\ 77\\ 0.\ 3754E+05\\ 36.\ 39\\ \end{array}$	
	27 AIR	7.262	14.55	0.1205E-02	0.6931E+05	0.1810E+06	0.3039E+05	0.3262E+05	
	Material	Number	Atom content	Partial Dens	sities				
	CARBON NITROGEN OXYGEN ARCON	6 7 8 20	0.15019E-03 0.78443 0.21075 0.46712E-02	0.14939E-06 0.90994E-03 0.27925E-03 0.15454E-04				10	
	mitton	20	0.401125-02	0.104042-04				19	

Regions summary

0 0

X FileViewer: ex4001.out

<u>File E</u>dit <u>V</u>iew

a 😋 ex 4001. out === Regions: materials and fields === License/version Region N. and Name Material N. and Name Magn. /El. Field (on/off) 🗄 🕼 Input Echo (Mat. N. and Name Magn./El. Field (on/off) for radioactive products) - 🗋 Nuclear Data Minimum and Maximum step size (cm) - 🖻 Mulmix Output 1 BLKHOLE BLCKHOLE OFF 0.00000E+00 9.99852E+04 1 Requested Products/Decays (1)BLCKHOLE OFF 🖹 Neutron Data 9.99852E+04 2 TARGS1 26 WATER OFF 0.00000E+00 🖹 dp/dx WATER (26) OFF) 9.99852E+04 TARGS2 10 ALUMINUM OFF 0.00000E+00 🖹 Blank Common 3 (10)ALUMINUM OFF Media Parameters TARGS3 LEAD 0.00000E+00 9.99852E+04 17 OFF 🖹 EMF-FLUKA (17 -LEAD OFF) -🖹 Fluka Particles 5 INAIR 27 AIR OFF 0.00000E+00 9.99852E+04 Beam Properties (27 AIR, OFF) - Particle Thresholds Termination Conditions -🖹 Mult. Coulomb Scattering - EM Showers - Particle Importances 🕀 🧰 Scoring - Material Properties Useful way to check Regions Summary Initialization Time material assignment -🖹 Output During Transport - Events by Region - Scattering Statistics 🗄 🤐 Run Summary Minimum/Maximum step sizes (set with STEPSIZE option otherwise default vaues are set)

Initialization time / Run informations

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X FileViewer: ex4001.out

<u>File E</u> dit <u>V</u> iew								ovent n	umbor t	imo
🗆 🔄 ex4001.out	=== End of th	e outpi	ut associ:	ated w	ith the i	nput ===			under, t	
License/version						-		the second second		
🕸 Input Echo								random s	seed, avel	rade
🗕 Nuclear Data	matal time was	d 6		-+	2 4 2		,			.ge
Halmix Output	I IUCAI CIME USE	u 101 .	Inicializ,	acron:	3.43	3		time user	l nor nrin	nary
Requested Products/Decays								LITTE USEL	וווע ושע ג	la y
- Neutron Data										
Hand dp/dx							/	available d	iurina the ri	un I
Blank Common										
Hai Media Parameters										
H EMF-FLUKA										
Harticles	1NUMBER OF BEAM		NUMBER OF	F BEAM	A	PPROXIMATE N	UMBER	AVERAGE TIME USED	TIME LEFT (RESERVED	NUMBER OF STARS
Har Beam Properties	PARTICLES HAND	LED	PARTICLE	S LEFT	0.	F BEAM PARTI	ICLES	BY A BEAM PARTICLE	10000.0 SECONDS	CREATED
Particle Thresholds					T	HAT CAN STIL	L BE		FOR PRINTOUT)	
Harmination Conditions					н	ANDLED				
Ha Mult. Coulomb Scattering	NEXT SEEDS	Π	Ω	n	n	0	Π	181cm 3039 0	n	
Ha EM Showers	1	Ŭ		999 Č	Ŭ	 999	Ŭ	3.0002594E-03	1.0000000E+30	1
Harticle Importances	NEXT SEEDS:	063	0	0	0	0	0	181CD 3039 0	0	
H Scoring	20			980		980	_	4.1494131E-03	1.000000E+30	19
B Daviana Commence	NEXT SEEDS:	2D145	U	0C0 U	U	U	U	181CD 3039 U	U 1 0000000 - 20	47
Regions Summary	40 NEXT SEEDS	ar99r	0	960 0	0	0 960	0	5.8991313E-03 181cm 3030 0	1.000000E+30	47
B Output During Transmost	60	1112221		940 Ŭ		940	Ů	6. 7989667E-03	1,0000000E+30	94
	NEXT SEEDS: 1	407A3	0	0	0	0	0	181CD 3039 0	0	
B Sectoring Statistics	80		!	920		920		6.2740505E-03	1.000000E+30	124
Per Scattering Statistics	NEXT SEEDS: 1	99F1E	0	0	0	0	0	181CD 3039 0	0	170
men Summary	100			900		900		6.8789625E-03	1.000000E+30	172

Results – *Scoring* Results of SCORE options for all region: **very useful** for debugging and for cross-check with estimators 000 X FileViewer: ex4001.out Edit View File 🔄 ex4001.out volume 1Region # name ALL-PART Star Density BEAMPART Star Density ENERGY EM-ENRGY Density Density License/version in cubic cm GeV/cm**3 GeV/cm**3 Stars/cm**3 Stars/cm**3 /one beam particle /one beam particle /one beam particle /one beam particle 2.928199323E+00 1 BLKHOLE 1.000000000<u>+</u>+00 0.00000000E+00 0.00000000E+00 4.557256612E-02 -🖹 Mulmix Output 2 TARGS1 1.00000000E 00 1.70000000E-02 8.00000000E-03 3.488408038E-03 1.713414203E-04 - Requested Products/Decays 5.70000000E-02 3.10000000E-02 8.922057690E-03 7.317583684E-04 3 TARGS2 1.00000000E+00 -🛅 Neutron Data 1.00000000E+00 1.56300000E+00 3.82000000E-01 3.983831246E-01 1.144531387E-01 4 TARGS3 🖹 dp/dx 5 INAIR 1.00000000E+0 8.50000000E-02 1.00000000E-02 9.016724646E-03 1.290495432E-03 Blank Common Total (integrated over volume) 1.722000000E+00 4.31000000E-01 1.622193000E-01 3.348009638E+00 Media Parameters EMF-FLUKA ***** Next control card ***** 0.000 0.000 STOP 0.000 0.000 0.000 0.000 Fluka Particles Beam Properties - Particle Thresholds # inelastic interactions of Termination Conditions Mult. Coulomb Scattering primary particles EM Showers Particle Importances Scoring - Material Properties - Regions Summary The volume is not automatically evaluated, 🕒 Initialization Time Output During Transport you have to specify it in the geom. description Events by Region Scattering Statistics 😂 Run Summary

Results – Statistics of Coulomb scattering

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X FileViewer: ex4001.out

<u>File E</u>dit <u>V</u>iew

🔄 ex4001.out	**** Total number of not-performed scatterings in FLUKA: 888
License/version	**** Total number of scatterings with no LDA in FLUKA: 12251
🕂 🐼 Input Echo	**** Ratio of rejected/accepted samplings from the Moliere's distribution in FLUKA: 0.0000
H Nuclear Data	**** (Total multiple scatterings: 9.5186E+04: Total single scatterings: 0.0000E+00)
H Mulmix Output	
Bequested Products/Decays	**** Total number of not-performed scatterings in FMF · 123
Hi Neutron Data	**** Total number of scatterings with no LDA in FMF 666
High dn/dx	**** Ratio of rejected/accepted samplings from the Moliere's distribution in EMF : 0,0000
High Blank Common	**** (Total multiple scatterings: 3.6342E+05: Total single scatterings: 0.0000E+00)
- Media Parameters	
B Fluka Particles	
B Ream Properties	
B Particle Thresholds	
B Termination Conditions	
B Mult Coulomb Scattering	
B EM Showers	
B Particle Importances	
En Asterial Properties	
B Designe Summers	
Hall Regions Summary	
Ha Output During Transport	
Har Events by Region	
E Scattering Statistics	
🕀 😂 Run Summary	

Results – Statistics of the run

X FileViewer: ex4001.out

<u>File E</u>dit <u>V</u>iew

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□	Total number of primaries run: 1000 for a weight of: 1.000000E+03 !!! Please remember that all results are normalized per unit weight !!! The main stack maximum occupancy was 81 out of 40000 available
☐ Núclear Data ☐ Mulmix Output ☐ Requested Products/Decays ☐ Neutron Data ☐ dn/dx	Total number of inelastic interactions (stars): 1722 Total weight of the inelastic interactions (stars): 1.722000E+03
- Blank Common - Media Parameters - EMF-FLUKA	Total number of elastic interactions: 1582 Total weight of the elastic interactions: 1.582000E+03
Fluka Particles Beam Properties Particle Thresholds	Total number of low energy neutron interactions: 20821 Total weight of the low energy neutron interactions: 2.082621E+04
Termination Conditions	Total CPU time used to follow all primary particles: 6.843E+00 seconds of
He INUIT. Coulomb Scattering	Average CPU time used to follow a primary particle: 6.843E-03 seconds of
Particle Importances	Maximum CPU time used to follow a primary particle: 4.699E-02 seconds of
Aterial Properties	Residual CPU time left: 1.000E+30 seconds of
Regions Summary Initialization Time Output During Transport Events by Region Scattering Statistics Scattering Statistics Scattering Statistics Scattering Statistics Totals/CPU time Totals/CPU time # of secondaries in stars # of fissions # of decay products # of particles decayed # of stopping particles # of part. from low en. neutrons Energy balance	CPU time is not real time!



Run summary: *detailed statistics*

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X FileViewer: ex4001.out

<u>File E</u>dit <u>V</u>iew

🚗 ev4001 out	Number of stars coner	ated per beam particle.	TEX.
	Promot radiation	Badioactine decene	IP
	1 7220F+00 (100 \$)		
EN Nuclear Date	0 0000ε+00 (100.0%)	0.0000F+00 (10.0%) generated by 4-HELIUM	
	0 0000E+00 (0.0%)	0.0000F+00 (0.0%) generated by 3-HELIUM	
	0.0000E+00 (0.0%)	0.0000E+00 (0.0%) generated by TRITON	
High Requested Products/Decays	1.0000E-03 (0.1%)	0.0000E+00 (0.0%) generated by DEUTERON	
Ha Neutron Data	0.0000E+00 (`0.0%)	0.0000E+00 (0.0%) generated by HEAVYION	
HB) dp/dx	0.0000E+00 (0.0%)	0.0000E+00 (0.0%) generated by OPTIPHOT	
Hank Common	0.0000E+00 (0.0%)	0.0000E+00 (0.0%) generated by RAY	
Media Parameters	6.4300E-01 (37.3≋)	0.0000E+00 (0.0%) generated by PROTON	
HI EME-ELUKA	0.0000E+00 (0.0%)	0.0000E+00 (0.0%) generated by APROTON	
H Fluka Particles	0.0000E+00 (0.0%)	0.0000E+00 (0.0%) generated by ELECTRON	
B Ream Properties	0.0000E+00 (0.0%)	0.0000E+00 (0.0%) generated by POSITRON	
B Particle Thresholds	U.UUUUE+UU (U.U%)	U.UUUUE+UU (U.U%) generated by NEUTRIE	
	U.UUUUE+UU (U.U%)	0.0000E+00 (0.0%) generated by ANEUTRIE	
	0.0000E+00 (0.0%) 0.0700≂ 01 (E0.1∞)	0.0000E+00 (0.0%) generated by PHUTUN	
Ha Mult. Coulomb Scattering	0.9700E-01 (32.1%)	0.0000E+00 (0.0%) generated by NEULINN	
Ha EM Showers	0.0000E+00 (0.0%)	0.0000F+00 (0.0%) generated by MUDIAU	
니희 Particle Importances	0.0000000000000000000000000000000000000	0.0000F+00 (0.0%) generated by MUON-	
🕀 🦲 Scoring	0 0000000000 (0.0%)	0.0000F+00 (0.0%) generated by KANNLONG	
Material Properties	5.0000E-02 (2.9%)	0.0000E+00 (0.0%) generated by PION+	
Ha Regions Summary	1.3000E-01 (7.5%)	0.0000E+00 (0.0%) generated by PION-	
H Initialization Time	0.0000E+00 (`0.0%)	0.0000E+00 (0.0%) generated by KAON+	
Output During Transport	0.0000E+00 (0.0%)	0.0000E+00 (0.0%) generated by KAON-	
B Events by Region	1.0000E-03 (0.1%)	0.0000E+00 (0.0%) generated by LAMBDA	
B Scattering Statistics	0.0000E+00 (0.0%)	0.0000E+00 (0.0%) generated by ALAMBDA	
	0.0000E+00 (0.0%)	0.0000E+00 (0.0%) generated by KAONSHRT	
B Totala (CDL) time	0.0000E+00 (0.0%)	0.0000E+00 (0.0%) generated by SIGMA-	
	U.UUUUE+UU (U.U%)	U.UUUUE+UU (U.U%) generated by SIGMA+	
= # of stars	U.UUUUE+UU (U.U%)	0.0000E+00 (0.0%) generated by SIGMAZER	
Har # of secondaries in stars	0.0000E+00 (0.0%)	U.UUUUL+UU (U.U%) generated by PIZERU D. 0000F.00 (U.U%) serveted by KAONEFDO	
Hand # of fissions	0.0000E+00 (0.0≷)	0.0000E+00 (0.0%) generated by KAUNZERO	
⊢ 🖹 # of decay products 🚬	0.0000E+00 (0.0%)	0.0000F+00 (0.0%) generated by ARADNALK	
# of particles decayed	0.00002+00 (0.0%)	0.0000F+00 (0.0%) generated by NEUTEIM	
# of stopping particles	0.00001000(0.0%)	0.0000F+00 (0.0%) generated by ANFUTEIM	
+ of part, from low en, neutrons	0.0000E+00 (0.0%)	0.000 +00 (0.0%) generated by RESERVED	
Energy balance	0.0000E+00 (0.0%)	Dotailed statistics per each particle	
	0.0000 E +00 (0.0%)		
	0.0000E+00 (0.0%)	0.0000 +00 (0.0%) generated by Astonazz	
	0.0000E+00 (0.0%)	0.0000E+00 (0.0%) generated by ASIGMA+	
	0.0000E+00 (0.0%)	0.0000E+00 (0.0%) generated by XSIZERO	

Energy Balance

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X FileViewer: ex4001.out

<u>File E</u>dit <u>V</u>iew

3 😋 ex4001.out - 🗋 License/version -🛅 Mulmix Output Requested Products/Decays Neutron Data – 🛅 dp/dx – 🕒 Blank Common - Media Parameters -🖺 EMF-FLUKA 🕒 Fluka Particles - 🖹 Beam Properties - 🖹 Particle Thresholds Termination Conditions - Mult. Coulomb Scattering EM Showers Particle Importances 🗄 🦲 Scoring - Material Properties - BRegions Summary 🕒 Initialization Time -🖹 Output During Transport Events by Region - Scattering Statistics 🕞 Run Summary -🖹 Totals/CPU time - A of stars + of secondaries in stars # of fissions - # of decay products + of particles decayed + f stopping particles # of part. from low en. neutrons Energy balance

(100.%) GeV available per beam particle divided into 3.5000E+00 Prompt radiation Radioactive decays 2.9309E-01 8.4%) 0.0000E+00 (0.0%) GeV hadron and muon dE/dx 3.3%) 1.1665E-01 0.0000E+00 (0.0%) GeV electro-magnetic showers 8.8952E-03 (0.3%) 0.0000E+00 (0.0%) GeV nuclear recoils and heavy fragments 0.0000E+00 0.0000E+00 (0.0%) GeV particles below threshold 0.0%) 0.0000E+00 0.0000E+00 (0.0%) 0.0%) GeV residual excitation energy 1.1821E-03 0.0000E+00 (0.0%) 0.0%) GeV low energy neutrons 2.9282E+00 0.0000E+00 ((83.7%) 0.0%) GeV particles escaping the system 1.6105E-02 0.0000E+00 (0.0%) GeV particles discarded (0.5%) 0.0000E+00 (0.0%) 0.0000E+00 (0.0%) GeV particles out of time limit 1.3589E-01 3.9%) GeV missing

Particles below threshold:

- Hadrons and muons below threshold are ranged out unless the threshold >100 MeV;
- e[±]/γ (EM- showers are not included).
 Escaping the system: going to *blackholes*.
 Discarded particle (i.e. neutrinos).

Missing Energy: Calculated by difference:

- pure EM problems it should be 0;
- in hadronic problems it is the energy spent in endothermic nuclear reactions (≈ 8 MeV/n), or gained in exothermic (i.e. mostly neutron capture): it is –total Q.

Error message

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X FileViewer: fluka_11407/ex4001.out

<u>F</u>ile <u>E</u>dit <u>V</u>iew

- Gatluka 11407/av4001 d										
E License/version	***** Next	control card *****	USRBDX	10.00	1.0000E-03	40.00	0.000	0.000	0.000	&
energy Scoring Bern Summary La ERROR	***** Next	control card *****	USRBDX	99.00	218.0	-50.00	4.000	5.000	329.9	Sp3ChH
	***** Next	control card *****	USRBDX	10.00	1.0000E-03	40.00	0.000	0.000	0.000	&
	***** Next	control card *****	USRBDX	99.00	218.0	-54.00	3.000	4.000	78.54	Sp2ChHA
	***** Next	control card *****	USRBDX	10.00	1.0000E-03	40.00	0.000	0.000	3.000	&
	**** Next	control card *****	USRTRACK	-1.000	218.0	-55.00	4.000	628.3	40.00	TrChH
	***** Next	control card *****	USRTRACK	10.00	1.0000E-03	0.000	0.000	0.000	0.000	&
	**** Next	control card *****	USRYIELD	124.0	209.0	-57.00	4.000	5.000	1.000	YieAng
	**** Next	control card *****	USRYIELD	180.0	0.000	18.00	10.00	0.000	3.000	&
	**** Next	control card *****	RESNUCLE	3.000	-60.00	0.000	0.000	4.000	0.000	activ
	***** Next	control card *****	START	1000.	0.000	0.000	0.000	0.000	0.000	
	Total time	used for input readi	ing: 4.999	E-03 s						

**** Region n. 4 (TARGS3) has no assigned material, run stopped **** Abort called from PRCHCK reason NO MATERIAL ASSIGNED TO A REGION Run stopped! STOP NO MATERIAL ASSIGNED TO A REGION

Flair: Data Processing



- Flair the first time scans the input for possible unformatted output data for each scoring card. It creates automatic rules for processing (merging).
 - If in the mean time you have modified the input click the "automatic" scan
- The default names are
 generated by the rules specified in the preference dialog
- The automatic rules could be modified by manually adding or removing files or by advanced pattern matching with the filter dialog

Plot List

		Plot List							
File		Title	Туре			Plots can be created in the "Plot"			
geometry enedep fluence resnuc	nTOF Target (Deposited Ene Particle Fluen Resitual Nucle	nTOF Target Geometry Deposited Energy Particle Fluence Resitual Nuclei		USRBIN USR-1D RESNUCLE		list frame. Either Add new plots or Clone from existing ones. It is important to set a unique filename for each plot. This filename will be used for every auxiliary file that the plot needs (changing the extension) The Filter button creates automatically one plot for each processed unit Double click on a plot, or hit Enter or click the Edit icon to display the plotting dialog			
						The list box is editable with a			
Plot Type	2C					"Slow Double Click"			
 Geor USRI USR· 	metry BIN -1D	For geometry plots For plotting the output of L To plot single differential q USRBDX, USRTRACK, USRCOLL	JSRBIN Juantities fro ., USRYIELD	om car	• ds	Right-click brings a popup menu with all options			
USRRESIUSEI	-2D NUCLE RDUMP	To plot double differential To plot 1d or 2d distributio To plot the output of USER visualizing the source distri							

Plotting Frames

USRsss Single Differential Plot

Plot		(
Title: USR-1D ngen_usrtrack_61	Options:	
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Y:	Opt: 🔽 legend Width:	Height:
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Gnuplot commands		
		M Plot
		5 Replot
		🛃 Save

All plot types share some common fields:

Title + options, Filename, Axis Labels, Legends (Keys) and Gnuplot Commands.

Plot button (Ctrl-Enter) will generate all the necessary files to display the plot, ONLY if they do not exist.

Re-Plot will force the creation of all files regardless their state Check the gnuplot manual to provide additional customization commands: e.g. To change the title font to Times size=20, add in the Opt: field the command: font 'Times,20'

General Tips

- To set some default parameters for gnuplot, create a file called ~/.gnuplot
- The output window displays all the commands sent to gnuplot. As well as the errors. In case of problem always consult the output window!
- In the Gnuplot commands you can fully customize the plot by adding manually commands. Please consult the gnuplot manual for available commands
- All buttons and fields have tool tips. Move the cursor on top of a field to get a short description

Geometry Plotting

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- For geometry plotting the following information is needed (Fields with white background):
 - Center (x,y,z) point defining the center of your plot
 - Basis (U,V): Two perpendicular axis vectors defining the new system
 - Extends (DU, DV) of the plot. The total width/height will be twice the extends
 - Scanning grid (NU, NV): how many points to scan
 - Plotting type (Only borders, Regions, Materials, ...)

Geometry Plotting

- All input fields with light-yellow background are used to perform operations on the previous fields. e.g. to rotate the basis-vectors
- When the "Plot" button is pressed, flair will create a temporary input file containing only the geometry and the related information together with the appropriate PLOTGEOM card. It will start a FLUKA run, and on exit it will convert the PLOTGEOM file in a format that gnuplot understands

USRBIN

- With the USRBIN plotting frame you can perform:
 - 2D projection or region/lattice plot
 - 1D projection or region/lattice plot
 - 1D maximum trace
 - 1D trace scan

of the data or errors from USRBIN data.

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Projection & L	imits	2D Histogram 1	D Histogram Region	
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- Set the usrbin summary file in the File: field
- Select from Det: the detector to use.
- All the available detector information will be displayed
- The information Mininum, Maximum and Integral will be filled after the plot! WARNING: it is always the projection min/max

USRBIN (2D plot)

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Projection & Limits	Type:	2D Projection	▼
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English a presentation			

- Select the "2D Projection" type
- Select the projection axis, limits, and rebinning
- swap: will exchange the plotting X and Y axis
- errors: will plot the (uncorrelated) error values as color plot
- Get: will get the projection limits from the gnuplot window
- Norm: is the normalization value or expression. You can even define a function to use as normalization using as argument x: e.g. 5*x**2+4*x
- log: select linear or log in the color bar axis

USRBIN (2D plot) cont.

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Norm:	✓ log Palette: FLUKA	▼ Round Axes: Auto ▼
Coupled a procession		

• The Minimum, Maximum, Colors and CPD (Colors Per Decade) are interconnected.

log10(Max) = log10(Min) + Colors/CPD

- Once the value is changed in one field, the Max will be calculated accordingly
- Palette: offers a possibility to the user to choose from various predefined palettes. The user can define his own palette using the "set palette" command from the "Gnuplot commands" text box

USRBIN (2D plot) cont..

Superimposing the geometry can be done either automatically or manually

- Auto: Select –Auto- in the Use: field of the Geometry and the program will try to draw the geometry at the middle of the limits on the projection axis. To change the position modify the Pos: value
- Manual: The dropdown listbox will display also a list of all geometry plots in the flair project. Select the one you prefer and the plotting axis. The manual mode can be used in special cases when the usrbin file do not contain the absolute coordinates

USRBIN (1D-plots)

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Projection & Limits	Type: 1D Projection	V
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Annalis contractor		

1D Projection

• Select the projection axis from "Projection & Limits" as before WARNING: When making projections the error is typically underestimated.

1D Max

• Same as the 1D Projection, but displays only the maximum value on each slice. (eg. on a Z-projection, it will display the maximum on each X-Y slice)

1D Trace H or V

 Displays the position of the maximum and also the FWHM on either the horizontal or vertical plane (requires the usbmax.c prg)
 Plotting Style: (see USR-1D) 38

USR-1D Single Differential Plot

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Detectors		Detector Info
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	7.	Smooth: V Color: V Style: 0 0
Templel seconds		

- USR-1D is able to plot the 1D single differential information from the USRBDX, USRCOLL, USRTRACK and USRYIELD cards (The 2D information is not handled).
- The file type in use should have the extension **__tab.lis** and are generated by the FLUKA data merging tools (See Data Frame)
- You can superimpose many scoring output in a single plot.

USR-1D Single Differential Plot

The basic steps to create a plot are:

- Add or Clone a _tab.lis file, in the Detectors listbox.
- Select the detector to be used from the Det: dropdown listbox
- Set a name in the Name: field. Names starting with # will not be displayed as keys in the plot
- Select the X: and Y: information to plot as well the Style: X,Y,Style have different values.
 Note: Different combination will be interpreted in different way from gnuplot, resulting to maybe unwanted results
- You have the possibility to select:
 - Plotting axes
 - Smoothing of the plot
 - Color, line type, width, point sizes etc. (Enter the command "test" in the gnuplot command and hit "Plot" you will get a plot of all possible types)
 - Predefined styles

USR-1D Plots

- X: choices: [xl, xh refer to the limits of each individual bin of the histogram]
 - GeoMean [sqrt(xl*xh)]
 - Mean [(xl+xh)/2]
 - Low [xl]
 - High [xh]
- Y: choices:
 - Y
 - Y × <X>
 - Y × <Xgeo>
 - $Y \times XI$
 - $Y \times Xh$
 - $Y \times DX$

Geometrical mean. Should be used if X is scored as a log-histogram Normal mean. For linear scoring Low value of the bin High value of the bin

Y-bin value as given by FLUKA
Y-bin value multiplied by the mean
X value of the bin (Isolethargic)
Y-bin value multiplied by the
geometrical X-mean of the bin
(Isolethargic)
-//- with the X-low value of the bin
-//- with the X-high value of the bin
-//- with the width of the bin

USR-1D Plots

- Style: has a huge list of choices as given by gnuplot. You can consult gnuplot manual for the description of the options. Some suggested settings are the following:
 - To make a line/scatter plot with or without errors
 - GeoMean (if scored in log), Mean (if scored in linear) X: Y:
 - $Y \times \langle Xgeo \text{ or } X \rangle$, for isolethargic plotting
 - Style: lines, linespoints, dots, errorbars, yerrorbars, errorlines...
 - To make a histogram
 - X: Xlow [xl] **Y**:
 - what ever choice you want to plot
 - Style: steps
 - or X: Xhigh [xh] Style:
 - <u>hi</u>steps

USR-1D Plots

- You have the possibility to superimpose plots. Useful if you want to show histograms with superimposed error bars superimposed.
- You can selected angular slices from USRBDX data using the "Block" option

 You can superimpose experimental data or any other data file and override all options using the "Using:" input field