FLUKA



Introduction to Flair.

23rd FLUKA Beginner's Course Lanzhou University Lanzhou, China June 2–7, 2024 About





V.Vlachoudis "FLAIR: A Powerful But User Friendly Graphical Interface For FLUKA" Proc. Int. Conf. on Mathematics, Computational Methods & Reactor Physics (M&C 2009), Saratoga Springs, New York, 2009

flea(r)

n [U,C] natural or instinctive ability (to do something well, to select or recognize what is best, more useful, etc. [Oxford Advanced Dictionary of Current English]

Introduction to Flair



FLUKA Advanced Interface [http://www.fluka.org/flair]

- All-in-one User friendly graphical Interface
- Minimum requirements on additional software
- Working in an intermediate level Not hiding the inner functionality of FLUKA, exploiting FLUKA utilities

Front-End interface:

Fully featured Input file Editor

Writes a standard .inp file

- Mini-dialogs for each card, allows easy editing
- Error checking and validation of the input file during editing
- Geometry: interactive visualization, editing, and debugging
- Generation of the FLUKA Executable if needed Through Ifluka and Idpmqmd
- Running and monitoring of the status of a/many run(s)

Through *rfluka*

Back-End interface:

- Inspection of the fluka_nnn subdirectories
- Fluka output file viewer divided in sections
- Post processing (merging) the output data files
- Plot generation through an interface with gnuplot

Other Goodies:

- Access to FLUKA manual as hyper text
- Checking for release updates of FLUKA and flair
- Nuclear wallet cards
- Library of materials

Look at it!! Utilities in \$FLUPRO/flutil

Look at it!!







Flair website http://www.fluka.org/flair (download and documentation) Two packages:

- flair : input / run and data handling / plotting
- flair-geoviewer: geometry handling and visualization

the python3 version is now recommended!

Installation using RPM/DEB packages (strongly recommended!). As super-user:

rpm -ivh flair-X-XX.noarch.rpm flair-geoviewer-X-XX.X86-64rpm or

dpkg -i flair_X.XX-X_all.deb flair-geoviewer_X.XX-XX_amd64.deb

- The package will create all file associations, menu items, and keep track of updates.
- The package will install the program to: /usr/local/flair

Installation using tar files when necessary (non-compatible operating system, no admin): see the website for instructions



Programs Menu (Linux)

Click the icon of Flair from the programs menu

Usually, Flair is in the Science/Physics sub-menu but this can change depending on the Linux distribution and window manager (look also in Applications, Education, Science, or Others sub-menus)

Window Manager (Linux, only via RPM or DEB installation)

Flair makes an association of the following extensions:



Console

Type the command flair

Check that your \$PATH includes the directory where flair is installed



At startup, flair

- Opens its window at the "flair" page
- Checks for the existence of a FLUKA installation (looking for the FLUPRO env. var.)
- Opens the "Check for Updates" dialog box (every 30 days interval)
- Reads the initialization files: /usr/local/flair/flair.ini and \$HOME/flair/flair.ini these contain standards and personal preferences about fonts, colors etc. Can be changed from the Config menu, not described in this lecture

#	🚔 🗕 + [untitled] - flair 💦 - 😐 🗙										
	🕬 📲 📲 📲 📲 • • • • • • • • • • • • • •								•		
*	Cut	🖬 👛 🖬	No	rmal		V		Report	0		
Paste	Сору	New-Open-Save	•	* 1	e / U S	•	Document Print Refresh	Config Opdates	Exit		
Clipbo					Edit						
0							Flair				×
Notes	;										
Inp:						C)ir: /home/psala	Exe:			**

Introduction to Flair

From here, one can open the various subpages (Input, Geometry, Run, Plot) and have fun

As soon as something is added, flair creates and fills a project file with extension flair



Store in a single file all relevant information:

- Project notes
- Links to needed files: input file, user routines, output files ...
- Definition of Multiple runs from the same input file
- Procedures on how to run the code
- Information on how to post process and create plots of the results

The format is plain ASCII with extension: .flair

To save it and give it a name:

■ the Save button in the flair main page, or at exit

To read it back:

- the Open button, or
- flair myproject.flair

2							- 1	· [u	Inti	itled] - fla
0 * * * ¹ 4	Flair	Inp	ut 🕬	Geor	net	ry	^A R	un	P	lot
	Cut		-	les!	No	ma	1		•	
Paste	Conv	Marrie		C		+	4	1		Document
	Coby	New-	Open-	Save-		2	U	5		
0										Flair
Note	s									
-	-									
1										
Inn [.]									D	ir: /home

The Input page



From the input page one can

- Load an existing input file
- Create New from template and modify it
- just start adding cards

and of course Save the inp

9 47			+ 1	[untitled] ·	flair			^
••••• •Flair •Input	Geometry ARun	=Plot					Calc	ulate
Paste Copy	×port • Preproce •Material	ssor ▼×Delete	Show- Comment- Comment-	•Move Up	*all* Search	▼ * >Viewer >Editor		
sop) a sdecay	••Change •	Clone St	ate- Kefresh			aprint		
empty	, Cal	u	Edit	Les est	Filter	view		
Saparal Slattice	-ions	precision simul	ations	inpu			1	
Primary sno ge	ometry TS	precision sinu	PRE					
Geometry®Voxel	e beam ch	aracteristics	11424	0.010				
Media	*BEAM		Beam: Morr	nentum 🔻	p:		Part: 🔻	
Physics	∆p:Flat ▼		Δp:		∆¢: Flat ▼		Δφ:	
Transport	Shape(X): Recta	ngular 🔻	Δx:		Shape(Y): Rectangula	ar 🔻	∆y:	
Biasing	Define the beam po	sition	¥1		V:		7.	
-Scoring	52A 03		cosx:		cosy:		Type: POSITIVE V	
Preprocessor	*+1+ BEAM	2+3	3+4.	+5.	+▼+7+			

Here we start a New from template Basic



🚔 + [untitled] - flair ^ - 1								
🐖 🖷 Flair 🔋 Input - Geometry 🕸 Run 🖷 Plot 💦 Calculator 🔻								
*Cut Load Paste Copy Save- *Ir	xport ▼	e Show· • Move Up Comment· State-®Refresh • Move Down	*all* Search	▼≜ ©Viewer ≠Editor ≈ ≠Print				
Clipboard Inpu	it Card	Edit	Filter	View				
0		Input			▲ ×			
 ✓Input ✓General ✓Primary ✓Geometry ✓Geobegin 	Define the beam characteristics *BEAM △p:Gauss ▼ Shape(X):Annular ▼	PRECISIO ▼ PRECISIO ▼ Beam: Energy ▼ Δp(FWHM):0.2355 Rmin:	E:20.0 △Φ:Flat ▼ Rmax:	⊥ Part: PROTON ▼ Δφ:				
 Bodies Region Geoend Media Physics 	*+1+2+ BEAM -20.0 -0.2		+ ▼+7+. <mark>-</mark> 1.0PROTON		1			
Inp: +	Active:3	Total:20			m 20			

Flair cards are extensions of the input cards, containing command, whats, and more:

- Comments
- Assemble continuation cards

- Fillable fields for whats with numbers
- Extra fields for multiple-meaning whats
- Drop-down menu for whats whith choices



#		+ [untitled] - f	flair		^ _ D X
Flair Input	Geometry & Run Plot			• C	Calculator 🔻 🖷
*Cut Load Paste Copy Save- *I	xport ▼ •Preprocessor ▼ ×Delete ●Material ▼ mport ▼ Add-●Change ▼ @Clone	Show- Move Up Comment- State-Refresh Move Down	*all* Search	Viewer Editor Print	
Clipboard Inpu	ut Card	Edit	Filter	View	
⊚ ∾General ∾Primary	*DEFAULTS Define the beam characteristics *BEAM	PRECISIO V Beam: Energy V	E:20.0	Part: PROTON V	
Geometry Geobegin Bodies Region Geoend Media	Ap: Gauss ▼ Shape(X): Annular ▼ *+1+2+ BEAM -20.0 -0.2	۵۵ (FWHM): 0.2355 Rmin:	AΦ:Flat ▼ 	Δφ:	
Physics Inp: +	Active:3	otal:20			12 #125

Flair cards are extensions of the input cards, containing command, whats, and more:

Always check the real input card

The card as written in the input file is shown at the bottom of the page

Check that it is what you wanted! Using the manual

You can open the manual from flair: the blue icon at the top-right or F1



	±	±	±	
*MATERIAL	Name: Skeletal	#	P:1.05	
Z:	Am:	A:	dE/dx: 🔻	
COMPOUND	Name: Skeletal 🔻	Mi×: Mass ▼	Elements: 79 🔻	
f1:10.1	M1: HYDROGEN V	f2:17.1	M2: CARBON V	
f3:3.6	M3: NITROGEN 🔻	f4:68.1	M4:OXYGEN 🔻	
f5:0.4	M5: POTASSIU V	f6:0.3	M6: SULFUR V	
f7:0.2	M7: PHOSPHO V	f8:0.1	M8: CHLORINE V	
f9:	M9: 🔻			
*+	2+3+4+5	+▼+7+		2
COMPOUND -10.3	L HYDROGEN -17.1 CARBON	-3.6 NITROGENSkeletal		
COMPOUND -68.3	L OXYGEN -0.4 POTASSIU	-0.3 SULFURSkeletal		
COMPOUND -0.2	PHOSPHO -0.1 CHLORINE	Skeletal		

Another example: Compound card, all continuation cards together, a field to choose the type of composition (mass/volume/atoms)

more on cards

A					+	[untitled]	- flair			
ACut ANew Paste Copy Save	Export •	Preprocessor Preprocessor Add a Change *	• Delete	State-al	Show- Comment- Refresh	Move Up	*all* Search		▼ • •V	
		General	Contract							
Input General Primary Geometry Media Physics Transport Biasing	'MAT	Primary Geometry		Name: Skeletal			ut	i and a second se		
	COM Physics Transport Biasing Scoring Flair		*ASSIGNMAT me: Skeletal * *COMPOUND MI: HYDROGEN * CORFACT MI: POTASSIU * LOW-MAT MI: PHOSPHO * LOW-PWXS MI: *		Mic Mass v (2:17.1 14:68.1 16:0.3 18:0.1					
Scoring Flair Preprocessor	*ASSI *ASSI *ASSI *ASSI *ASSI	Preprocessor !#\$ ABCD	MAT-PRO MATERIA OPT-PRO STERNH		Mat: BLC ay): • Mat: VAC	KHOLE V		Reg:BLKBOD' Step: Reg:VOID ¥ Step:	(•	
	*ASS	EF	Mat:COPPER V			Reg:TARGET *				
	Set tr	GHIL MOPQ	seed Unit 01 + ary histories to be simulated in the run No Time:				Seed:			
	Set thR STAIS	S TUV				un	Core: ¥ Report: default ¥			
	COMPC	**WXYZ COMPOUND -10.1 COMPOUND -68.1 COMPOUND -0.2		3 SEN SEN PHO	-17.1 -0.4 -0.1	CARBON POTASSIU CHLORINE	-3.6 -0.3	NITROGENSkel SULFURSkel Skel	etal etal etal	
Inp: +		A	tive:20	Total:	26					

13

Cards can be

- Edited (click on it)
- Added
 - they are grouped in categories
- Cloned
- Enabled / Disabled
- deleted

Saving

The input can be saved at any moment ("Save") Or when Saving the project (from the flair main page) Or when exiting flair (it asks) remember: the "master" for Fluka is the input file, not the flair file

Example, with the basic input template





- Four projections: Blue, Green, Red, Magenta
- can move "Pan", zoom in, zoom out..
- projection planes moved with hatched lines

Example, with the basic input template



 Four projections: Blue, Green, Red, Magenta

- can move "Pan", zoom in, zoom out.
- Mouse click with "info" or "select" active: information on region/material/position



Example, with the basic input template





- Layers define what is polotted
- Default is Media (colors==materials)
- Powerful 3D Layer
- Layers can be customized

Example, with a geometry error added on purpose



- Defined a hole in the target
- Forgot to take away from the target
- The message Error found appears
- The zone is hatched
- Mouse click shows two regions in the same place
- Lateral panel gives error points



Run Run settings

A		+ [untitled] - f	lair	∧ _ □ ×
	etry ARu	un ¤Plot		🔺 Compile 🔻 🖤
Clipboard	e Up ×P e Down ∘L ame ≉C Input	Remove *Default Verve oop Continue No Clone Attach To Job Run	/:0 0:5 Clean [€] Run Kill Action	▲ ×
+ Run	Spawn	Title Charged pion	fluence inside and around a p	roton-irradiated Be ta
<untitled></untitled>		Primaries 0	Rnd 0	a
		Time 0	Exe	× -2
		Defines Defau	lt Defines	
		Name	Value	
		Progress		
		Status: Finished OK	Input: example	Dir:
		Started:	ETA:	Time/prim:
		Elapsed:	Cycle:	Run:
		Cycles:		
		Primaries:		
Inp: example.inp		Running 0 out of 1		# 20

- Basic use: run fluka
- Choose number of cycles and previous cycle
- Advanced use will be explained later
- $\blacksquare \rightarrow \mathsf{start}$
- launchs the \$FLUPRO/flutil/rfluka script

18

Introductiexample!inp

Run Run settings II

Here with example.inp from the standard distribution

#	+ [u	ntitled] - flair		∧ _ □ ×
	try *Run •Plot			🔺 Compile 🔻 🕫
*Cut Paste Copy Clipboard View	Up ×Remove 4*Defa Down 9Loop Contin me &Clone #Attact Input	ult ♥Prev: 0 nue No: 5 n To: 5	Clean *Run Refresh Start *Kill Action	
© .	Creative Title Cl	Run		×
+ Kun <untitled></untitled>	Primaries 0		Rnd 0	proton-irradiated Be ta
	Time 0	Default D	Exe	××
	Derines	Derault D	Value	
	INC	anne	Value	P
	Programs			
	Status: R	unning	Input: example	Dir: fluka 199
	Started: 2	024.04.24 10:2	7: ETA: 2024.04.24 10:28	Time/prim: 0.102406
	Elapsed: 9	.42136 s	Cycle: 819.249 ms	Run: 36.8511 s
	Cycles:	(Current: 2 [5] Completed:	20%
	Primaries:	Currer	t: 92001 [100000] Comp	leted: 92%
Herevannie inn	Bunning	0 out of 1		=×

Iaunchs the **\$FLUPRO/flutil/rfluka** script

and keeps track of the status



Intro

Run

H

Output files

example!inp	

ere	with	example.inp	from	the	standard	distribution

A	🙀 🔶 + [untitled] - flair 🔋 🔥 - 😐 🗴								
•Flair •Input •Geome	etry ARun Plot			🔺 Compile 🔻 🕈					
*Cut Paste _Copy Clipboard	Filter VI	ewer Editor							
Output files inspecting particular									
 <untitled></untitled> 	001 002 003 004 005 006 compile data input	example001_fort.50 example001_fort.51 example001_fort.47 ranexample001_fort.47 example001_fort.49 example001_fort.48 example001_fort.48	50 51 Output 47 -file- 49 48 Error	Size Date 24002:2024.04.24 I 1 8238 2024.04.24 I 21561:2024.04.24 I 1 4324 2024.04.24 I 1651 2024.04.24 I 282 2024.04.24 I 282 2024.04.24 I 282 2024.04.24 I 282 2024.04.24 I 29650 2024.04.24 I					
	input plot temporary	example001.log example001_fort.77 example.out	Log 77 . Output	12984 2024.04.24 1 5195742024.04.24 1 5158 2024.04.24 1					
H6tiexample!inp	Files: 11 Total S	Size: 3197996		# 2					

- Warning:: flair output is not fluka output
- example.out contains what would be on the screen when you run from the command line
- example001.out is the real fluka output



Intro

Run

Output files

elinp	 Files: 1

Flere with example.inp from the signation distribution
--

🚆	+ [untitle	d] - flair		∧ _ □ ×
🗝 🗝 Flair 🏽 Input 🗣 Geome	etry ARun Plot			🔺 Compile 🔻
Cut Paste Copy Copy Copy	ilter	Viewer Editor		
Clipboard Vic Output files	Files	Action		
inspecting pa	age	Run		×
+ Run <untitled></untitled>	Spawn Cycles 001 002 003 004 005 006 compile data input plot temporary	File example001_fort.50 example001_fort.51 example001_fort.47 ranexample001 example001_fort.49 example001_fort.48 example001_err example001_err example001_fort.77 example.out	Type 50 51 Output 47 -file- 49 Error Log 77 Output	Size Date 24002 2024.04.24 1 24002 2024.04.24 1 21561 2024.04.24 1 4324 2024.04.24 1 1651 2024.04.24 1 282 2024.04.24 1 29650 2024.04.24 1 29650 2024.04.24 1 15957 2024.04.24 1 5158 2024.04.24 1
and example inp	Files: 11 Total	Size: 3197996		



double click on example001.out

www.fluka.org

Run

Output files

Here with example.inp from the standard distribution

		+ [untitle	d] - flair				∧ _ □
+Flair >Input +Geome	try «Run »Plot					× \	/iewer 🔻
Paste Cut Copy Search	Load Rel	oad Edit Print Close					
Clipboard Searcl	n	File					
0		Vi	ewer				>
Files	1Region # name	volume	ENERGY	Density	BEAMPART	Star Density	
example001.out	Star Density	Star	Density				
 License/version 		in cubic cm	GeV/	cm**3	Stars/cm	**3	Stars,
sinput Echo	cm**3	Stars/cm**3					
 Nuclear Data 			/one be	eam particle	/one bea	m particle	/one
- Mulmix	eam particle	/one beam par	ticle				
a Products/Decays	· ·						
- Neutron	1 reaBH1	1.000000000D+6	0	4.824728814D+01	0	.000000000D+00	3
-Blank Common	0.000000000D+00	0.00006	0000D+00				
-Madia Parameters	2 regVA2	1.00000000D+6	0	0.00000000D+00	0	.000000000D+00	3
AME	0.000000000D+00	0.00006	0000D+00				
aParticles	3 reaBE3	1.000000000D+6	0	1.306563311D-02	6	.372000000D-02	2
Beam	0.0000000000000000000000000000000000000	0.00006	00000+00		-		
Particle Thresholds	4 regBF4	1.0000000000000000000000000000000000000	000000.000	1.8244150940-02	5	80800000-02	,
a Termination Conditions	A 000000000000000000000000000000000000	0 00000	00000+00	110211250510 02	5	100000000000000000000000000000000000000	
Mult. Coulomb Scattering	0.00000000000000	0.00000	00000100				
+EM Showers	Total (integrat	out aver velume)		4 9279507020+01	1	2190000000.01	
Scoring				4.02/039/930+01	1	.210000000-01	-
Material	0.00000000000000	0.00000	00000+00				
Regions	***** Nout cont		CTOD	0.000	0 000	0.000	0 000
 Initialization Time 	a ana Next Cont		STUP	0.000	0.000	0.000	0.000
 Output During Transport 	0.000 0						
Events by Region							
 Scattering Statistics 							
 Run Summary 							
ERROR							
Inp: example.inp							,

- The fluka output divided in sections
- Always have a look!!!
- especially when setting up a simulation
- or in case of crashes



Run

Merge Data

Here with example.inp from the standard distribution

🚔	+ [u	ntitled] - flair				∧ – □ ×
+Flair >Input +Geometry +F	Run Plot				⊂ Vie	ewer 🔻
*Remove Paste _Copy un'ile at Scan *Remove *Rename	Add Remove Rules					
Merge output	Files Action	Run				A X
+ Bun Snaw	n Usrxxx					
<untitled></untitled>	Bun	Command		Output		Unit
	<untitled></untitled>	usrbdy	example 47 hpx	output		47
	<untitled></untitled>	usrtrack	example 48.trk			48
	<untitled></untitled>	usrtrack	example 49.trk			49
	<untitled></untitled>	usrbin	example 50.bnn			50
	<untitled></untitled>	usrbin	example 51.bnn			51
	Parameters • Files					
	File	,	Type	Size	Date	
	example001 fort 47		47	4324	2024 04 24 10	27.26
	example001_fort.48		48	282	2024.04.24 10:	27.26
	example001 fort 49		49	282	2024.04.24.10	27:26
	example001 fort 50		50	2400238	2024 04 24 10	27.26
	example001 fort.51		51	8238	2024.04.24 10:	27:26
	example002 fort 47		47	4324	2024.04.24 10:	27:39
	example002 fort 48		48	282	2024 04 24 10	27:39
	example002 fort.49		49	282	2024.04.24 10:	27:39
	example002 fort 50		50	2400238	2024.04.24.10	27:39
	example002 fort 51		51	8238	2024 04 24 10	27.30
Inp: example.inp	Files: 25					

 "Process" mergse data from different cycles

- launchs the utility programs in \$FLUPRO/flutil/
- Wait for the scoring lecture for details



Plot



Here with example.inp from the standard distribution

A		+ [untitled] - flair			∧ _ ¤ ×
+Flair >Input +Geometry	/ «Run »Plot				Viewer v
Paste Copy Tenne aC	Print Clean Plot				
Geometry	Accord	Plot			▲ ×
Red HISP-2D	Title: Plot #5				Display:0
Green USBBIN	Axes				
Blue USEBDUMP	▼ Label		Log	Min	Max
 Magenta -RESNUCLE 	X:		· -		
proces	y:				
	Detectors				
	#Detector 1	Detector Info			
		File: example_47_tab.lis	Det: 1 piFluent	JD	V
		Show Plot			
		graph Type:histogram	▼ X Norm:		V
		 legend Value: Y 	Y Norm:		
		Options	The source of the A	•	
		Color: blue	 Line width: 4 Deint size: 1 	I	
		Point type: dot	Point size: 1	•	
					0
Inp: example.inp	Saved: plot0	5.png			-8

- Plot results with gnuplot
- Using files produced by merging utilities
- Wait for the scoring lecture for details



Here with example.inp from the standard distribution



- Plot results with gnuplot
- Using files produced by merging utilities
- Wait for the scoring lecture for details



- flair is a powerful graphical interface for FLUKA
- here only a glimpse was given
- more all along this course
- best learning method is practising
- important: The master file, the one used by fluka, is always the .inp file
- Flair exploits the standard fluka utilities (scripts and auxiliary codes)
- Thus, in case of problems, crashes, etc, look at the fluka .out and .err files, sometimes also the output from auxiliary programs can be instructive (see scoring lecture)