The C47 project
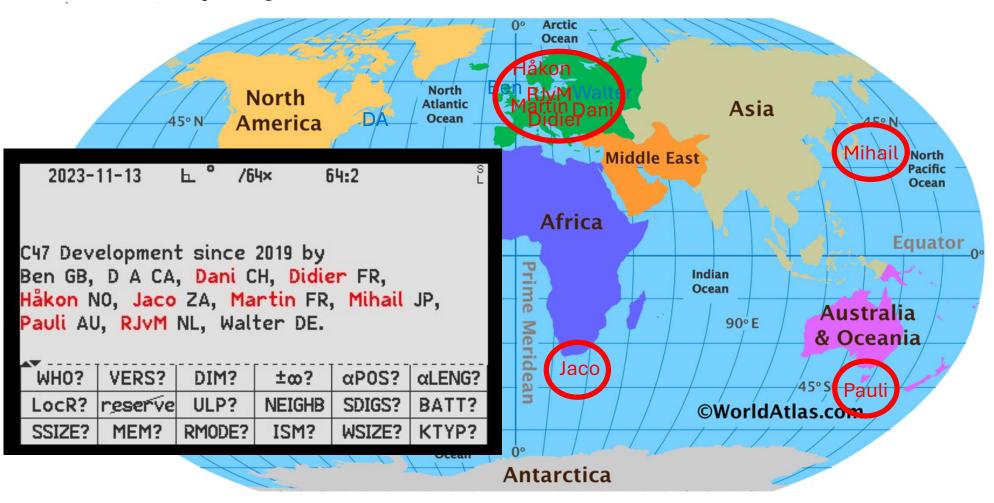
- Development

- Design

- Documentation

- Jaco Mostert, Developer (67, 11, 28, 42)

- Robbert van Meenen, Documentation (25, 41, 48)

The 47 project team

Jaco

2023-11-13   ⌐ °   /64×   64:2   S L

C47 Development since 2019 by
Ben GB, D A CA, Dani CH, Didier FR,
Håkon NO, Jaco ZA, Martin FR, Mihail JP,
Pauli AU, RJvM NL, Walter DE.

WHO?	VERS?	DIM?	±∞?	αPOS?	αLENG?
LocR?	reserve	ULP?	NEIGHB	SDIGS?	BATT?
SSIZE?	MEM?	RMODE?	ISM?	WSIZE?	KTYP?

Håkon
RJvM Walter
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Pauli

What is the C47?

- https://gitlab.com/h2x/c47-wiki/-/wikis/home

- https://forum.swissmicros.com/viewtopic.php?f=41&t=4073

- RPN / Windows / Linux / Mac / Hardware

- C47 is an **open-source**, community developed, **RPN-based**, programmable scientific calculator program. To use C47 as a physical, handheld pocket calculator, the program is installed on the hardware of the SwissMicros DM42 calculator along with a keyboard overlay. It can also be used on a PC-Mac-Linux **simulator**

- C47 has features for engineers, scientists, mathematicians, computer scientists, and students and fills the current void in the market of a modern, RPN based, advanced scientific calculator

How can you say more than 1000 functions, for a calculator?

What can the C47 do?

- high-resolution display with 4 stack levels, 3 rows of menus, and status bar always shown
- 34 digits of precision; exponents to ±6144; up to 1000 named variables
- full mathematical support for real and complex numbers (rectangular and polar)
- scientific calculator functions like trigonometry, hyperbolics, logs, and antilogs
- support for arbitrary bases from 2 to 16 and bitwise operations
- fraction support
- matrix/vector math
- 2-variable statistics with best-fit modelling and basic plotting
- equation writer with support for solving, numeric integration and derivatives, and basic plotting
- time value of money operations
- keystroke programmable with tests, flags, looping, and branching
- date and time math as well as built-in clock
- built-in unit conversions and library of constants
- user-customizable keyboard and softkey-based menus
- I/O to built-in flash memory or via USB for backing up and restoring states, programs and configuration

Count of Item		INCLUDE		
MainType	SubType	TRUE	FALSE	Grand Total
Command	internal	5	13	18
	nonpgm	39	4	43
	special	1		1
	strike	9	1	10
	TAM	13		13
	legacy		2	2
	PEM	23		23
	submnu	2		2
	Command	344	13	357
	cyclic ; nonpgm	1		1
	HW	6	1	7
	nonpgm ; HW	1		1
Command Total		**444**	**34**	**478**
Function	legacy	7		7
	proposal		1	1
	linked ; monadic	186		186
	legacy ; monadic	4		4
	triadic	12		12
	monadic	249	1	250
	cyclic ; monadic	3		3
	internal ; strike		1	1
	monadic ; dyadic	2		2
	dyadic	63		63
	niladic	1		1
Function Total		**527**	**3**	**530**
MENU	ASM	8		8
	internal	1	2	3
	MENU	123	4	127
	strike	2		2
	TAM	14		14
	item	17		17
	43		4	4
	47	2		2
	ASM ; legacy		2	2
	TAM ; ASM	3		3
	43S		1	1
	TAM ; proposal		1	1
MENU Total		**170**	**14**	**184**
Setting	cyclic	2		2
	internal		1	1
	pgm	119	2	121
	Setting	70	16	86
	SIM	1		1
	strike	3		3
	legacy	2		2
	pgm ; deprecated		1	1
	pgm ; stack	2		2
	cyclic ; stack	1		1
	pgm ; HW	3		3
	HW	2		2
Setting Total		**205**	**20**	**225**
Grand Total		**1346**	**71**	**1417**

Where did C47 come from?

- HP41C/X
- HP42S
- HP15C
- HP16C
- HP35S
- WP34S
- WP43S
- WP43C
- C43
- C47

Where did C47 come from?

- HP41C/X
- HP42S
- HP15C
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- WP34S
- WP43S
- WP43C
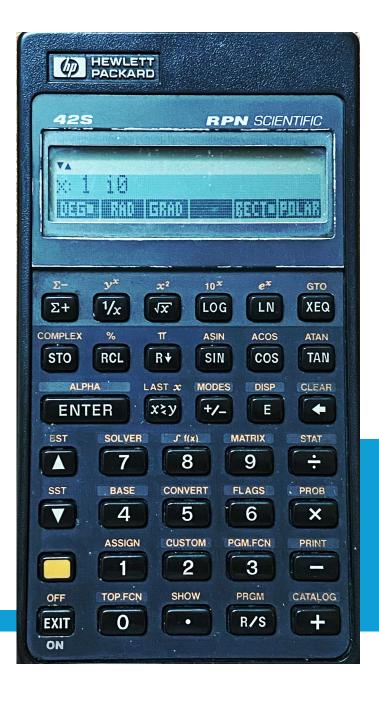- C43
- C47

WHAT WOULD HP HAVE DONE WITH RPN IN 2024
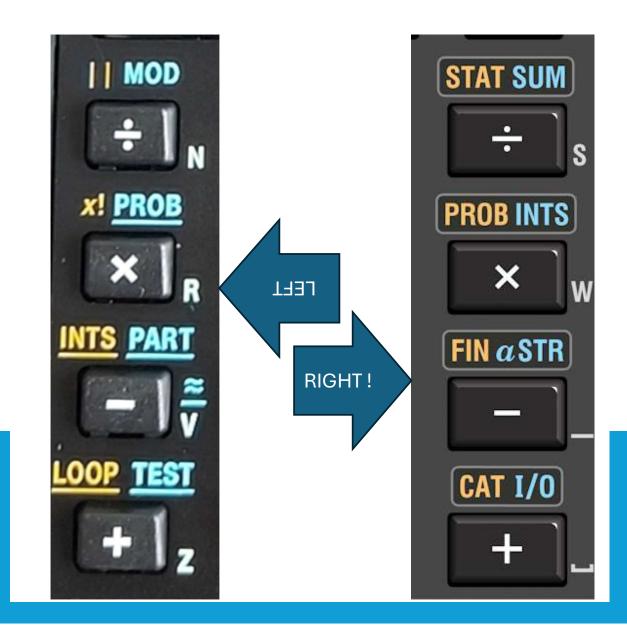
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Major Inspirations

GOLD
STANDARD
42

- HP41C/X - operation
- **HP42S - 90% influence**
- HP15C - appearance
- HP16C - BASE operation
- HP35S – complex entry
- WP34S - underlying code
- WP43S - complete system
- WP43C - operator location ÷×−+
- C43 - trying to keep compatibility
- C47 - more HP influence

- Keys & layout
- Complex type
- Programming
- Menu names
- Checkboxes
- BASE

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Major Inspirations

- HP41C/X - operation
- HP42S - 90% influence
- HP15C - appearance
- HP16C - BASE operation
- HP35S - complex entry
- WP34S - underlying code
- **WP43S - complete system – not layout**
- WP43C - operator location ÷×−+
- C43 - trying to keep compatibility
- C47 - more HP influence

Major Inspirations

- HP41C/X - operation
- **HP42S - physical appearance**
- **HP15C - physical appearance**
- HP16C - BASE operation
- HP35S - complex entry
- WP34S - underlying code
- WP43S - complete system
- WP43C - operator location ÷×−+
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HP32SII

HP42S

HP35S

C47

HP15C

WP43

HP48SX

DM42

Labels and Fonts

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Major Inspirations

42S

- HP41C/X - operation
- **HP42S - physical appearance**
- **HP15C - physical appearance**
- HP16C - BASE operation
- HP35S - complex entry
- WP34S - underlying code
- WP43S - complete system
- WP43C - operator location ÷×−+
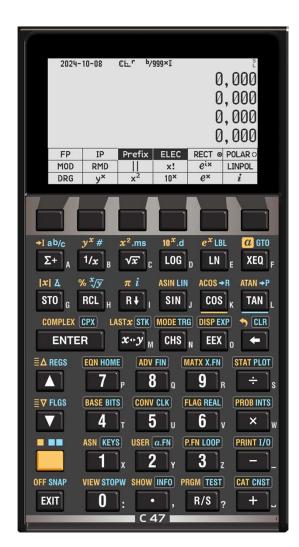- C43 - trying to keep compatibility
- C47 - more HP influence

42

15C

C47

R47

47 User interface design and principles

- Explainability
- Use case and Duplication
- Conformity and Layout
- Familiarity and Ease of Use
- Style and Taste and "Rhythm"
- Logic
- Separation (e.g. RB, CB)
- Navigation (reduce up/dn)

The important stuff, whatever that is

The hard to change things

How to document the 47 flexibility?

Workbook:

Sheets	85
Cells with data	1024075
Tables	0
PivotTables	32
Formulas	829711

The 47 calculator has different layouts:

DM42, C47, R47, D, E, N, V47
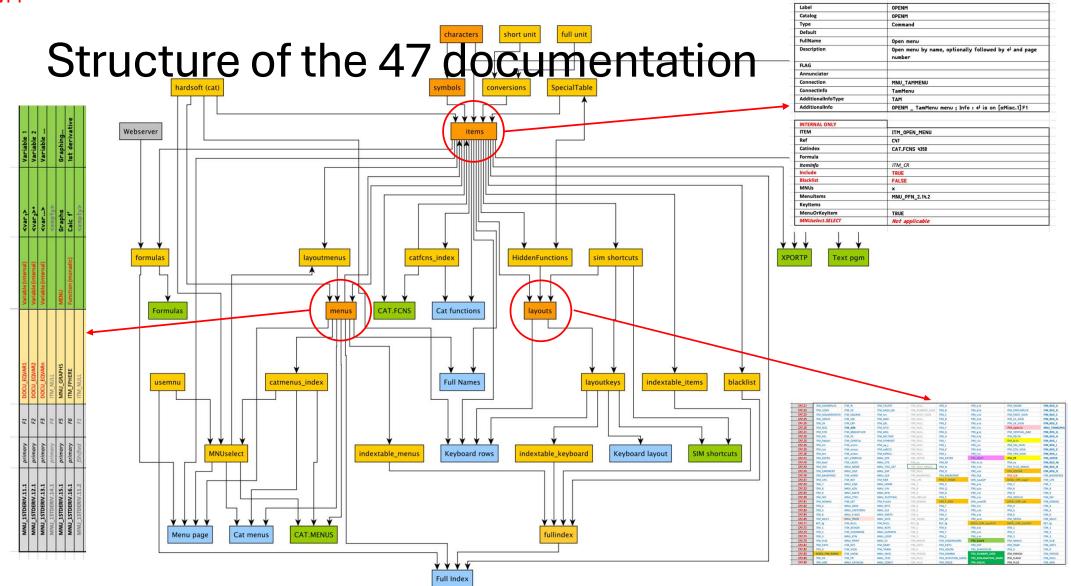
The simulator has to accomodate different PC keyboards

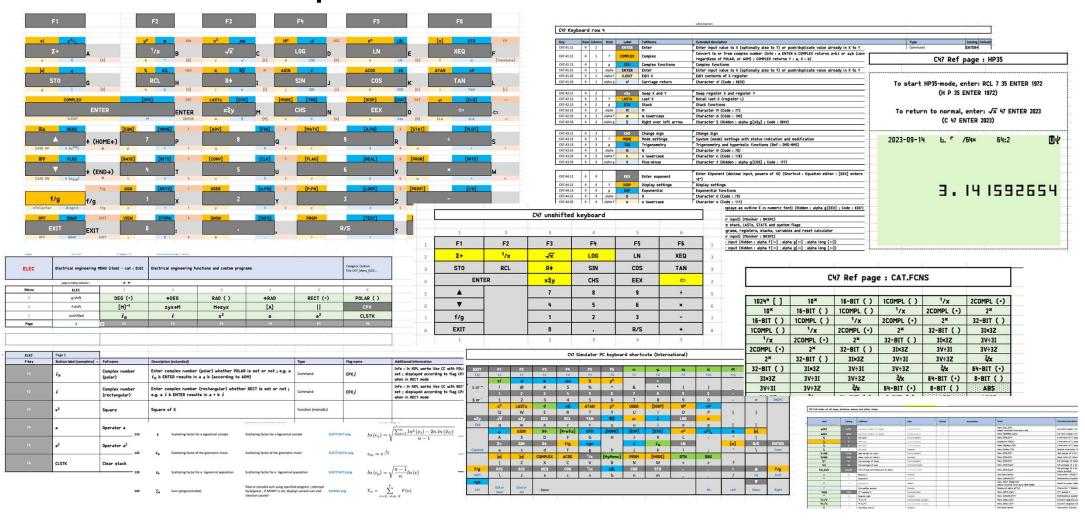The user interface is highly customisable

Structure of the 47 documentation

Some examples of the 47 documentation

C47 Keyboard layout (all layers)

C47 menu page description (ELEC menu p1)

ELEC	Electrical engineering MENU (item) - cat : ELEC	Electrical engineering functions and custom programs			Category: Custom File: C47_Menu_ELEC...

page scrolling indicator : ▲ ▼

Menu	ELEC	1	2	3	4	5	6
3	g-shift	DEG (•)	⇒DEG	RAD ( )	⇒RAD	RECT (•)	POLAR ( )
2	f-shift	[M]$^{-1}$	zyx⇒M	M⇒zyx	[A]	||	CPX
1	unshifted	$i_\odot$	i	x^2	a	a^2	CLSTK
Page	**1**	F1	F2	F3	F4	F5	F6

ELEC	Page 1								
F-key	**Button label (complete)**	**Full name**	**Description (extended)**	**Type**	**Flag name**	**Additional information**	**Catalog**	**Default**	**Status**
F1	$i_\odot$	Complex number (polar)	Enter complex number (polar) whether POLAR is set or not ; e.g. a $i_\odot$ b ENTER results in a ∡ b (according to ADM)	Command	CPX j	Info : In NIM, works like CC with POLAR set ; displayed according to flag CPX j when in RECT mode	op_$i_\odot$		
F2	i	Complex number (rectangular)	Enter complex number (rectangular) whether RECT is set or not ; e.g. a i b ENTER results in a + b i	Command	CPX j	Info : In NIM, works like CC with RECT set ; displayed according to flag CPX j when in RECT mode	op_i		
F3	x^2	Square	Square of X	Function (monadic)			x^2		
F4	a	Operator a	Insert value of 1 ∠ 120°	Command			op_a		
F5	a^2	Operator a^2	Insert value of 1 ∠ 240°	Command			op_a^2		
F6	CLSTK	Clear stack	Clear all stack data	Command		Hidden : long [⇔]	CLSTK		

C47 Function Catalog (CAT.FCNS)

C47 Ref page : CAT.FCNS

1024^n [ ]	10^x	16-BIT ( )	1COMPL ( )	$^1/x$	2COMPL ($\cdot$)
10^x	16-BIT ( )	1COMPL ( )	$^1/x$	2COMPL ($\cdot$)	2^x
16-BIT ( )	1COMPL ( )	$^1/x$	2COMPL ($\cdot$)	2^x	32-BIT ( )
1COMPL ( )	$^1/x$	2COMPL ($\cdot$)	2^x	32-BIT ( )	3I×3Z
$^1/x$	2COMPL ($\cdot$)	2^x	32-BIT ( )	3I×3Z	3V÷3I
2COMPL ($\cdot$)	2^x	32-BIT ( )	3I×3Z	3V÷3I	3V÷3Z
2^x	32-BIT ( )	3I×3Z	3V÷3I	3V÷3Z	$\sqrt[3]{x}$
32-BIT ( )	3I×3Z	3V÷3I	3V÷3Z	$\sqrt[3]{x}$	64-BIT ($\cdot$)
3I×3Z	3V÷3I	3V÷3Z	$\sqrt[3]{x}$	64-BIT ($\cdot$)	8-BIT ( )
3V÷3I	3V÷3Z	$\sqrt[3]{x}$	64-BIT ($\cdot$)	8-BIT ( )	ABS

C47 Simulator PC keyboard shortcuts (Intl)

C47 Simulator PC keyboard shortcuts (International)

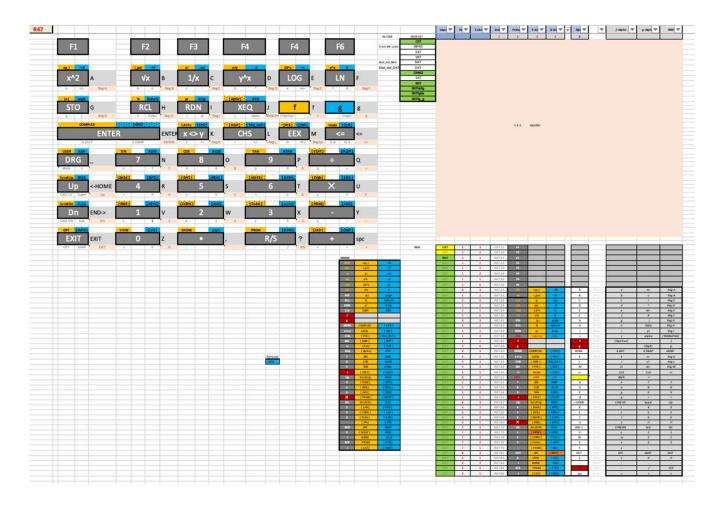| EXIT	F1	F2	F3	F4	F5	F6	·n	·μ	·m	·k	·M		
ESC	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13
	x!	.d	#	.ms	%	yˣ		×				÷	
± or ~	!	@	#	$	%	^	&	*	(	)	_	+	
	1	2	3	4	5	6	7	8	9	0	-	.d	⇐
§ or `	1	2	3	4	5	6	7	8	9	0	-	=	BKSPC
	x²	LASTx	e	→R	ATAN	yˣ	USER	[DISP]	10ˣ	→P			
	Q	W	E	R	T	Y	U	I	O	P	{	}	
x⫩y	√x	x⫩y	EEX	RCL	TAN	ˣ√y	↻	i	LOG	π			
TAB	q	w	e	r	t	y	u	i	o	p	[	]	
	∡	ASIN	R▲	[Prefix]	GTO	[HOME]	[EXP]	[STK]	eˣ	aᵇ/c	#	|x|	
	A	S	D	F	G	H	J	K	L	:	"	|	
	Σ+	SIN	R▼	f/g	<g>		i	i⊗	LN		[α]	R/S	ENTER
Capslock	a	s	d	f	g	h	j	k	l	;	'	\	Enter
	|x|	|x|	COMPLEX	ACOS	¹/x	[MyMenu]	PRGM	[MODE]	RTN	DRG			
	|	Z	X	C	V	B	N	M	<	>	?		
f/g	R/S	R/S	XEQ	COS	¹/x	LBL	CHS	STO	.	.	÷	▲	f/g
Shift	\	z	x	c	v	b	n	m	,	.	/	Up	Shift
<g>												▼	
Ctrl	Opt or Start	Cmd or Alt	Space							Alt	Left	Down	Right

C47 Full index

C47 Full index of all keys, buttons, menus and other items

Label	Catalog	FullName	Type	Default	Annunciator	Index	Extended description
#DEC	#DEC	Current number of digits	Variable (longint)	3		Menu [ALL.2] F5 (Also) reached from menu VAR	Current number of d
#DEC	#DEC	Current number of digits	Variable (longint)	3		Menu [NUMBRS.1] g F6	Current number of d
%	%	Percent	Function (dyadic)			Menu [FIN.1] F3	X Percent of Y, keep
%	%	Percent	Function (dyadic)			Keyboard f [RCL]	X Percent of Y, keep
%	%	Percent	Function (dyadic)			Menu [MyMenu.2] F1	X Percent of Y, keep
%	--	Percent	Character			Menu [αMisc.1] F5	Special character %
%+MG	%+MG	Add margin to cost	Function (dyadic)			Menu [FIN.1] F5	Add margin of X to c
%MRR	%MRR	Mean rate of return	Command			Menu [FIN.1] F6	Mean rate of return
%T	%T	Percentage of total	Function (dyadic)			Menu [FIN.1] F2	Percentage of total,
%Σ	%Σ	Percentage of sum	Function (monadic)			Menu [FIN.1] g F2	Percentage of x to :
%Σ,Δ%x̄	%Σ,Δ%x̄	Pct of sum and Delta pct to mean	Function (monadic)			Menu [FIN.1] g F3	Percentage of x to : stack levels))
1	--	Binary 1	Character			See description	Character 1 (Code :
^	--	Exponent	Character			Menu [αMath.2] F1	Mathematical symbol
^	--	Exponent	Symbol			Menu [EDIT [EQN].1] F3 (Also) reached from menu NEW [EQN]	Raise to power (Hidd
^	--	Circumflex accent	Character			Keyboard alpha g [1/x]	Character ^ (Hidden
^MOD	^MOD	Z^Y modulo X	Function (triadic)			Menu [INTS.1] g F4	Z^Y modulo X
°	--	Degree sign	Character			Menu [αMath.3] f F1	Mathematical symbol
°C→°F	--	°C to °F	Function (linked ; monadic)			Menu [Misc:.1] F3	Convert degrees Cel
°F→°C	--	°F to °C	Function (linked ; monadic)			Menu [Misc:.1] F4	Convert degrees Fal
ₒ	--	Overflow Carry	Character			See description	Character ₒ (Code :

Interaction : design ⇔ development ⇔ doc

Example 1: support discussion of new keyboard layout R47

Example 2: menu redesign mockups & import into code base

Example 3: what Greek characters to support in the simulator

Example 4: redesign TAM menu workflow

RJvM

1: Support discussion of R47 layout

2: Menu redesign & import into code base

RJvM

3: What Greek characters for the simulator

Item	Label	Type	GREEK	δ	ε	ζ	η	θ	ι	κ
				948	949	950	951	952	953	954
CST_56	α_F	Constant (#55)	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
CST_58	γ_{EM}	Constant (#57)	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	
CST_59	γ_P	Constant (#58)	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	
CST_60	$\Delta\nu_{Cs}$	Constant (#59)	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	
CST_61	ε_0	Constant (#60)	TRUE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	
CST_62	λ_C	Constant (#61)	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	
CST_63	λ_{Cn}	Constant (#62)	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	
CST_64	λ_{CP}	Constant (#63)	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	
CST_65	μ_0	Constant (#64)	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	
CST_66	μ_B	Constant (#65)	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	
CST_67	μ_e	Constant (#66)	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	
CST_68	μ_e/μ_B	Constant (#67)	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	
CST_69	μ_n	Constant (#68)	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	
CST_70	μ_P	Constant (#69)	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	
CST_71	μ_ν	Constant (#70)	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	
CST_72	μ_μ	Constant (#71)	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	
CST_73	σ_B	Constant (#72)	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	
CST_74	φ	Constant (#73)	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	
CST_75	φ_0	Constant (#74)	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	
CST_76	$\omega_\oplus$	Constant (#75)	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	
CST_80	ξ_B	Constant (#79)	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	
CST_81	δ_S	Constant (#80)	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	
CST_82	μ_G	Constant (#81)	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE

4: redesign TAM menu workflow

Questions and Comments?

Demonstration of the simulator