

## Case Study 4.1: Pizza ? Just eat !

V.2.1



Two Piiza meals are shown in the following. Between the two examples lie about 1.5 years of user experience, and tuning the autoISF FCL using the emulator.

### Pizza w/ well tuned autoISF FCL

Home-made Pizza, size of an European baking oven rack (ALDI Süd dough roll) with canned tomatoes, salami, mozzarella, pre-fried eggplant, bell pepper, onions & garlic topping. I ate half of it for my ~12:15 h lunch.

FCL using Lyumjev (AAPS dev w/autoISF 2.2.8): Theoref(1) SMB+UAM algo can deal very well with Pizza after autoISF gave 2 SMBs, together 4.8 U, at 12:33 + 12:38 PM.



Carbs and bolus		
06:13PM	0.20 U	SMB PH
05:13PM	0.20 U	SMB PH
05:03PM	0.40 U	SMB PH
04:58PM	0.40 U	SMB PH
04:53PM	0.10 U	SMB PH
04:28PM	0.10 U	SMB PH
04:13PM	0.40 U	SMB PH
04:03PM	0.70 U	SMB PH
02:38PM	1.70 U	SMB PH
02:23PM	0.10 U	SMB PH
02:18PM	0.80 U	SMB PH
01:18PM	2.30 U	SMB PH
12:38PM	3.00 U	SMB PH
12:33PM	1.80 U	SMB PH
11:13AM	1.20 U	SMB PH
11:08AM	0.40 U	SMB PH
10:17AM	0.10 U	SMB PH
10:13AM	0.10 U	SMB PH
02:48AM	0.80 U	SMB PH

No initial bolus given by me (1,2 U at 11:13 from automatic regulation towards the pre-lunch bg target of 74 mg/dl), and without any carb announcement.

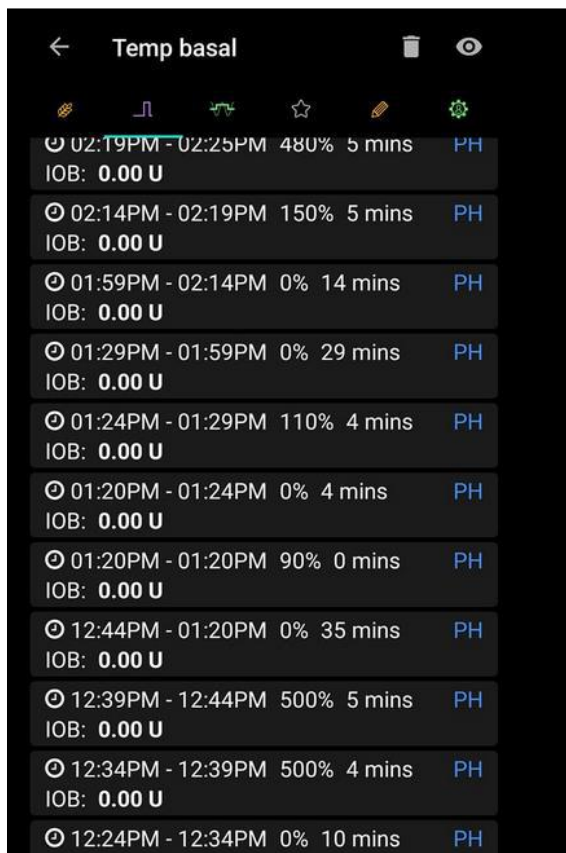
Note that TT 74 is automatically again set at steep rise starting again around 14:10 h.

With iob being back below iobTH then, 0.9 U of additional insulin is given (02:18 - 02:23)

Another TT 74 is automatically set after the one **jumpy CGM value** around 14:30, leading to 1,7 U (02:38 PM) additional insulin due to the „fake“ strong rise (a problem that is discussed further in [Case study 1.5](#)). This is made the situation risky with respect to going a bit too low between 17 and 18 h, and I had to watch out whether I need a snack, or whether I just get to a nice low starting bg for my dinner.

PS: The yellow graph on bottom of diagram 1 is the "carb deviation": As I did not tell my loop what I ate, it tells me back (calculates), what I „must have consumed“ that would explain the glucose development (in light of the calculated insulin decay).

In autoISF 3.0, iobTH is set via an iobTH\_percent of iobMAX in /Preferences



Temp basal				
02:19PM - 02:25PM	480%	5 mins	PH	
IOB: 0.00 U				
02:14PM - 02:19PM	150%	5 mins	PH	
IOB: 0.00 U				
01:59PM - 02:14PM	0%	14 mins	PH	
IOB: 0.00 U				
01:29PM - 01:59PM	0%	29 mins	PH	
IOB: 0.00 U				
01:24PM - 01:29PM	110%	4 mins	PH	
IOB: 0.00 U				
01:20PM - 01:24PM	0%	4 mins	PH	
IOB: 0.00 U				
01:20PM - 01:20PM	90%	0 mins	PH	
IOB: 0.00 U				
12:44PM - 01:20PM	0%	35 mins	PH	
IOB: 0.00 U				
12:39PM - 12:44PM	500%	5 mins	PH	
IOB: 0.00 U				
12:34PM - 12:39PM	500%	4 mins	PH	
IOB: 0.00 U				
12:24PM - 12:34PM	0%	10 mins	PH	

12:38 PM my iobTH was first time exceeded  
=> Temp SMB shut-off, and "only"  
500%TBR (graph 3, 12:34 - :44).

12:44 PM basla was reduced to zero for half  
an hour, for satey reasons and to watch the  
further glucose development

01:18 PM iob had fallen below iobTH again,  
as more carbs of my pizza had required  
insulin. . Die nächste große (2,3 U) SMB  
kam

At 01:18 PM the next big (2.3 U) SMB was  
triggered, and iobTH was exceeded again.

The zig-zag shaped blue iob curve (lower part of diagram 1) shows nicely, how – over many hours – the loop was able to keep up sufficient iob for digesting the pizza, without – thanks to my set iobTH - ever shooting up into iob levels that would be unsafe for me.

Overall, this ended up as a day with 99% TIR.

#### *Pizza before all autoISF weights were properly tuned*

About 1.5 years earlier, I had used a „standardized“ commercial type of Pizza to determine the various ISF\_weights.

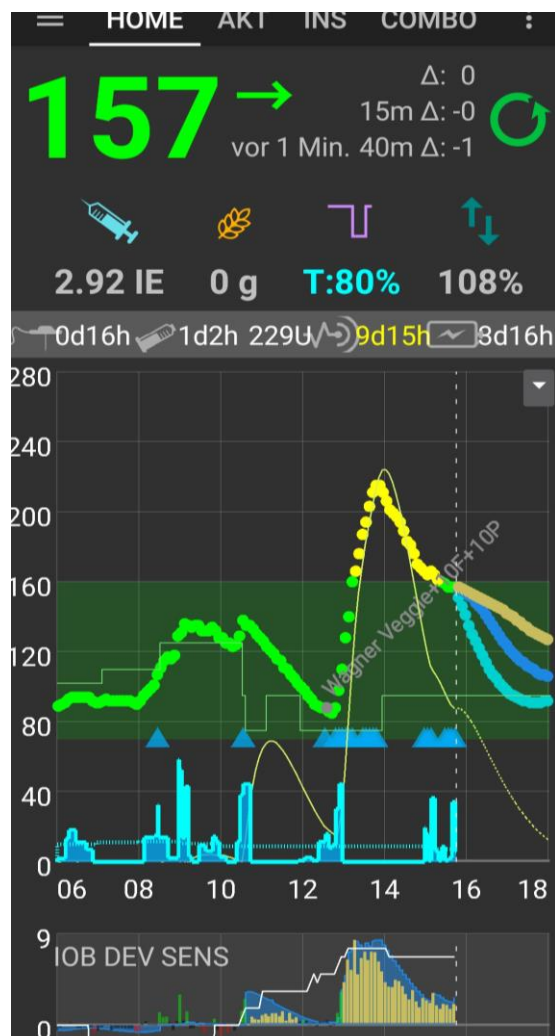
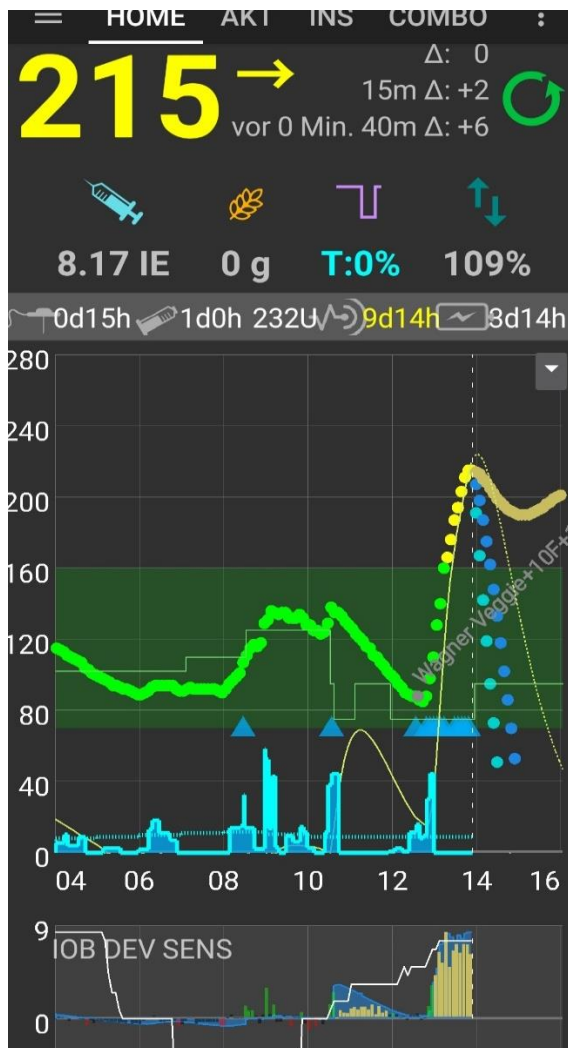
*After this experience*, the conclusion was that bgAccel\_ISF\_weight had to be strengthened, while pp\_ISF- and deltaISF\_weights needed to be softened for better results:

#### *The testing meal*

~ 12:30 PM: Wagner Veggie Pizza with extra ham + Mozzarella topping + red wine

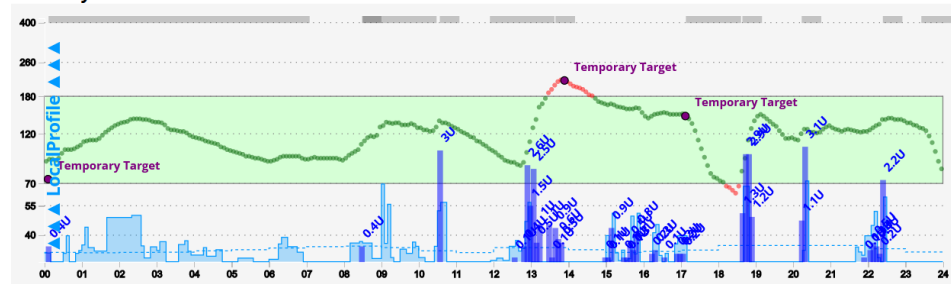
15g fast carbs + 75 g other carbs + 34 g protein + 30 g fat

Very rapidly AAPS was building over 8 U of iob (graph on the left). Using about 6 U up (graph on the right) the glucose rise was within less than an hour after starting to eat in control. After over an hour pause, more SMBs were fired after 03 PM, as more carbs came to absorption from this greasy meal:

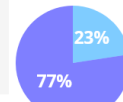


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Thursday 10.2.2022



**Bolus insulin:** 35.8U  
 Base basal insulin: 13.7U  
 Positive temp basal insulin: 5.7U  
 Negative temp basal insulin: -9.0U  
**Total basal insulin:** 10.5U  
**Total daily insulin:** 46.3U  
 Total carbs: 0 g  
 Total protein: 0 g  
 Total fat: 0 g



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After 05:30 PM (17:30) glucose sinks a bit too fast because a dogwalk coinciding with the „tail activity“ from the SMBs while nearly all carbs were digested

#### How to improve settings: Analysis using the Emulator

Primary goal would be to limit the initial bg rise. But also the hypo tendency in the end is worrisome, and certainly should not increase further.

bgAccelISF\_weight drives the first SMBs that are best suited to limit initial rises of bg after meal start.

Limiting the peak height is also a good means to reduce hypo danger. Moreover, hypo danger very often emanates from „over“-treating either high bg level (bgISF\_weight) or duration (duralSF\_weight).

Lowering iobTH could be another measure against going low. However, we have seen the need for a high iob initially (when diet includes high carb foods).

A look into the effects of all the autoISF categories (and the underlying respective \_weights) should help coming to a hypothesis, how to shift weights for desired improvement.



In the following table (note: it is based on an older emulator and autoISF version):

- yellow markings: where stronger SMBs (lower resulting „ISF emul“)
- red markings, where weaker or no SMBs (higher „ISF emul“) would be desired

Findings (with references to the table shown below):

- Autosense (grey: AS orig => ISF AS) is not helpful and should be switched off
- delta ISF weight seems way too strong and leads to lowered ISFs in times when we would like to reduce SMBs already (red marked, W 14-23). Moreover, delta\_ISF is responsible in lines 42 und 50 of the table for an extra of (0.9+0.8=) 1.7 U that contributes to going low in the end of the investigated meal time window.
- Above the blue line (line 15, 13:02 MEZ, 12:02 Z) we minimum like to retain the sizes of SMBs. As we like to take down the delta\_ISF contributions, for keeping insulin supply for W12-15, we then must shrpnen accel\_ISF (and autoISF\_max). To retain the SMB size like in AD12-15, an emuliertated ISF as in Y12-15 must result, with help from a lowered accel\_ISF (X12-15).

	D	E	F	G	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AD	AE
1				AS	5% rang	glu av	parabola	parabc	parabol	parabol	Accel	ISF	ISF	ISF	ISF	ISF	ISF	ISF	ISF	Ins.Reqt	SMB	TBR
2	MEZ	bg	iob	orig	dura	avg	corr	dura	last-d	next-d	=O-N	orig	prof	AS	dura	high	delta	acce	emul	emul	emul	emul
3	12:03	98	0,71	1,04	0	98						40	43	41,3	43	43	43	39,9	39,9	-0,03	0	0,15
4	12:08	95	0,59	1,04	5	96,5	0,9981	15	-2,8	-3,3	-0,5	43	43	41,3	43	43	43	44,8	43	0	0	0,165
5	12:13	93	0,47	1,05	10	95,3	0,9978	35	-2,26	-2,22	0,04	41	43	41	42,2	43	43	42,7	41	-0,02	0	0,06
6	12:18	90	0,36	1,06	10	92,7	0,9979	40	-2,43	-2,43	0	41	43	40,6	42,2	43	43	43	40,6	0	0	0,055
7	12:23	89	0,27	1,05	15	91,8	0,9973	45	-2,16	-2,11	0,05	41	43	41	42,2	43	43	42,7	41	0,07	0	0,7175
8	12:27	88	0,23	1,06	15	90	0,9945	45	-1,77	-1,66	0,11	41	43	40,6	42,2	43	43	42,3	40,6	0,12	0	0,715
9	12:33	88	0,2	1,06	20	89,6	0,9936	30	-0,29	0,29	0,58	40	43	40,6	41,7	43	43	39,6	39,6	0,2	0,1	0,983
10	12:38	86	0,29	1,06	20	88,2	0,9886	45	-0,78	-0,52	0,26	41	43	40,6	42,2	43	43	41,5	40,6	0	0	0,483
11	12:43	85	0,25	1,06	25	87,7	0,9877	45	-0,54	-0,27	0,27	41	43	40,6	41,7	43	43	41,4	40,6	0,02	0	0,623
12	12:48	88	0,22	1,06	30	87,7	0,9642	45	0,44	0,86	0,42	27	43	40,6	41,7	43	26,9	41,2	26,9	0,63	0,4	1,843
13	12:53	98	0,69	1,07	0	98	0,9959	15	9,41	14,91	5,5	22	43	40,2	43	43	14,3	23,3	21,5	4,09	2,6	5,5
14	12:58	110	3,42	1,08	0	110	0,9971	20	13,18	17,89	4,71	22	43	39,8	43	43	12,6	24,8	21,5	2,33	1,5	0
15	13:02	128	4,79	1,08	0	128	0,9991	15	17,2	21,2	4	21	41	38	41	41	8,9	25,1	20,5	3,85	2,5	0
16	13:08	140	7,09	1,09	0	140	0,9945	20	15,54	16,97	1,43	21	41	37,6	41	41	12,1	33,7	20,5	0,83	0,5	0
17	13:12	160	7,35	1,09	0	160	0,9971	25	17,97	19,76	1,79	21	41	37,6	41	41	8,2	32,1	20,5	1,654	1	0
18	13:18	166	8,04	1,09	5	163	0,9901	30	14,33	14,52	0,19	21	41	37,6	41	41	18,6	39,9	20,5	-1,12	0	0
19	13:23	176	7,7	1,09	0	176	0,9921	25	8,69	6,4	-2,29	25	41	37,6	41	41	13,7	49,3	24,7	-1,46	0	0
20	13:28	187	7,32	1,09	0	187	0,9989	15	11,6	14,1	2,5	21	41	37,6	41	41	12,8	29,4	20,5	1,682	1	0
21	13:33	194	7,91	1,09	5	191	0,9973	15	8	6,5	-1,5	23	41	37,6	41	41	17,1	46,4	23,2	0,3	0,1	0
22	13:38	203	7,58	1,09	5	199	0,9979	20	7,91	7,06	-0,85	22	41	37,6	41	41	14,6	44	22	1,422	0,9	0
23	13:38	203	7,55	1,09	5	200	0,9979	20	7,91	7,06	-0,85	22	41	37,6	41	41	14,6	44	22	1,447	0,9	0
24	13:43	211	8,03	1,09	5	206	0,9986	15	8,6	9,1	0,5	21	41	37,6	41	41	15,8	38	20,5	0,975	0,6	0
25	13:48	215	8,15	1,09	10	208	0,9983	15	4,6	2,1	-2,5	28	41	37,6	36,6	41	22,8	51	28,4	0,852	0,5	0
26	13:53	215	8,16	1,09	15	209	1	15	0	-4	-4	51	41	37,6	34,7	41	41	60,3	51,1	-0,8	0	0
27	13:53	215	8,11	1,09	10	214	1	15	0	-4	-4	53	41	37,6	37,6	41	41	60,3	55,3	-1,25	0	0
28	13:57	211	7,66	1,09	20	210	1	15	-4	-8	-4	51	41	37,6	35	41	41	60,3	51,5	-1,36	0	0
29	14:03	206	7,15	1,09	25	210	0,9937	30	-6,21	-9,5	-3,29	44	40	36,7	33,1	40	40	53,1	43,7	0	0	0
30	14:07	201	6,66	1,08	30	209	0,9995	15	-5,2	-5,7	-0,5	33	40	37	32	40	40	41,7	33,2	0	0	0

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	D	E	F	G	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AD	AE
1				AS	5% ranglu av	parabola	parabola	parabola	parabola	Accel	ISF	ISF	ISF	ISF	ISF	ISF	ISF	ISF	ISF	Ins.Requ	SMB	TBR
2	MEZ	bg	iob	orig	dura	avg	corr	dura	last-d	next-d	=O-N	orig	prof	AS	dura	high	delta	acce	emul	emul	emul	emul
31	14:13	199	6,17	1,08	15	204	0,9948	15	-2,6	-1,1	1,5	33	40	37	35,7	40	40	32,6	32,6	0	0	0
32	14:18	197	5,69	1,08	15	201	0,996	20	-1,57	-0,29	1,28	33	40	37	35,7	40	40	33,4	33,4	0	0	0
33	14:23	194	5,22	1,08	20	199	0,9981	15	-2,8	-3,3	-0,5	36	40	37	34,5	40	40	41,6	36	0	0	0
34	14:27	189	4,77	1,08	20	196	0,9991	15	-4,8	-6,3	-1,5	40	40	37	34,8	40	40	45,4	39,5	0	0	0
35	14:33	183	4,35	1,08	25	194	0,9997	20	-6,14	-7,57	-1,43	38	40	37	33,9	40	40	45,1	38,1	0	0	0
36	14:37	181	3,94	1,08	10	184	0,9881	15	-3	-1,5	1,5	33	40	37	37,4	40	40	33	33	0	0	0
37	14:42	176	3,56	1,08	10	180	0,9891	40	-4,64	-4,91	-0,27	38	40	37	37,7	40	40	40,8	37,8	0	0	0
38	14:47	170	3,19	1,08	15	178	0,998	15	-6,4	-8,4	-2	43	40	37	36,7	40	40	47,4	43,4	0	0	0
39	14:53	168	2,85	1,08	10	171	0,9915	35	-4,19	-4,14	0,05	37	40	37	37,7	40	40	39,7	37	-0,22	0	0
40	14:57	166	2,53	1,08	15	170	0,9918	20	-1,66	-0,23	1,43	33	40	37	37	40	40	33,1	33,1	0,3	0,1	1,194
41	15:02	164	2,42	1,08	15	167	1	15	-2	-2	0	37	40	37	37	40	40	37	37	0,3	0,1	0,06
42	15:07	166	2,25	1,08	20	167	0,989	30	0,67	1,98	1,31	29	40	37	36	40	28,6	33,7	28,6	1,4	0,9	3,286
43	15:12	164	3,08	1,08	25	166	0,9826	45	0,02	0,73	0,71	35	40	37	35,4	40	40	36,6	35,3	0	0	0,406
44	15:17	161	2,86	1,08	30	166	0,9647	15	-3,6	-6,1	-2,5	40	40	37	34,5	40	40	45,9	39,6	0	0	0,026
45	15:23	160	2,61	1,08	35	165	0,9802	15	-1,6	-1,1	0,5	34	40	37	33,9	40	40	37,6	33,8	0,03	0	0,546
46	15:27	159	2,42	1,08	40	164	0,9866	20	-0,94	-0,37	0,57	33	40	37	33,1	40	40	37,1	33,1	0,27	0,1	0,03
47	15:32	157	2,29	1,08	45	164	0,9943	15	-1,8	-2,3	-0,5	34	40	37	32,5	40	40	41,6	33,7	0,24	0,1	0,13
48	15:38	157	2,18	1,08	50	163	0,9857	30	-0,64	-0,29	0,35	32	40	37	31,7	40	40	38,1	31,8	0,82	0,5	2,126
49	15:43	157	2,63	1,08	50	162	0,987	35,2	-0,13	0,26	0,39	32	40	37	32	40	40	37,9	31,9	0,6	0,3	0,37
50	15:47	159	2,75	1,08	55	162	0,9723	40	0,77	1,27	0,5	29	40	37	31,3	40	28,6	37,8	28,6	1,33	0,8	3,146
51	15:53	158	3,52	1,08	60	161	0,9616	45	0,89	1,32	0,43	31	40	37	30,8	40	40	38,4	30,7	-0,03	0	0
52	15:58	151	3,29	1,08	60	160	0,9893	14,8	-6,44	-11,04	-4,6	46	40	37	30,8	40	40	59,6	46	0	0	0
53	16:03	145	3,06	1,07	5	148	0,9808	15	-7,41	-9,92	-2,51	44	39	36,4	39	39	39	46,6	43,5	0	0	0
54	16:08	142	2,83	1,07	5	144	0,9987	15	-3,39	-1,38	2,01	30	39	36,4	39	39	39	29,6	29,6	0	0	0
55	16:12	145	2,6	1,07	15	146	0,9895	15	2,4	6,9	4,5	24	39	36,4	36,8	39	24,4	23,7	23,7	0,42	0,2	1,3536
56	16:17	148	2,68	1,07	20	146	0,9831	25	4,12	7,2	3,08	24	39	36,4	36,1	39	24,4	27,7	24,4	0,61	0,3	1,7336
57	16:22	149	2,9	1,07	25	147	0,9933	15	1,4	0,4	-1	35	39	36,4	35,5	39	32,5	42,1	35,1	0	0	0,2936
58	16:27	150	2,7	1,07	30	147	0,9947	20	0,72	-0,14	-0,86	35	39	36,4	34,8	39	32,5	41,7	34,8	-0,14	0	0

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	D	E	F	G	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AD	AE
1				AS	5% ranglu av	parabola	parabola	parabola	parabola	Accel	ISF	ISF	ISF	ISF	ISF	ISF	ISF	ISF	ISF	Ins.Requ	SMB	TBR
2	MEZ	bg	iob	orig	dura	avg	corr	dura	last-d	next-d	=O-N	orig	prof	AS	dura	high	delta	acce	emul	emul	emul	emul
59	16:32	151	2,48	1,07	35	148	1	15	1	1	0	33	39	36,4	34,2	39	32,5	39	32,5	0,25	0,1	0,36
60	16:37	150	2,39	1,07	40	148	0,9909	30	-0,43	-1,14	-0,71	36	39	36,4	33,6	39	39	41,1	35,5	-0,23	0	0
61	16:43	148	2,18	1,07	45	148	0,9896	15	-2,2	-3,7	-1,5	37	39	36,4	33,1	39	39	43,7	37,1	0	0	0
62	16:48	148	1,97	1,07	50	148	0,9651	40	-1,72	-2,4	-0,68	34	39	36,4	32,5	39	39	40,4	33,8	0,15	0	0,8136
63	16:52	148	1,84	1,07	55	148	0,9426	20	0,06	0,62	0,56	32	39	36,4	32	39	39	37,5	32,1	0,34	0,2	1,1936
64	16:57	148	1,95	1,07	60	148	0,9408	25	0,33	0,79	0,46	32	39	36,4	31,5	39	39	37,9	31,6	0,32	0,2	1,2
65	17:02	149	2,12	1	65	148	0,9407	30	0,83	1,31	0,48	31	38	38	30,6	38	31,7	36,8	30,6	0,39	0,2	1,35
66	17:07	149	2,24	1	65	148	0,9407	30	0,83	1,31	0,48	32	38	38	34,5	38	31,7	36,8	31,7	0	0	0
67	17:07	146	2,24	1	70	148	0,7372	15	-2	-3,5	-1,5	34	38	38	34,2	38	38	38	34,3	0	0	0
68	17:12	141	2,05	1	75	148	0,9947	15	-5,4	-8,4	-3	44	38	38	34,2	38	38	49,2	44,1	0	0	0
69	17:17	134	1,86	1	0	134	1	15	-6,99	-8,97	-1,98	45	38	38	38	38	38	45,2	45,2	0	0	0
70	17:22	124	1,68	1	0	124	0,9998	15	-9,81	-12,33	-2,52	48	38	38	38	38	38	47,5	47,5	0	0	0
71	17:27	112	1,51	1	0	112	0,9999	20	-12,15	-14,59	-2,44	47	38	38	38	38	38	47,2	47,2	0	0	0
72	17:32	102	1,34	1	0	102	0,9986	15	-10,76	-10,72	0,04	38	38	38	38	38	38	37,8	37,8	0	0	0
73	17:37	93	1,18	1	0	93	0,9999	15	-8,79	-7,29	1,5	34	38	38	38	38	38	33,9	33,9	0	0	0
74	17:43	85	1,03	1	0	85	1	15	-8,01	-7,02	0,99	33	38	38	38	38	38	32,8	32,8	0	0	0
75	17:47	78	0,89	1	0	78	1	15	-7,02	-6,03	0,99	33	38	38	38	38	38	32,8	32,8	0	0	0
76	17:53	75	0,76	1	5	76,5	0,9991	30	-4,6	-3,13	1,47	34	38	38	38	38	38	34	34	0	0	0
77	17:58	74	0,63	1	10	75,7	0,9984	35	-2,22	-0,52	1,7	34	38	38	38	38	38	33,5	33,5	0	0	0
78	18:03	72	0,5	1	10	73,7	0,9985	40	-0,71	0,95	1,66	32	36	36	36	36	36	31,8	31,8	0	0	0
79	18:07	71	0,37	1	15	73	0,9981	45	0,43	1,99	1,56	32	36	36	36	36	36	32,1	32,1	0	0	0
80	18:12	68	0,26	1	10	70,3	0,9903	45	0,64	1,94	1,3	33	36	36	36	36	36	32,9	32,9	0	0	0
81	18:18	67	0,15	1	5	67,5	0,9832	30	-1,67	-1,62	0,05	36	36	36	36	35,8	36	35,8	35,8	0	0	0
82	18:22	65	0,05	1	10	66,7	0,9886	35	-1,72	-1,69	0,03	35	36	36	36	35,1	36	35,9	35,1	0	0	0
83	18:27	63	-0	1	15	65,8	0,9966	15	-2,21	-2,71	-0,5	36	36	36	36	34,1	36	37,5	35,5	0	0	0
84	18:32	68	-0,1	1	0	68	0,9075	45	-0,23	0,08	0,31	37	36	36	36	36,5	36	35,9	36,5	0	0	0
85	18:37	80	-0,2	1	0	80	1	15	12	19,01	7,01	23	36	36	36	36	36	23,1	23,1	2,03	1,1	4,76
86	18:38	80	-0,2	1	0	80	1	15	12	19,01	7,01	18	36	36	36	36	36	17	18	5,11	1,1	6

89 (Around 18:30h is start of next meal)

90 Note: You could look into a similar table with the weight settings you are contemplating to  
91 alternatively try. The limitation of doing this is that, going down the new table (the additional “what-  
92 if”- related columns), whenever a first relevant effect occurs, this would change everything  
93 thereafter. So, you see (like also in the graph, example given on next page) moments in which it  
94 would make a difference (a) first and (b) later, if the situation (iob, bg) were remaining similar.

## Resulting tuning

Autosense interference is not helpful and will be shut off

bgAccel\_ISF\_weight 0.16 is responsible for the early SMB sizes. It will be sharpened to 0.20, considering that some delta\_ISF contribution will be reduced also in this phase. .

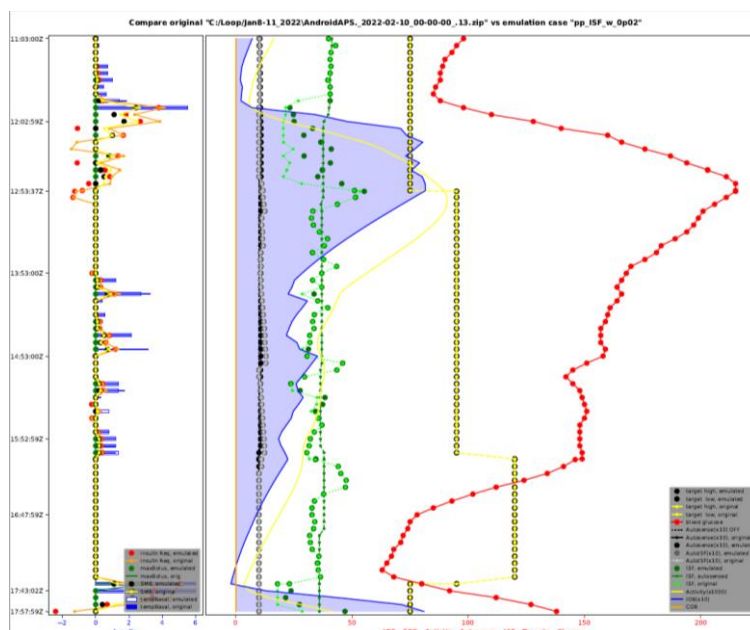
bgBrake\_weight will be slightly elevated 0.08 -> 0.11

max\_autoISF is elevated from 2 to 2.5 erhöht.. min\_autoISF\_ratio goes 0.5 to 0.4

delta\_ISF\_weight ( 0.8) is reduced to 0.6

pp-ISF\_weight showed over long stretches a too strong lowering of ISF. It gets strongly reduced from 0.1 -> 0.02.

This measure was cross-checked using the emulator, see next graph: ,



Investigating effect of reduced pp\_ISF\_weight (0.02, dark green points) vs. past setting (light green: ISF with 0.1 value) using the d.b. emulator:

In the mid and late stage of rising glucose, there would be an effect of lower insulin given.

Also after the max., there a a couple of instances where glucose jumps up briefly, and less insulin would be given with the reduced setting.

A nice way to check an alternative setting is to make use on the emulator on the phone (see FCL e-book, section 11.2)