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Weighing Diverse Theoretical Models on Turkish *Maqam* Music Against Pitch Measurements: A Comparison of Peaks Automatically Derived from Frequency Histograms with Proposed Scale Tones

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Original paper can be found here: http://www.ozanyarman.com/files/theoryVSpractice.pdf

First of all I would like to thank the authors of the original paper for their excellent study.
It presents the most useful pitch measurements of Turkish Maqam music I could find.
However, I feel the most important tuning system has not been included in the comparison.
The pure Pythagorean system.
I've therefore added the pitch data in cents of both a 12-tone and 24-tone Pythagorean scale to the comparison tables. The aditional data is presented in red, I've made no modification to the original data which is all in black.
I've chosen a 24 tones (24 tones linked by 23 pure 3:2 fifths) as the number of tones so there could be a fair comparison against the other 24 tone scales included in the original study.
The Pythagorean system itself is of course not limited to 24 tones, but instead continues indefinitely.

My conclusion is that the 24-tone Pythagorean scale clearly gives a better match overall to the data of this study than the scales compared in the original paper.
Furthermore, I also find Pythagorean to make the most sense of all scales included. It is a pure just intonation system without tempering, the oldest known tuning system in the world and it has already formed the basis for western music for millennia, as well for for instance Chinese music and the Indian 22-tone Shruti (though this is also often interpreted as a 5-limit JI scale, this 5-limit interpretation differs only a maximum of 2 cents from a perfect Pythagorean chain of fifths).
It then makes sense to think the human brain uses a universal system to intepret musical pitch and that this system is based on the simple math of factoring the numbers 2 and 3 giving rise to the Pythagorean system.

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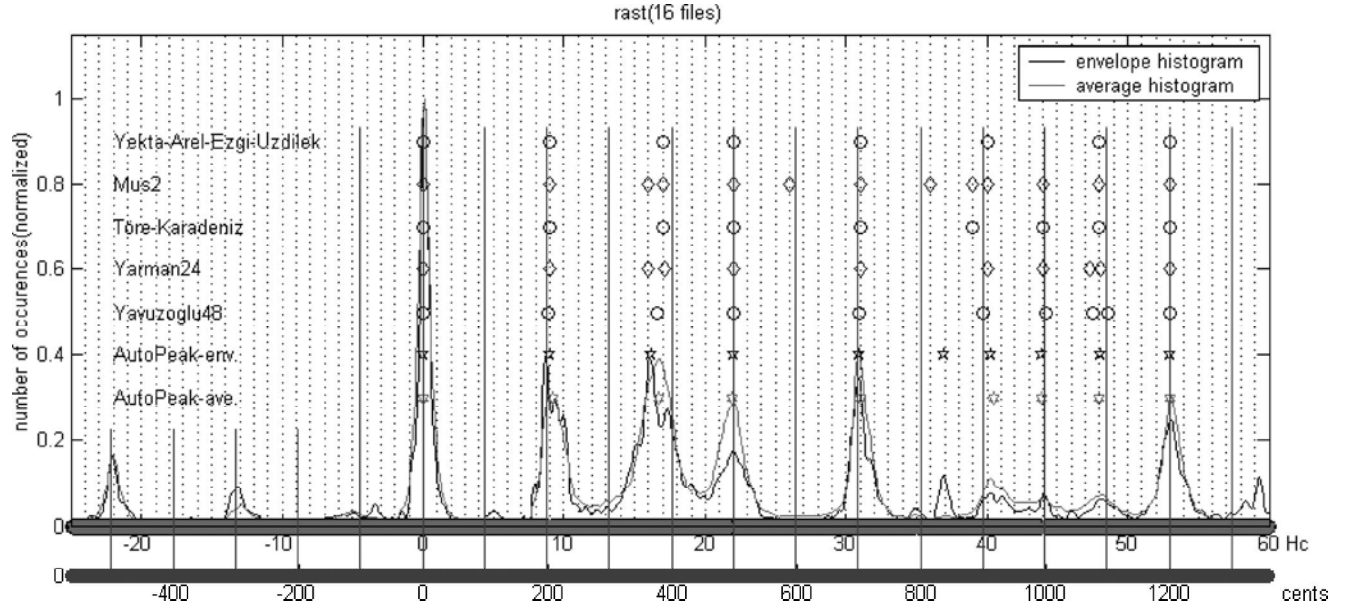
Fig. 4. Histogram computed for *maqam Rast* comparing autopeaks with theorized scales.

Table 1. Data used in histogram for Figure 4 and quantitative comparison of theorized scales with measured relative pitches. M_e, D_e: maximum and average distance values computed with respect to AutoPeak-env. M_a, D_a: maximum and average distance values computed with respect to AutoPeak-ave. E, C: mean efficiency and mean complexity in percentage.

Rast	Distance to tonic in Holderian *commas*												M_e	D_e	M_a	D_a	E	C
YAEU	9.01		16.98	22		31			40.01			47.98	0.85	0.23	**0.4**	0.18	100	75
Mus2	9	16	17	22	~~26~~	31	36	~~39~~	40	44		48	0.93	0.2	0.41	**0.17**	68.2	85.8
TK	9		17	22		31		39		44		48	1.24	0.35	1.41	0.31	100	82.9
Yarman24	9.01	15.88	17.06	22		31			40.01	43.99	47.33	48.07	**0.26**	**0.11**	0.42	0.18	77.8	**70.8**
Yavuzoglu48	8.83	16.56		22.08		30.92			39.75	44.17	47.48	48.58	0.49	0.27	0.66	0.31	87.5	85.4
AutoPeak-env.	9	16.13		21.99		30.88	36.93		40.24	43.94		48.12						
AutoPeak-ave.	9.17	16.64		21.9		31.02			40.41	43.91		48.01						

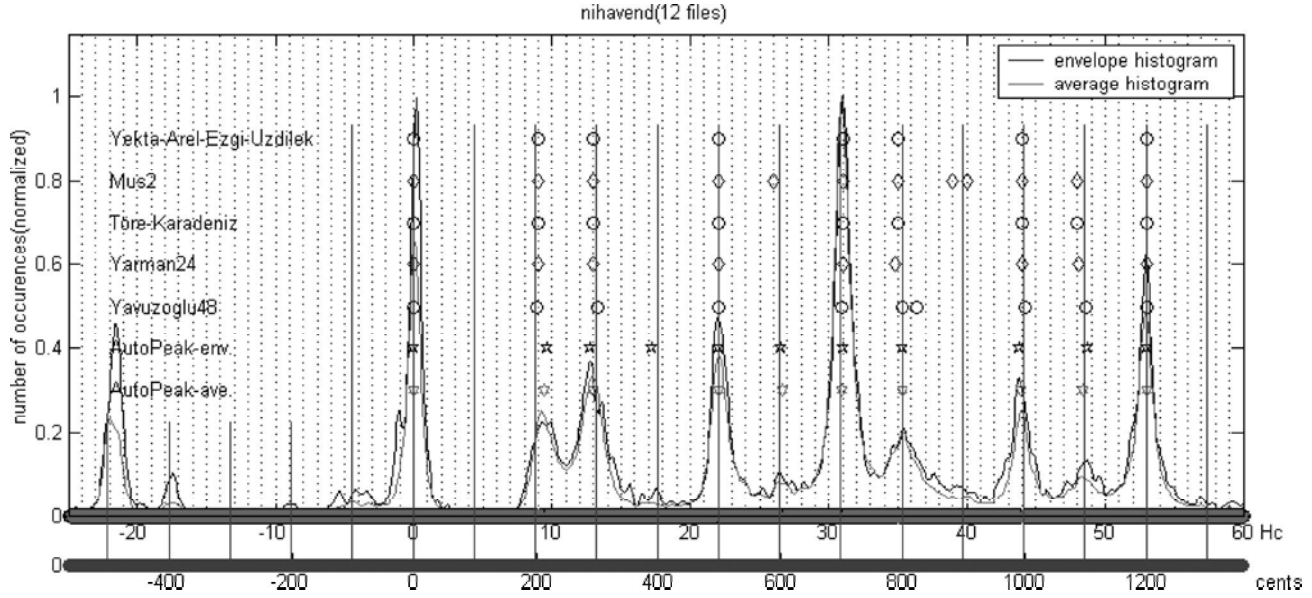| *Rast*	Distance to tonic in cents												M_e	D_e	M_a	D_a
YAEU	204		384.5	498.1		701.9			905.9			1086.3	19.2	5.2	**9.1**	4.1
Mus2	203.8	362.2	384.9	498.1	~~588.7~~	701.9	815.1	~~883.0~~	905.7	996.2		1086.8	21.0	4.5	9.3	**3.8**
TK	203.8		384.9	498.1		701.9		883.0		996.2		1086.8	28.1	7.9	31.9	7.0
Yarman24	204	359.5	386.3	498.1		701.9			905.9	996	1071.6	1088.4	**5.9**	**2.5**	9.5	4.1
Yavuzoglu48	200	375		500		700			900	1000	1075	1100	11.0	6.1	14.9	7.0
AutoPeak-env.	203.8	365.2		497.9		699.2	836.2		911.1	994.9		1089.5				
AutoPeak-ave.	207.6	376.8		495.8		702.3			914.9	994.2		1087.0				
Pyth12	203.9		384.4	498		702			905.9	996.1		1086.3				
Pyth24	203.9	360.9	384.4	498		702			905.9	996.1	1062.9	1086.3				

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nihavend(12 files)

Fig. 5. Histogram computed for *maqam Nihavend* comparing autopeaks with theorized scales.

Table 2. Data used in histogram for Figure 5 and quantitative comparison of theorized scales with measured relative pitches. M_e, D_e: maximum and average distance values computed with respect to AutoPeak-env. M_a, D_a: maximum and average distance values computed with respect to AutoPeak-ave. E, C: mean efficiency and mean complexity in percentage.

Nihavend						Distance to tonic in Holderian *commas*						M_e	D_e	M_a	D_a	E	C
YAEU	9.01	12.99		22		31	34.99			43.99		**0.57**	**0.24**	**0.37**	**0.16**	100	75
Mus2	9	13		22	26	31	35		~~39~~ ~~40~~	44	48	0.63	0.32	0.68	0.25	80	84.9
TK	9	13		22		31	35			44	48	0.63	0.3	0.38	0.19	100	82.9
Yarman24	9.01	12.9		22		31	34.82			43.99	48.07	0.58	0.3	0.49	0.19	100	**70.8**
Yavuzoglu48	8.83	13.25		22.08		30.92	35.33	~~36.44~~		44.17	48.58	0.75	0.25	0.55	0.2	87.5	85.4
AutoPeak-env.	9.58	12.74	17.26	22.08	26.48	31	35.35			43.8	48.63						
AutoPeak-ave.	9.38	12.9		22.07	26.68	30.95	35.31			43.94	48.36						

Nihavend						Distance to tonic in cents						M_e	D_e	M_a	D_a
YAEU	204	294.1		498.1		701.9	792.2			996		**12.9**	**5.4**	**8.4**	**3.6**
Mus2	203.8	294.3		498.1	588.7	701.9	792.5	~~883.0~~	~~905.7~~	996.2	1086.8	14.3	7.2	15.4	5.7
TK	203.8	294.3		498.1		701.9	792.5			996.2	1086.8	14.3	6.8	8.6	4.3
Yarman24	204	292.1		498.1		701.9	788.4			996	1088.4	13.1	6.8	11.1	4.3
Yavuzoglu48	200	300		500		700	800	~~825~~		1000	1100	17.0	5.7	12.5	4.5
AutoPeak-env.	216.9	288.5	390.8	499.9	599.5	701.9	800.4			991.7	1101.1				
AutoPeak-ave.	212.4	292.1		499.7	604.1	700.8	799.5			994.9	1094.9				
Pyth12	203.9	294.1		498		702	792.2			996.1	1086.3 or 1109.8 *				
Pyth24	203.9	294.1		498		702	792.2			996.1	1086.3	1109.8 *				

* the data seems equally likely to indicate a major seventh of 1109.8 cents here to me instead of a diminished octave of 1086.3 cents.
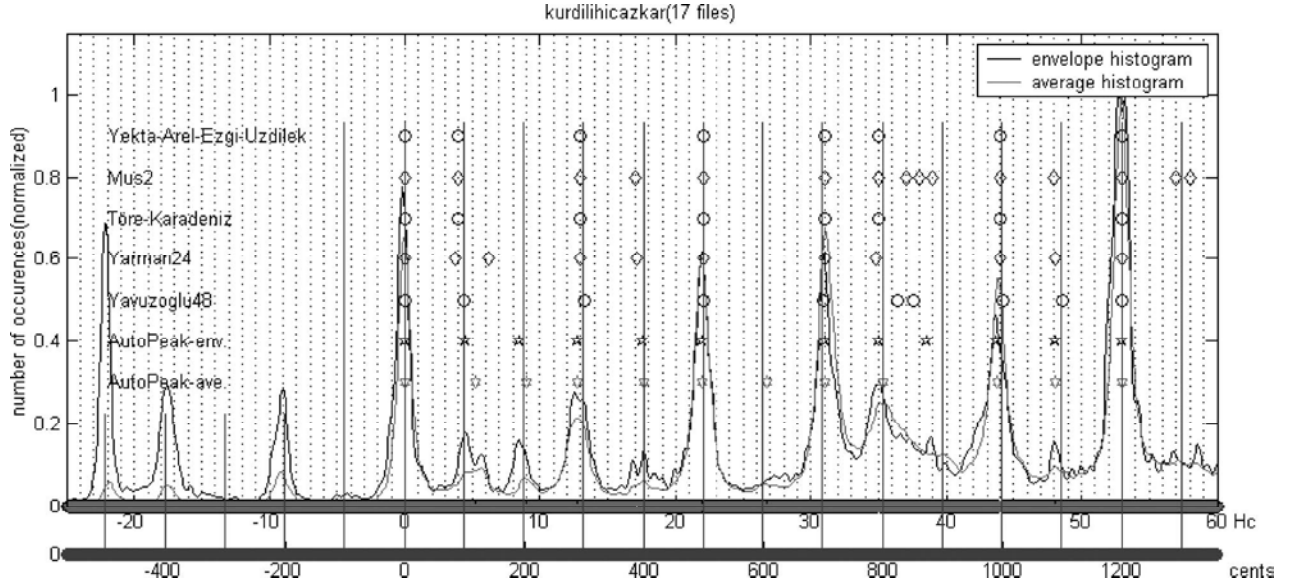
Fig. 6. Histogram computed for *maqams Kürdilihicazkar* comparing autopeaks with theorized scales.

Table 3. Data used in histogram for Figure 6 and quantitative comparison of theorized scales with measured relative pitches. M_e, D_e: maximum and average distance values computed with respect to AutoPeak-env. M_a, D_a: maximum and average distance values computed with respect to AutoPeak-ave. E, C: mean efficiency and mean complexity in percentage.

K.Hicazkar	Distance to tonic in Holderian *commas*											M_e	D_e	M_a	D_a	E	C
YAEU	3.99		12.99		22		31	34.99				43.99		0.53	0.2	1.27	0.39	100	75
Mus2	4		13	17	22		31	35	~~37~~ ~~38~~ 39	44	48	0.58	0.25	1.26	0.38	77.3	84.0
TK	4		13		22		31	35			44	**0.52**	**0.2**	1.26	0.39	100	85.4
Yarman24	3.73	6.29	12.9	17.06	22		31	34.82		43.99	48.07	2.19	0.47	**1.03**	**0.35**	94.4	**64.6**
Yavuzoglu48	4.42		13.25		22.08		30.92	36.44	37.54	44.17	48.58	1.46	0.54	1.09	0.54	93.7	84.4
AutoPeak-env.	4.52	8.48	12.76	17.58	21.93		31.02	34.98	38.55	43.67	48.06						
AutoPeak-ave	5.26	9	12.71	17.64	21.9	26.74	31.1	35.35		43.77	48.05						

K.Hicazkar	Distance to tonic in cents												M_e	D_e	M_a	D_a
YAEU	90.3		294.1		498.1		701.9	792.2			996		12	4.5	28.8	8.8
Mus2	90.6		294.3	384.9	498.1		701.9	792.5	~~837.7~~ ~~860.4~~ 883	996.2	1086.8		13.1	5.7	28.5	8.6
TK	90.6		294.3		498.1		701.9	792.5			996.2		**11.8**	**4.5**	28.5	8.8
Yarman24	84.5	142.4	292.1	386.3	498.1		701.9	788.4		996	1088.4		49.6	10.6	**23.3**	**7.9**
Yavuzoglu48	100		300		500		700	825	850	1000	1100		33.1	12.2	24.7	12.2
AutoPeak-env.	102.3	192	288.9	398.0	496.5		702.3	792	872.8	988.8	1088.2					
AutoPeak-ave	119.1	203.8	287.8	399.4	495.8	605.434	704.1509	800.4		991	1087.9					

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Pyth12      90.2        294.1 384.4 498      702   792.2        996.1 1086.3
Pyth24     113.7 137.1  294.1 407.8 498      702   792.2        996.1 1109.8 *
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* here I've used Pyth24 in an alternative way which seems to give a higher match to the data, while also
making the comma distinction in the first tone. only the last tone (which shows only a very weak peak in
the data) has to be interpreted a comma higher at 1109.9 cents, otherwise the 137.1 cents tone would not
fit the same 24 tone Pythagorean subscale.
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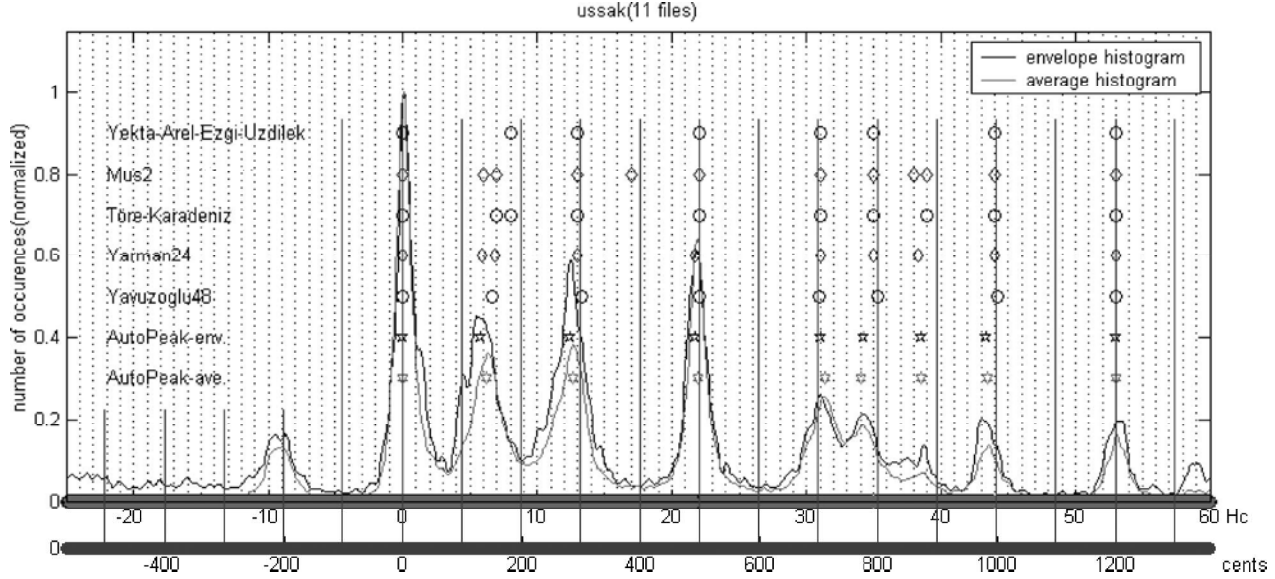
Fig. 7. Histogram computed for *maqam Uşşak* comparing autopeaks with theorized scales.

Table 4. Data used in histogram for Figure 7 and quantitative comparison of theorized scales with measured relative pitches. M_e, D_e: maximum and average distance values computed with respect to AutoPeak-env. M_a, D_a: maximum and average distance values computed with respect to AutoPeak-ave. E, C: mean efficiency and mean complexity in percentage.

Uşşak	Distance to tonic in Holderian *commas*										M_e	D_e	M_a	D_a	E	C
YAEU		7.97	12.99		22	31	34.99			43.99	2.24	0.74	1.69	0.68	100	75
Mus2	6	~~7~~	13	~~17~~	22	31	35	~~38~~	39	44	0.74	0.43	1.01	0.45	70	86.8
TK	7	~~8~~	13		22	31	35		39	44	1.27	0.57	1.01	0.52	87.5	82.9
Yarman24	5.84	~~6.87~~	12.99		21.74	31	34.99	38.33		43.99	**0.73**	**0.34**	**1**	**0.44**	87.5	**70.8**
Yavuzoglu48	6.63		13.25		22.08	30.92	35.33			44.17	1.07	0.68	1.35	0.61	100	87.5
AutoPeak-env.		5.73	12.41		21.78	31.04	34.26	38.52		43.34						
AutoPeak-ave.		6.28	12.62		21.89	31.36	33.99	38.53		43.43						

Uşşak	Distance to tonic in cents										M_e	D_e	M_a	D_a
YAEU		180.5	294.1		498.1	701.9	792.2			996	50.7	16.8	38.3	15.4
Mus2	135.8	158.5	294.3	~~384.9~~	498.1	701.9	792.5	~~860.4~~	883	996.2	16.8	9.7	22.9	10.2
TK	158.5	181.1	294.3		498.1	701.9	792.5		883	996.2	28.8	12.9	22.9	11.8
Yarman24	132.2	~~155.5~~	294.1		492.2	701.9	792.2	867.8		996	**16.5**	**7.7**	**22.6**	**10**
Yavuzoglu48	150		300		500	700	799.9			1000	24.2	15.4	30.6	13.8
AutoPeak-env.		129.7	281		493.1	702.8	775.7	872.2		981.2				
AutoPeak-ave.		142.2	285.7		495.6	710.0	769.6	872.4		983.3				

Pyth12	113.7	294.1	498	702	792.2			996.1	
Pyth24	156.9	294.1	498	702	768.7	859	882.4	972.6	
Pyth24	137.1	294.1	498	702	792.2	839.1		996.1	*

* I've given 2 Pyth24 interpretations here as the first interval seems to match 137.1 best, but for the other intervals the first interpretation with 156.9 cents first interval seems to match best overall.
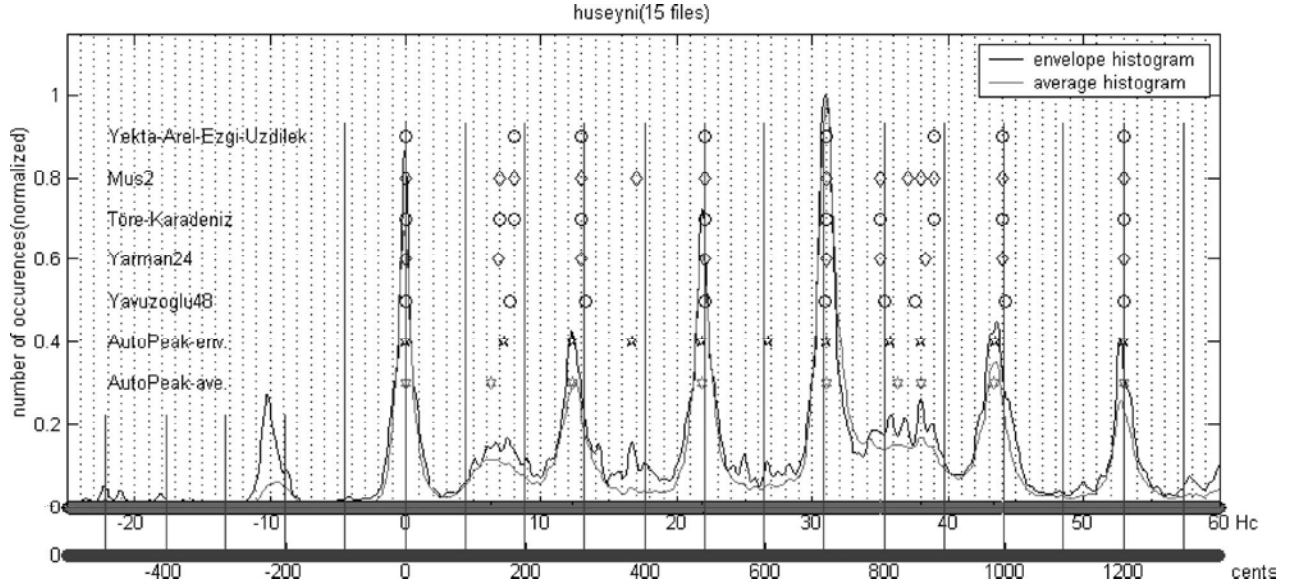
Fig. 8. Histogram computed for *maqam Hüseyni* comparing autopeaks with theorized scales.

Table 5. Data used in histogram for Figure 8 and quantitative comparison of theorized scales with measured relative pitches. M_e, D_c: maximum and average distance values computed with respect to AutoPeak-env. M_a, D_a: maximum and average distance values computed with respect to AutoPeak-ave. E, C: mean efficiency and mean complexity in percentage.

Hüseyni				Distance to tonic in Holderian *commas*								M_e	D_e	M_a	D_a	E	C
YAEU	7.97		12.99		22		31				38.97	43.99	0.96	0.52	1.6	0.68	100	75
Mus2	7	8	13	17	22		31	35	37	38	~~39~~	44	**0.71**	**0.34**	**0.66**	**0.41**	68.2	85.8
TK	7	8	13		22		31	34.99		38.33	39	44	0.99	0.5	1.34	0.65	87.5	82.9
Yarman24	6.87		12.99		22		31	35.33		37.54		43.99	0.73	0.42	1.35	0.53	100	**70.8**
Yavuzoglu48	7.73		13.25		22.08		30.92	35.71		38.01	43.38	44.17	0.92	0.48	1.36	0.7	100	85.4
AutoPeak-env.	7.28		12.33	16.74	21.81	26.76	30.98		36.34	37.98	43.36							
AutoPeak-ave.	6.37		12.35		21.81		31.05											

Hüseyni			Distance to tonic in cents									M_e	D_e	M_a	D_a
YAEU	180.5		294.1		498.1		701.9				882.3	996	21.7	11.8	36.2	15.4
Mus2	158.5	~~181.1~~	294.3	384.9	498.1		701.9	792.5	837.7	860.4	~~883~~	996.2	**16.1**	**7.7**	**14.9**	**9.3**
TK	158.5	~~181.1~~	294.3		498.1		701.9	792.5			883	996.2	22.4	11.3	30.3	14.7
Yarman24	155.5		294.1		498.1		701.9	792.2		867.8		996	22.4	9.5	30.6	12
Yavuzoglu48	175		300		500		700	800		850		1000	16.5	10.9	30.8	15.8
AutoPeak-env.	164.8		279.2	379	493.8	605.9	701.4	808.5		860.6	982.2		20.8			
AutoPeak-ave.	144.2		279.6		493.8		703.0		822.8	859.9	981.7					

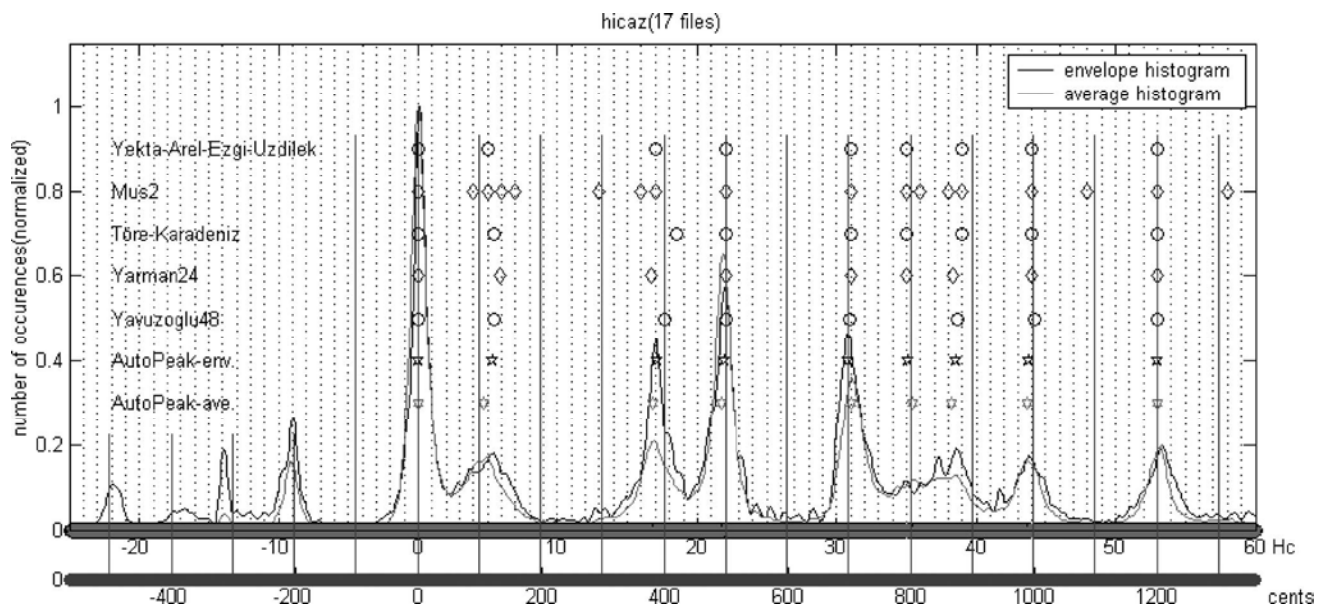|															
Pyth12	180.5		294.1	384.4	498		702	792.2		882.4		996.1				
Pyth24	157		270.7	384.4	498		702	792.2		858.9	972.6	996.1				

Fig. 9. Histogram computed for *maqam Hicaz* comparing autopeaks with theorized scales.

Table 6. Data used in histogram for Figure 9 and quantitative comparison of theorized scales with measured relative pitches. M_e, D_e: maximum and average distance values computed with respect to AutoPeak-env. M_a, D_a: maximum and average distance values computed with respect to AutoPeak-ave. E, C: mean efficiency and mean complexity in percentage.

Hicaz	Distance to tonic in Holderian *commas*														M_e	D_e	M_a	D_a	E	C
YAEU		5.02					16.98	22	31	34.99			38.97	43.99		**0.4**	**0.18**	0.74	0.32	100	**70.8**
Mus2	4	5	6	7	13	16	17	22	31	35	36	38	39	44	48	0.43	0.19	**0.38**	**0.25**	46.7	86.8
TK		5.5					18.5	22	31	35			39	44		1.46	0.38	1.69	0.61	100	82.9
Yarman24		5.84					16.79	22	31	34.99		38.33		43.99		0.54	0.23	1.19	0.33	100	**70.8**
Yavuzoglu48		5.52					17.67	22.08	30.92				38.65	44.17		0.62	0.26	0.87	0.51	100	87.5
AutoPeak-env.		5.3					17.04	21.92	30.84	35.05		38.57		43.75							
AutoPeak-ave.		4.65					16.81	21.79	31.09	35.38		38.23		43.7							

Hicaz	Distance to tonic in cents											M_e	D_e	M_a	D_a
YAEU		113.7					384.9	498.1	701.9	792.2			882.3	996		**9.1**	**4.1**	16.8	7.2
Mus2	90.6	113.2	135.8	158.5	294.3	362.3	384.9	498.1	701.9	792.5	815.1	860.4	883	996.2	1086.8	9.7	4.3	**8.6**	**5.7**
TK		124.5					418.9	498.1	701.9	792.5			883	996.2		33.1	8.6	38.3	13.8
Yarman24		132.2					380.2	498.1	701.9	792.2		867.8		996		12.2	5.2	26.9	7.5
Yavuzoglu48		125					400	500	700				875	1000		14	5.9	19.7	11.5
AutoPeak-env.		120					385.8	496.3	698.3	793.6		873.3		990.6					
AutoPeak-ave.		105.3					380.6	493.4	703.9	801.1		865.6		989.4					

Pyth12	90.2				384.4	498	702	792.2		882.4	996.1	
Pyth24	113.7				384.4	498	702	792.2		882.4	996.1	*
Pyth24	90.2				384.4	498	702	792.2		858.9	996.1	*

* The data seems to indicate the possibility to interpret 113.7 a comma lower and 882.4 a comma lower as provided in the second Pyth24 scale.
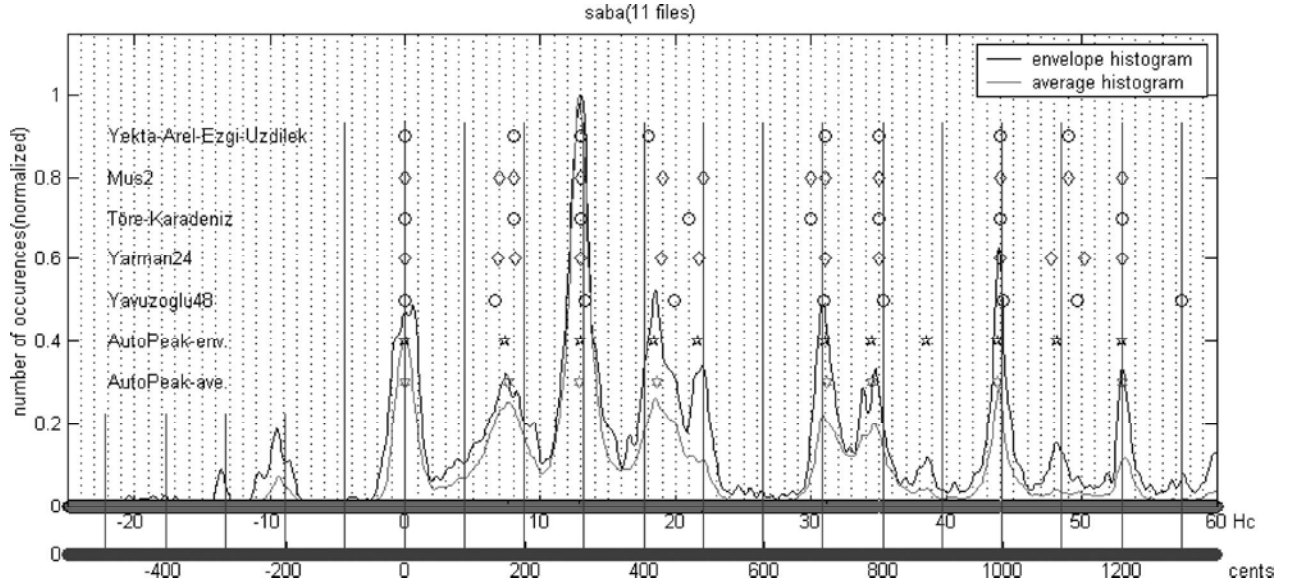
Fig. 10. Histogram computed for *maqam Saba* comparing autopeaks with theorized scales.

Table 7. Data used in histogram for Figure 10 and quantitative comparison of theorized scales with measured relative pitches. M_e, D_e: maximum and average distance values computed with respect to AutoPeak-env. M_a, D_a: maximum and average distance values computed with respect to AutoPeak-ave. E, C: mean efficiency and mean complexity in percentage.

Saba											M_e	D_e	M_a	D_a	E	C
				Distance to tonic in Holderian *commas*												
YAEU	7.97		12.99	18.01		31	34.99		43.99		49.02	0.88	0.37	0.69	0.33	92.8	72.9
Mus2	7	8	13	19	22	~~30~~ 31	35		44		49	0.86	0.37	0.46	0.28	70	86.8
TK	8		13		21	30	35		44			0.97	0.49	2.3	0.78	100	85.4
Yarman24	6.87	8.06	12.99	18.88	21.74	31	34.99		43.99	47.72	~~50.28~~	**0.52**	0.27	**0.45**	0.26	70	**70.8**
Yavuzoglu48	6.63		13.25	19.88		30.92	35.33		44.17		49.69	1.55	0.76	1.18	0.67	92.8	86.5
AutoPeak-env.	7.39		12.89	18.42	21.67	30.97	34.53	38.49	43.85		48.14						
AutoPeak-ave.		7.61	12.79		18.7	31.14	34.54		43.81								

Saba											M_e	D_e	M_a	D_a
				Distance to tonic in cents										
YAEU	180.5		294.1	407.8		701.9	792.2		996		1109.9	19.9	8.4	15.6	7.5
Mus2	158.5	181.1	294.3	430.2	498.1	~~679.2~~ 701.9	792.5		996.2		1109.4	19.5	8.4	10.4	6.3
TK	181.1		294.3		475.5	679.2	792.5		996.2			22	11.1	52.1	17.7
Yarman24	155.5	182.5	294.1	427.5	492.2	701.9	792.2		996	1080.5	~~1138.4~~	**11.8**	**6.1**	**10.2**	**5.9**
Yavuzoglu48	150		300	450		700	800		1000		1125	35.1	17.2	26.7	15.2
AutoPeak-env.	167.3		291.8	417.1	490.6	701.2	781.8	871.5	992.8		1090				
AutoPeak-ave.		172.3	289.6		423.4	705.1	782.0		991.9						

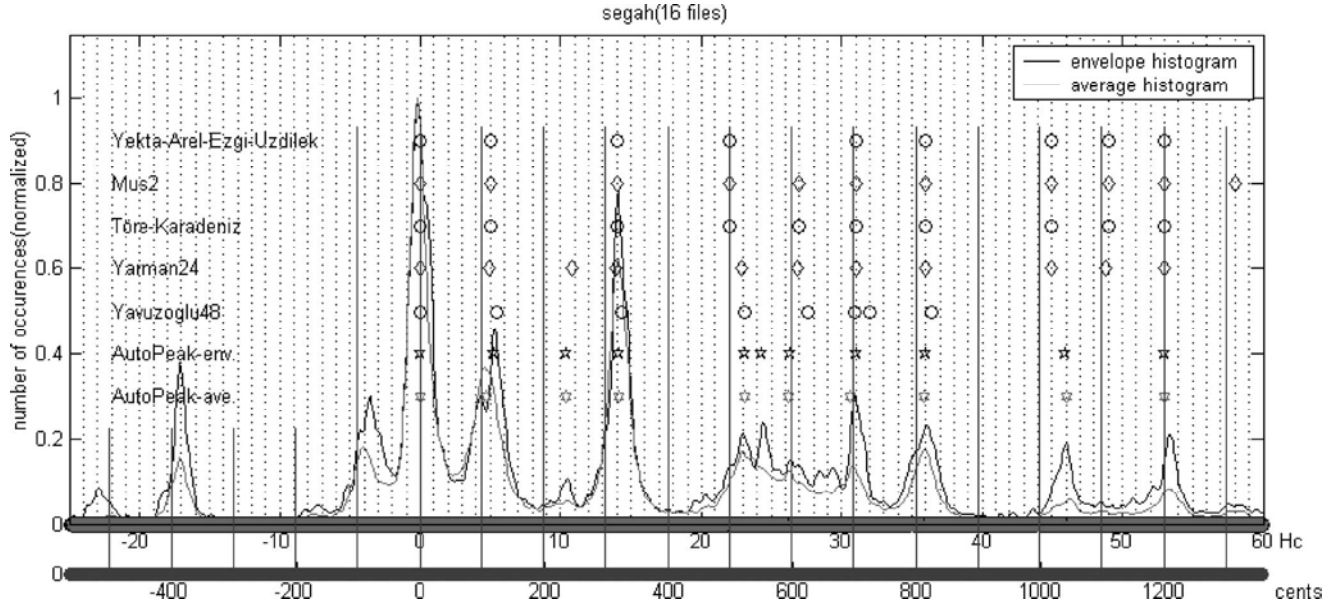| Pyth12	203.9	294.1	407.8	498	702	792.2	996.1	1109.8
Pyth24	180.5	294.1	407.8	498	702	792.2	882.4	996.1	1086.3

Fig. 11. Histogram computed for *maqam Segah* comparing autopeaks with theorized scales.

Table 8. Data used in histogram for Figure 11 and quantitative comparison of theorized scales with measured relative pitches. M_e, D_e: maximum and average distance values computed with respect to AutoPeak-env. M_a, D_a: maximum and average distance values computed with respect to AutoPeak-ave. E, C: mean efficiency and mean complexity in percentage.

Segah			Distance to tonic in Holderian *commas*							M_e	D_e	M_a	D_a	E	C
YAEU	5.02		14.03	22			31		36.02	45.03	~~49.02~~	1.08	0.4	1.11	0.49 85.7 75
Mus2	5		14	22		27	31		36	45	~~49~~	1.08	0.45	1.11	0.53 87.5 86.8
TK	5		14	22		27	31		36	45	~~49~~	1.08	0.45	1.11	0.53 87.5 82.9
Yarman24	4.93	10.82	13.94	22.95		26.93	31		35.94	44.94	~~48.84~~	**0.96**	**0.34**	**1.06**	**0.4** 88.9 **66.7**
Yavuzoglu48	5.52		14.35	23.19		27.6	30.92	~~32.02~~	36.44			1.29	0.42	1.34	0.55 85.7 87.5
AutoPeak-env.	5.23	10.33	14.15	23.08 24.28		26.31	31.03		35.95	45.9					
AutoPeak-ave.	4.68	10.32	14.08	23.11		26.27	30.69		35.87	46.01					

Segah			Distance to tonic in cents							M_e	D_e	M_a	D_a
YAEU	113.7		317.7	498.1			701.9		815.5	1019.5	~~1109.9~~	24.5	9.1 25.1 11.1
Mus2	113.2		317	498.1		611.3	701.9		815.1	1018.9	~~1109.4~~	24.5	10.2 25.1 12
TK	113.2		317	498.1		611.3	701.9		815.1	1018.9	~~1109.4~~	24.5	10.2 25.1 12
Yarman24	111.6	245	315.6	519.6		609.7	701.9		813.7	1017.5	~~1105.8~~	**21.7**	**7.7 24 9.1**
Yavuzoglu48	125		325	525		625	700	~~725~~	825			29.2	9.5 30.3 12.5
AutoPeak-env.	118.4	233.9	320.4	522.6	549.7	595.7	702.6		814	1039.2			
AutoPeak-ave.	106	233.7	318.8	523.2		594.8	694.9		812.2	1041.7			

Pyth12   113.7   317.6 498   611.7 702   815.6 1019.6
Pyth24   113.7 227.4 317.6 521.5 545 611.7 702   815.6 1043

Unlike all the other scales presented here, Pyth24 seems to match the data very closely.
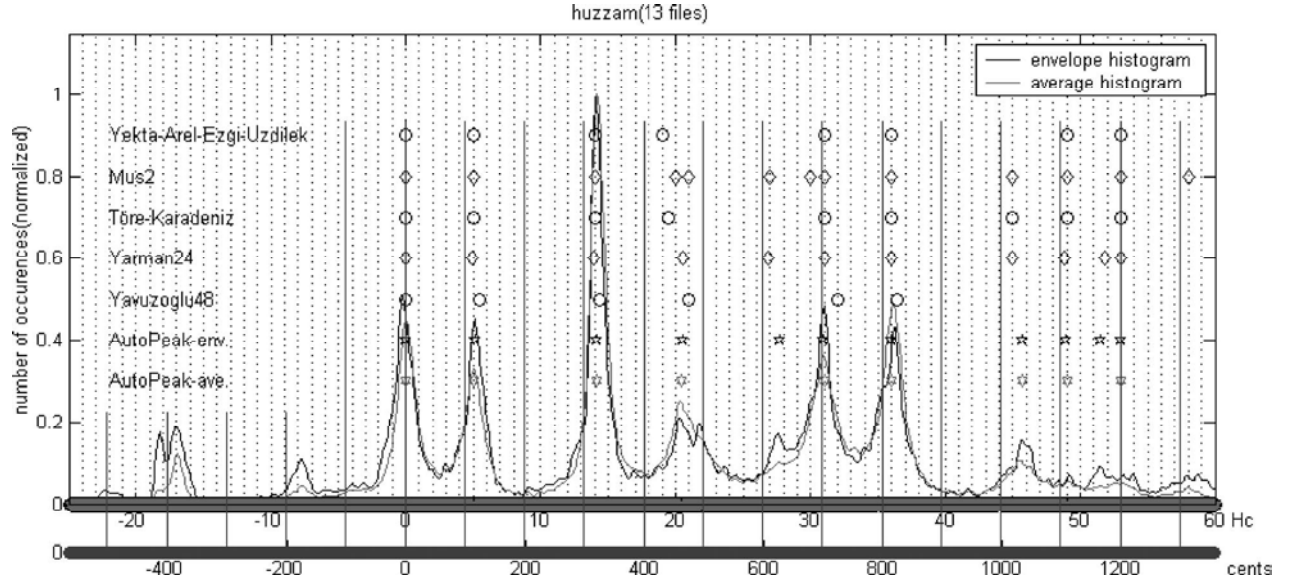
Fig. 12. Histogram computed for *maqam Hüzzam* comparing autopeaks with theorized scales.

Table 9. Data used in histogram for Figure 12 and quantitative comparison of theorized scales with measured relative pitches. M_e, D_e: maximum and average distance values computed with respect to AutoPeak-env. M_a, D_a: maximum and average distance values computed with respect to AutoPeak-ave. E, C: mean efficiency and mean complexity in percentage.

Hüzzam				Distance to tonic in Holderian *commas*							M_e	D_e	M_a	D_a	E	C
YAEU	5.02	14.03	19.05			31	36.02		49.02		1.42	0.3	1.4	0.28	100	75
Mus2	5	14	20	21	27	30	31	36	45	49	**0.75**	**0.29**	**0.66**	**0.2**	75	85.8
TK	5	14	19.5			31	36	45	49		0.97	0.3	0.95	0.27	100	82.9
Yarman24	4.93	13.94	20.59		26.93	31	35.94	44.94	48.84	51.81	0.82	0.3	0.71	**0.2**	88.9	**66.7**
Yavuzoglu48	5.52	14.35	20.98			32.02	36.44				1.11	0.54	1.05	0.54	100	89.6
AutoPeak-env.	5.11	14.12	20.47		27.75	30.91	35.98	45.74	48.95	51.46						
AutoPeak-ave.	4.99	14.17	20.45			30.97	36.03	45.66	48.98							

Hüzzam				Distance to tonic in cents							M_e	D_e	M_a	D_a
YAEU	113.7	317.7	431.3				701.9	815.5		1109.9		32.2	6.8	31.7	6.3
Mus2	113.2	317	452.8	475.5	611.3	679.2	701.9	815.1	1018.9	1109.4		**17**	**6.6**	**14.9**	**4.5**
TK	113.2	317	441.5				701.9	815.1	1018.9	1109.4		22	6.8	21.5	6.1
Yarman24	111.6	315.6	466.2		609.7		701.9	813.7	1017.5	1105.8	1173.1	18.6	6.8	16.1	**4.5**
Yavuzoglu48	125	325	475				725	825				25.1	12.2	23.8	12.2
AutoPeak-env.	115.7	319.7	463.5		628.3		699.8	814.6	1035.6	1108.3	1165.1				
AutoPeak-ave.	113	320.8	463.0				701.2	815.8	1033.8	1109					

Pyth12	113.7	317.6	498		611.7		702	815.6	1019.6	1109.8	
Pyth24	113.7	317.6	474.6		611.7		702	815.6	1019.6	1109.8	1176.5