

Scientific Research Project Biomechanical Analyses

at the



Final Report

Combined Events

**Biomechanical analyses of selected events at the
12th IAAF World Championships in Athletics,
Berlin 15–23 August 2009**

A Project by the German Athletics Federation

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in co-operation with

IAT Leipzig

OSP Berlin

OSP Hessen

OSP Rheinland

Martin Luther-Universität Wittenberg-Halle



DLV Scientific Research Project

Deutscher
Leichtathletik-
Verband



IAT
Institut für Angewandte
Trainingswissenschaft



Olympiastützpunkte
Berlin
Hessen
Rheinland



MLU Halle-Wittenberg

Report-layout:

Helmar HOMMEL (DLV)

Biomechanics-Team:

Helmar HOMMEL (DLV, Project Co-ordinator • helmar.hommel@leichtathletik.de)

Marko BADURA (IAT Leipzig)

Dr. Luis MENDOZA (OSP Hessen)

Jörg BÖTTCHER (OSP Berlin)

Ralf MÜLLER (OSP Rheinland)

Dr. Ralf BUCKWITZ (OSP Berlin)

Eberhard NIXDORF (OSP Hessen)

Dr. Olaf ERNST (IAT Leipzig)

Dr. Bettina PERLT (IAT Leipzig)

Dr. Dieter GOHLITZ (IAT Leipzig)

Wilko SCHAA (IAT Leipzig)

Rolf GRAUBNER (Uni Halle)

Falk SCHADE (OSP Rheinland)

Regine ISELE (OSP Hessen)

Axel SCHLEICHARDT (IAT Leipzig)

Mirko LANDMANN (Uni Halle)

Anja STARKE (Uni Halle)

Dr. Frank LEHMANN (IAT Leipzig)

Biomechanical analysis

12th IAAF World Championships in Athletics Berlin, August 15 - 23, 2009



DLV Scientific Research Project



100m Men

Decathlon

		Round	Wind	RT	t _{20m}	t _{40m}	t _{60m}	t _{80m}	t _{100m}	t ₂₀₋₄₀	t ₄₀₋₆₀	t ₆₀₋₈₀	t ₈₀₋₁₀₀	t _{30m}	t ₃₀₋₆₀
Hardee Trey	USA	Ht 3	0,2	0,130	2,98	4,87	6,70	8,54	10,45	1,89	1,83	1,84	1,91	2,98	3,72
Eaton Ashton	USA	Ht 3	0,2	0,162	3,00	4,90	6,77	8,61	10,53	1,90	1,87	1,84	1,92	3,00	3,77
García Yordani	CUB	Ht 3	0,2	0,156	3,05	4,96	6,83	8,68	10,60	1,91	1,87	1,85	1,92	3,05	3,78
Kasyanov Oleksiy	UKR	Ht 3	0,2	0,162	3,08	5,01	6,89	8,73	10,63	1,93	1,88	1,84	1,90	3,08	3,81
Bouraada Larbi	ALG	Ht 3	0,2	0,131	3,10	5,04	6,92	8,77	10,68	1,94	1,88	1,85	1,91	3,10	3,82
Raja Andres	EST	Ht 3	0,2	0,159	3,11	5,08	6,98	8,87	10,82	1,97	1,90	1,89	1,95	3,11	3,87
Sysoev Alexey	RUS	Ht 1	0,3	0,144	3,17	5,15	7,06	8,93	10,85	1,98	1,91	1,87	1,92	3,17	3,89
Coertzen Willem	RSA	Ht 5	-0,5	0,181	3,14	5,09	7,01	8,91	10,89	1,95	1,92	1,90	1,98	3,14	3,87
Behrenbruch Pascal	GER	Ht 4	0,0	0,135	3,10	5,07	7,00	8,92	10,92	1,97	1,93	1,92	2,00	3,10	3,90
Pogorelov Aleksandr	RUS	Ht 2	-0,3	0,168	3,17	5,15	7,07	8,97	10,95	1,98	1,92	1,90	1,98	3,17	3,90
Wiberg Nicklas	SWE	Ht 5	-0,5	0,161	3,15	5,11	7,04	8,97	10,96	1,96	1,93	1,93	1,99	3,15	3,89
Müller Norman	GER	Ht 4	0,0	0,131	3,13	5,13	7,07	8,99	11,01	2,00	1,94	1,92	2,02	3,13	3,94
Arnold Jake	USA	Ht 5	-0,5	0,163	3,13	5,10	7,06	8,99	11,01	1,97	1,96	1,93	2,02	3,13	3,93
Karpov Dmitriy	KAZ	Ht 1	0,3	0,158	3,19	5,18	7,12	9,03	11,02	1,99	1,94	1,91	1,99	3,19	3,93
Sintnicolaas Eelco	NED	Ht 4	0,0	0,166	3,17	5,16	7,11	9,04	11,05	1,99	1,95	1,93	2,01	3,17	3,94
Cleve Moritz	GER	Ht 2	-0,3	0,172	3,21	5,23	7,17	9,08	11,06	2,02	1,94	1,91	1,98	3,21	3,96
Suárez Leonel	CUB	Ht 4	0,0	0,154	3,10	5,10	7,07	9,06	11,13	2,00	1,97	1,99	2,07	3,10	3,97
Barras Romain	FRA	Ht 5	-0,5		3,20	5,21	7,18	9,12	11,14	2,01	1,97	1,94	2,02	3,20	3,98
Šebrle Roman	CZE	Ht 2	-0,3	0,160	3,17	5,17	7,13	9,08	11,16	2,00	1,96	1,95	2,08	3,17	3,96
Krauchanka Andrei	BLR	Ht 2	-0,3	0,169	3,20	5,22	7,19	9,15	11,18	2,02	1,97	1,96	2,03	3,20	3,99
Martineau Eugene	NED	Ht 2	-0,3	0,124	3,18	5,21	7,18	9,15	11,18	2,03	1,97	1,97	2,03	3,18	4,00
Kharlamov Vasilij	RUS	Ht 1	0,3	0,184	3,14	5,13	7,12	9,12	11,22	1,99	1,99	2,00	2,10	3,14	3,98

Team Sprint/Hurdles: Rolf Graubner, Dr. Ralf Buckwitz, Mirko Landmann, Anja Starke

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Biomechanical analysis

12th IAAF World Championships in Athletics Berlin, August 15 - 23, 2009



400m Men

Decathlon

		Round	RT	t _{400m}	t _{200m}	Diff.	t _{200-400m}	t _{300m}	t _{100m}	t ₁₀₀₋₂₀₀	t _{200-300m}	t _{300-400m}
Díaz Yunior	CUB	Ht 2	0,180	46,15	21,94	2,27	24,21	33,50	11,27	10,67	11,56	12,65
Almgren Daniel	SWE	Ht 2	0,167	47,68	22,80	2,08	24,88	34,78	11,80	11,00	11,98	12,90
Eaton Ashton	USA	Ht 2	0,171	47,75	22,70	2,35	25,05	34,94	11,39	11,31	12,24	12,81
Kasyanov Oleksiy	UKR	Ht 2	0,136	47,85	23,00	1,85	24,85	35,36	11,78	11,22	12,36	12,49
Suárez Leonel	CUB	Ht 2	0,137	48,00	22,66	2,68	25,34	34,74	11,41	11,25	12,08	13,26
Hardee Trey	USA	Ht 4	0,148	48,13	22,50	3,13	25,63	34,64	11,41	11,09	12,14	13,49
Müller Norman	GER	Ht 3	0,184	48,20	22,58	3,04	25,62	34,55	11,65	10,93	11,97	13,65
García Yordani	CUB	Ht 4	0,150	48,34	22,68	2,98	25,66	35,06	11,07	11,61	12,38	13,28
Bouraada Larbi	ALG	Ht 2	0,141	48,58	22,00	4,58	26,58	34,20	11,35	10,65	12,20	14,38
Coertzen Willem	RSA	Ht 4	0,189	48,63	22,62	3,39	26,01	34,84	11,42	11,20	12,22	13,79
Behrenbruch Pascal	GER	Ht 3	0,142	48,72	22,54	3,64	26,18	34,86	11,35	11,19	12,32	13,86
Wiberg Nicklas	SWE	Ht 4	0,198	48,73	22,95	2,83	25,78	35,09	11,76	11,19	12,14	13,64
Krauchanka Andrei	BLR	Ht 4	0,207	48,77	22,88	3,01	25,89	35,17	11,63	11,25	12,29	13,60
Raja Andres	EST	Ht 3	0,170	49,00	22,98	3,04	26,02	35,79	11,67	11,31	12,81	13,21
Cleve Moritz	GER	Ht 4	0,195	49,17	23,43	2,31	25,74	35,36	12,08	11,35	11,93	13,81
Sysoev Alexey	RUS	Ht 1	0,141	49,32	23,23	2,86	26,09	35,48	11,79	11,44	12,25	13,84
Karpov Dmitriy	KAZ	Ht 5	0,127	49,45	23,17	3,11	26,28	35,47	11,89	11,28	12,30	13,98
Vos Ingmar	NED	Ht 1	0,155	49,99	22,90	4,19	27,09	35,21	11,68	11,22	12,31	14,78
Newdick Brent	NZL	Ht 1	0,158	50,10	23,29	3,52	26,81	35,62	11,76	11,53	12,33	14,48
Šebrle Roman	CZE	Ht 1	0,164	50,42	23,55	3,32	26,87	36,11	11,99	11,56	12,56	14,31
Pogorelov Aleksandr	RUS	Ht 5	0,171	50,72	23,81	3,10	26,91	36,41	12,05	11,76	12,60	14,31

Team Sprint/Hurdles: **Rolf Graubner**, Dr. Ralf Buckwitz, Mirko Landmann, Anja Starke

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Biomechanical analysis

12th IAAF World Championships in Athletics Berlin, August 15 - 23, 2009



110m Hurdles Men

Decathlon

		Round	Wind	RT	t _{1.H}	t _{2.H}	t _{3.H}	t _{4.H}	t _{5.H}	t _{6.H}	t _{7.H}	t _{8.H}	t _{9.H}	t _{10.H}	t _{end}
Hardee Trey	USA	Ht 2	0,3	0,134	2,65	3,75 1,10	4,82 1,07	5,87 1,05	6,93 1,06	8,03 1,10	9,09 1,06	10,21 1,12	11,29 1,08	12,41 1,12	13,86 1,45
García Yordani	CUB	Ht 2	0,3	0,156	2,61	3,69 1,08	4,78 1,09	5,89 1,11	6,99 1,10	8,11 1,12	9,21 1,10	10,30 1,09	11,45 1,15	12,59 1,14	14,08 1,49
Krauchanka Andrei	BLR	Ht 3	-0,1	0,175	2,77	3,89 1,12	4,99 1,10	6,07 1,08	7,17 1,10	8,25 1,08	9,35 1,10	10,45 1,10	11,56 1,11	12,67 1,11	14,13 1,46
Pogorelov Aleksandr	RUS	Ht 1	0,3	0,146	2,82	3,94 1,12	5,04 1,10	6,15 1,11	7,25 1,10	8,34 1,09	9,41 1,07	10,52 1,11	11,64 1,12	12,74 1,10	14,19 1,45
Raja Andres	EST	Ht 2	0,3	0,151	2,67	3,79 1,12	4,91 1,12	6,00 1,09	7,10 1,10	8,19 1,09	9,29 1,10	10,43 1,14	11,55 1,12	12,71 1,16	14,22 1,51
Behrenbruch Pascal	GER	Ht 2	0,3	0,156	2,75	3,87 1,12	4,97 1,10	6,07 1,10	7,17 1,10	8,28 1,11	9,39 1,11	10,50 1,11	11,63 1,13	12,77 1,14	14,24 1,47
Coertzen Willem	RSA	Ht 3	-0,1	0,152	2,75	3,86 1,11	4,97 1,11	6,08 1,11	7,17 1,09	8,27 1,10	9,39 1,12	10,49 1,10	11,63 1,14	12,79 1,16	14,26 1,47
Barras Romain	FRA	Ht 3	-0,1	0,135	2,72	3,85 1,13	4,96 1,11	6,07 1,11	7,15 1,08	8,27 1,12	9,37 1,10	10,49 1,12	11,61 1,12	12,75 1,14	14,27 1,52
Eaton Ashton	USA	Ht 2	0,3	0,178	2,70	3,79 1,09	4,87 1,08	5,97 1,10	7,07 1,10	8,17 1,10	9,27 1,10	10,45 1,18	11,61 1,16	12,75 1,14	14,28 1,53
Šebrle Roman	CZE	Ht 3	-0,1	0,165	2,77	3,91 1,14	5,01 1,10	6,11 1,10	7,21 1,10	8,35 1,14	9,44 1,09	10,57 1,13	11,73 1,16	12,90 1,17	14,44 1,54

		Round	Wind	RT	t _{1.H}	t _{2.H}	t _{3.H}	t _{4.H}	t _{5.H}	t _{6.H}	t _{7.H}	t _{8.H}	t _{9.H}	t _{10.H}	t _{end}
Kasyanov Oleksiy	UKR	Ht 3	-0,1	0,163	2,73	3,85 1,12	4,95 1,10	6,07 1,12	7,18 1,11	8,31 1,13	9,45 1,14	10,59 1,14	11,77 1,18	12,96 1,19	14,44 1,48
Suárez Leonel	CUB	Ht 2	0,3	0,139	2,65	3,78 1,13	4,89 1,11	6,01 1,12	7,13 1,12	8,25 1,12	9,39 1,14	10,51 1,12	11,68 1,17	12,85 1,17	14,45 1,60
Karpov Dmitriy	KAZ	Ht 4	0,0	0,141	2,73	3,85 1,12	4,94 1,09	6,03 1,09	7,17 1,14	8,31 1,14	9,45 1,14	10,61 1,16	11,73 1,12	12,91 1,18	14,46 1,55
Vos Ingmar	NED	Ht 5	0,3	0,178	2,76	3,91 1,15	5,04 1,13	6,16 1,12	7,28 1,12	8,40 1,12	9,52 1,12	10,66 1,14	11,80 1,14	12,99 1,19	14,51 1,52
Cleve Moritz	GER	Ht 3	-0,1	0,162	2,77	3,87 1,10	5,05 1,18	6,17 1,12	7,28 1,11	8,37 1,09	9,49 1,12	10,67 1,18	11,81 1,14	12,99 1,18	14,54 1,55
Díaz Yunior	CUB	Ht 1	0,3	0,155	2,69	3,86 1,17	5,00 1,14	6,13 1,13	7,26 1,13	8,38 1,12	9,51 1,13	10,66 1,35	11,86 1,00	13,08 1,22	14,56 1,48
Bourraada Larbi	ALG	Ht 5	0,3	0,140	2,74	3,88 1,14	5,04 1,16	6,18 1,14	7,31 1,13	8,49 1,18	9,64 1,15	10,78 1,14	11,94 1,16	13,12 1,18	14,57 1,45
Müller Norman	GER	Ht 1	0,3	0,172	2,79	3,93 1,14	5,05 1,12	6,17 1,12	7,30 1,13	8,42 1,12	9,55 1,13	10,70 1,15	11,86 1,16	13,40 1,54	14,59 1,19
Wiberg Nicklas	SWE	Ht 5	0,3	0,208	2,84	4,00 1,16	5,11 1,11	6,20 1,09	7,33 1,13	8,48 1,15	9,64 1,16	10,86 1,22	12,02 1,16	13,22 1,20	14,75 1,53
Sysoev Alexey	RUS	Ht 4	0,0	0,150	2,87	3,95 1,08	5,10 1,15	6,29 1,19	7,49 1,20	8,65 1,16	9,83 1,18	11,02 1,19	12,23 1,21	13,42 1,19	14,97 1,55
Almgren Daniel	SWE	Ht 4	0,0	0,193	2,89	4,08 1,19	5,25 1,17	6,39 1,14	7,53 1,14	8,75 1,22	9,93 1,18	11,11 1,18	12,31 1,20	13,52 1,21	15,14 1,62

Team Sprint/Hurdles: Rolf Graubner, Dr. Ralf Buckwitz, Mirko Landmann, Anja Starke

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Long Jump Decathlon, 12th IAAF World Championships in Athletics - Berlin

No.	Name	Att.	Distance [m]	Wind [m/s]	Run-Up-Velocity		
					11-6m [m/s]	6-1m [m/s]	
1184	Hardee	1.A	7.80	-0.9	10.17	10.14	19. Aug 09 s11:37:24
1184	Hardee	2.A	7.77	-0.5	10.12	10.13	19. Aug 09 s12:05:20
1184	Hardee	3.A	7.83	+1.9	10.11	10.31	19. Aug 09 s12:30:46
306	Suarez	1.A	6.76	+1.2	9.90	9.84	19. Aug 09 s11:23:27
306	Suarez	2.A	x	+1.7	0.00	0.00	19. Aug 09 s11:52:31
306	Suarez	3.A	7.24	-0.3	9.97	9.83	19. Aug 09 s12:20:05
1088	Pogorelov	1V	7.29	-0.1	9.50	9.69	19.08.2009 s11:30:14
1088	Pogorelov	2V	7.26	+0.2	0.00	0.00	19.08.2009 s11:59:01
1088	Pogorelov	3V	7.49	-0.4	9.99	10.02	19.08.2009 s12:31:14
1144	Kasyanov	1.A	7.80	+0.9	10.00	9.96	19. Aug 09 s11:30:01
1144	Kasyanov	2.A	x	+0.1	9.70	9.43	19. Aug 09 s12:00:26
1144	Kasyanov	3.A	7.76	+0.3	10.24	10.35	19. Aug 09 s12:25:58
1020	Sysoev	1V	6.83	+0.9	9.59	9.88	19.08.2009 s11:19:53
1020	Sysoev	2V	6.87	+1.0	0.00	0.00	19.08.2009 s11:48:23
1020	Sysoev	3V	6.60	-0.7	9.67	9.92	19.08.2009 s12:21:23
527	Behrenbruch	1V	x	-0.3	9.56	9.60	19.08.2009 s11:18:36
527	Behrenbruch	2V	7.09	+1.6	10.01	10.15	19.08.2009 s11:46:41
527	Behrenbruch	3V	x	+0.1	9.92	9.86	19.08.2009 s12:17:08
1084	Wiberg	1.A	x	-0.9	9.83	9.81	19. Aug 09 s11:40:15
1084	Wiberg	2.A	7.20	+0.0	0.00	0.00	19. Aug 09 s12:07:36
1084	Wiberg	3.A	7.25	-0.4	9.88	9.96	19. Aug 09 s12:33:53
301	Garcia	1.A	x	+0.9	9.33	9.39	19. Aug 09 s11:42:48
301	Garcia	2.A	6.63	+0.0	9.14	9.24	19. Aug 09 s12:10:46
301	Garcia	3.A	7.05	+1.0	9.34	9.40	19. Aug 09 s12:36:47
559	Müller	1.A	7.23	+0.0	9.85	9.87	19. Aug 09 s11:21:55
559	Müller	2.A	7.35	+8.0	9.80	9.84	19. Aug 09 s11:51:14
559	Müller	3.A	x	+2.0	9.83	9.74	19. Aug 09 s12:18:17
530	Cleve	1V	6.80	+0.5	9.80	9.97	19.08.2009 s11:28:42
530	Cleve	2V	7.27	-0.3	9.86	9.92	19.08.2009 s11:57:37
530	Cleve	3V	x	+0.2	9.82	9.83	19.08.2009 s12:29:37

Biomechanical analysis

12th IAAF World Championships in Athletics Berlin, August 15 - 23, 2009



200m Women

Heptathlon

	Round	Wind	RT	t _{200m}	t _{100m}	Diff.	t _{100-200m}	t _{150m}	t _{0-50m}	t _{50-100m}	t _{100-150m}	t _{150-200m}	
Ennis Jessica	GBR	Ht 1	0,0	0,182	23,25	11,76	-0,27	11,49	17,33	6,53	5,23	5,57	5,92
Yosypenko Lyudmyla	UKR	Ht 1	0,0	0,177	23,86	12,01	-0,16	11,85	17,64	6,67	5,34	5,63	6,22
Tyminska Karolina	POL	Ht 1	0,0	0,174	23,87	12,04	-0,21	11,83	17,75	6,72	5,32	5,71	6,12
Melnychenko Hanna	UKR	Ht 1	0,0	0,140	24,11	11,96	0,19	12,15	17,79	6,53	5,43	5,83	6,32
Chernova Tatyana	RUS	Ht 1	0,0	0,127	24,13	12,24	-0,35	11,89	17,99	6,73	5,51	5,75	6,14
Hazel Louise	GBR	Ht 3	-0,2	0,187	24,19	12,01	0,17	12,18	17,82	6,57	5,44	5,81	6,37
Oeser Jennifer	GER	Ht 3	-0,2	0,194	24,30	12,19	-0,08	12,11	18,00	6,78	5,41	5,81	6,30
Chudzik Kamila	POL	Ht 3	-0,2	0,187	24,33	12,28	-0,23	12,05	18,03	6,80	5,48	5,75	6,30
Mächtigt Julia	GER	Ht 3	-0,2	0,181	24,39	12,31	-0,23	12,08	18,13	6,78	5,53	5,82	6,26
Tarasova Yuliya	UZB	Ht 3	-0,2	0,194	24,60	12,17	0,26	12,43	18,06	6,80	5,37	5,89	6,54
Theisen Brianne	CAN	Ht 1	0,0	0,185	24,62	12,35	-0,08	12,27	18,29	6,88	5,47	5,94	6,33
Samuelsson Jessica	SWE	Ht 1	0,0	0,208	24,71	12,25	0,21	12,46	18,22	6,71	5,54	5,97	6,49
Pickler Diana	USA	Ht 2	-0,3	0,173	24,75	12,33	0,09	12,42	18,29	6,77	5,56	5,96	6,46
Wisse Yvonne	NED	Ht 1	0,0	0,173	24,78	12,28	0,22	12,50	18,26	6,84	5,44	5,98	6,52
Antoinette Nana Djimou Ida	FRA	Ht 4	-0,3	0,170	24,83	12,25	0,33	12,58	18,22	6,71	5,54	5,97	6,61
Dobrynska Nataliya	UKR	Ht 3	-0,2	0,198	25,02	12,39	0,24	12,63	18,41	6,83	5,56	6,02	6,61
Züblin Linda	SUI	Ht 3	-0,2	0,175	25,04	12,31	0,42	12,73	18,32	6,73	5,58	6,01	6,72
Day Sharon	USA	Ht 4	-0,3	0,232	25,15	12,48	0,19	12,67	18,55	6,84	5,64	6,07	6,60
De Aniceto Marisa	FRA	Ht 2	-0,3	0,187	25,32	12,59	0,14	12,73	18,72	6,82	5,77	6,13	6,60
Grabuste Aiga	LAT	Ht 4	-0,3	0,170	25,49	12,46	0,57	13,03	18,63	6,86	5,60	6,17	6,86

Team Sprint/Hurdles: **Rolf Graubner**, Dr. Ralf Buckwitz, Mirko Landmann, Anja Starke

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Biomechanical analysis

12th IAAF World Championships in Athletics Berlin, August 15 - 23, 2009



100m Hurdles Women

Heptathlon

		Round	Wind	RT	t _{1,H}	t _{2,H}	t _{3,H}	t _{4,H}	t _{5,H}	t _{6,H}	t _{7,H}	t _{8,H}	t _{9,H}	t _{10,H}	t _{end}
Ennis Jessica	GBR	Ht 1	-0,4	0,155	2,65	3,70 1,05	4,72 1,02	5,73 1,01	6,74 1,01	7,74 1,00	8,76 1,02	9,78 1,02	10,82 1,04	11,86 1,04	12,93 1,07
Pickler Diana	USA	Ht 1	-0,4	0,169	2,72	3,78 1,06	4,84 1,06	5,90 1,06	6,94 1,04	8,00 1,06	9,04 1,04	10,11 1,07	11,20 1,09	12,30 1,10	13,50 1,20
Chudzik Kamila	POL	Ht 1	-0,4	0,178	2,74	3,84 1,10	4,91 1,07	5,98 1,07	7,02 1,04	8,06 1,04	9,13 1,07	10,19 1,06	11,26 1,07	12,33 1,07	13,50 1,17
Chernova Tatyana	RUS	Ht 4	-0,2	0,18	2,73	3,81 1,08	4,87 1,06	5,90 1,03	6,95 1,05	8,02 1,07	9,09 1,07	10,17 1,08	11,26 1,09	12,38 1,12	13,58 1,20
Melnychenko Hanna	UKR	Ht 1	-0,4	0,138	2,67	3,72 1,05	4,81 1,09	5,86 1,05	6,92 1,06	8,01 1,09	9,09 1,08	10,19 1,10	11,29 1,10	12,40 1,11	13,60 1,20
Hazel Louise	GBR	Ht 3	-0,1	0,184	2,70	3,75 1,05	4,82 1,07	5,89 1,07	6,94 1,05	8,00 1,06	9,07 1,07	10,14 1,07	11,24 1,10	12,39 1,15	13,60 1,21
Oeser Jennifer	GER	Ht 1	-0,4	0,137	2,71	3,78 1,07	4,84 1,06	5,89 1,05	6,96 1,07	8,09 1,13	9,20 1,11	10,28 1,08	11,38 1,10	12,49 1,11	13,62 1,13
Yosypenko Lyudmyla	UKR	Ht 4	-0,2	0,169	2,76	3,86 1,10	4,92 1,06	5,98 1,06	7,04 1,06	8,13 1,09	9,21 1,08	10,29 1,08	11,40 1,11	12,50 1,10	13,64 1,14
Wisse Yvonne	NED	Ht 1	-0,4	0,162	2,81	3,89 1,08	4,96 1,07	6,04 1,08	7,10 1,06	8,14 1,04	9,22 1,08	10,29 1,07	11,38 1,09	12,49 1,11	13,66 1,17
Tyminska Karolina	POL	Ht 3	-0,1	0,162	2,75	3,88 1,13	4,99 1,11	6,04 1,05	7,12 1,08	8,19 1,07	9,23 1,04	10,30 1,07	11,40 1,10	12,50 1,10	13,67 1,17

		Round	Wind	RT	t _{1,H}	t _{2,H}	t _{3,H}	t _{4,H}	t _{5,H}	t _{6,H}	t _{7,H}	t _{8,H}	t _{9,H}	t _{10,H}	t _{end}
Theisen Brianne	CAN	Ht 4	-0,2	0,159	2,76	3,84 1,08	4,91 1,07	5,99 1,08	7,06 1,07	8,14 1,08	9,22 1,08	10,30 1,08	11,40 1,10	12,50 1,10	13,69 1,19
Grabuste Aiga	LAT	Ht 1	-0,4	0,181	2,76	3,86 1,10	4,94 1,08	6,02 1,08	7,09 1,07	8,16 1,07	9,24 1,08	10,34 1,10	11,44 1,10	12,56 1,12	13,78 1,22
De Aniceto Marisa	FRA	Ht 4	-0,2	0,217	2,80	3,92 1,12	5,00 1,08	6,07 1,07	7,12 1,05	8,20 1,08	9,28 1,08	10,38 1,10	11,48 1,10	12,59 1,11	13,78 1,19
Schwarzkopf Lilli	GER	Ht 2	-0,3	0,143	2,79	3,87 1,08	4,95 1,08	6,01 1,06	7,09 1,08	8,15 1,06	9,22 1,07	10,33 1,11	11,45 1,12	12,57 1,12	13,80 1,23
Dobrynska Nataliya	UKR	Ht 2	-0,3	0,186	2,78	3,85 1,07	4,91 1,06	5,99 1,08	7,07 1,08	8,15 1,08	9,24 1,09	10,36 1,12	11,49 1,13	12,64 1,15	13,85 1,21
Day Sharon	USA	Ht 2	-0,3	0,205	2,80	3,90 1,10	5,01 1,11	6,09 1,08	7,17 1,08	8,27 1,10	9,35 1,08	10,47 1,12	11,58 1,11	12,69 1,11	13,90 1,21
Samuelsson Jessica	SWE	Ht 3	-0,1	0,182	2,78	3,90 1,12	5,00 1,10	6,10 1,10	7,20 1,10	8,30 1,10	9,41 1,11	10,51 1,10	11,63 1,12	12,78 1,15	13,96 1,18
Tarasova YuliYa	UZB	Ht 4	-0,2	0,233	2,85	3,98 1,13	5,08 1,10	6,20 1,12	7,30 1,10	8,41 1,11	9,54 1,13	10,69 1,15	11,84 1,15	13,02 1,18	14,23 1,21
Mächtigt Julia	GER	Ht 3	-0,1	0,171	2,77	3,92 1,15	5,08 1,16	6,24 1,16	7,38 1,14	8,52 1,14	9,67 1,15	10,84 1,17	12,03 1,19	13,21 1,18	14,40 1,19

Team Sprint/Hurdles: Rolf Graubner, Dr. Ralf Buckwitz, Mirko Landmann, Anja Starke

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Biomechanical Analysis of the Long Jump Women Heptathlon

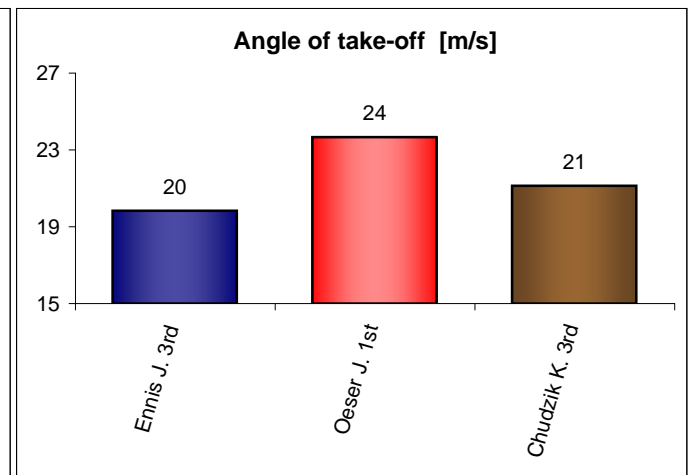
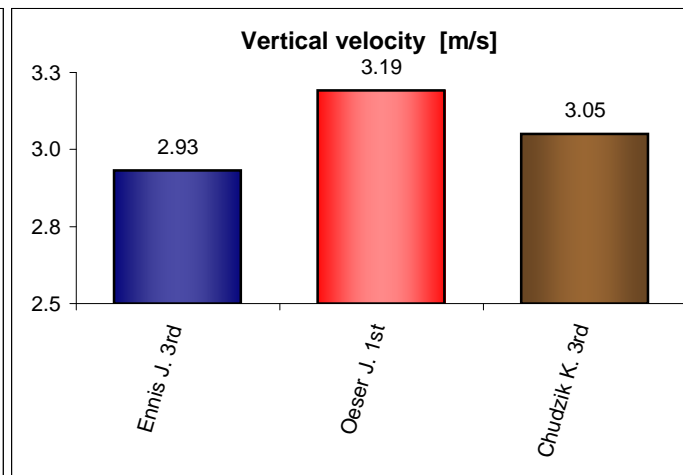
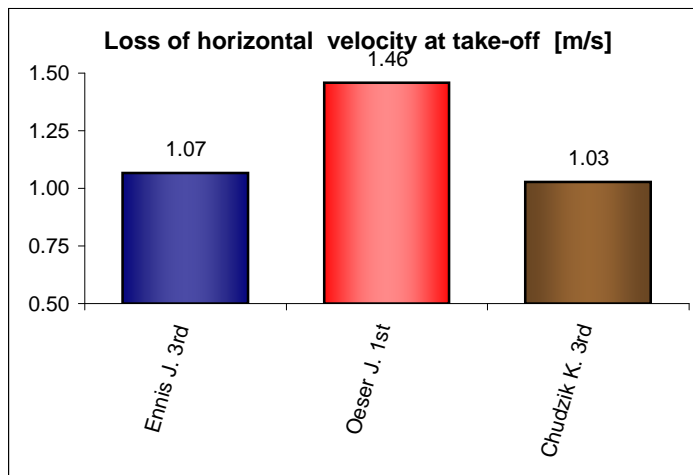
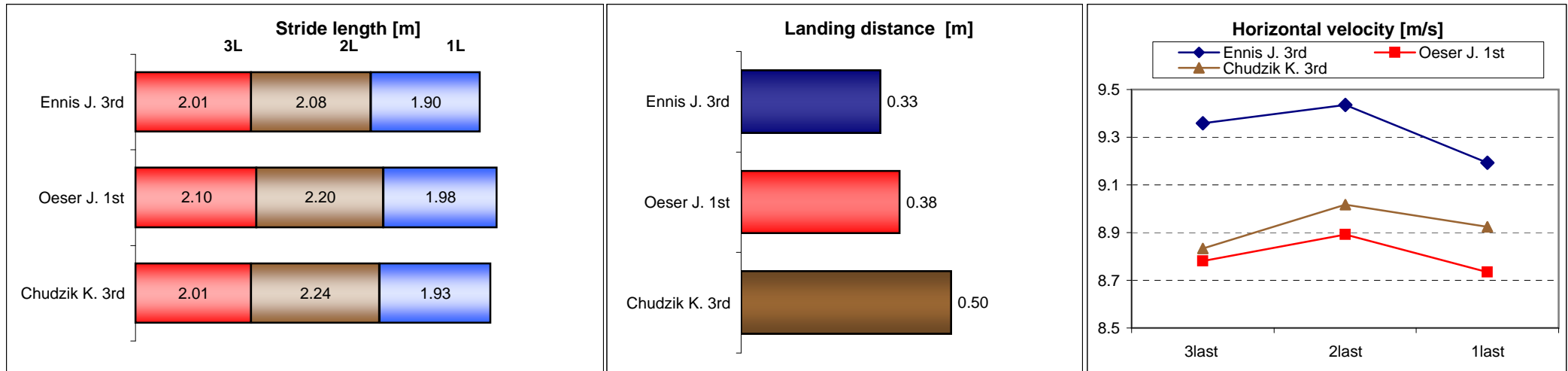
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Name / Attempt	Distance [m]				Stride length [m]					lowering of CM	Velocity [m/s]					
	officially measured	real	loss at take-off (toe-to-board)	loss by landing	3last	2last	1last	relative length 2last / 3last [%]	relative length 1last / 2last [%]		3last	2last	1last	take-off instant	loss at take-off	vertical velocity at take-off
Ennis J. 3rd	6.29	6.46	0.17	0.00	2.01	2.08	1.90	104	91	0.08	9.36	9.43	9.19	8.13	1.07	2.93
Oeser J. 1st	6.42	6.44	0.02	0.00	2.10	2.20	1.98	105	90	0.10	8.78	8.89	8.73	7.28	1.46	3.19
Chudzik K. 3rd	6.55	6.66	0.11	0.05	2.01	2.24	1.93	111	86	0.05	8.83	9.02	8.92	7.90	1.03	3.05

Name / Attempt	Take-off						Lead leg		Landing			
	duration [s]	inclination angle [°]	trunk-angle [°]	trunk rotation [°]	minimal knee-angle [°]	angle of take-off [°]	thigh-angle at take-off [°]	average velocity [°/s]	distance [m]	trunk angle [°]	knee angle [°]	hip angle [°]
Ennis J. 3rd	0.12	25	101	12	136	19.8	-6	741	0.33	66	124	79
Oeser J. 1st	0.13	25	99	5	137	23.7	-1	801	0.38	95	107	87
Chudzik K. 3rd	0.11	21	100	9	145	21.1	-5	870	0.50	86	126	86

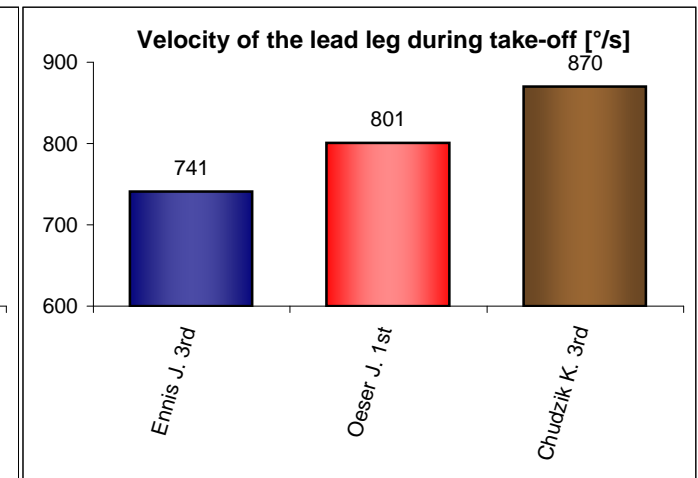
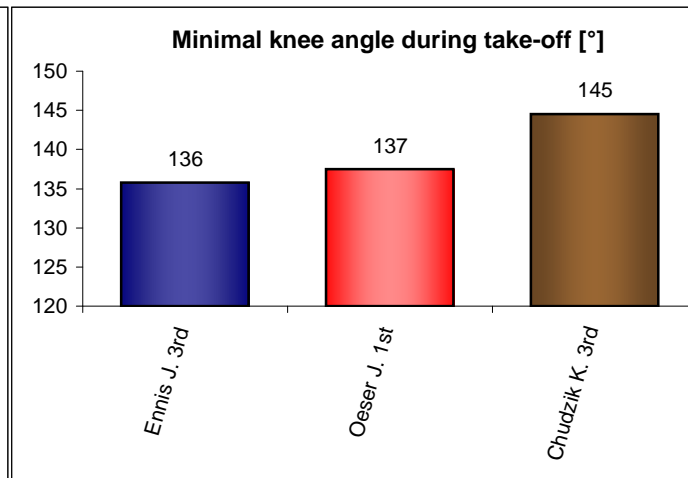
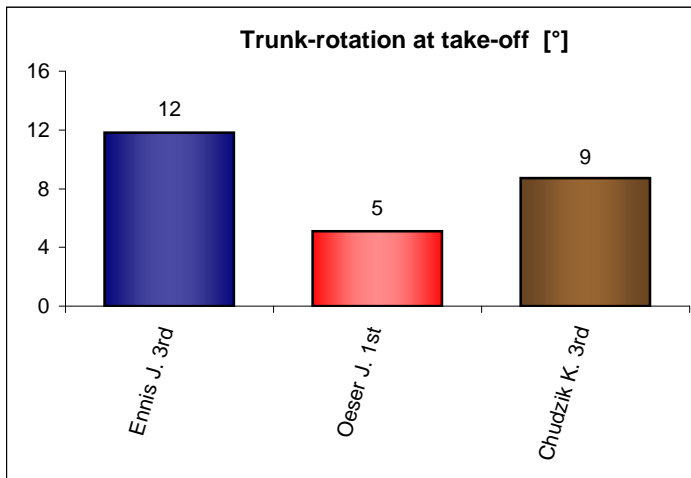
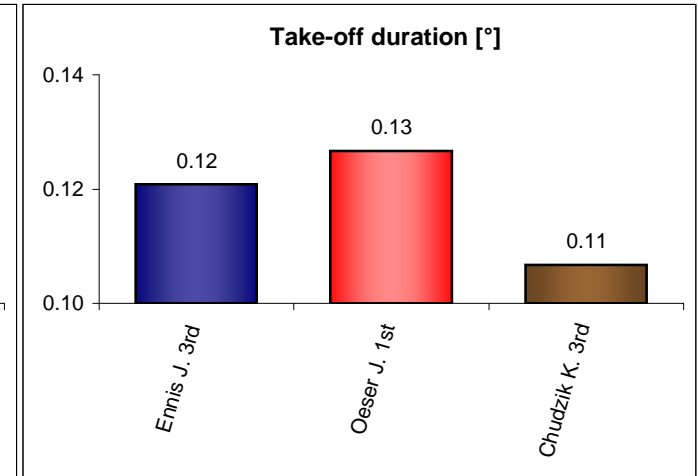
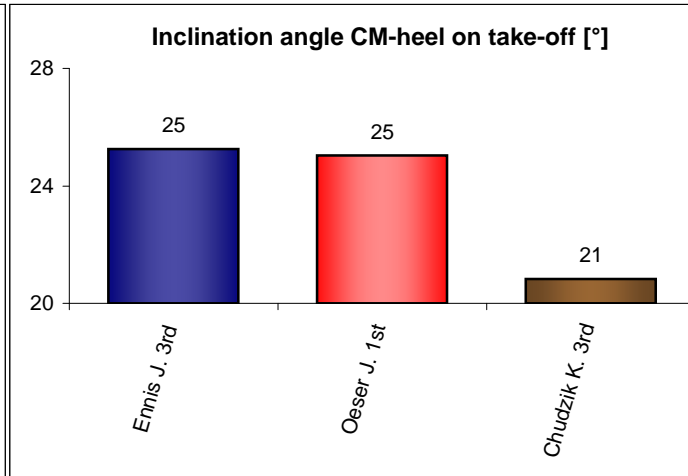
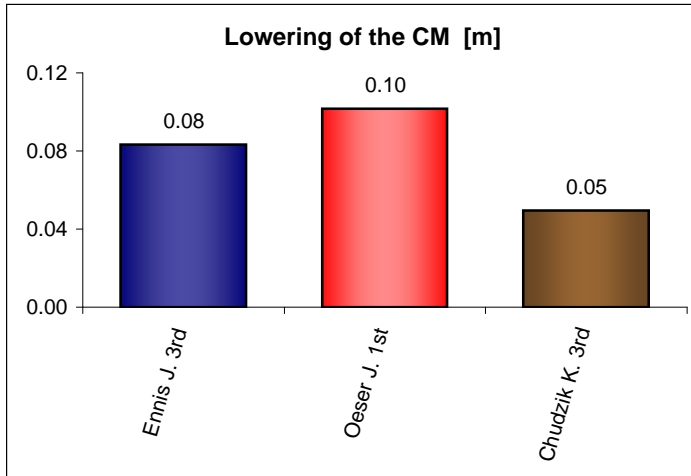
Biomechanical Analysis of the Long Jump Women Heptathlon

12th IAAF World Championships in Athletics - Berlin 16. August 2009



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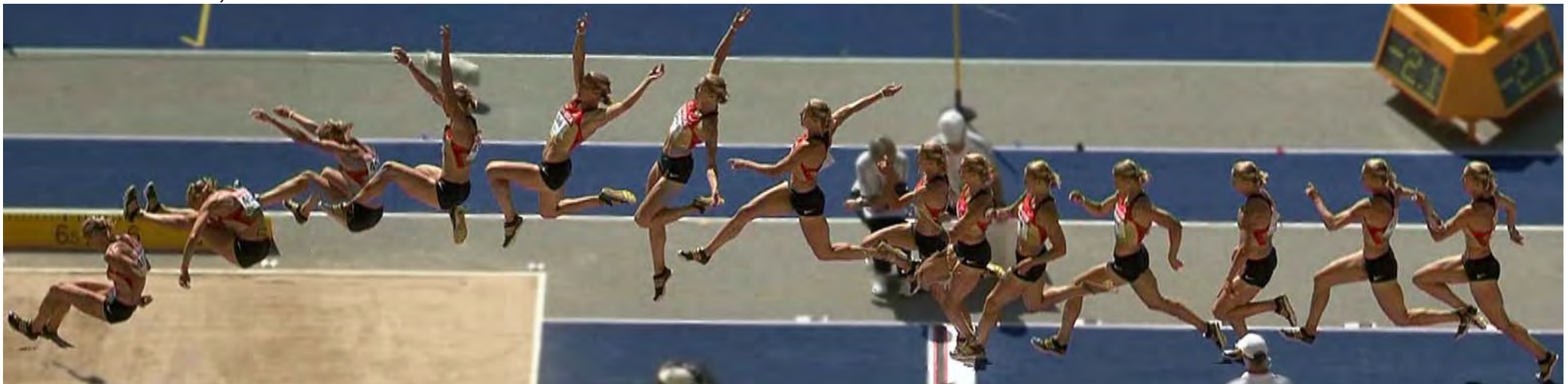
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Ennis J. 3 6,29m



Oeser J. 1 6,42m



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Chudzik K. 3 6,55m



Long Jump Heptathlon, 12th IAAF World Championships in Athletics - Berlin

No.	Name	Att.	Distance [m]	Wind [m/s]	Run-Up-Velocity		
					11-6m [m/s]	6-1m from the Take-Off Board [m/s]	
387	Ennis	1V	6.19	+0.0	9.25	9.52	16. Aug 09 s11:40:15
387	Ennis	2V	6.08	+0.9	9.31	9.43	16. Aug 09 s11:59:23
387	Ennis	3V	6.29	-0.8	9.25	9.31	16. Aug 09 s12:22:00
451	Oeser	1V	6.42	+1.0	8.39	8.80	16. Aug 09 s11:49:16
451	Oeser	2V	6.32	+0.4	8.57	8.72	16. Aug 09 s12:09:03
451	Oeser	3V	5.76	-1.9	8.25	8.85	16. Aug 09 s12:33:01
707	Chudzik	1V	6.31	-0.1	8.59	8.82	16. Aug 09 s11:50:36
707	Chudzik	2V	6.37	+0.0	8.55	8.84	16. Aug 09 s12:10:56
707	Chudzik	3V	6.55	+0.2	8.58	8.92	16. Aug 09 s12:34:23
931	Dobrynska	1V	6.24	+0.5	8.59	8.83	16. Aug 09 s11:45:50
931	Dobrynska	2V	6.41	+0.6	8.66	8.89	16. Aug 09 s12:05:40
931	Dobrynska	3V	6.33	-1.6	8.81	8.99	16. Aug 09 s12:28:35
962	Yosypenko	1V	6.09	-0.6	8.60	8.67	16. Aug 09 s11:38:30
962	Yosypenko	2V	6.12	+1.0	8.35	8.71	16. Aug 09 s11:58:03
962	Yosypenko	3V	6.20	-0.6	8.24	8.78	16. Aug 09 s12:20:38
940	Melnychenko	1V	6.43	+0.8	9.06	9.28	16. Aug 09 s11:43:11
940	Melnychenko	2V	6.32	+0.3	9.10	0.00	16. Aug 09 s12:03:06
940	Melnychenko	3V	x	-0.5	8.94	9.17	16. Aug 09 s12:25:28
783	Chernova	1V	6.33	-0.1	8.97	9.03	16. Aug 09 s11:53:32
783	Chernova	2V	6.44	+0.0	9.07	8.82	16. Aug 09 s12:13:47
783	Chernova	3V	6.50	-0.1	8.71	9.02	16. Aug 09 s12:37:46
440	Mächtigt	1V	x	+0.0	8.69	8.95	16. Aug 09 s11:51:53
440	Mächtigt	2V	x	+0.0	8.91	8.97	16. Aug 09 s12:12:00
440	Mächtigt	3V	6.36	+0.4	8.91	9.10	16. Aug 09 s12:36:10