



TG 1 Progress Overview

OPTIMAT BLADES

Block tests and (NEW) WISPER

Results, Analysis, and Predictions using various Miner formulations and Residual Strength Degradation Model

Rogier Nijssen, OPTIMAT TG1 meeting

Thursday 15/9/2005, CRES, Pikerimi, Greece

OB_TG1_R023, doc. No. 10310



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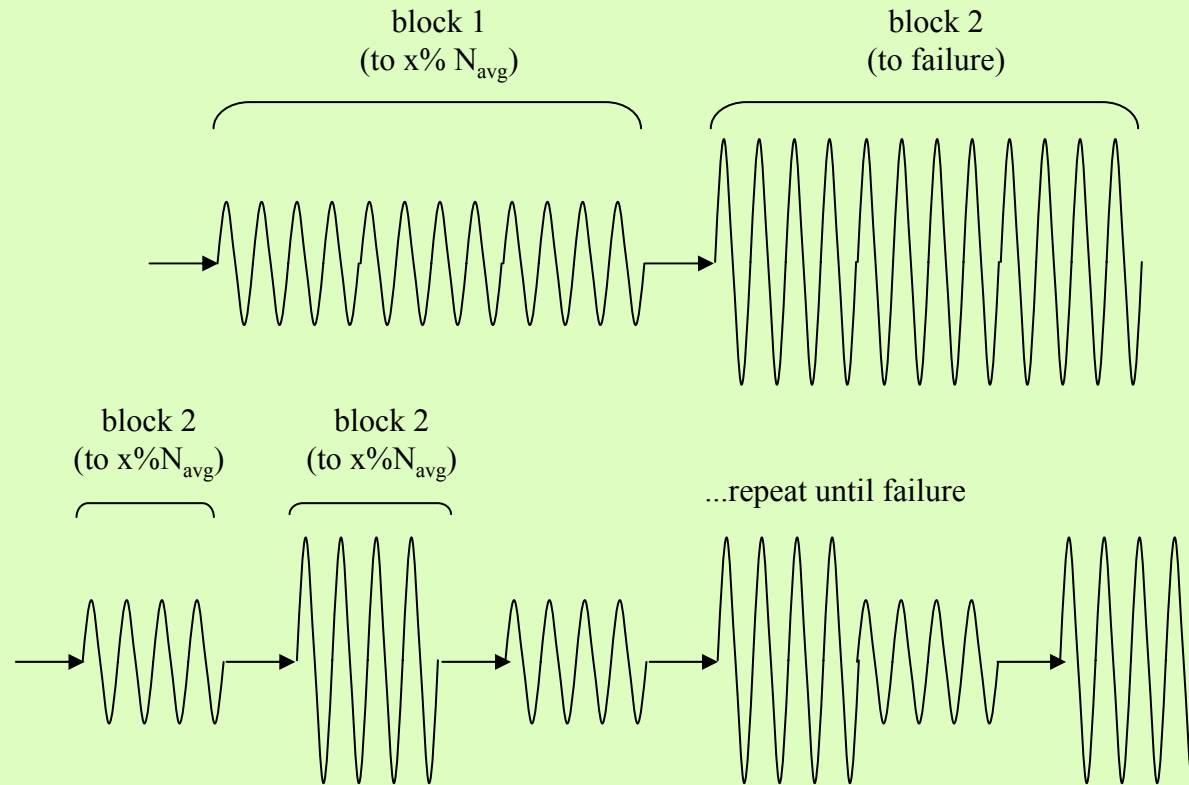
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- **Selected block test results**
- **Life prediction for block tests using strength degradation model**
- **Overview of spectrum properties**
- **Different formulations of Constant Life Diagrams**
 - for use in Miner's sum life prediction
 - And strength degradation model
- **Predictions using different CLDs and strength degradation model**



Block tests (RN)

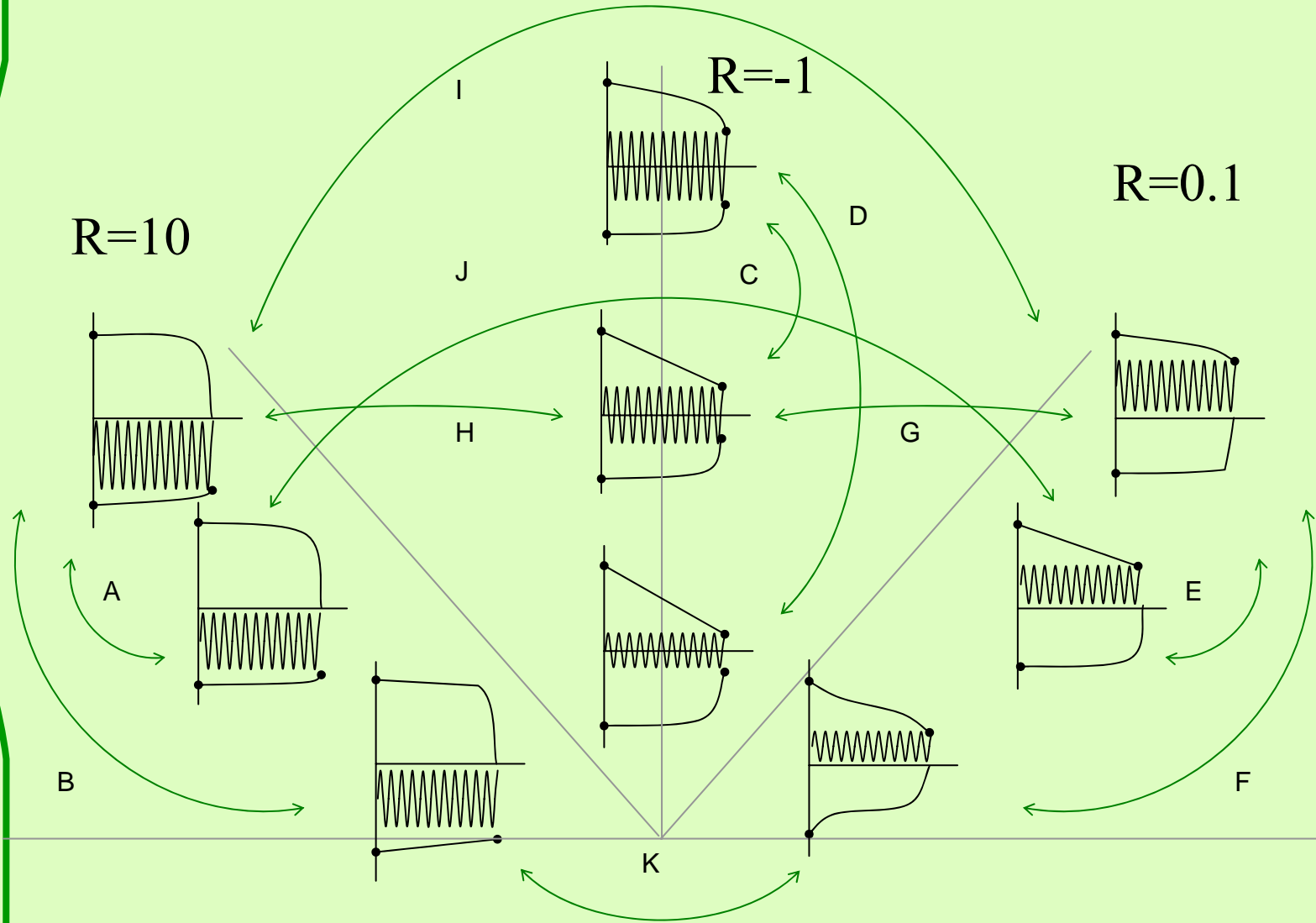
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Block tests

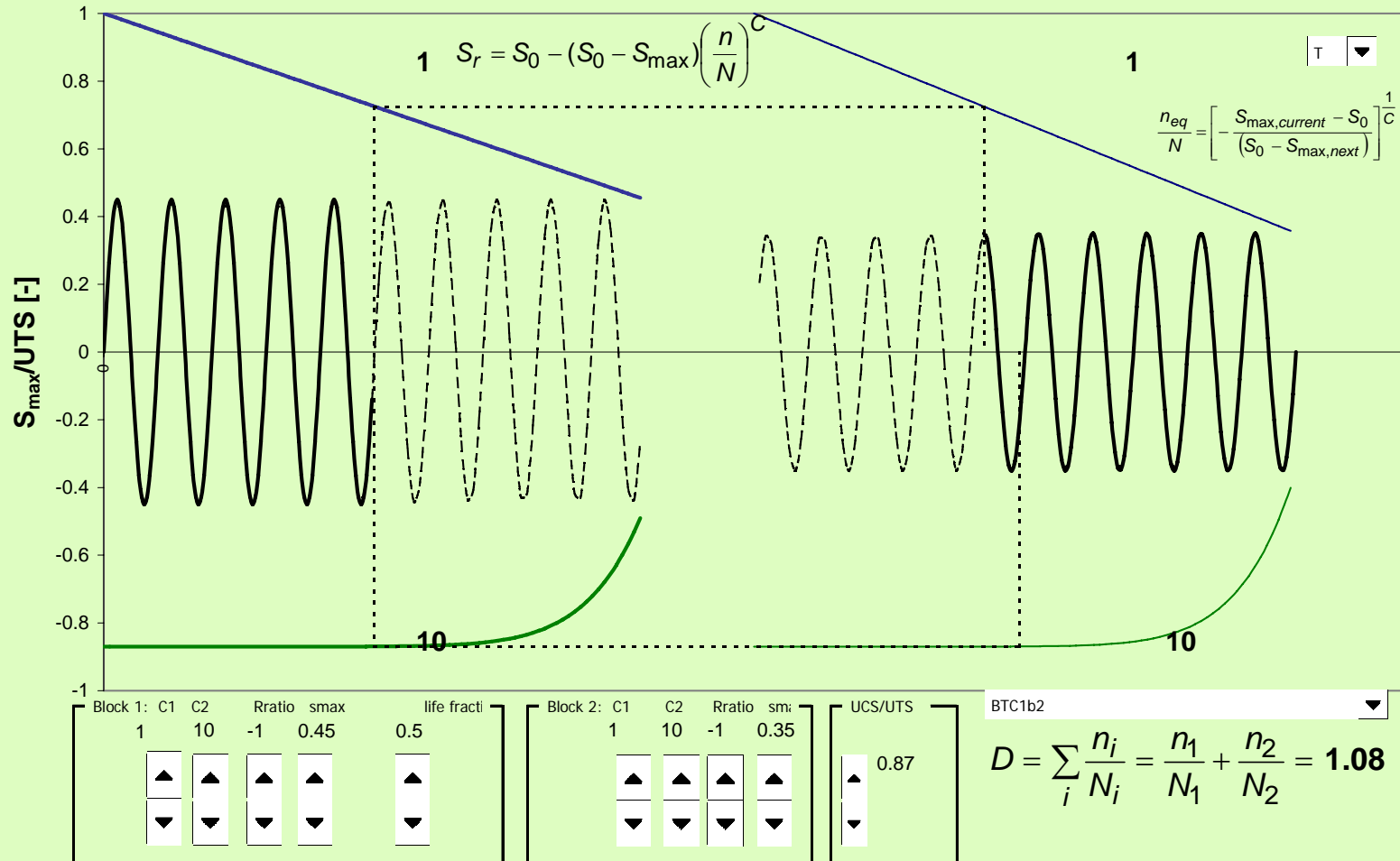
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Block tests

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Block tests

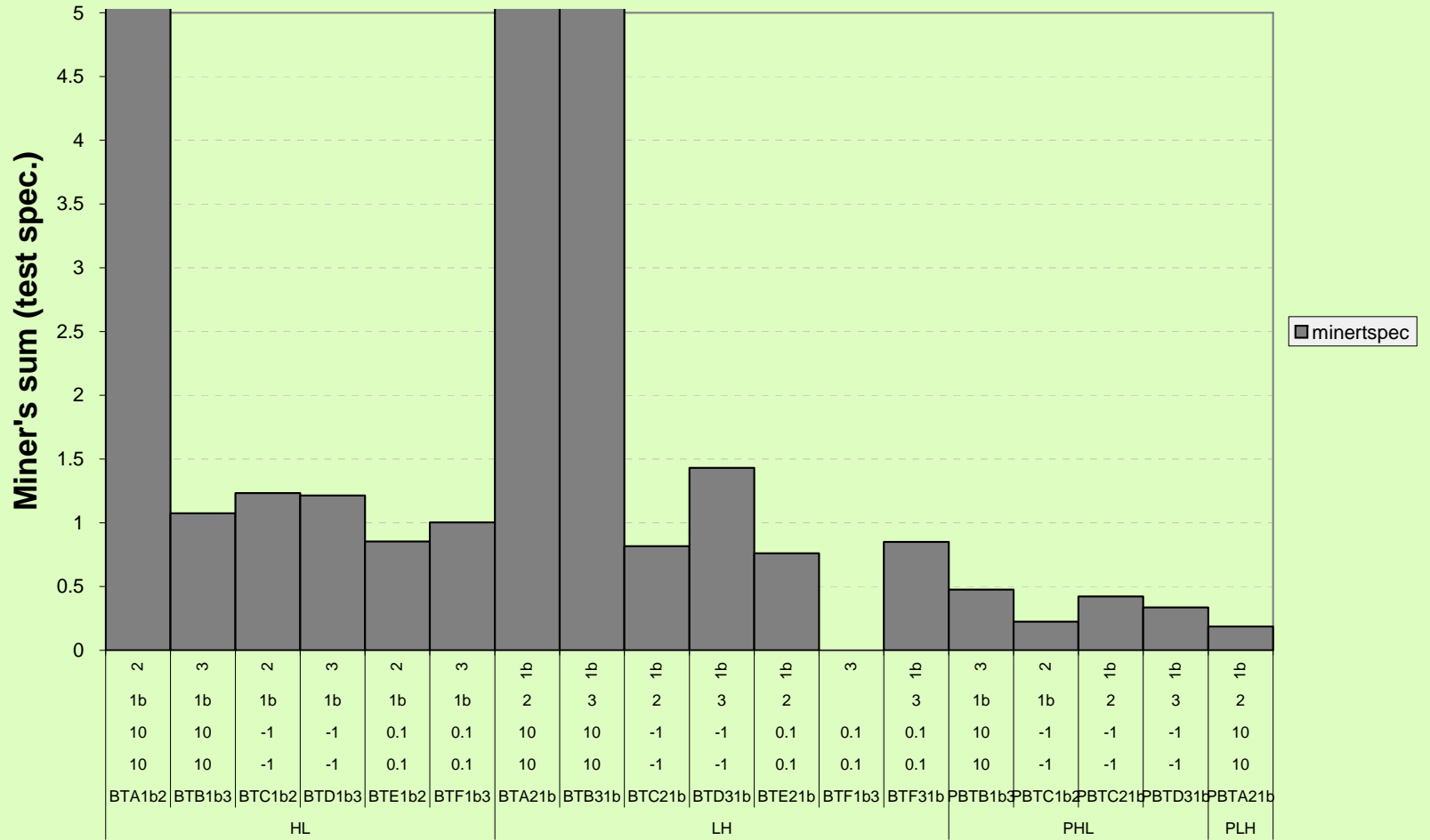
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bloktesttyp	test type	R1	R2	Miner (test spec)		Miner (test spec)			Miner (all CA)			n of specs
				level1	level2	block 1	block 2	total	block 1	block 2	total	
CN	BTH1b2	10	-1	1b	2	0.5	1.34538	1.84538	0.19401	3.32412	3.51813	3
CT	BTI1b1b	10	0.1	1b	1b	0.5	1.1346	1.6346	0.19401	1.77781	1.97182	2
	RBTI1b1b	10	0.1	1b	1b	0.43	0.4282	0.8582	0.16685	0.67095	0.8378	2
	RBTJ22	10	0.1		2 2	0.51	0.50677	1.01677	0.2692	0.86009	1.12929	2
HL	BTB1b3	10	10	1b	3	0.5	0.57391	1.07391	0.19401	0.66471	0.85872	3
	BTF1b3	0.1	0.1	1b	3	0.5	0.50252	1.00252	0.78345	0.58223	1.36568	5
	RBTA1b2	10	10	1b	2	5.315	5.31548	10.6305	2.06232	2.80573	4.86804	2
	RBTB1b3	10	10	1b	3	1.235	1.23501	2.47001	0.4792	1.43041	1.90961	2
	RBTC1b2	-1	-1	1b	2	0.54	0.54637	1.08637	2.49117	1.34996	3.84113	3
	RBTE1b2	0.1	0.1	1b	2	0.21827	0.21809	0.43635	0.342	0.37014	0.71214	3
LH	BTA21b	10	10		2 1b	0.5	1.0429	1.5429	0.26392	0.40466	0.66858	2
	BTB31b	10	10		3 1b	0.5	7.7236	8.2236	0.57911	2.9969	3.576	2
	BTE21b	0.1	0.1		2 1b	0.5	0.3824	0.8824	0.8486	0.59919	1.44778	3
	BTF31b	0.1	0.1		3 1b	0.3883	0.53153	0.91983	0.44989	0.83286	1.28275	3
NC	BTH21b	-1	10		2 1b	0.5	0.59107	1.09107	1.23538	0.22934	1.46473	3
	RBTH21b	-1	10		2 1b	0.8	0.85733	1.65733	1.97661	0.33266	2.30927	3
NT	BTG21b	-1	0.1		2 1b	0.5	0.2584	0.7584	1.23538	0.40489	1.64027	2
	RBTG21b	-1	0.1		2 1b	0.245	0.2374	0.4824	0.60534	0.37198	0.97732	2
TC	BTI1b1b	0.1	10	1b	1b	0.5	0.1986	0.6986	0.78345	0.07706	0.86051	2
	BTJ22	0.1	10		2 2	0.5	2.92434	3.42434	0.8486	1.54359	2.39219	1
TN	BTG1b2	0.1	-1	1b	2	0.49187	0.65665	1.14851	0.77071	1.62242	2.39313	3
PNT	PBTG21b	-1	0.1		2 1b	0.11792	0	0.11792	0.29135	0	0.29135	1
PHL	PBTB1b3	10	10	1b	3	0.4766	0	0.4766	0.18493	0	0.18493	1
	PBTC1b2	-1	-1	1b	2	0.22328	0	0.22328	1.03005	0	1.03005	5
PLH	PBTA21b	10	10		2 1b	0.18616	0	0.18616	0.09826	0	0.09826	2



Block tests

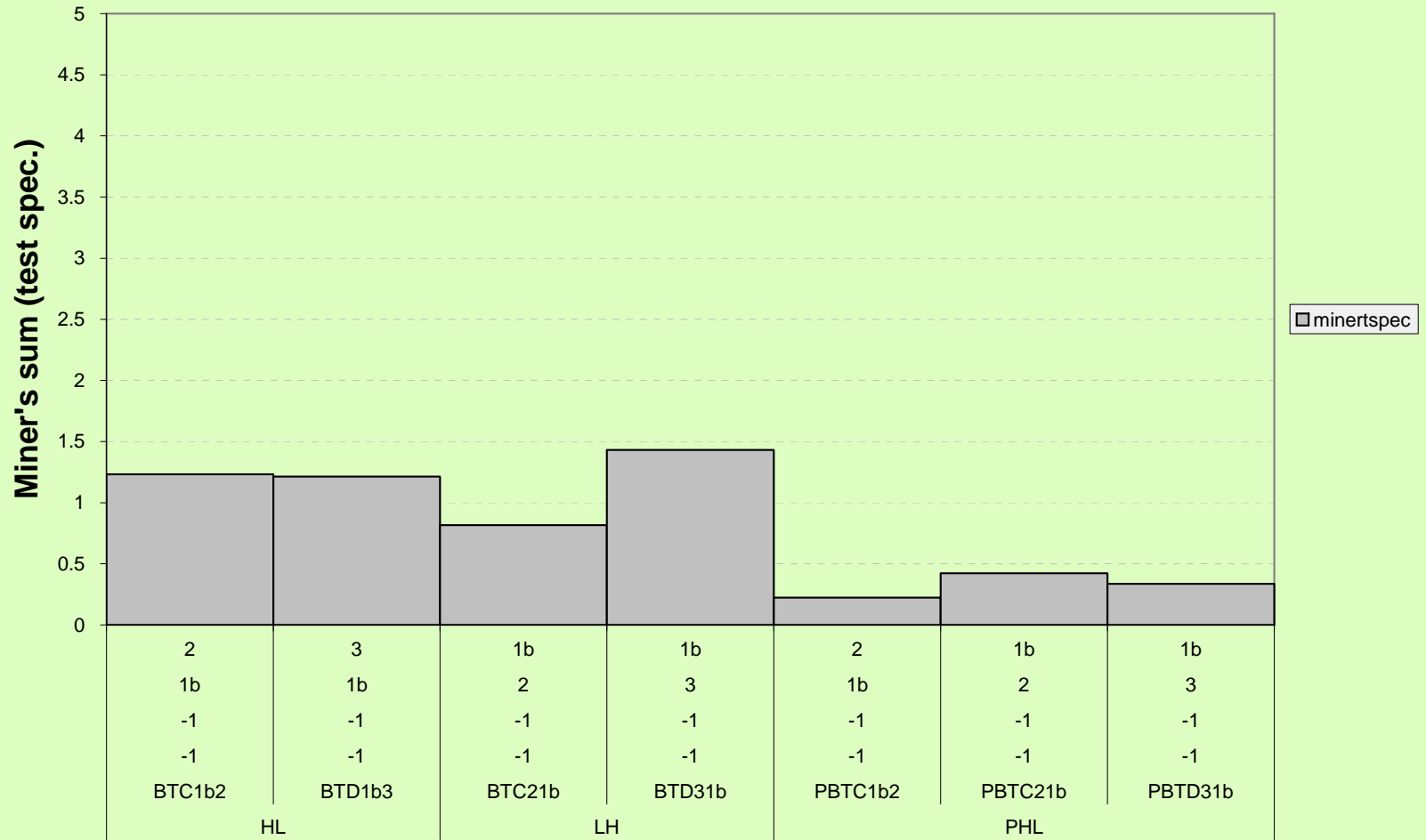
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Block tests

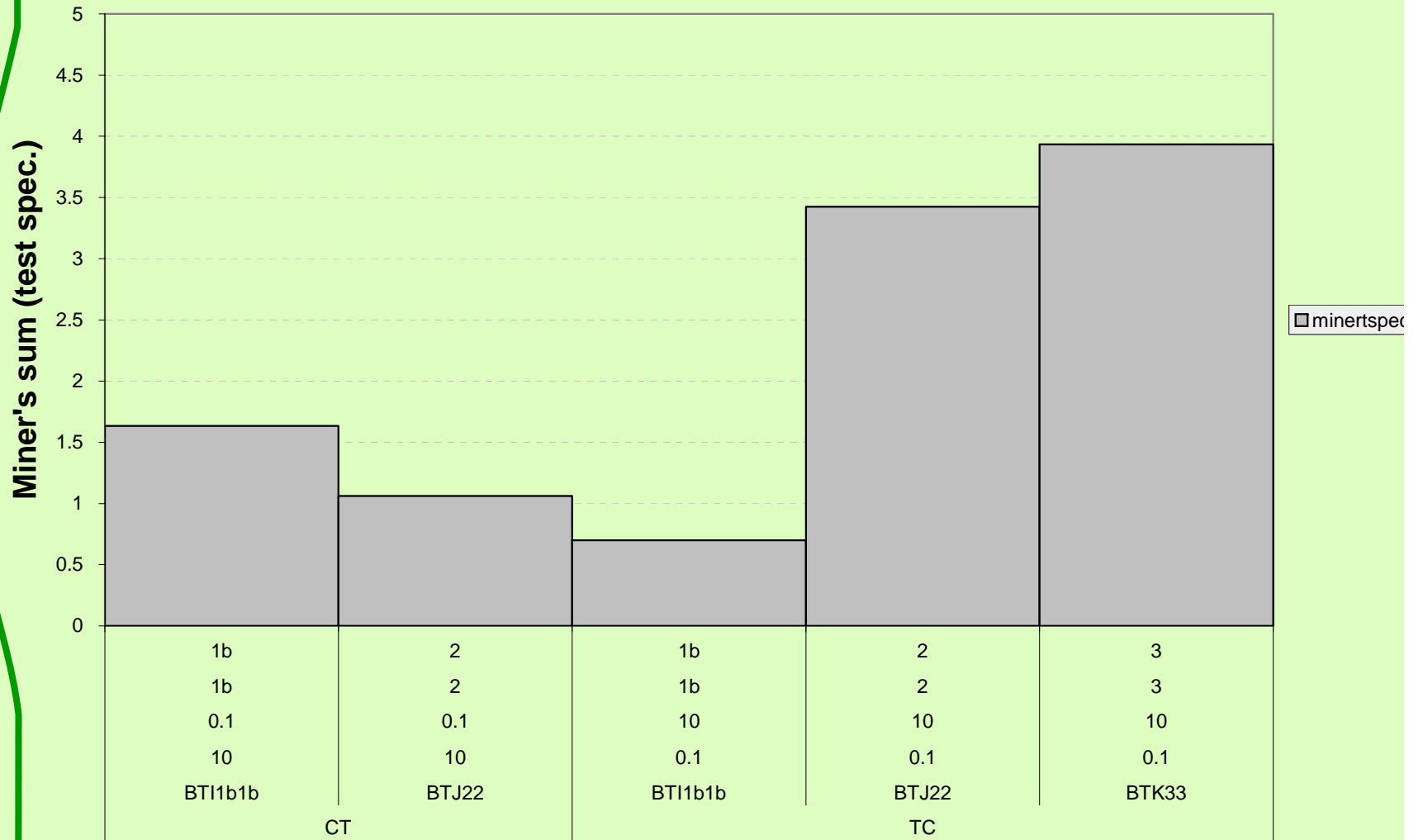
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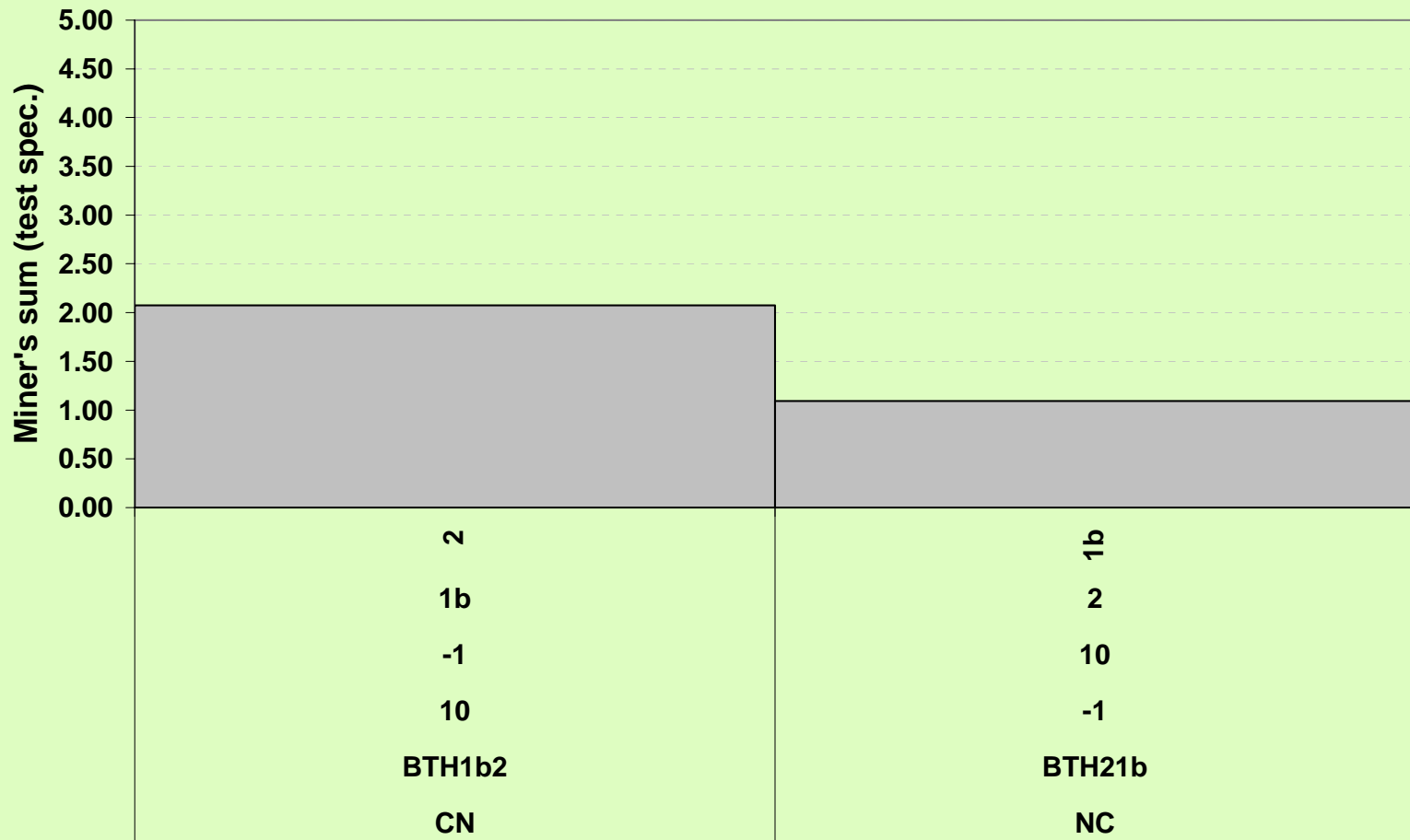
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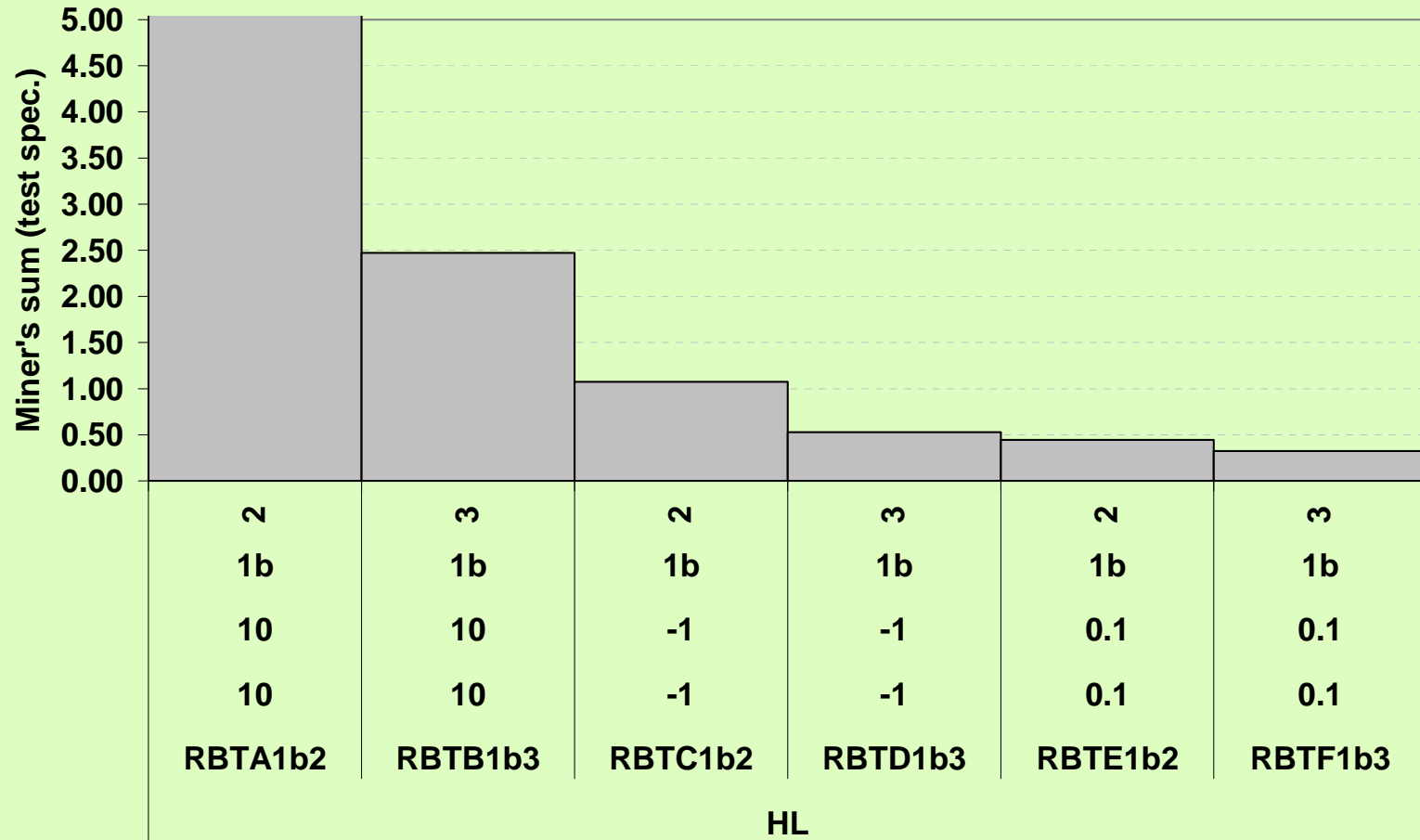
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Block tests

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Spectrum tests (RN)

- **Results**

Spectrum	Integers			no. of cycles	cumulative levels	av. segment length	av. level	max. at record	min. at record
	min	max	zero stress						
R	1	64	25	132711	3612010	14	41	34482	123303
RX	1	64	25	12831	487864	19	41	5298	13482
/ISPER	5	59	22	47735	1397142	15	34	95459	1

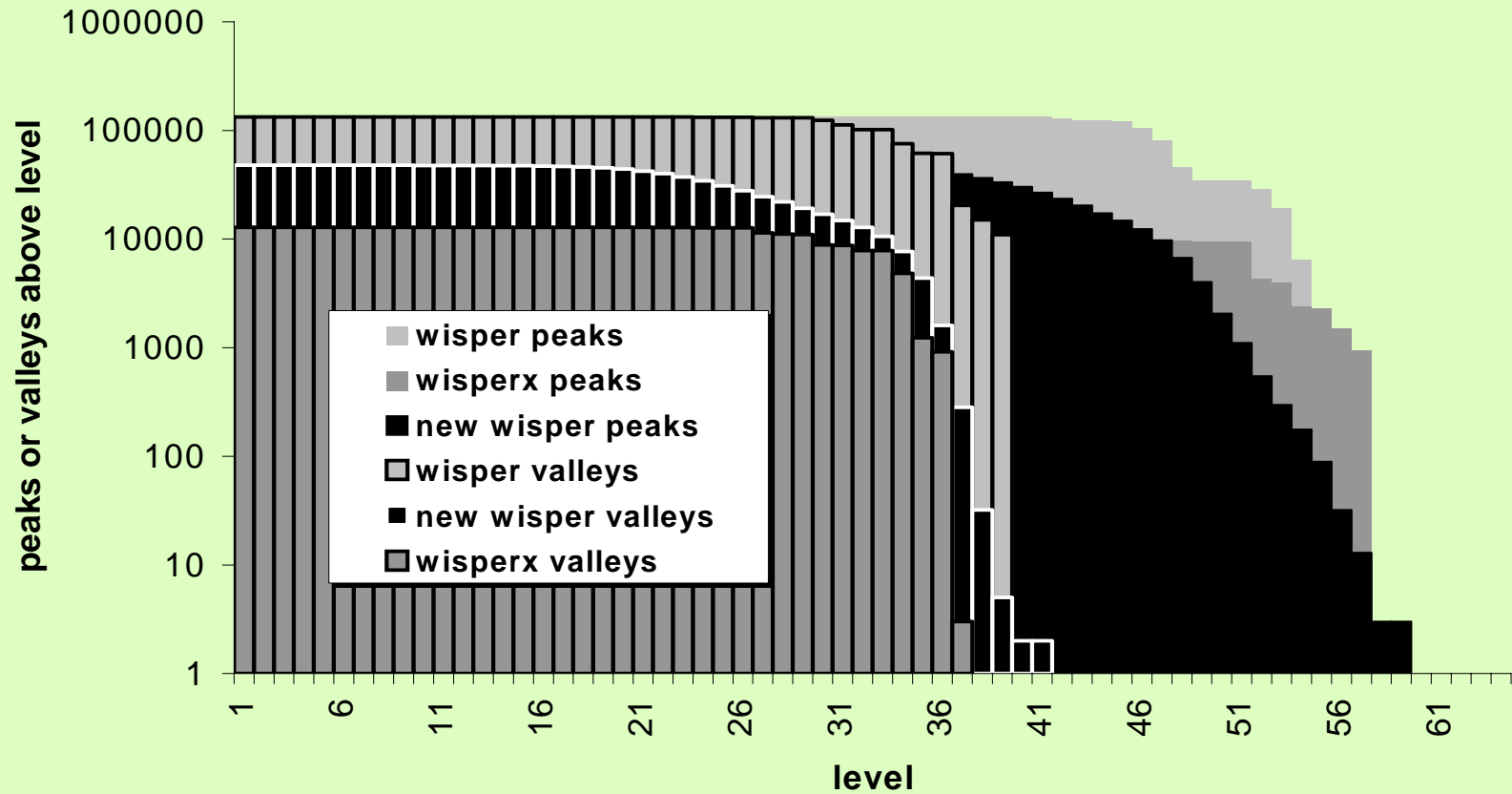
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Spectrum tests (RN)

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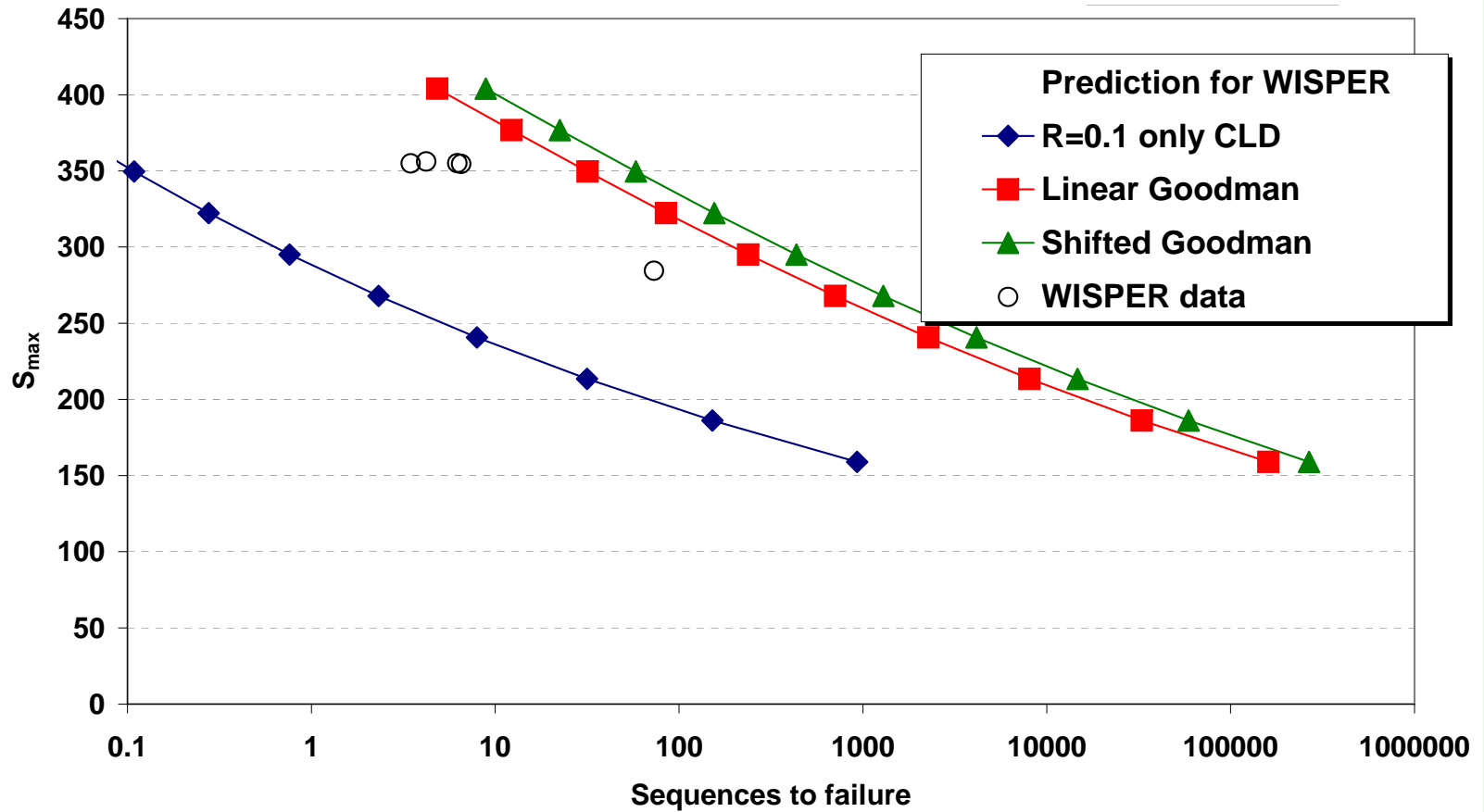
● Results





Standard MD coupon

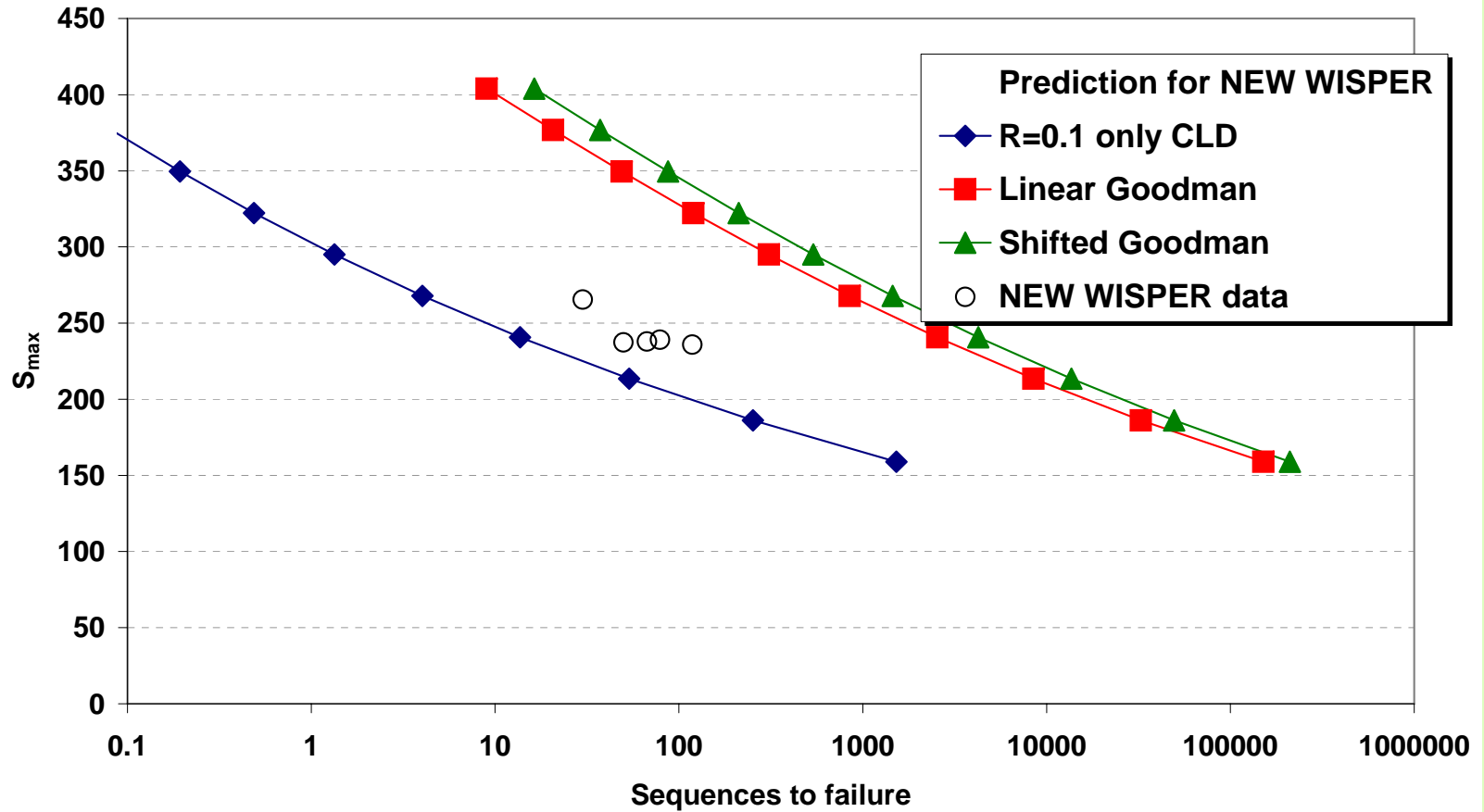
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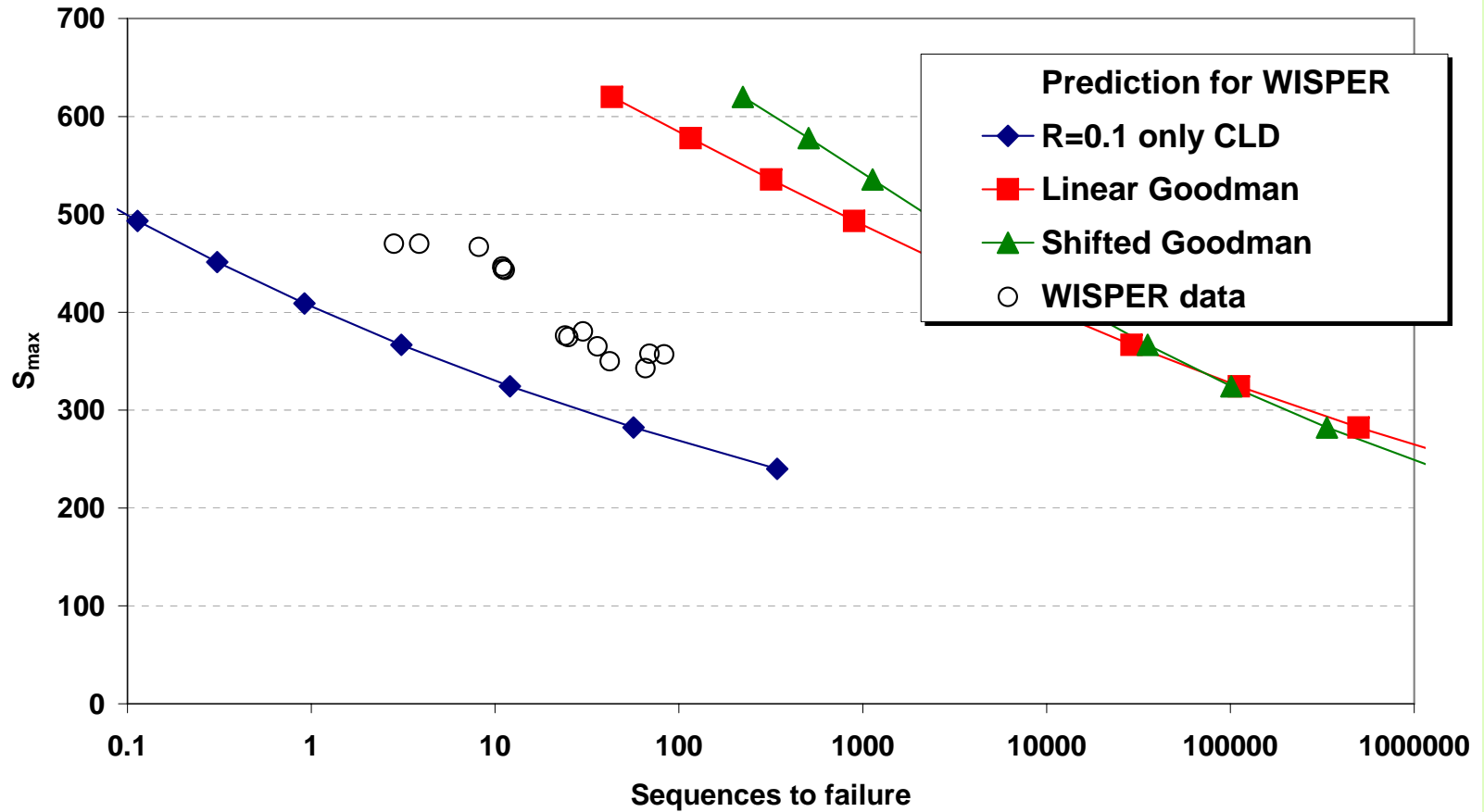
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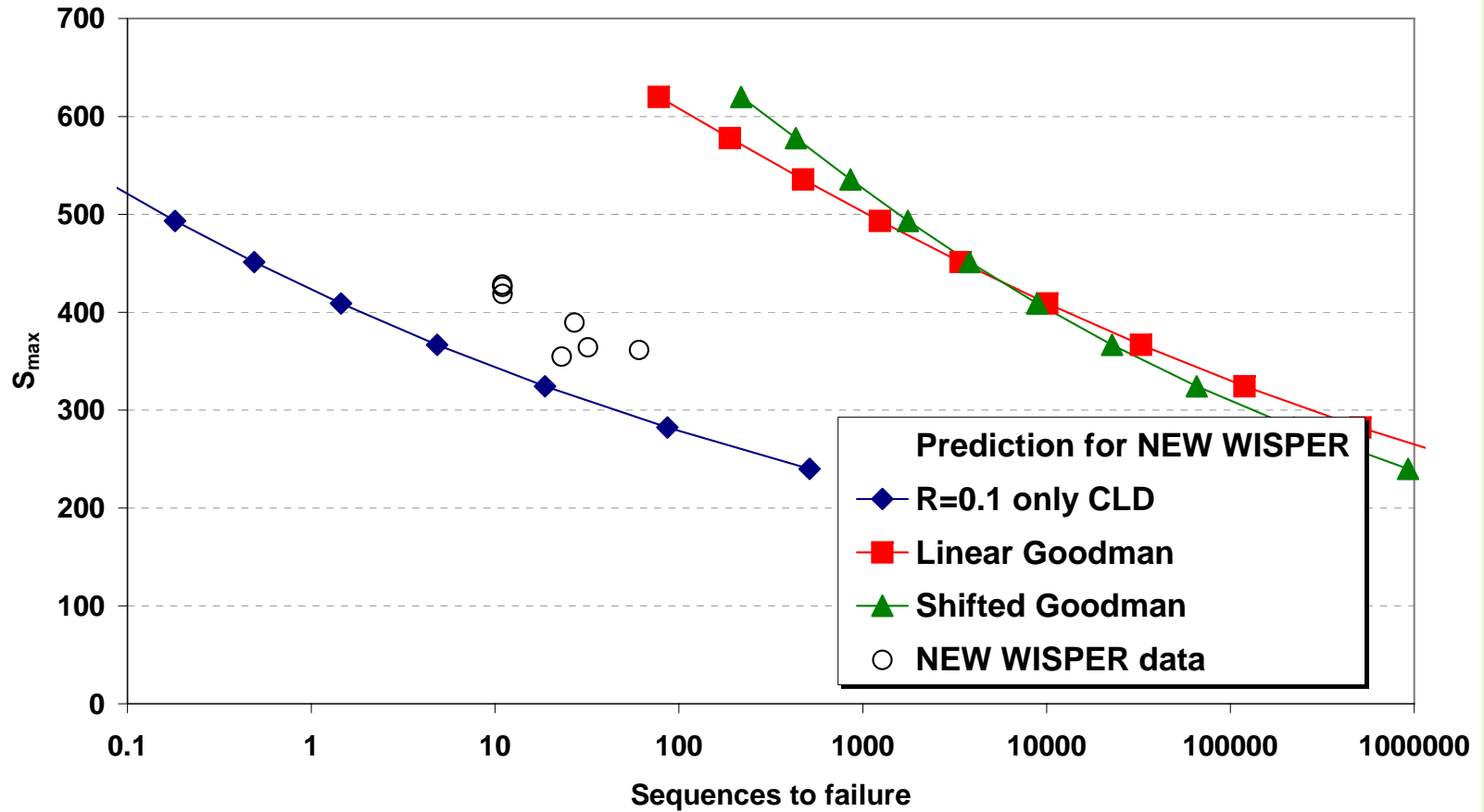
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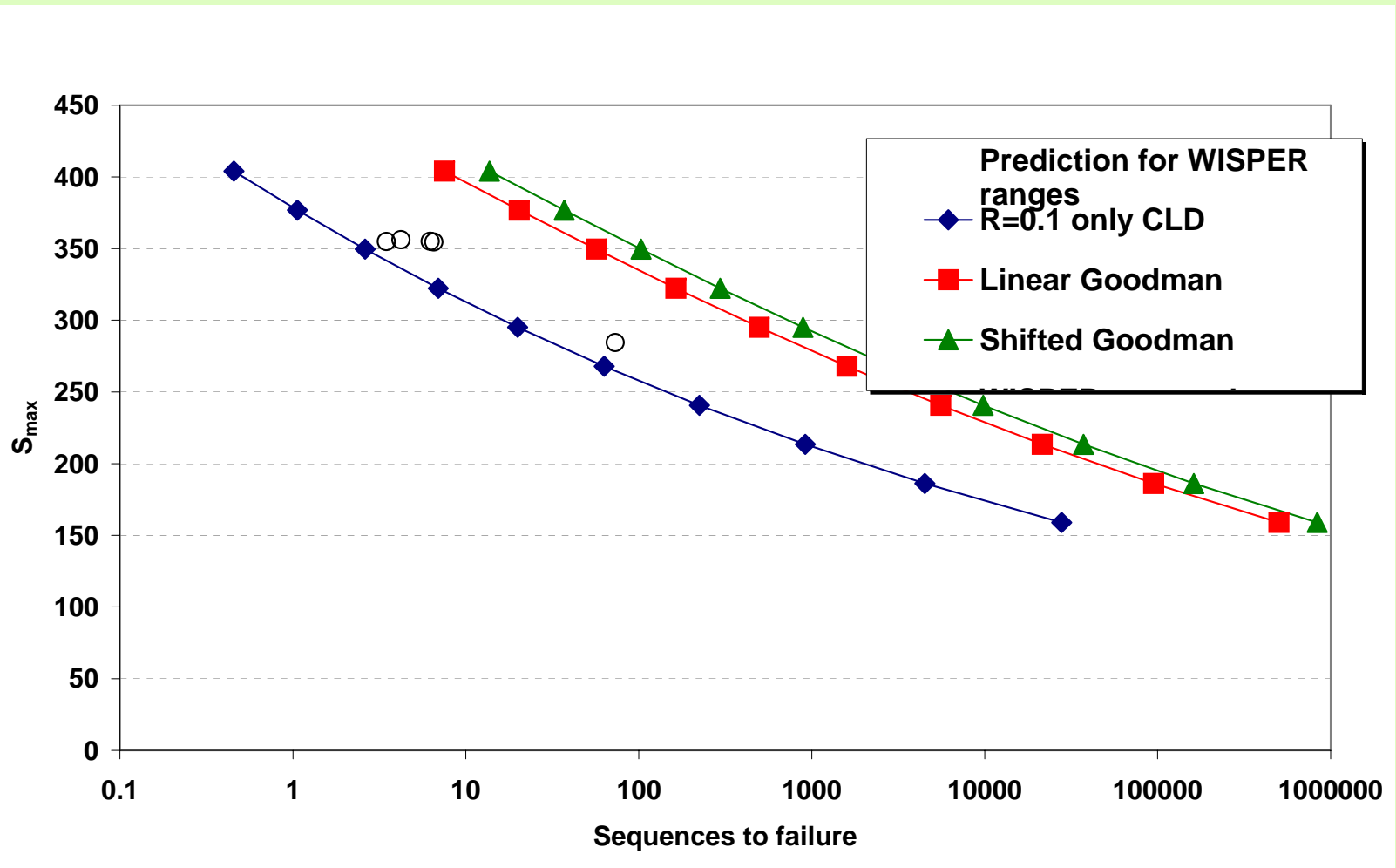
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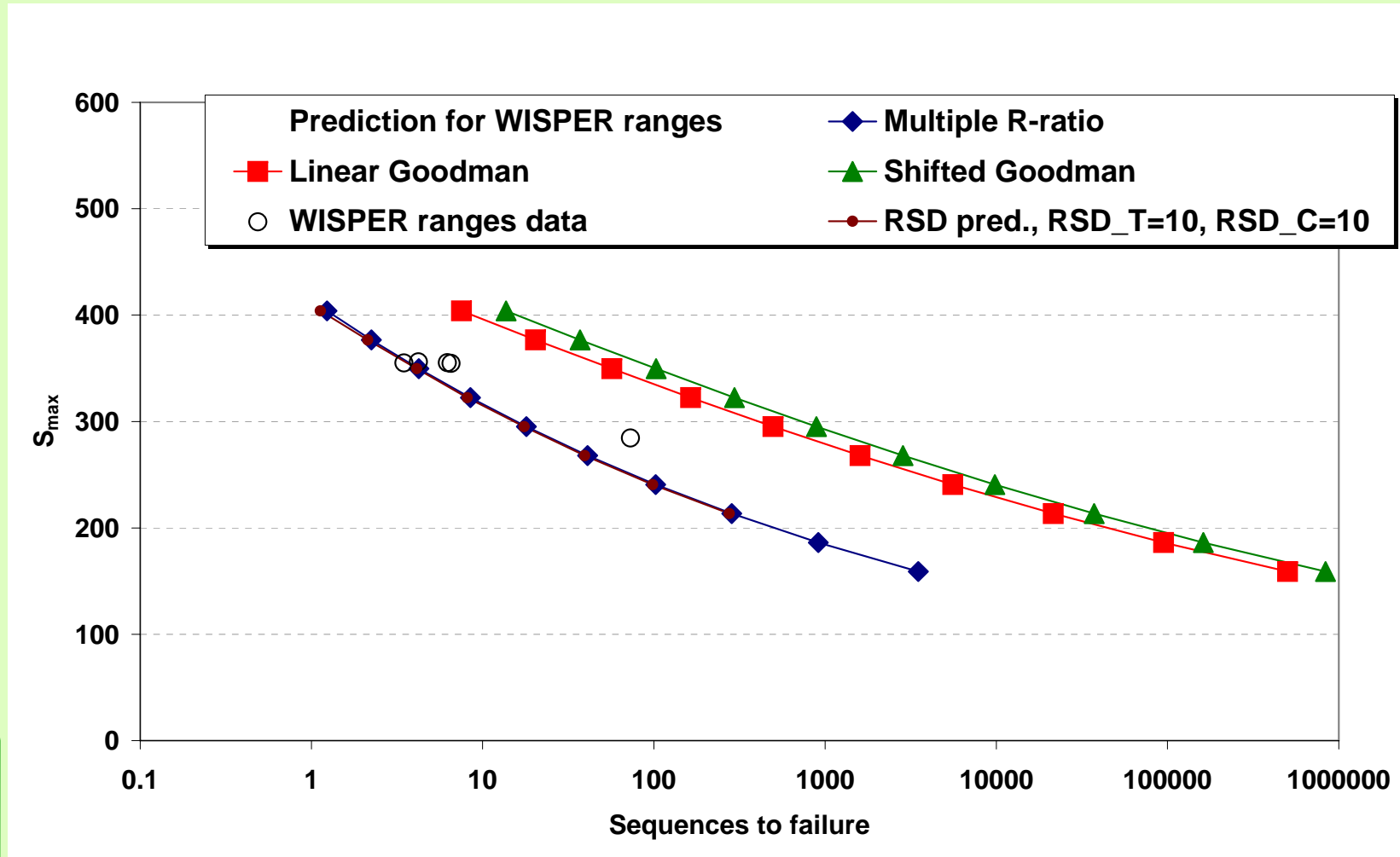
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Spectrum tests (RN)

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Concluding Remarks

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- **Block test results**
 - Interpretation of results sensitive to:
 - Average fatigue life, i.e. S-N curve definition
 - Plate-to-plate variation, small sample size
 - From results for most two-block load cases:
 - sequence influence (High-Low test vs Low-High) moderate
 - Repeated block spectra show tendency towards Miner <1 ,
 - this is consistent with strength degradation model
 - R=10 very flat S-N curve, time-consuming, continue in phase II?
- **Spectrum results**
 - Compared to Miner-predictions
 - Linear Goodman Diagram, Shifted Goodman diagram (as per GL 1999, 2003)
 - generally non-conservative and inaccurate for spectra/material combinations tested
 - Multiple R-ratio CLD can give acceptable predictions
 - Single R-ratio CLD, using R=0.1 only gives conservative predictions
 - Residual strength degradation model was implemented
 - RSD model gives accurate or conservative predictions in investigated cases