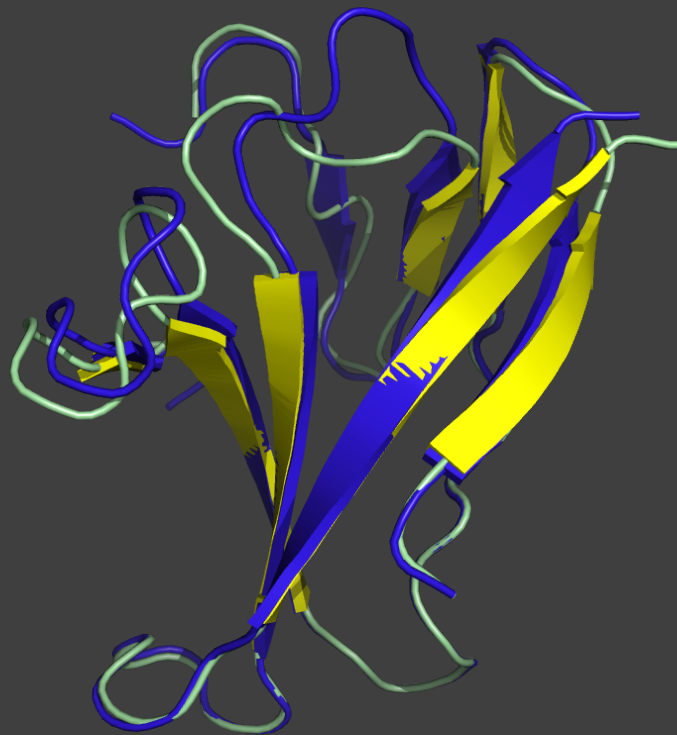
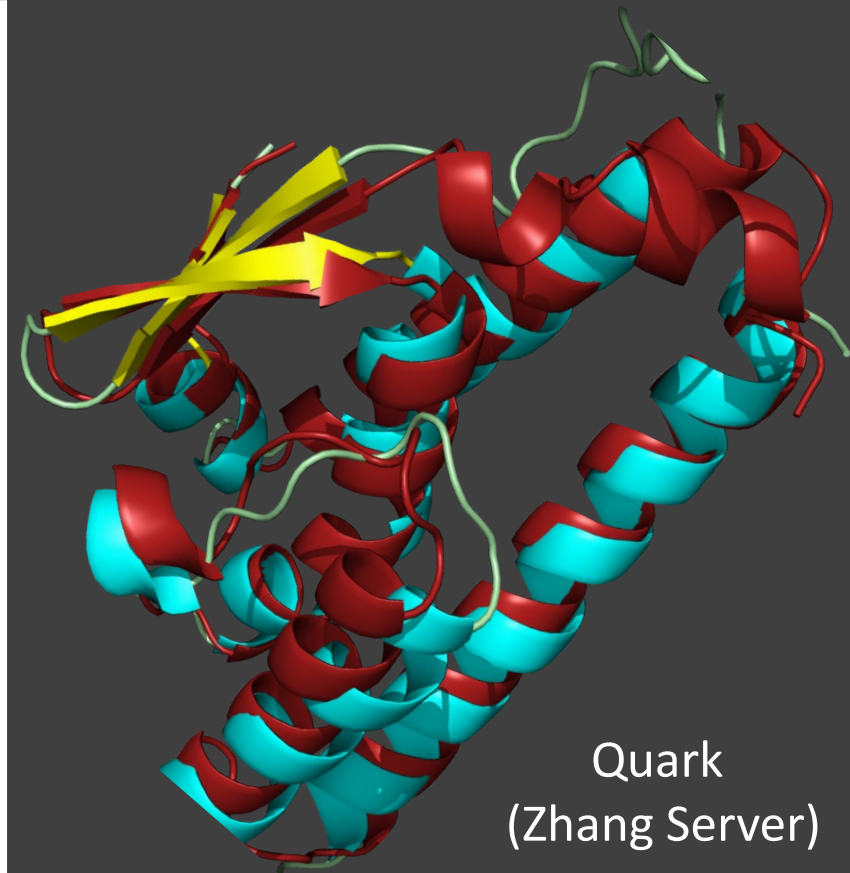


Baker



AlphaFold2



Quark
(Zhang Server)

CASP14 Tertiary Structure Prediction Assessment Topology (FM) Category

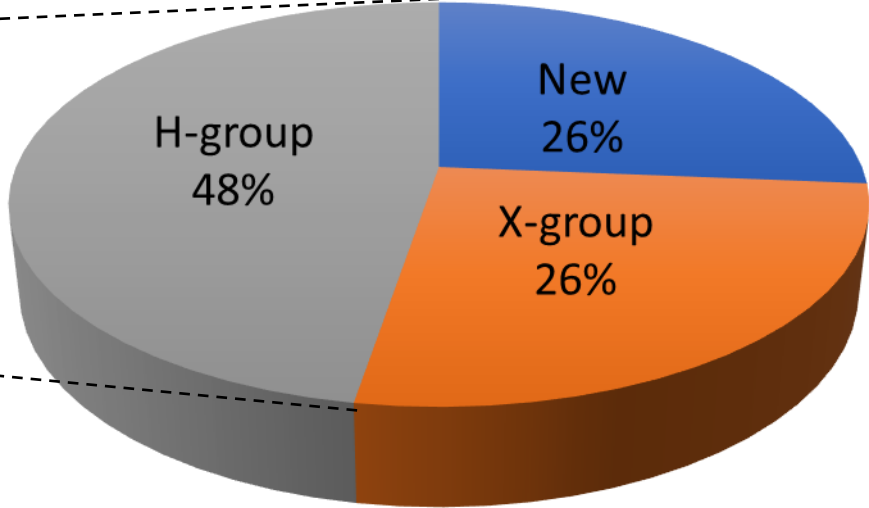
Lisa Kinch, Jimin Pei, Dustin Schaeffer, Nick Grishin

CASP14 FM Tertiary Structure Assessment in Numbers

23 FM Target EVUs

15 FM/TBM EVUs

Fungi	5%
Bacteria	32%
Virus	63%

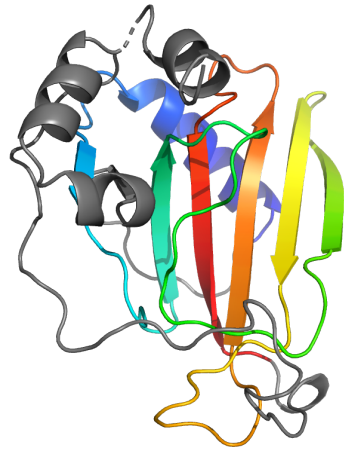


Many FM targets have homologous templates

ECOD Relationships to Templates

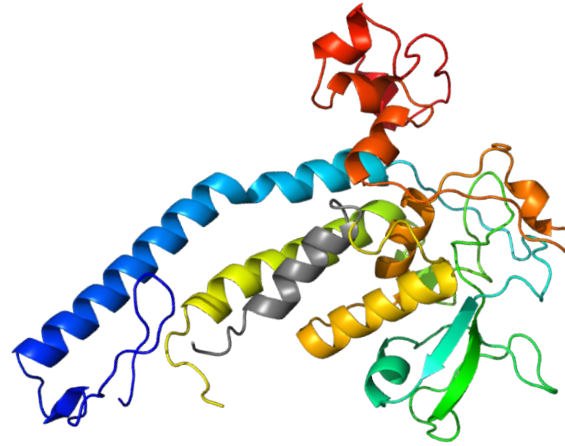
FM with Homologous Templates: Indels and SSE shifts

TARGET



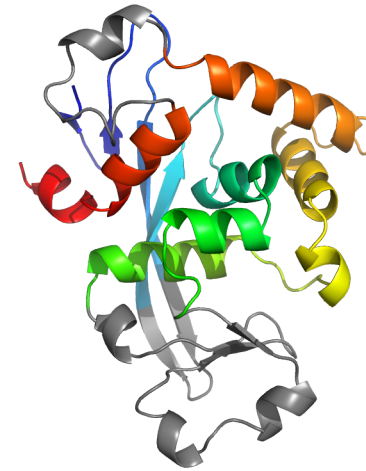
T1090-D1

RSC complex Subunit Ssr4



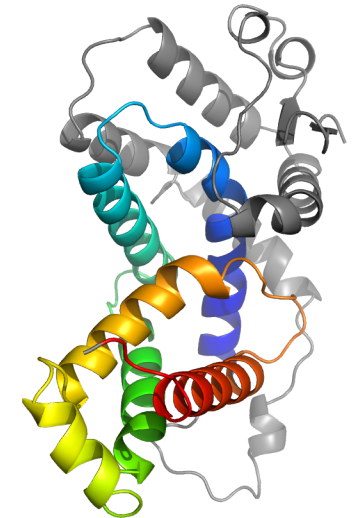
T1093-D3

Phage RNA Pol beta'



T1094-D2

Phage RNA Pol Beta



T1096-D1

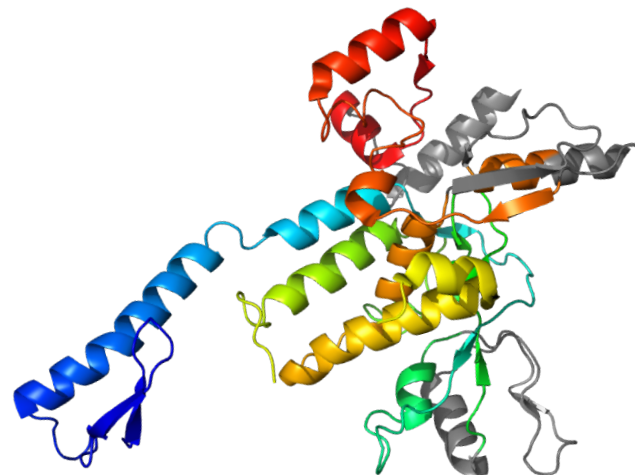
Phage RNA Pol Subunit

TEMPLATE



Rice Stress Response

Transcription Factor Nac1



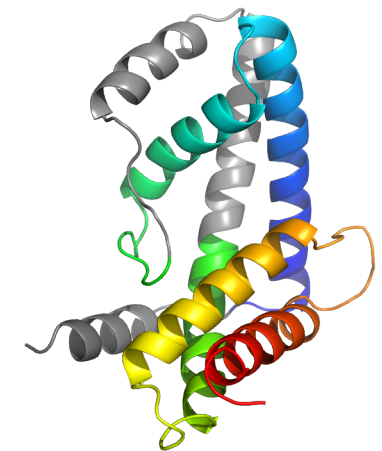
6pstJ

E. coli RNA Pol Beta'



4a3kB

Yeast RNA Pol II



3les RNA Pol

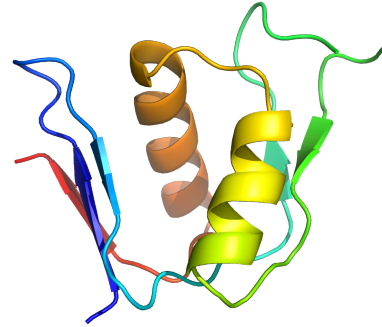
Sigma Factor

New Folds Combine Existing SSE Motifs

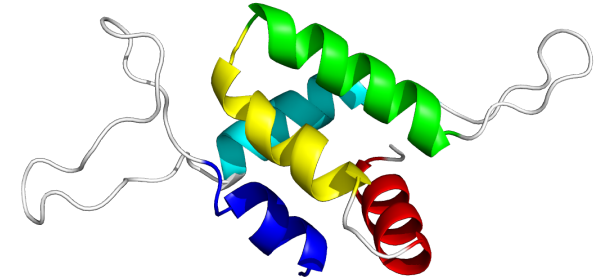
TARGET



T1038-D1
TSWV glycoprotein N

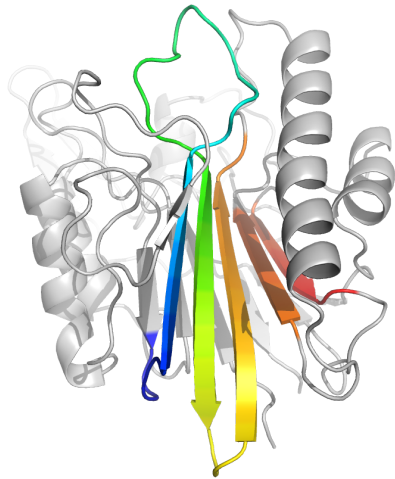


T1047s2-D3
Flagellar P-ring FlgI

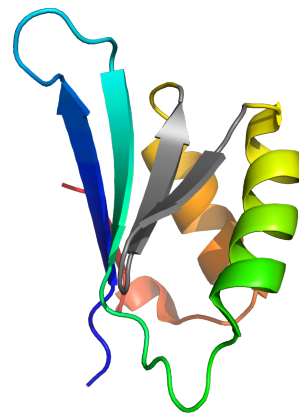


T1035-D1
RNA Pol Domain

TEMPLATE



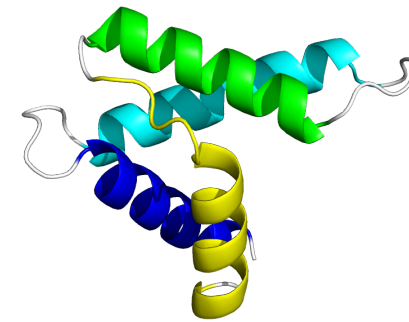
3i48A sheet Analog



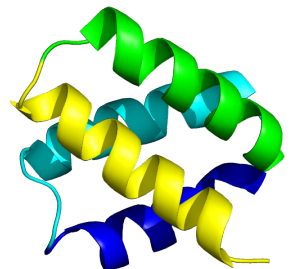
4mo0 indels



2hm2 indels



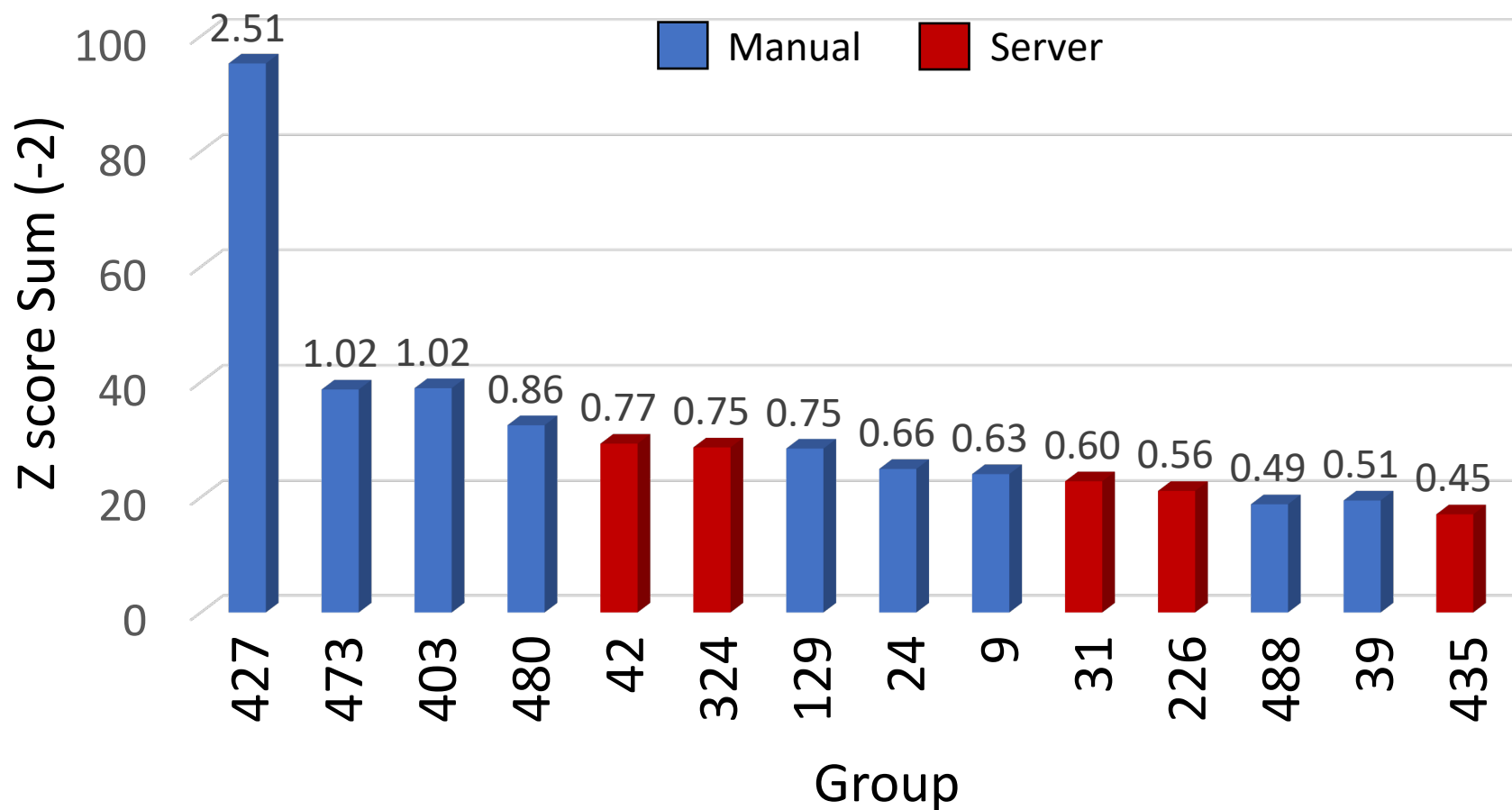
1x42A2 H1-H3



6e4jA1 H2-H4

The Ranks: Formula for Regular FM Assessment

- Analysis on the models designated as "1"
- All groups on 'all groups' targets
- Scores and Weights for FM and FM/TBM domains:

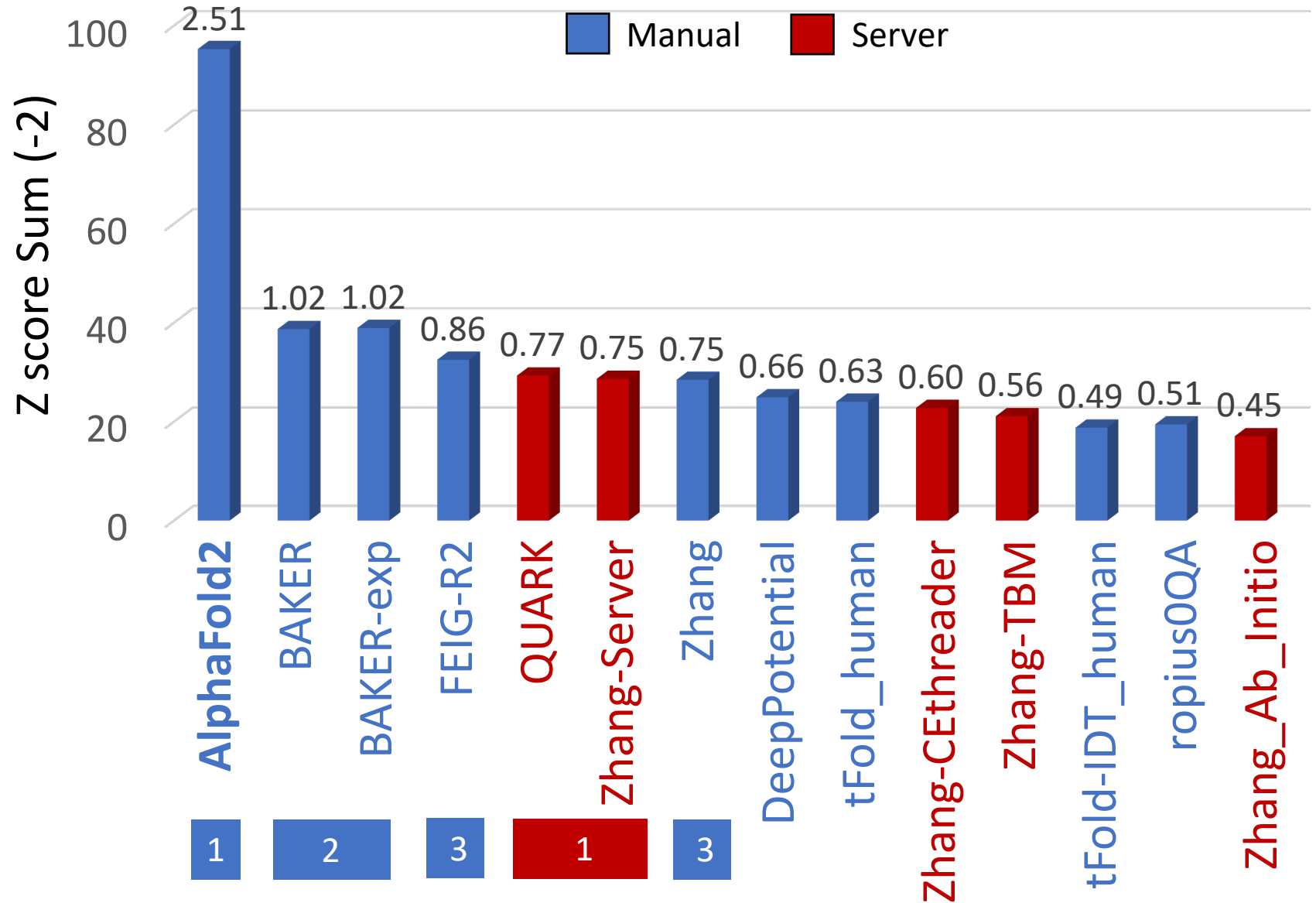


1 x GDT_TS, 1 x QCS, 0.1 x MolProbity

The Ranks: AlphaFold2 Outranks the Rest

- Analysis on the models designated as "1"
- All groups on 'all groups' targets
- Scores and Weights for FM and FM/TBM domains:

*1 x GDT_TS, 1 x QCS,
0.1 x MolProb*

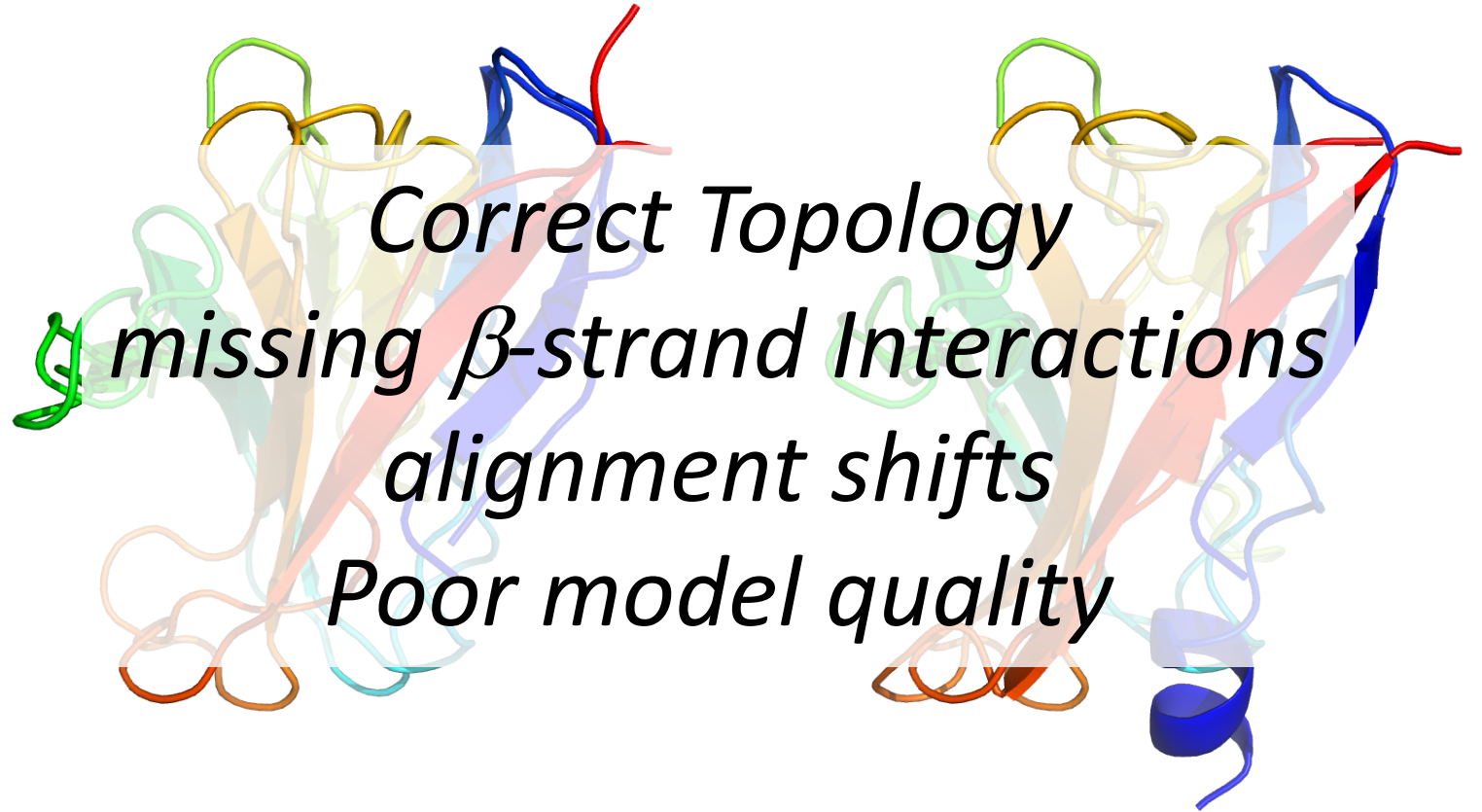


The Ranks: AlphaFold2 Outranks the Rest

T1064 SARS CoV2 ORF8



AlphaFold2 Model1
GDT_TS 86.96

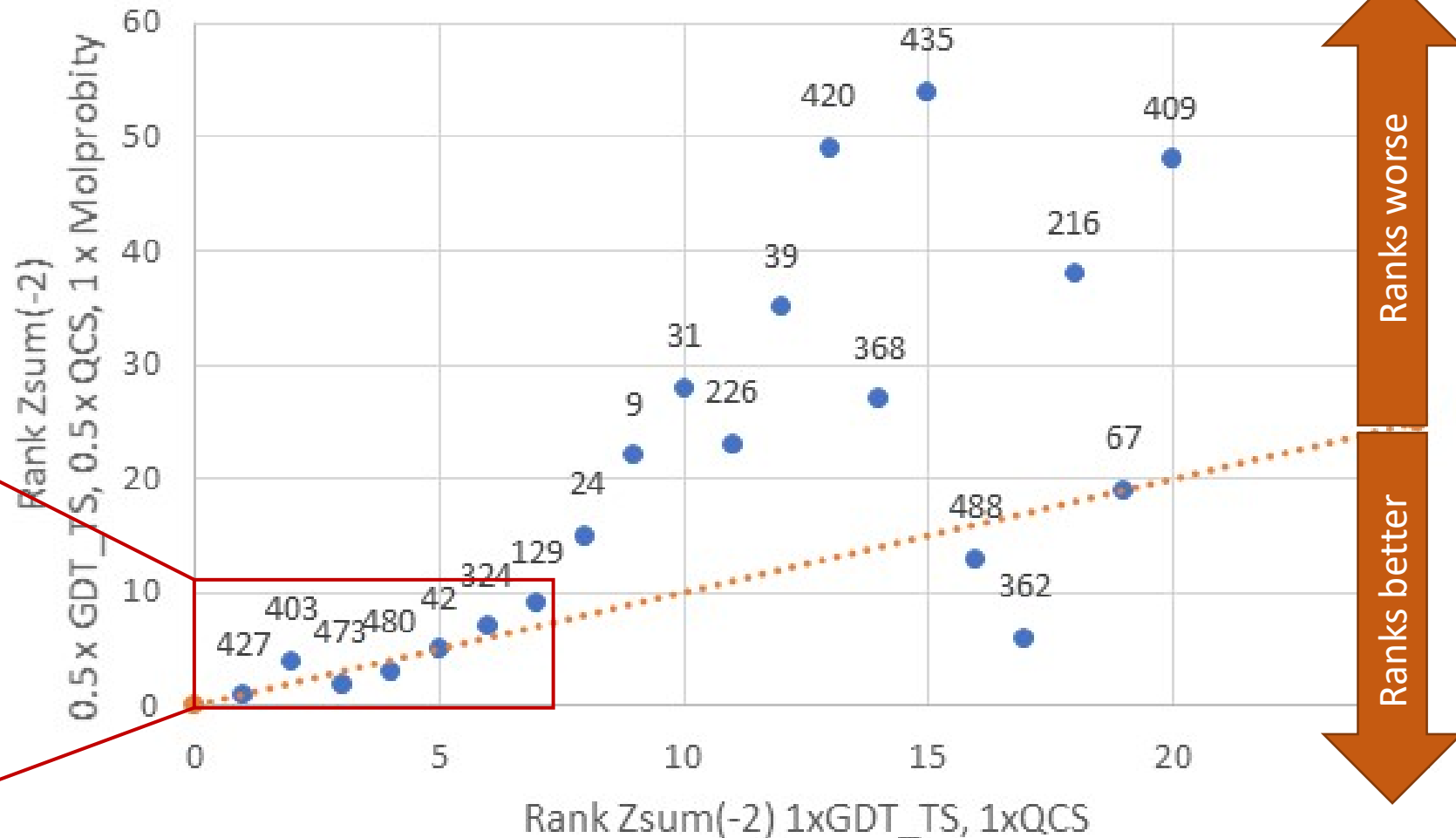
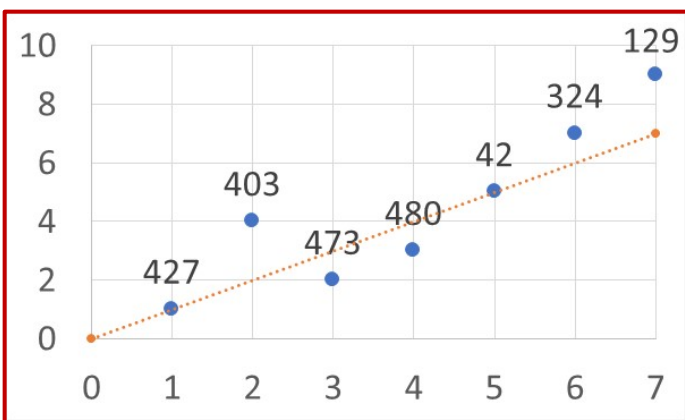


xianmingpan Model1
GDT_TS 42.94

BhageerathH-Plus Model4
GDT_TS 36.96

Model Quality Should Improve: MolProbability Comparison

Ranks can change drastically if we consider MopProbity as Half of the score, but not too much for the top performers



too much of a penalty, we chose 1x GTD, 1x QCS, and 0.1x Molprobability

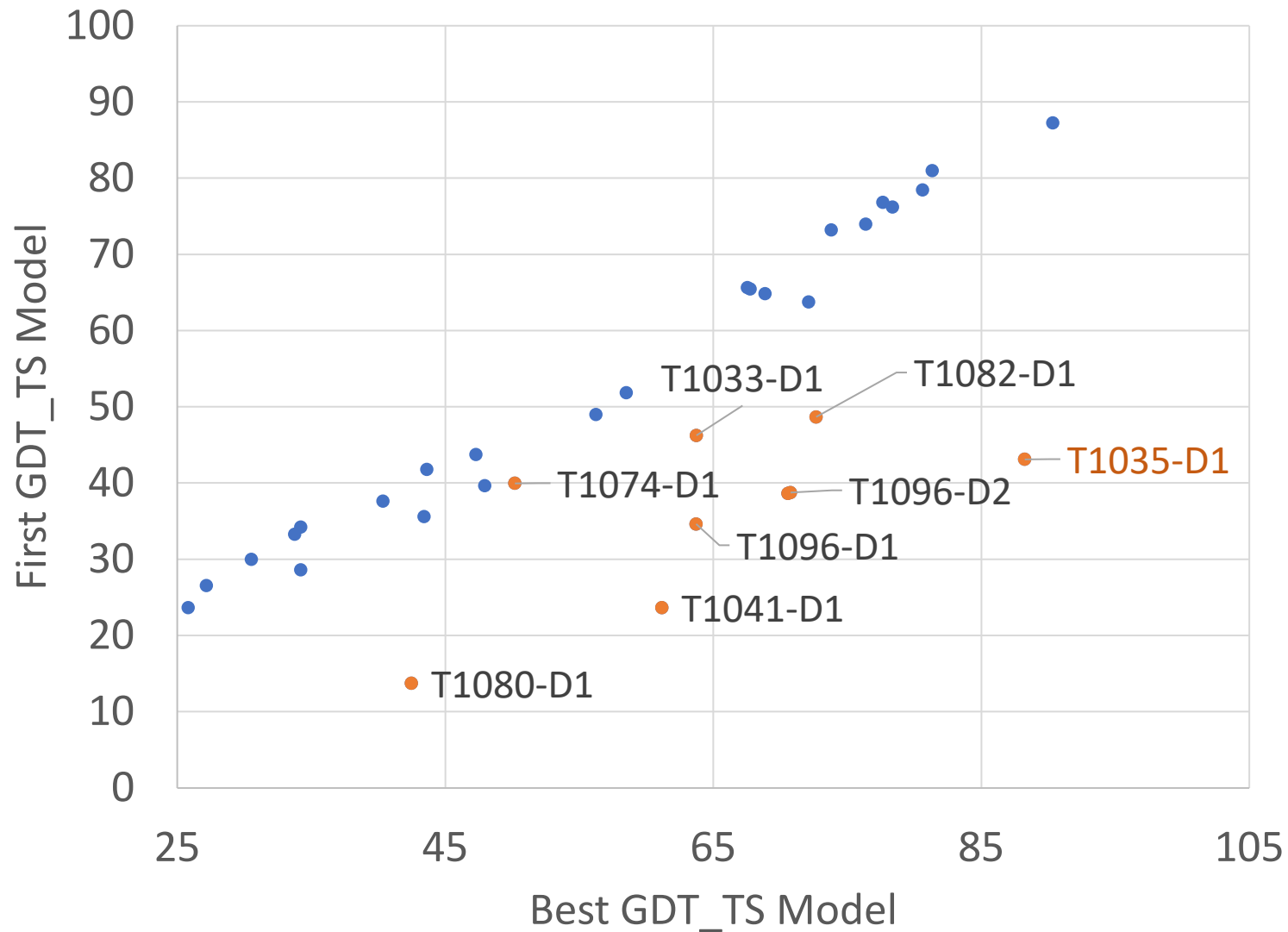
Consistent Top Ranks: Comparison of Chosen Parameters

1xGDT_TS, 1xQCS, 0.1 MolPrb

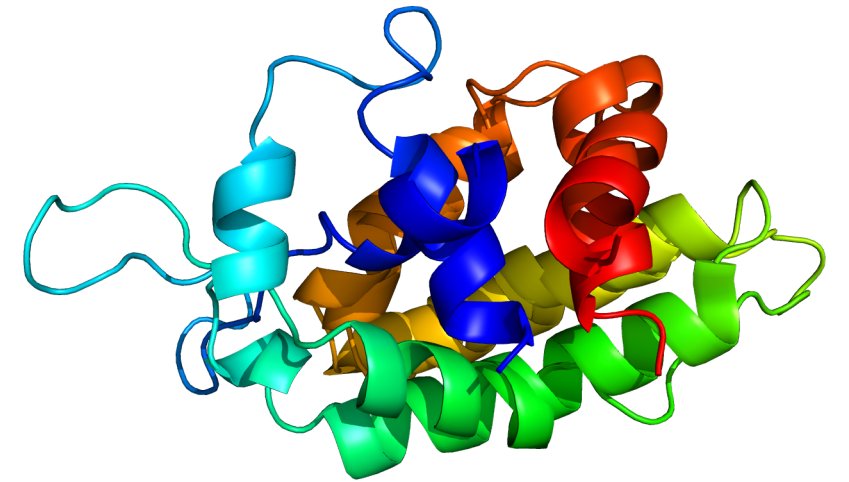
		FM/TBM First Chosen		FM only First Chosen		Best Model Chosen		FM Equation CASP 13		TBM Equation CASP 13		
	GR_code	GROUP_NAME	SumZ(>-2)	Rank	SumZ(>-2)	Rank	SumZ(>-2)	RSumZ(>-2)	SumZ(>-2)	RSumZ(>-2)	SumZ(>-2)	Rank
Invited	427	AlphaFold2	95.2619	1	72.7423	1	98.1145	1	98.6963	1	108.9149	1
	403	BAKER-exp	38.9449	2	29.3544	2	40.4491	2	39.5088	2	39.1232	3
	473	BAKER	38.7108	3	28.5485	3	40.1406	3	39.1136	3	39.2756	2
	480	FEIG-R2	32.5213	4	23.8974	4	33.1355	4	32.3283	4	28.2938	4
	42	QUARK	29.3174	5	21.8233	5	30.0154	5	29.6602	5	27.5888	6
	324	Zhang-Server	28.6666	6	21.3322	6	29.3757	7	29.0659	6	28.2407	5
	129	Zhang	28.4668	7	20.2609	7	29.5387	6	28.9676	7	27.5537	7
	24	DeepPotential	24.9264	8	18.2855	8	26.0906	9	25.7011	8	13.709	18
	9	tFold_human	24.0308	9	16.8172	10	25.1792	10	24.941	9	-7.0613	61
	31	Zhang-CEthreader	22.7807	10	17.1828	9	23.9352	11	23.7614	10	10.3811	25
Best vs. First	226	Zhang-TBM	21.1112	11	16.105	11	23.2603	13	21.739	11	9.0027	27
	39	ropius0QA	19.4464	12	12.529	17	20.5595	17	20.8463	12	11.9975	21
	368	tFold-CaT_human	19.1203	13	12.6847	15	22.4777	16	19.6361	14	-8.5029	63
	488	tFold-IDT_human	18.7899	14	14.3833	12	28.3196	8	18.4611	16	-3.7302	55
	362	Seok-refine	18.4966	15	12.6208	16	19.1489	21	17.7495	17	15.6123	13
	420	MULTICOM	17.4943	16	11.1945	19	22.9165	14	19.7178	13	19.12	8
	67	ProQ2	17.3723	17	13.0303	13	18.787	22	17.5304	19	14.4243	17
	435	Zhang_Ab_Initio	17.0493	18	12.8138	14	17.8589	24	19.4825	15	14.5023	16
	498	VoroMQA-select	17.004	19	12.2854	18	17.7827	26	16.4388	22	15.8775	11
	216	EMAP_CHAE	16.3815	20	10.3662	21	17.1256	28	17.6669	18	15.9825	10

Group 488 Best Models Approach the Top

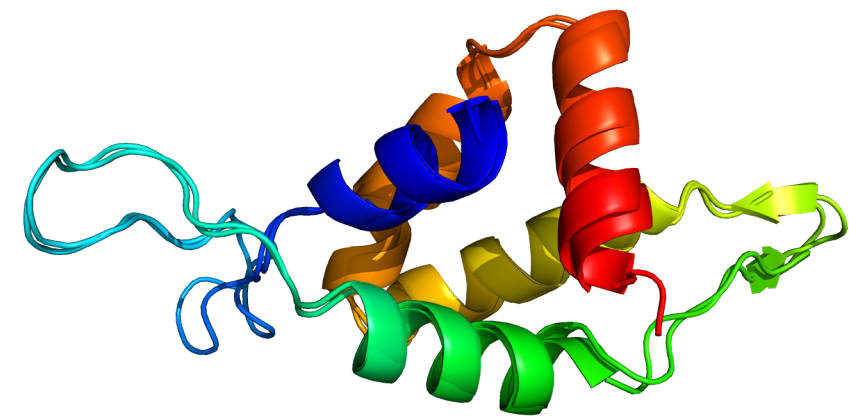
Group 488 (tFold-IDT_human) Model Selection



T1035 Superpositions



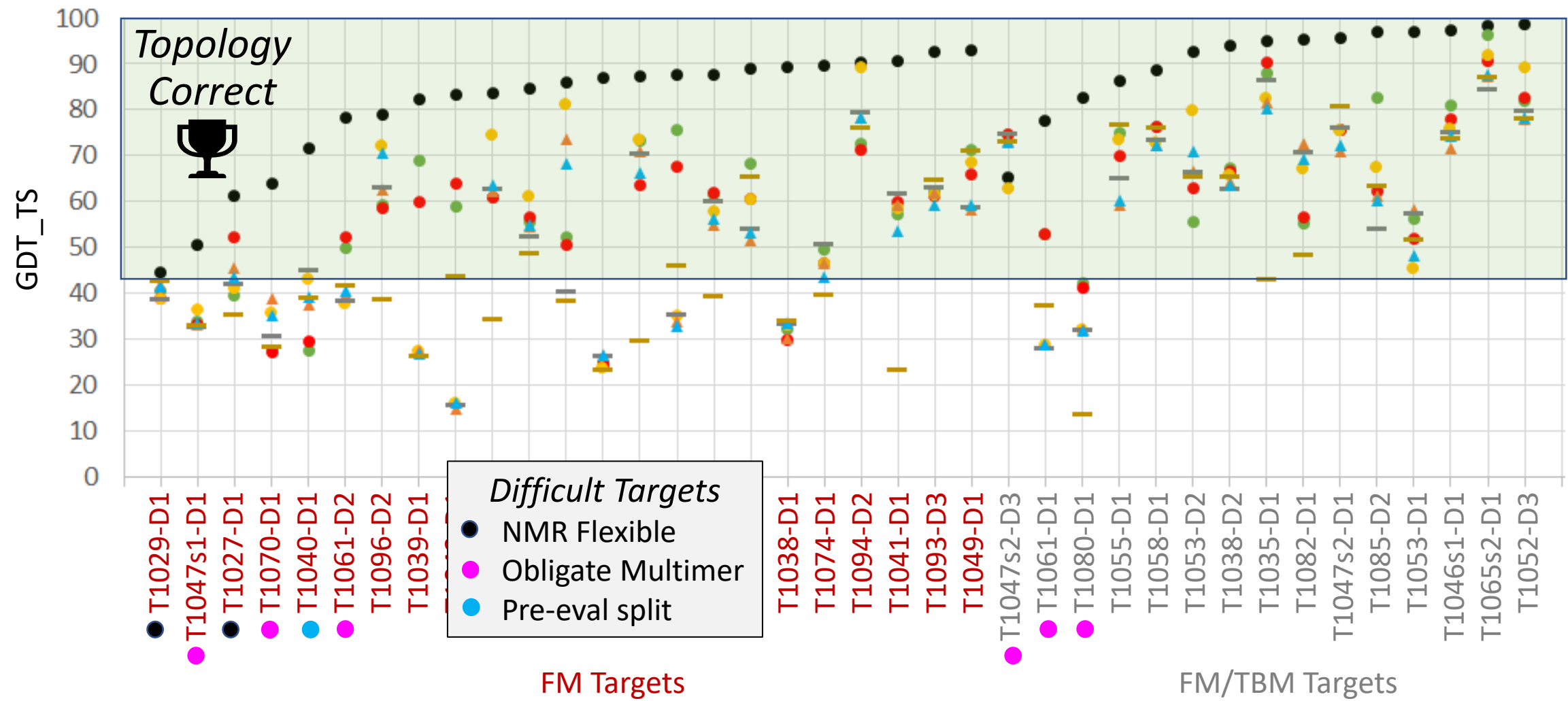
Model 1



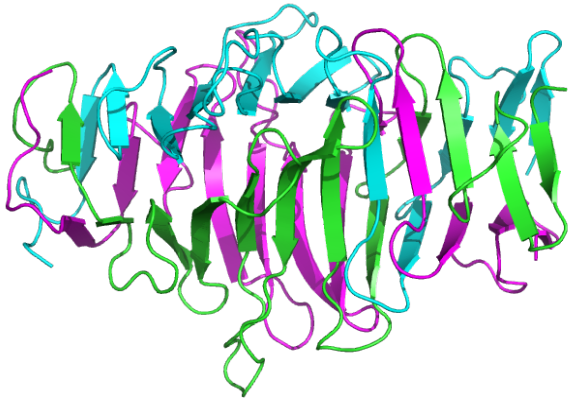
Model 3

Top Performing Groups on FM and FM/TBM Targets

● 427 ● 473 ● 403 ● 480 ▲ 042s - 129 ▲ 324s - 488



Trends in Difficult Targets: Consider Multichain Assemblies

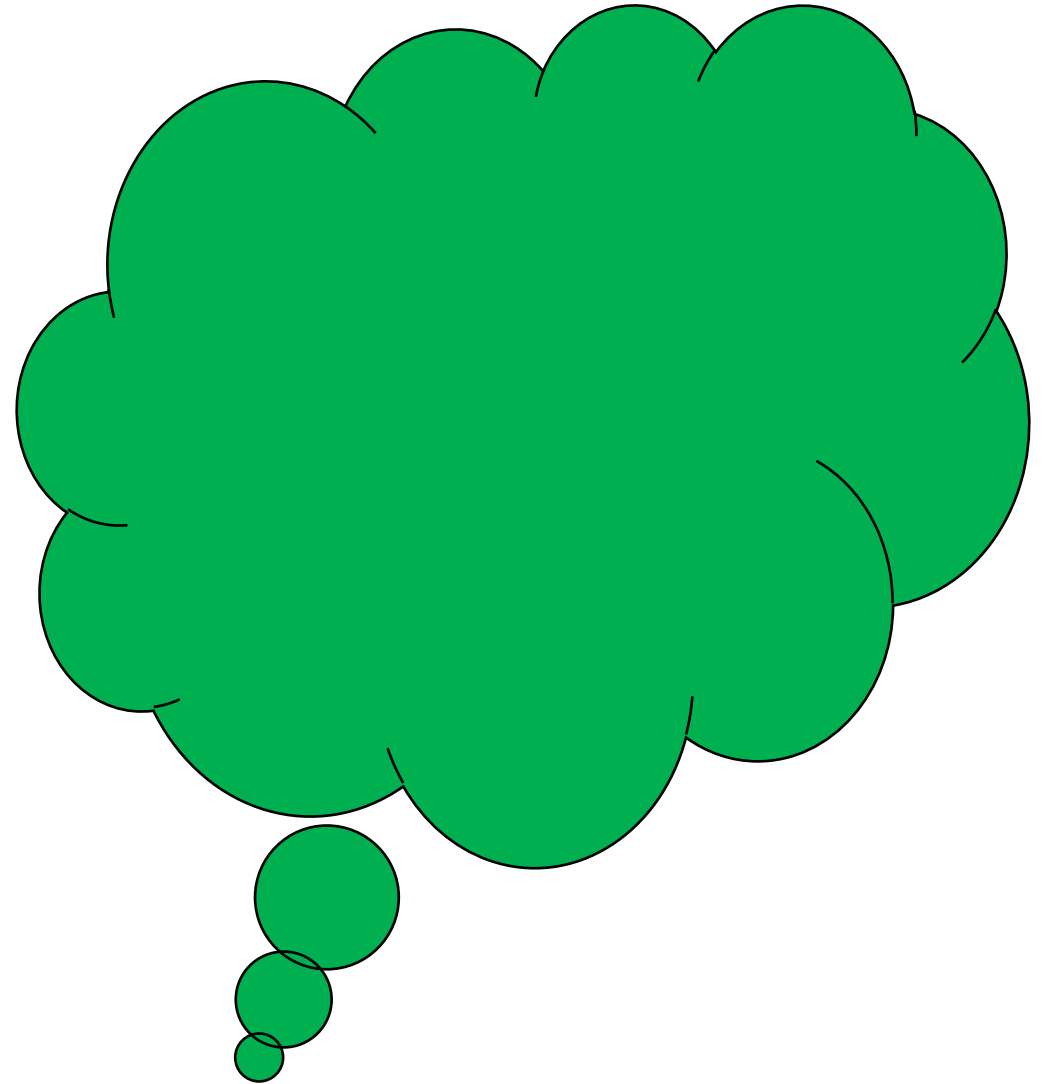


Phage tail fiber
protein
trimerization
domain Homolog

T1080 – Tailspike protein (trimer)

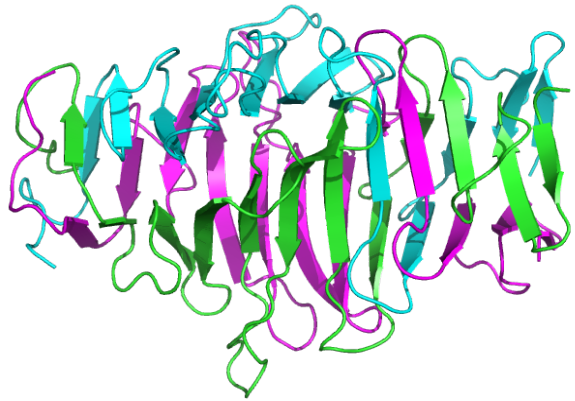


T1070 – Tailspike protein (trimer)



T1047 – Flagellar Ring Complex

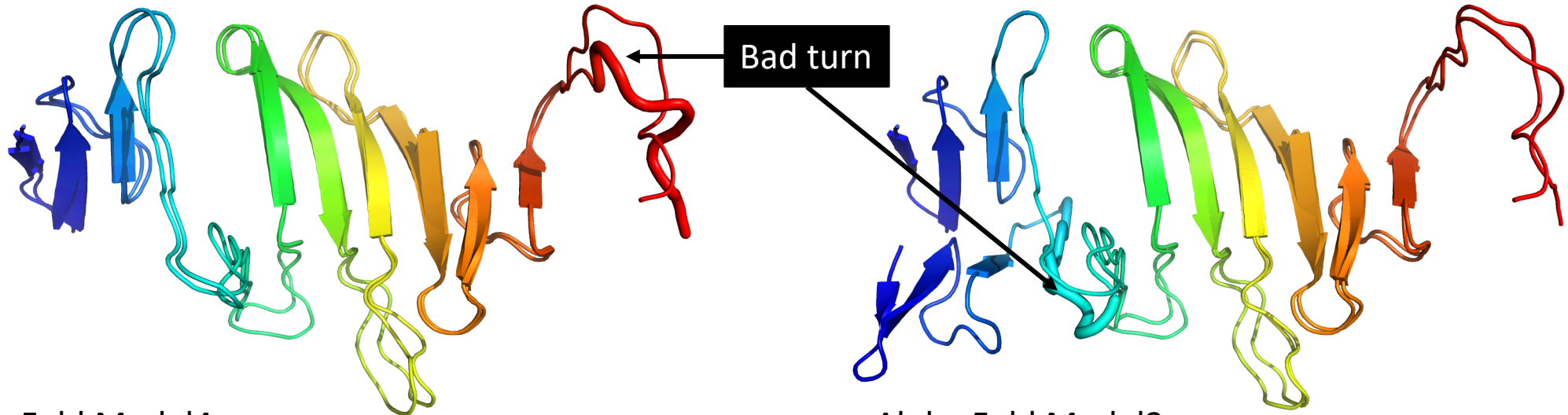
Trends in Difficult Targets: Consider Multichain Assemblies



Phage tail fiber
protein
trimerization
domain Homolog

*Can inter vs. intra chain
distances be distinguished?*

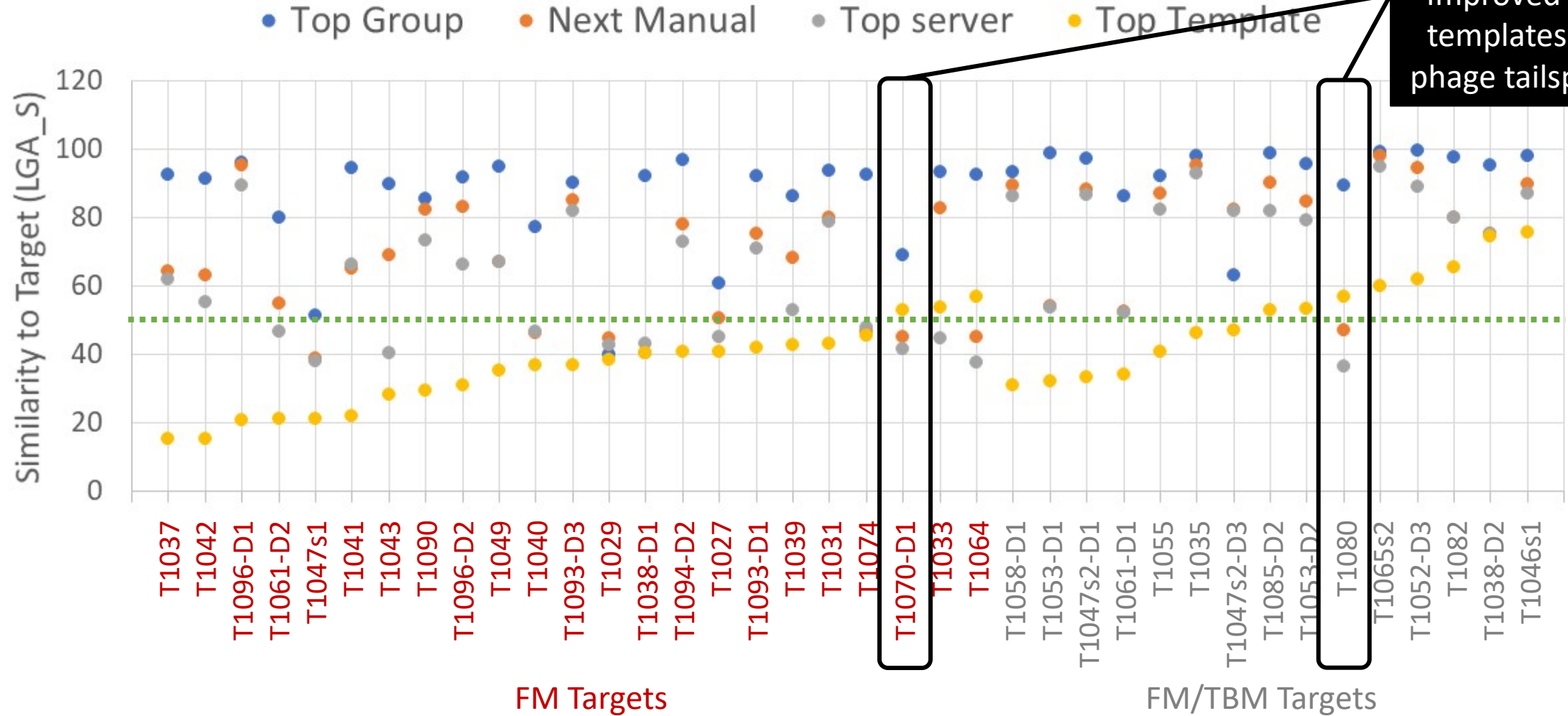
T1080 – Tailspike protein (trimer)



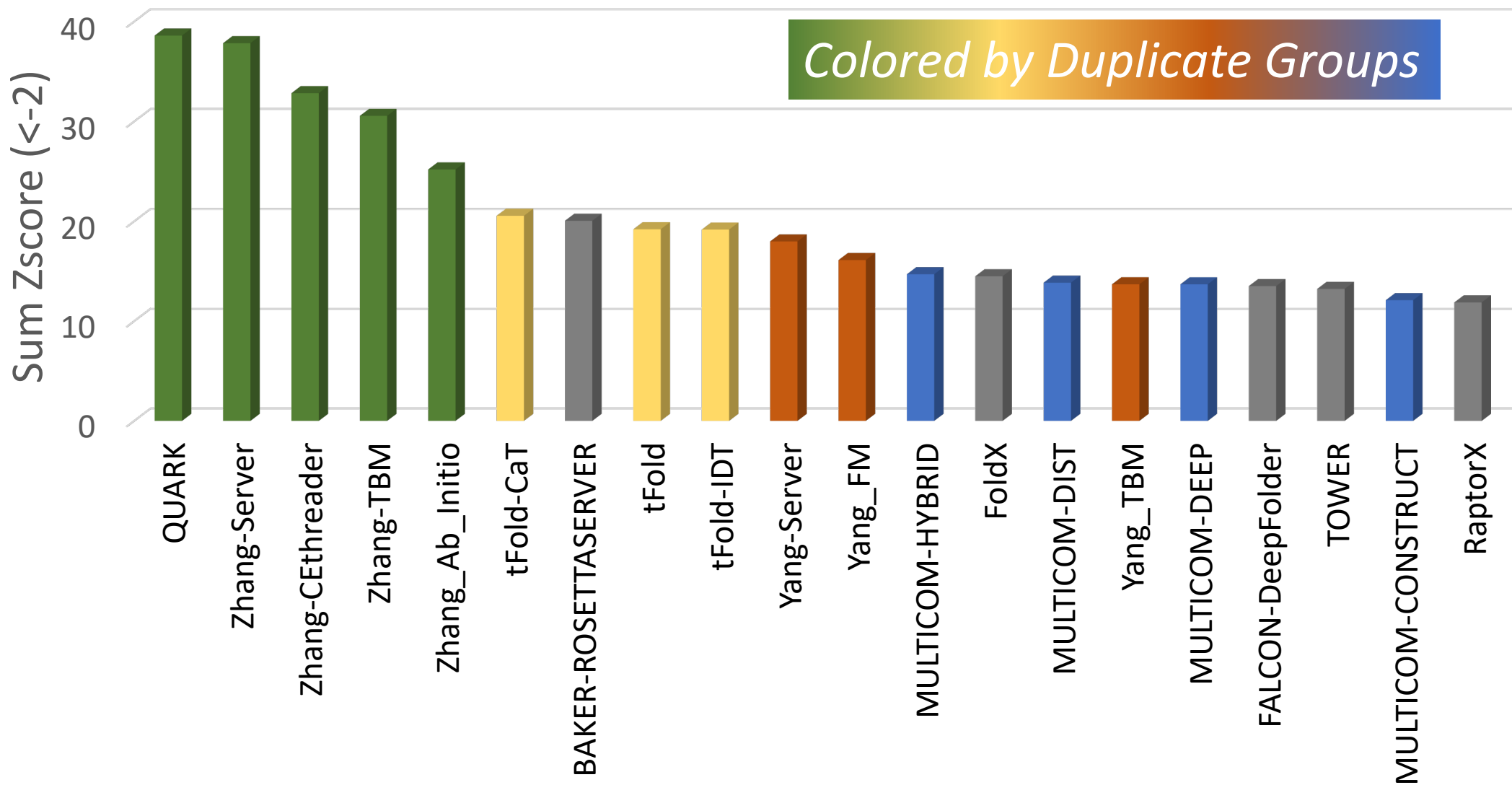
Alpha Fold Model4

Alpha Fold Model3

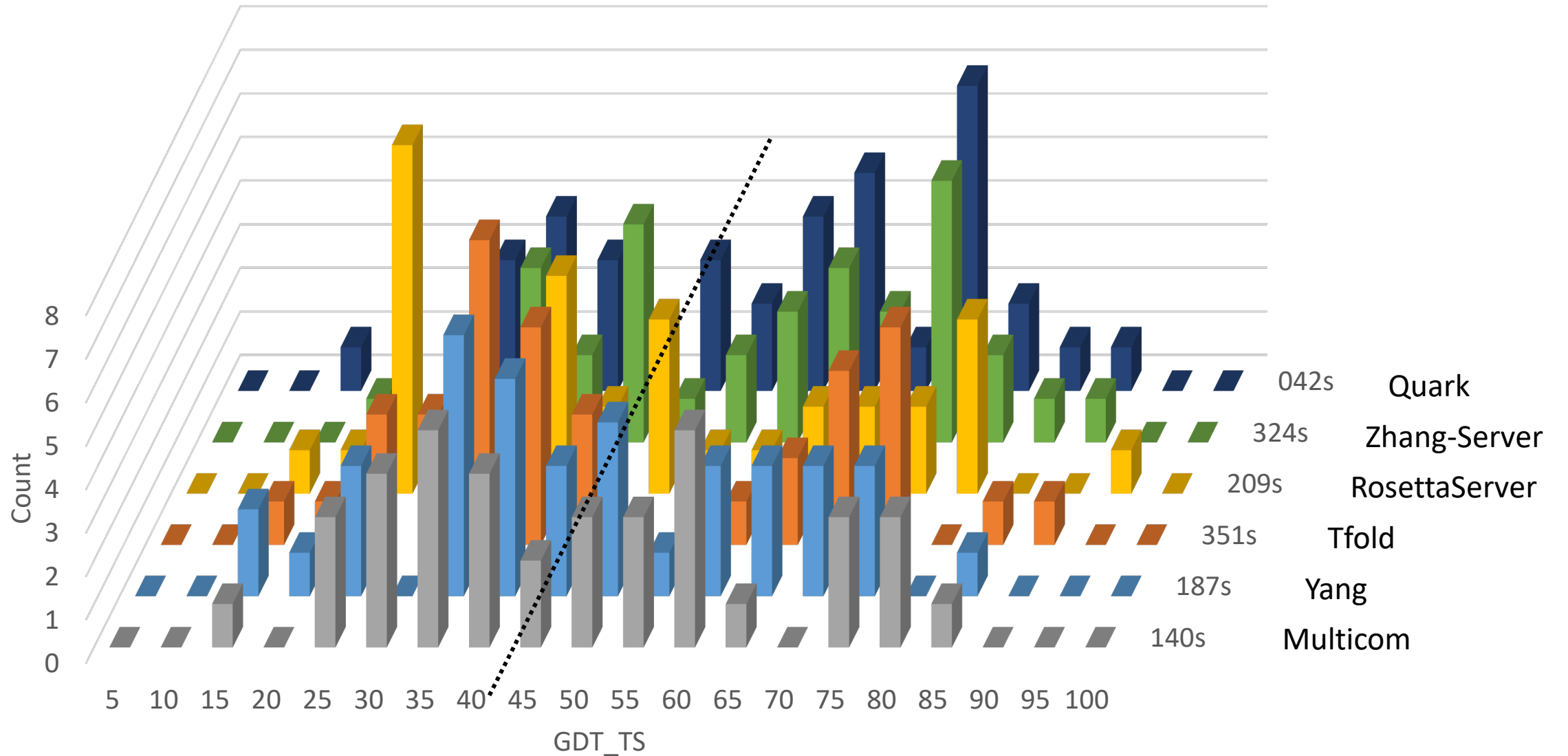
Top Prediction Models Beat Top Templates



Top 20 Server Performance (Ranked by 1xGDT_TS, 1xQCS, 0.1xMolProb)



Server Score Distributions: Getting Many Topologies

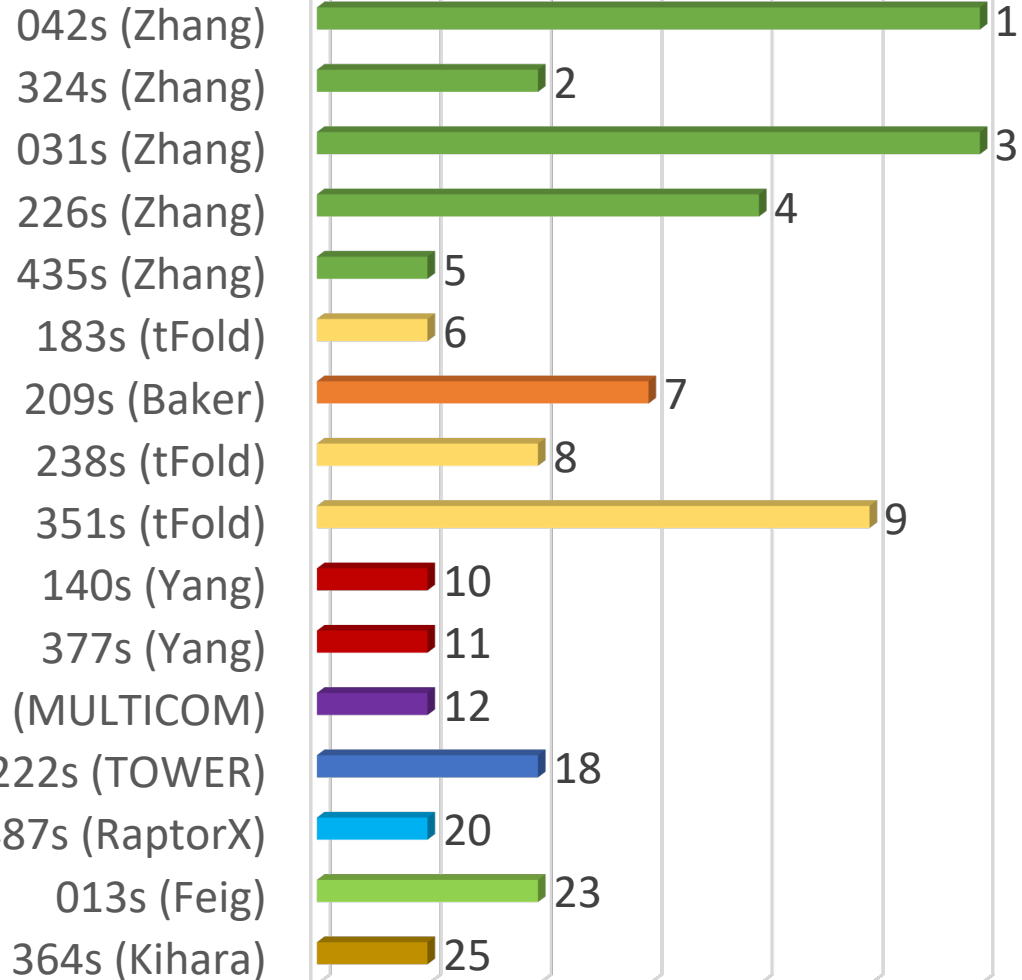


What if these groups could select their best models?

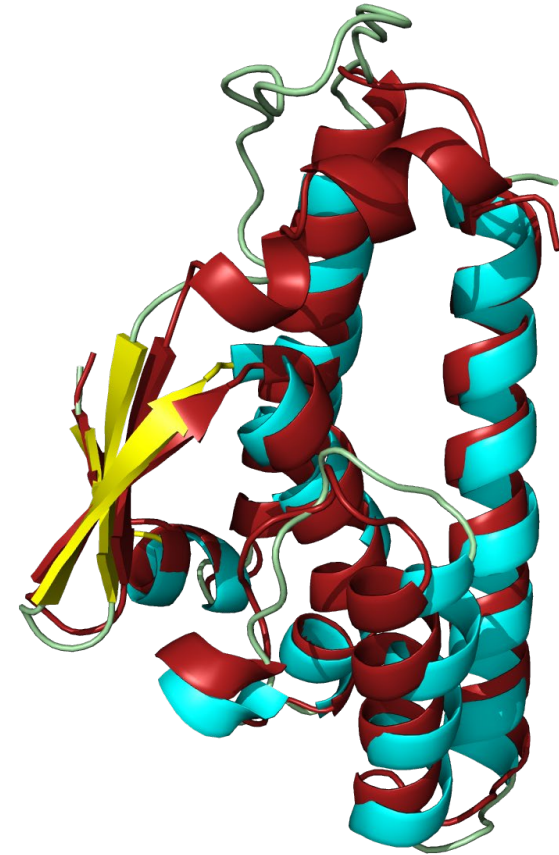
Server Performance: Top First Prediction Models

Top First Model Count by GDT_TS (Overall Rank)

0 1 2 3 4 5 6 7 8



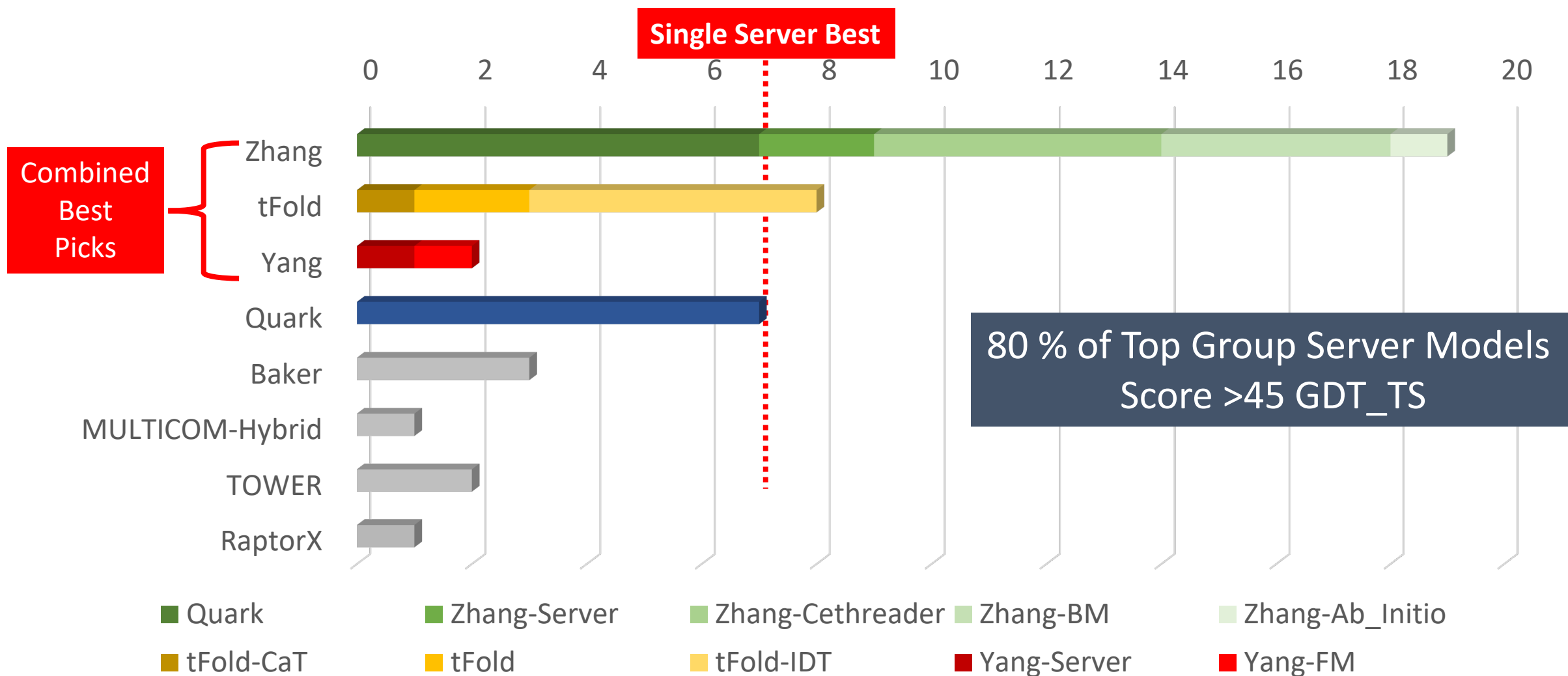
T1093-D1



Quark (Zhang Server) Outperforms

What if these groups could select their best models?

Server Performance: Combined Top First Prediction Models

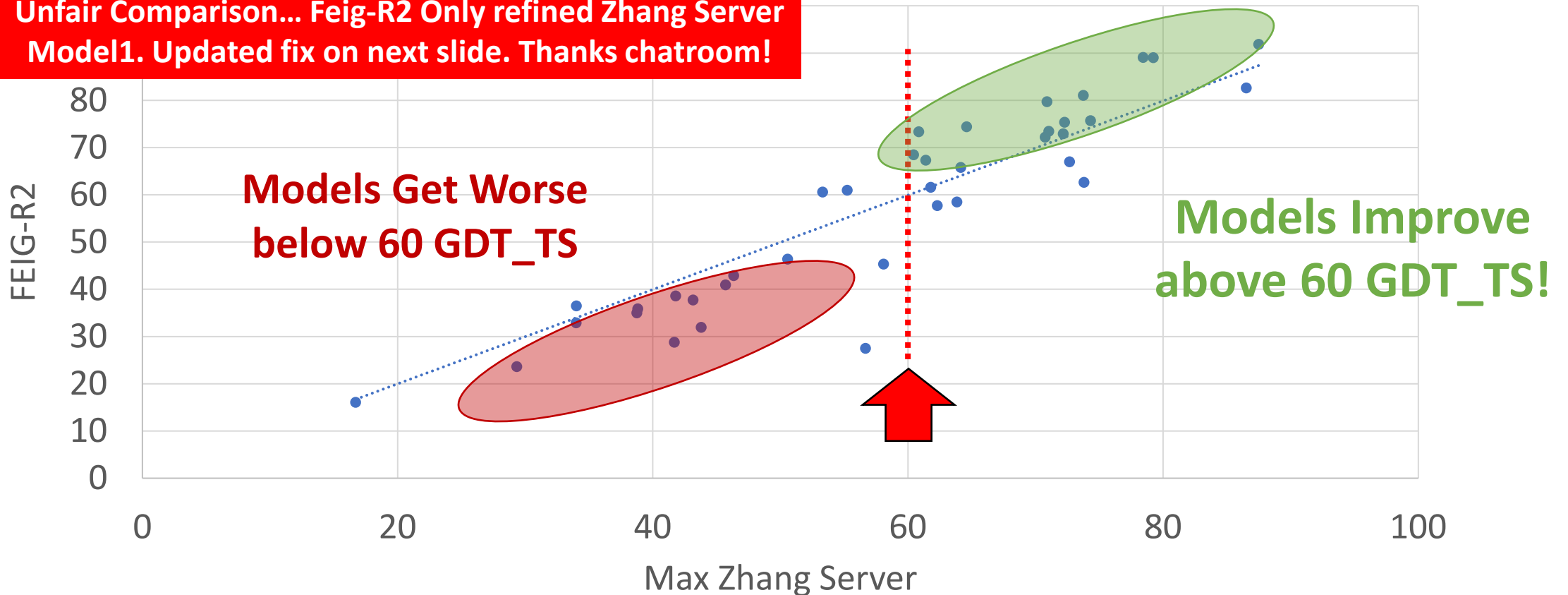


What if these groups could select their best models?

Feig-R2 Refined Zhang Server Model1

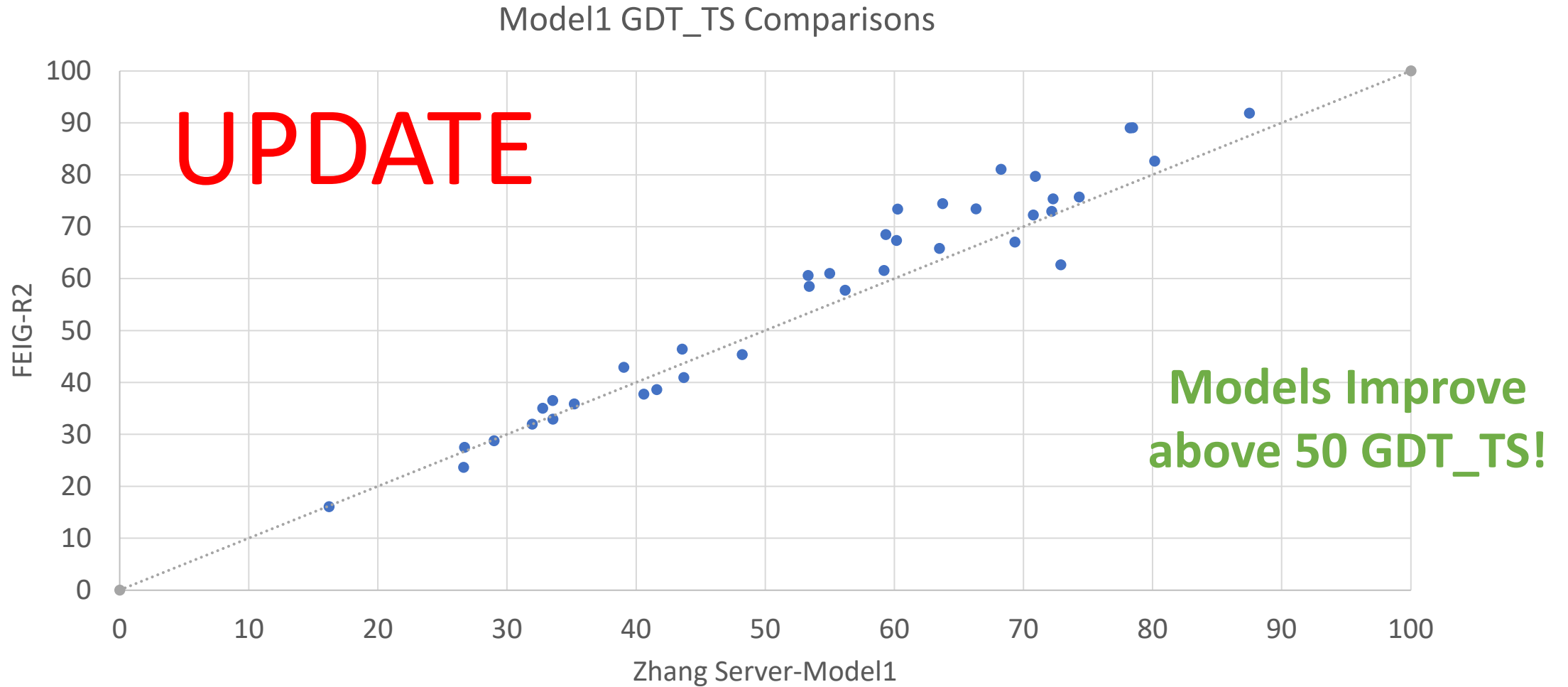
Model1 GDT_TS Comparisons

Unfair Comparison... Feig-R2 Only refined Zhang Server Model1. Updated fix on next slide. Thanks chatroom!



What if these groups could select their best models?

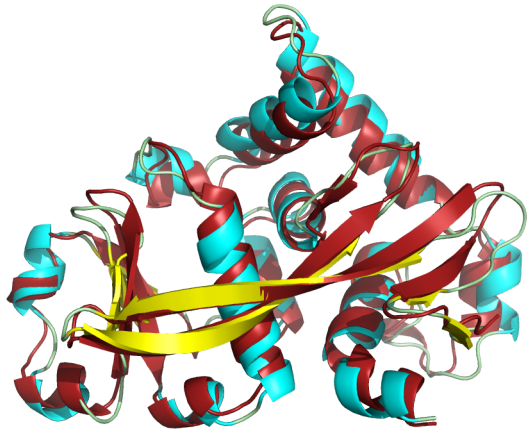
Feig-R2 Refined Zhang Server Model1



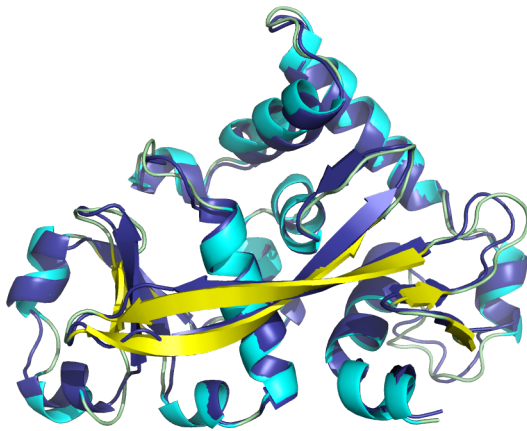
What if these groups could refine their best models?

Feig-R2 Selected Among Zhang Server Models

T1094-D2

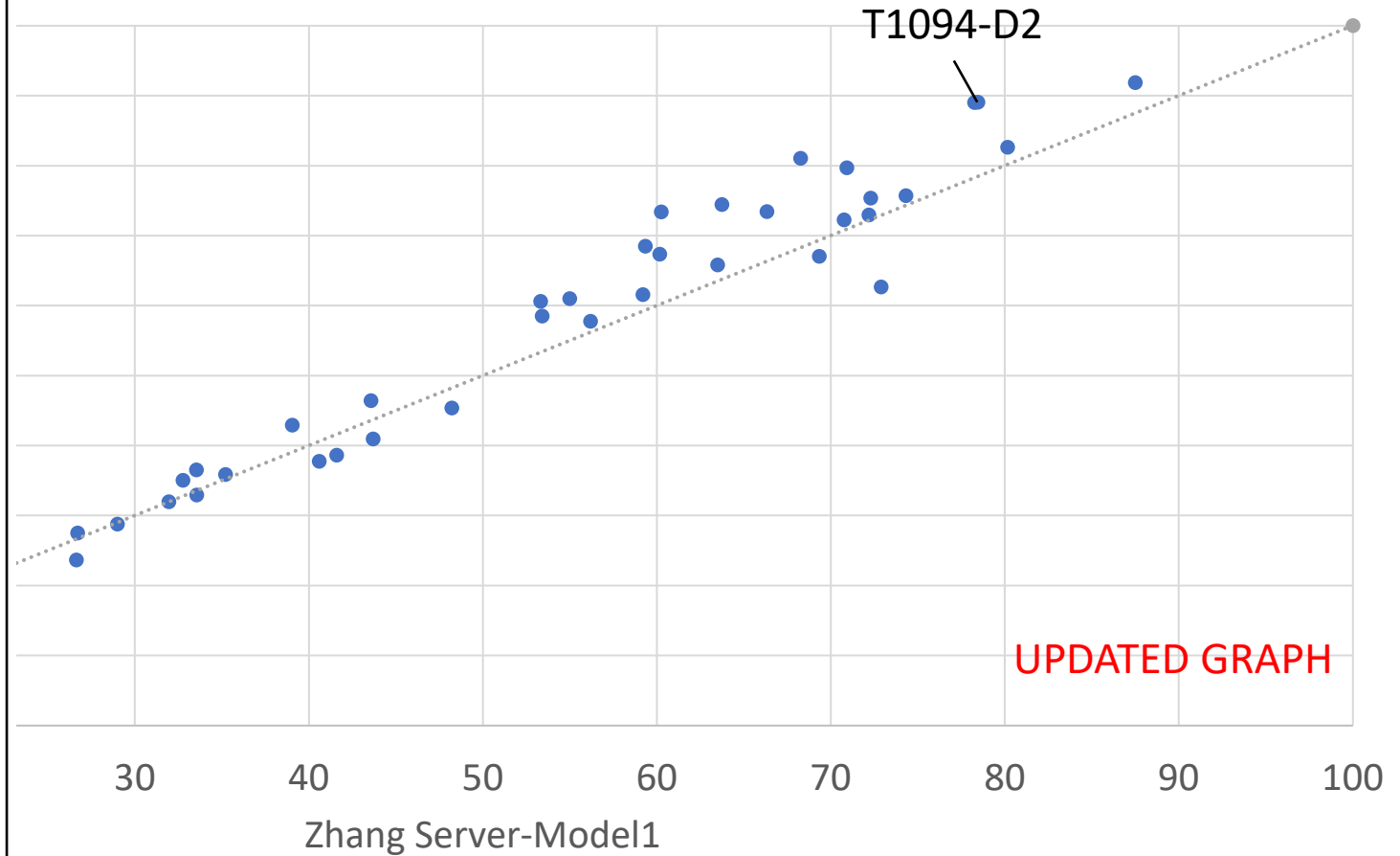


Zhang-Server Model1



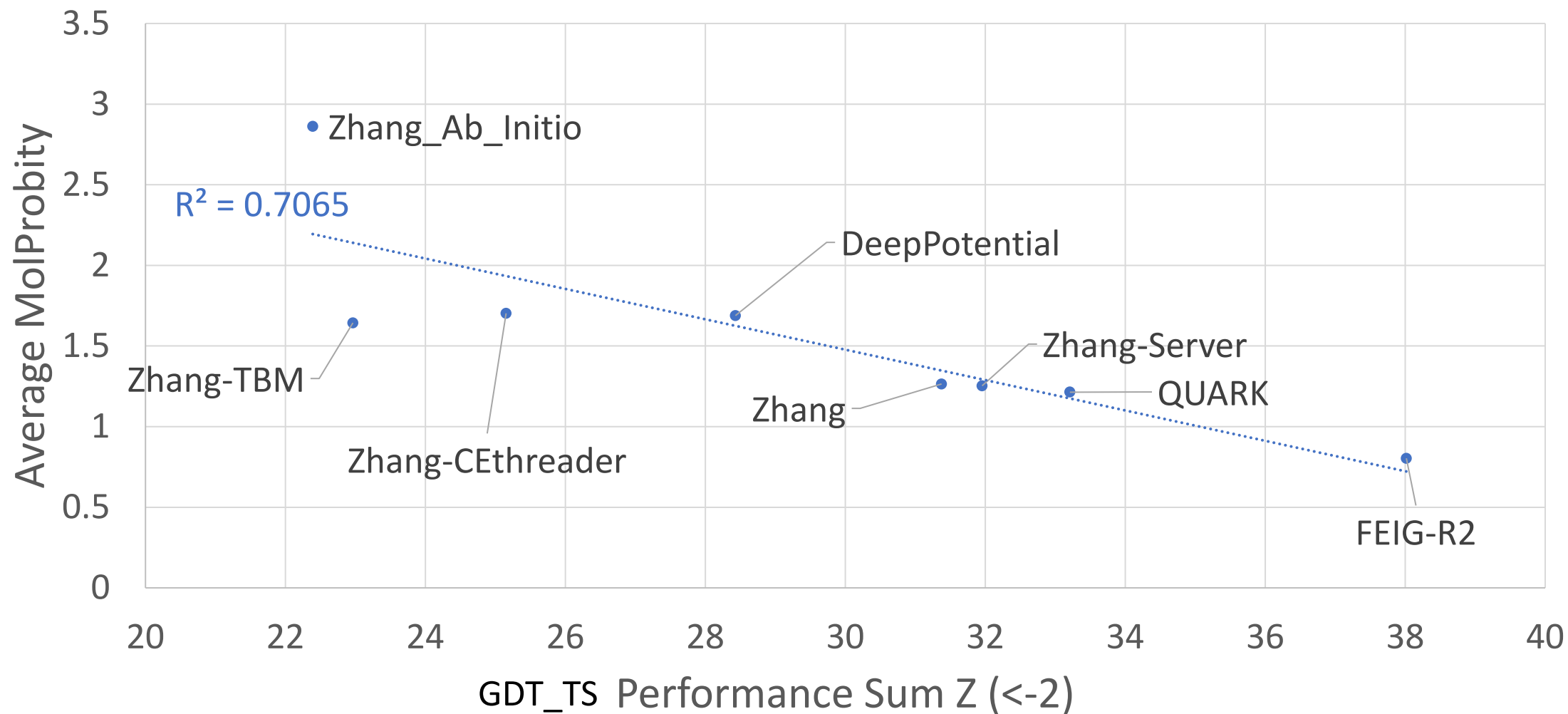
Feig-R2 Model1

Model1 GDT_TS Comparisons



What if these groups could **refine** their best models?

Overall Performance Correlates with MolProbability

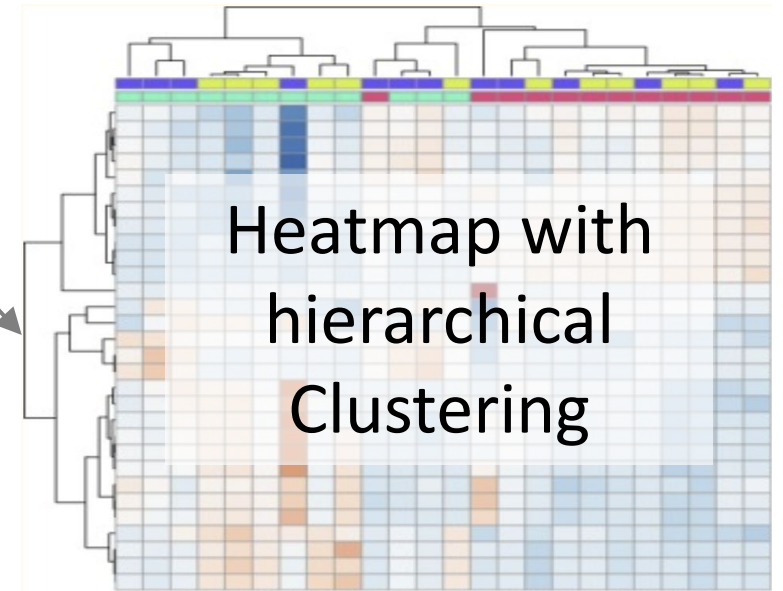
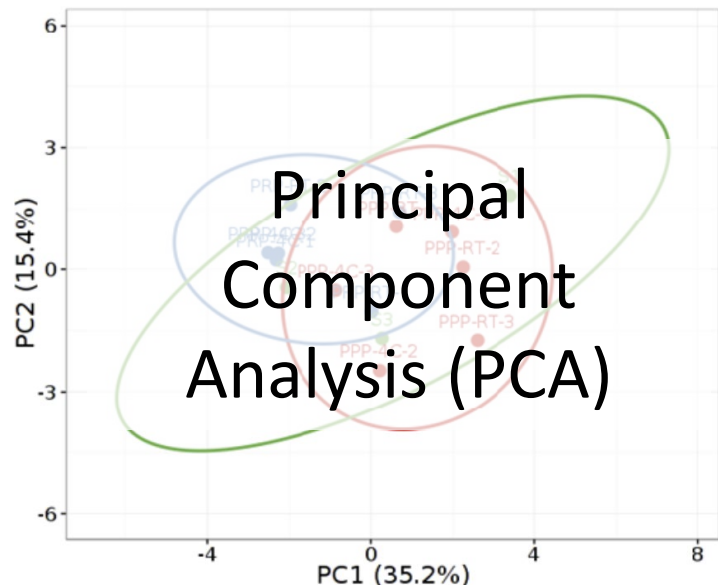


What if these groups could **refine** their best models?

Cluster Data to Compare Group performance

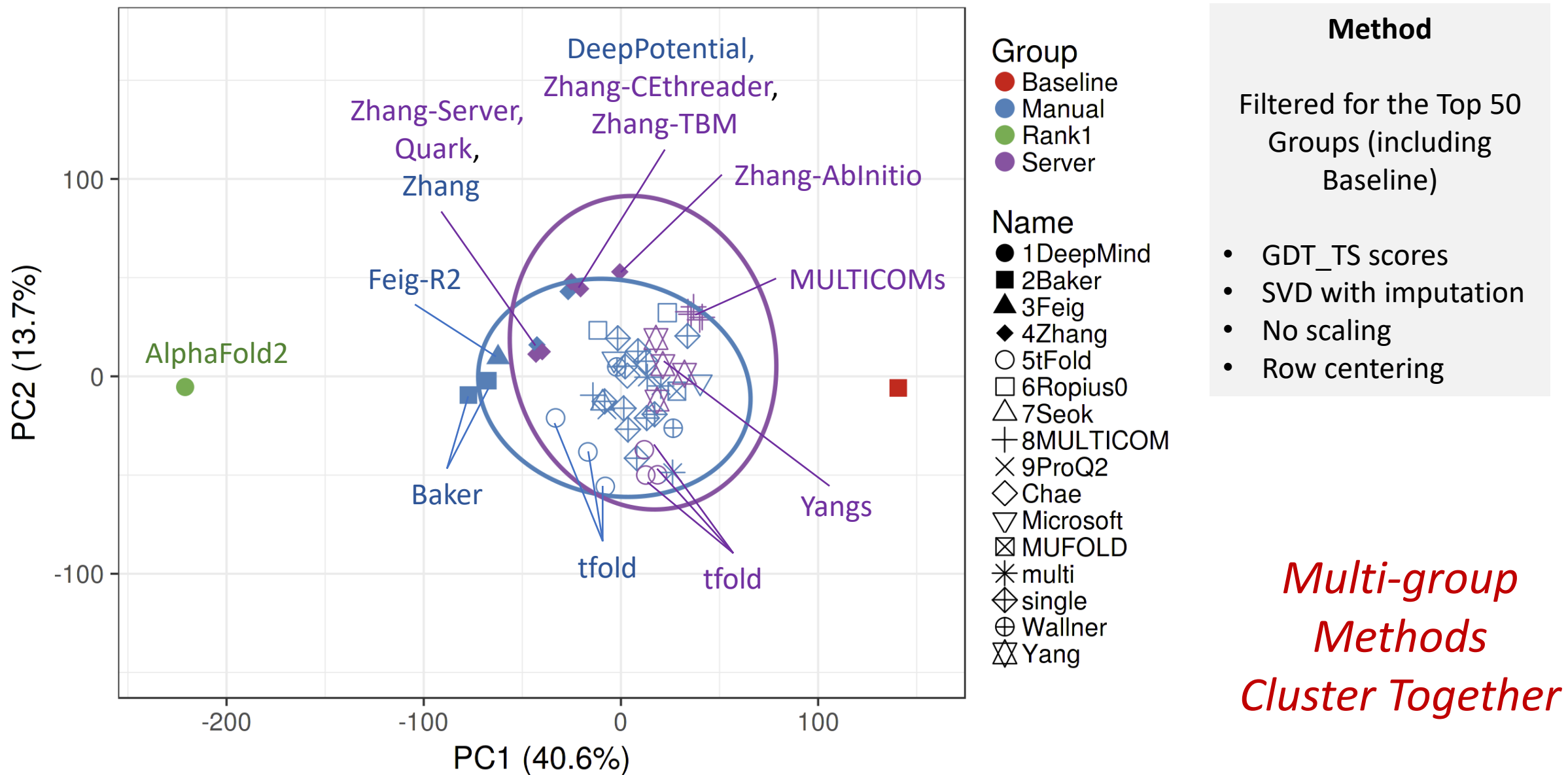
		Target1	Target2	Target3	Target4	Target5	Target6	Target7	Target8	Target96		
Filter groups with missing scores	Group1	score1	s11	s12	s13	s14	s15	s16	s17	s18	s196	<i>Method</i>
	Group2	score2	s21	s22	s23	s24	s25	s26	s27	s28	s296	
	Group3	score3	s31	s32	s33	s34	s35	s36	s37	s38	s396	
	Baseline	score4	s41	s42	s43	s44	s45	s46	s47	s48	s496	
	Server1	score5	s51	s52	s53	s54	s55	s56	s57	s58	s596	
	Server2	score6	s61	s62	s63	s64	s65	s66	s67	s68	s696	
	Server3	score7	s71	s72	s73	s74	s75	s76	s77	s78	s796	

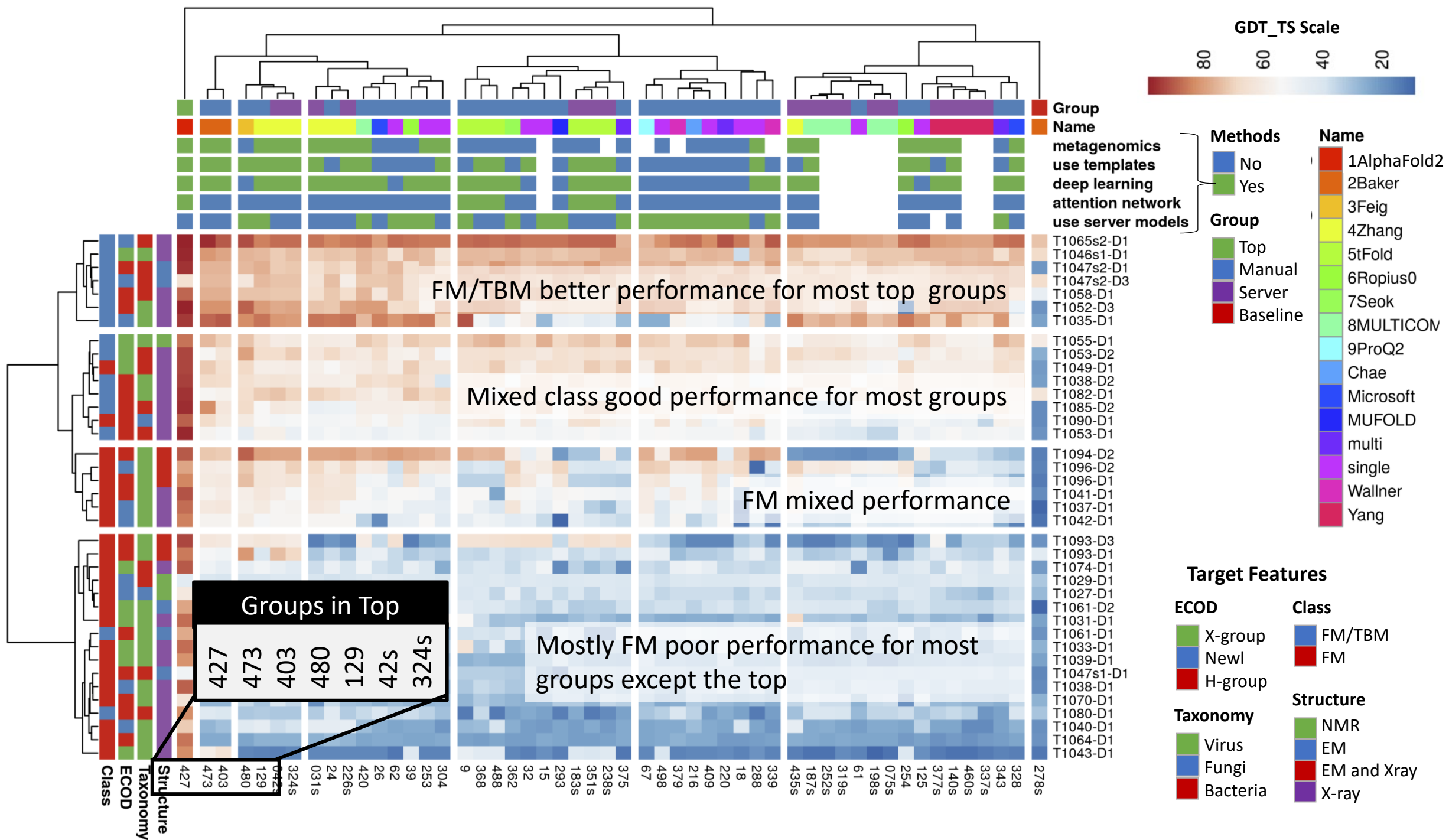
Data Matrix

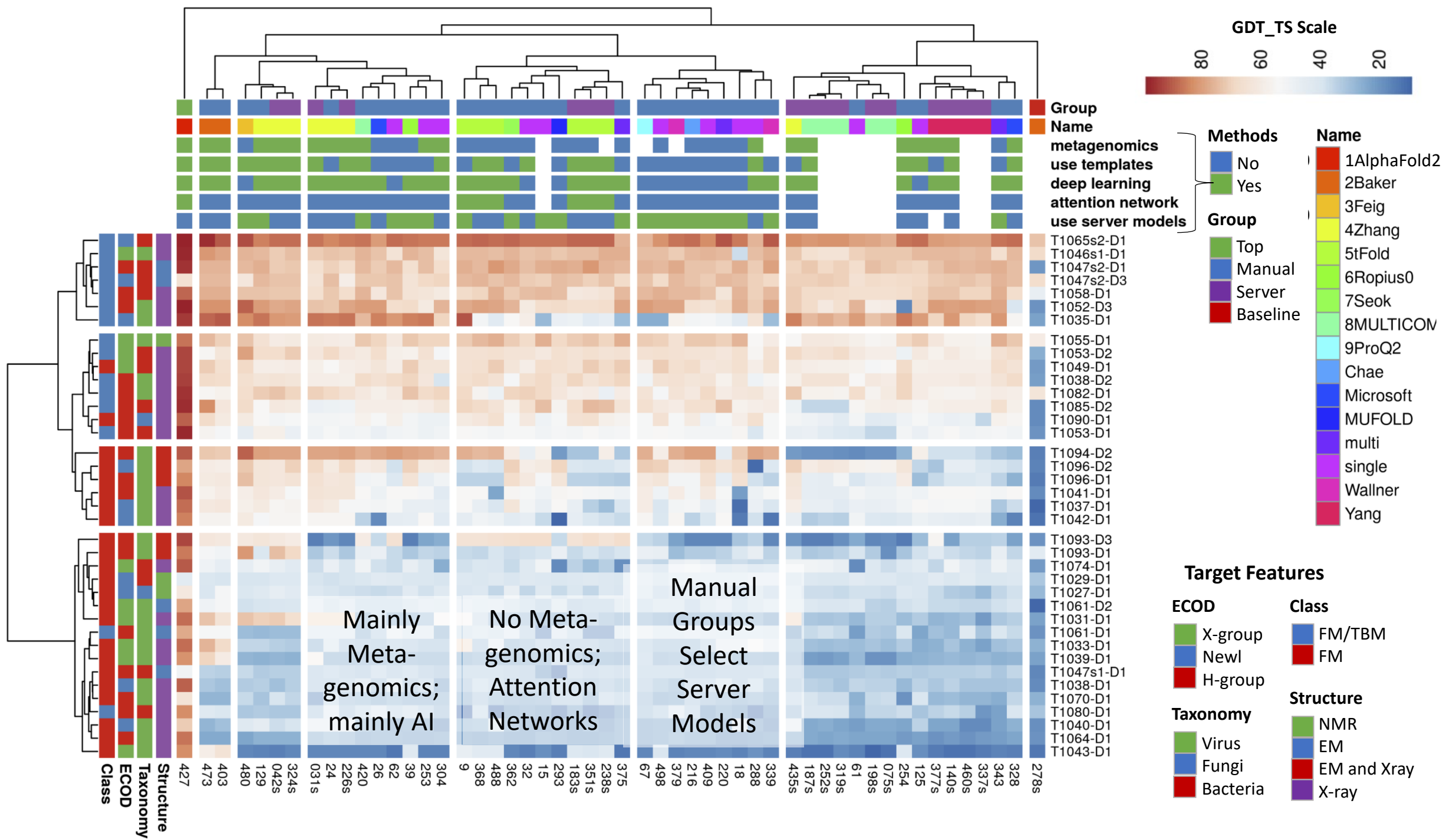


PMID: 25969447

Top Group is Distinct in PCA GDT_TS Clusters







Conclusions

- Group 427 AlphaFold2 outranked the rest: better details and consistent performance
- Other groups are getting the topology correct and beating top templates
- Difficult targets are flexible or are obligate multimers
- Servers are performing near the top, could improve with selection and refinement of models (similar to what manual groups are doing)
- Model quality is essential: Molprobity correlates with GDT_TS

EXAMPLES