

# Integrative Structure Validation Report

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*The following software was used in the production of this report:*

*IHMValidation Version 3.0*

*Python-IHM Version 2.5*

*MolProbity Version 4.5.2*

*pyHMMER Version 0.11.1*

PDB ID	9A5D   pdb_00009a5d
PDB-Dev ID	PDBDEV_00000270
Structure Title	Integrative model of WALK-YYCH by crosslinking MS and deep learning
Structure Authors	Stahl, K.; Brock, O.; Rappsilber, J.
Deposited on	2024-01-23

*This is a PDB-IHM Structure Validation Report.*

*We welcome your comments at [helpdesk@pdb-ihm.org](mailto:helpdesk@pdb-ihm.org)*

*A user guide is available at [https://pdb-ihm.org/validation\\_help.html](https://pdb-ihm.org/validation_help.html) with specific help available everywhere you see the  symbol.*

*List of references used to build this report is available [here](#).*

## 1. Overview

### 1.1. Summary

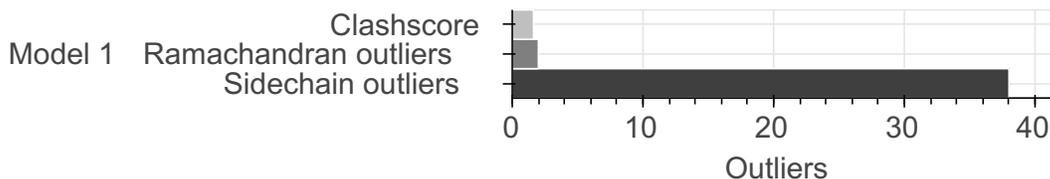
*This entry consists of 1 model(s). A total of 1 dataset(s) were used to build this entry.*

Name	Type	Count
Crosslinking-MS data	Experimental data	1

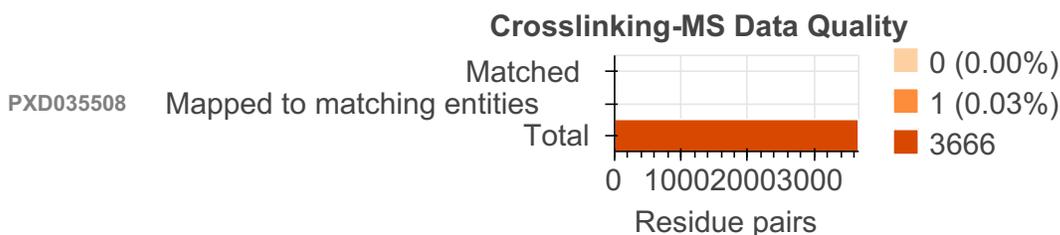
### 1.2. Overall quality

This validation report contains model quality assessments for all structures, data quality and fit to model assessments for SAS and crosslinking-MS datasets. Data quality and fit to model assessments for other datasets and model uncertainty are under development. Number of plots is limited to 256.

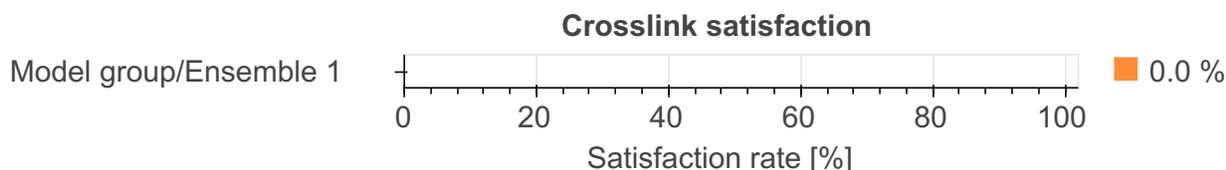
### Model Quality: MolProbity Analysis ?



### Data Quality ?



### Fit to Data Used for Modeling ?



## 2. Model Details ?

### 2.1. Ensemble information ?

This entry consists of 0 distinct ensemble(s).

### 2.2. Representation ?

This entry has 1 representation(s).

ID	Model(s)	Entity ID	Molecule name	Chain(s) [auth]	Total residues	Rigid segments	Flexible segments	Model coverage/ Starting model coverage (%)	Scale
1	1	1	WALK_BACSU	A	611	-	1-611	100.00 / 0.00	Atomic
		2	YYCH_BACSU	B	455	-	1-455	100.00 / 0.00	Atomic

### 2.3. Datasets used for modeling ?

There is 1 unique dataset used to build the models in this entry.

ID	Dataset type	Database name	Data access code
1	Crosslinking-MS data	PRIDE	<a href="#">PXD035508</a>

## 2.4. Methodology and software

This entry is a result of 1 distinct protocol(s).

Step number	Protocol ID	Method name	Method type	Method description	Number of computed models	Multi state modeling	Multi scale modeling
1	1	AlphaLink2	AlphaLink2	Not available	1	False	False

There is 1 software package reported in this entry.

ID	Software name	Software version	Software classification	Software location
1	<a href="#">AlphaLink2</a>	1.00	model building	<a href="https://github.com/Rappsilber-Laboratory/AlphaLink2">https://github.com/Rappsilber-Laboratory/AlphaLink2</a>

## 3. Data quality

### 3.2. Crosslinking-MS

At the moment, data validation is only available for crosslinking-MS data deposited as a fully *compliant* dataset in the *PRIDE Crosslinking* database. Correspondence between crosslinking-MS and entry entities is established using *pyHMMER*. Only residue pairs that passed the reported threshold are used for the analysis. The values in the report have to be interpreted in the context of the experiment (i.e. only a minor fraction of in-situ or in-vivo dataset can be used for modeling).

[PXD035508](#)

Number of entities in the crosslinking-MS dataset: 810

Number of entities in the entry: 2

Matching entities:

Entity ID	Molecule name	Crosslinking-MS Entity ID	E-value	Exact match
1	WALK_BACSU	dbseq_P54576_target	0.00	False
2	YYCH_BACSU	Not available	Not available	Not available

Residue pairs stats:

Source	Total	In matched entities	Total matched
9A5D	1	1 (100.00%)	0 (0.00%)
PXD035508	3666	1 (0.03%)	0 (0.00%)

## 4. Model quality

For models with atomic structures, MolProbity analysis is performed. For models with coarse-grained or multi-scale structures, excluded volume analysis is performed.

### 4.1b. MolProbity Analysis

Excluded volume satisfaction for the models in the entry are listed below. The Analysed column shows the number of particle-particle or particle-atom pairs for which excluded volume was analysed.

#### Standard geometry: bond outliers

There are 1 bond length outliers in this entry (0.01% of 8770 assessed bonds). A summary is provided below.

Chain	Res	Type	Atoms	Z	Observed (Å)	Ideal (Å)	Model ID (Worst)	Models (Total)
A	336	ARG	CZ-NH2	4.08	1.28	1.33	1	1

#### Standard geometry: angle outliers

There are 57 bond angle outliers in this entry (0.48% of 11854 assessed bonds). A summary is provided below.

Chain	Res	Type	Atoms	Z	Observed (Å)	Ideal (Å)	Model ID (Worst)	Models (Total)
A	606	ASP	CA-CB-CG	6.30	118.90	112.60	1	1
A	433	ASP	CA-CB-CG	5.97	118.57	112.60	1	1
A	604	GLN	OE1-CD-NE2	5.50	117.10	122.60	1	1
A	533	ASP	CA-CB-CG	5.36	117.96	112.60	1	1
A	62	GLN	OE1-CD-NE2	5.16	117.44	122.60	1	1
A	578	HIS	CB-CG-CD2	5.08	124.59	131.20	1	1
A	315	GLN	OE1-CD-NE2	5.06	117.54	122.60	1	1
A	327	GLN	OE1-CD-NE2	4.96	117.64	122.60	1	1
A	326	GLN	OE1-CD-NE2	4.95	117.65	122.60	1	1
B	140	PHE	CA-CB-CG	4.92	118.72	113.80	1	1
B	153	ASP	CA-CB-CG	4.86	117.46	112.60	1	1
B	103	GLN	OE1-CD-NE2	4.86	117.74	122.60	1	1
B	280	GLN	OE1-CD-NE2	4.81	117.79	122.60	1	1
B	29	GLN	OE1-CD-NE2	4.78	117.82	122.60	1	1
A	27	GLN	OE1-CD-NE2	4.77	117.83	122.60	1	1
A	471	GLN	OE1-CD-NE2	4.74	117.86	122.60	1	1
B	26	TRP	CG-CD2-CE3	4.70	129.20	133.90	1	1
A	477	ARG	NE-CZ-NH2	4.67	123.40	119.20	1	1
B	411	GLN	OE1-CD-NE2	4.64	117.96	122.60	1	1
A	375	GLN	OE1-CD-NE2	4.57	118.03	122.60	1	1
A	246	HIS	CB-CG-CD2	4.56	125.27	131.20	1	1

Chain	Res	Type	Atoms	Z	Observed (Å)	Ideal (Å)	Model ID (Worst)	Models (Total)
B	5	ASN	OD1-CG-ND2	4.55	118.05	122.60	1	1
A	282	ASN	OD1-CG-ND2	4.53	118.07	122.60	1	1
B	54	GLN	OE1-CD-NE2	4.52	118.08	122.60	1	1
B	283	GLN	OE1-CD-NE2	4.44	118.16	122.60	1	1
A	576	GLN	OE1-CD-NE2	4.44	118.16	122.60	1	1
A	370	GLN	OE1-CD-NE2	4.42	118.18	122.60	1	1
A	490	GLN	OE1-CD-NE2	4.42	118.18	122.60	1	1
B	126	GLN	OE1-CD-NE2	4.42	118.18	122.60	1	1
A	158	GLN	OE1-CD-NE2	4.41	118.19	122.60	1	1
A	208	HIS	CB-CG-CD2	4.40	125.48	131.20	1	1
B	134	ASP	CA-CB-CG	4.38	116.98	112.60	1	1
A	453	GLN	OE1-CD-NE2	4.35	118.25	122.60	1	1
B	102	ASP	CA-CB-CG	4.35	116.95	112.60	1	1
A	609	ASP	CA-CB-CG	4.31	116.91	112.60	1	1
B	73	HIS	CB-CG-CD2	4.30	125.61	131.20	1	1
A	36	GLN	OE1-CD-NE2	4.29	118.31	122.60	1	1
A	282	ASN	CA-CB-CG	4.29	116.89	112.60	1	1
A	184	LEU	C-CA-CB	4.28	118.24	110.10	1	1
A	475	PHE	CA-CB-CG	4.27	118.07	113.80	1	1
B	199	GLN	OE1-CD-NE2	4.26	118.34	122.60	1	1
B	242	GLN	OE1-CD-NE2	4.25	118.35	122.60	1	1
A	472	HIS	CB-CG-CD2	4.24	125.69	131.20	1	1
A	11	GLN	OE1-CD-NE2	4.20	118.40	122.60	1	1
A	607	ASP	CA-CB-CG	4.19	116.79	112.60	1	1
B	334	GLN	OE1-CD-NE2	4.18	118.42	122.60	1	1
B	278	GLN	OE1-CD-NE2	4.14	118.46	122.60	1	1
B	61	ARG	NH1-CZ-NH2	4.10	113.98	119.30	1	1
A	51	GLN	OE1-CD-NE2	4.08	118.52	122.60	1	1
A	446	GLN	OE1-CD-NE2	4.06	118.54	122.60	1	1
A	386	HIS	CB-CG-CD2	4.06	125.92	131.20	1	1
A	464	ARG	NE-CZ-NH1	4.06	125.56	121.50	1	1
B	293	GLN	OE1-CD-NE2	4.04	118.56	122.60	1	1
B	137	GLN	OE1-CD-NE2	4.03	118.57	122.60	1	1
A	255	GLN	OE1-CD-NE2	4.02	118.58	122.60	1	1
B	145	GLN	OE1-CD-NE2	4.02	118.58	122.60	1	1

Chain	Res	Type	Atoms	Z	Observed (Å)	Ideal (Å)	Model ID (Worst)	Models (Total)
B	276	GLN	OE1-CD-NE2	4.00	118.60	122.60	1	1

### Too-close contacts

The following all-atom clashscore is based on a MolProbity analysis. All-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The table below contains clashscores for all atomic models in this entry.

Model ID	Clash score	Number of clashes
1	1.63	28

There are 28 clashes. The table below contains the detailed list of all clashes based on a MolProbity analysis. Bad clashes are  $\geq 0.4$  Angstrom.

Atom 1	Atom 2	Clash(Å)	Model ID (Worst)	Models (Total)
A:91:ARG:HH11	A:144:ILE:HD11	0.67	1	1
B:231:VAL:HG23	B:375:ILE:HD11	0.66	1	1
A:285:ILE:HG21	A:288:LEU:HD11	0.62	1	1
A:390:THR:HG21	A:559:ARG:HH22	0.62	1	1
B:89:LEU:HD11	B:157:ILE:HD11	0.62	1	1
A:98:LYS:HE2	A:161:VAL:HA	0.58	1	1
A:390:THR:HG21	A:559:ARG:NH2	0.57	1	1
A:113:VAL:HG13	B:43:VAL:HG11	0.56	1	1
B:106:LYS:HA	B:176:GLN:HE22	0.56	1	1
A:185:ALA:HA	B:26:TRP:CZ3	0.52	1	1
A:16:LEU:HD22	B:11:LEU:HD23	0.51	1	1
A:295:LEU:HA	A:336:ARG:HH22	0.49	1	1
A:184:LEU:C	B:26:TRP:HZ3	0.48	1	1
B:82:TYR:C	B:82:TYR:CD1	0.48	1	1
A:56:LEU:CD2	A:93:ILE:HD11	0.48	1	1
A:586:SER:HB2	A:592:THR:HG23	0.46	1	1
B:157:ILE:HG21	B:192:MET:HE3	0.46	1	1
B:113:PHE:CD2	B:156:LEU:HD11	0.45	1	1
B:113:PHE:CE2	B:156:LEU:HD11	0.44	1	1
A:184:LEU:C	B:26:TRP:CZ3	0.44	1	1
B:278:GLN:CD	B:364:LYS:HE3	0.43	1	1
B:22:THR:O	B:26:TRP:CD1	0.42	1	1
A:66:SER:C	A:68:ASN:H	0.42	1	1
B:61:ARG:NH2	B:82:TYR:CE1	0.42	1	1
A:185:ALA:CA	B:26:TRP:CZ3	0.41	1	1

Atom 1	Atom 2	Clash(Å)	Model ID (Worst)	Models (Total)
A:572:LYS:HA	A:582:ILE:HG21	0.41	1	1
A:185:ALA:N	B:26:TRP:CZ3	0.41	1	1
A:188:THR:HG1	B:26:TRP:HH2	0.40	1	1

### Torsion angles: Protein backbone ?

In the following table, Ramachandran outliers are listed. The Analysed column shows the number of residues for which the backbone conformation was analysed.

Model ID	Analysed	Favored	Allowed	Outliers
1	1062	1030	30	2

There are 2 unique backbone outliers. Detailed list of outliers are tabulated below.

Chain	Res	Type	Models (Total)
A	607	ASP	1
B	419	ASP	1

### Torsion angles : Protein sidechains ?

In the following table, sidechain rotameric outliers are listed. The Analysed column shows the number of residues for which the sidechain conformation was analysed.

Model ID	Analysed	Favored	Allowed	Outliers
1	967	893	36	38

There are 38 unique sidechain outliers. Detailed list of outliers are tabulated below.

Chain	Res	Type	Models (Total)
A	71	THR	1
A	85	THR	1
A	99	SER	1
A	134	LEU	1
A	184	LEU	1
A	194	LEU	1
A	202	LEU	1
A	220	LEU	1
A	247	LEU	1
A	251	LEU	1
A	258	THR	1
A	299	SER	1
A	302	THR	1
A	340	LEU	1

Chain	Res	Type	Models (Total)
A	392	LEU	1
A	425	GLU	1
A	437	LEU	1
A	527	LEU	1
A	602	GLU	1
A	610	GLU	1
B	1	MET	1
B	11	LEU	1
B	14	LEU	1
B	39	THR	1
B	89	LEU	1
B	134	ASP	1
B	177	LEU	1
B	209	SER	1
B	283	GLN	1
B	289	SER	1
B	341	THR	1
B	372	THR	1
B	375	ILE	1
B	377	THR	1
B	381	GLU	1
B	396	THR	1
B	404	ASP	1
B	455	GLU	1

## 5. Fit to Data Used for Modeling Assessment ?

### 5.2. Crosslinking-MS ?

#### 5.2.1. Restraint types ?

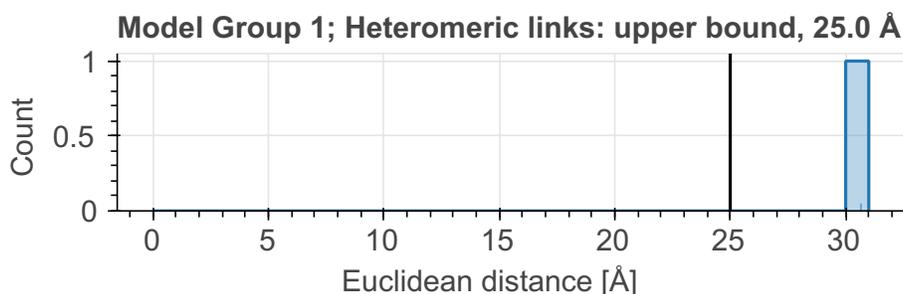
*This table summarizes information about crosslinker(s) used for data generation, and how crosslinking information was translated into actual modeling restraints. Restraints assigned "by-residue" are interpreted as between CA atoms. Restraints between coarse-grained beads are indicated as "coarse-grained". Restraint group represents a set of crosslinking restraints applied collectively in the modeling.*

There are 1 crosslinking restraints combined in 1 restraint groups.

Linker	Residue 1	Atom 1	Residue 2	Atom 2	Restraint type	Distance, Å	Count
SDA	LYS	CA	LYS	CA	upper bound	25.00	1

#### Distograms of individual restraints

Distograms (i.e., histogram plots of distances) provide an overview of distributions of distances between residues for which chemical crosslinks were identified. The shift of the distogram relative to the threshold value may indicate a poor model. Restraints with identical thresholds are grouped into one plot. Only the best distance per restraint per model group/ensemble is plotted. Inter- and intramolecular (including self-links) restraints are also grouped into one plot. Distance for a restraint between coarse-grained beads is calculated as a minimal distance between shells; if beads intersect, the distance will be reported as 0.0. A bead with the highest available resolution for a given residue is used for the assessment.



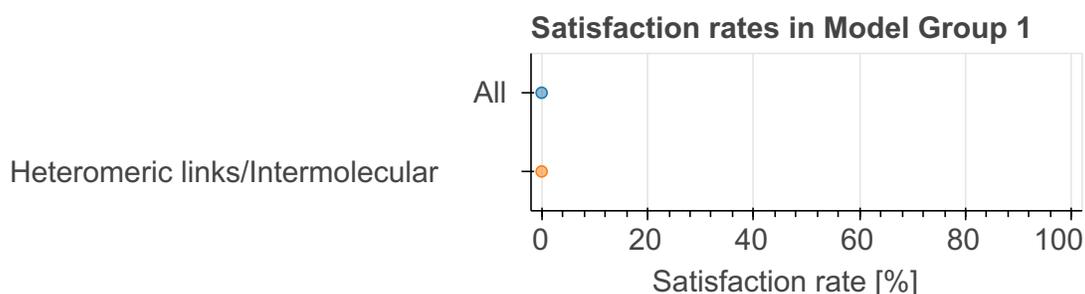
#### 5.2.2. Satisfaction of restraints ?

Satisfaction of restraints is calculated on a *restraint group* (a set of crosslinking restraints applied collectively in the modeling) level. Satisfaction of a restraint group depends on satisfaction of individual restraints in the group and the conditionality (all/any). A restraint group is considered satisfied, if the condition was met in at least one model of the model group/ensemble. The number of measured restraints can be smaller than the total number of restraint groups if crosslinks involve non-modeled residues. Only deposited models are used for validation right now.

State group	State	Model group	# of Deposited models/Total	Restraint group type	Satisfied (%)	Violated (%)	Count (Total=1)
1	1	1	1/1	All	0.00	100.00	1
				Heteromeric links/ Intermolecular	0.00	100.00	1

#### Per-model satisfaction rates in ensembles

Every point represents one model in a model group/ensemble. Where possible, boxplots with quartile marks are also plotted.



## 6. Fit to Data Used for Validation Assessment

Validation for this section is under development.

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### *Acknowledgments*

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