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

PDB ID	9A10 | pdb_00009a10
PDB-Dev ID	PDBDEV_00000072
Structure Title	Modeling of the interaction between doublecortin and microtubule, NDCs fixed at lateral orientation
Structure Authors	Rafiei A; Lee L; Crowder A; Saltzberg D; Sali A; Brouhard G; Schreimer DC
Deposited on	2021-02-09

This is a PDB-IHM Structure Validation Report.

We welcome your comments at helpdesk@pdb-ihm.org

A user guide is available at 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

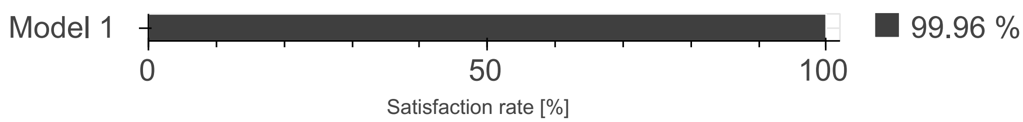
This entry consists of 1 model(s). A total of 4 dataset(s) were used to build this entry.

Name	Type	Count
Crosslinking-MS data	Experimental data	1
Experimental model	Starting model	3

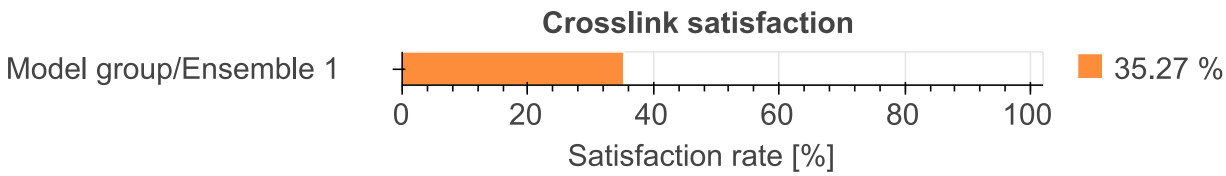
1.2. Overall quality

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: Excluded Volume Analysis



Fit to Data Used for Modeling



2. Model Details

2.1. Ensemble information

This entry consists of 1 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	Doublecortin	A	365	51-140, 177-251	141-176, 252-330	76.71 / 58.93	Multiscale: Coarse-grained: 1 - 10 residue(s) per bead
				B					
		2	Alpha-Tubulin	C	451	1-37, 47-435	-	94.46 / 100.00	Coarse-grained: 1 residue(s) per bead
				D					
				E					
				F					
				G					
				H					
				I					
				J					
				K					
				L					

ID	Model(s)	Entity ID	Molecule name	Chain(s) [auth]	Total residues	Rigid segments	Flexible segments	Model coverage/ Starting model coverage (%)	Scale
				M					
				N					
		3	Beta-Tubulin	O	445	1-37, 38-429	-	96.40 / 100.00	Coarse-grained: 1 residue(s) per bead
				P					
				Q					
				R					
				S					
				T					
				U					
				V					
				W					
				X					
				Y					
				Z					

2.3. Datasets used for modeling

There are 4 unique datasets used to build the models in this entry.

ID	Dataset type	Database name	Data access code
1	Experimental model	PDB	pdb_00004atu
2	Experimental model	PDB	pdb_00006fnz
3	Experimental model	PDB	pdb_00006evz
4	Crosslinking-MS data	Zenodo	10.5281/zenodo.4526498

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	Sampling	Replica exchange monte carlo	Not available	240000	False	True

There are 2 software packages reported in this entry.

ID	Software name	Software version	Software classification	Software location
1	IMP PMI module	2.14.0	integrative model building	https://integrativemodeling.org
2	Integrative Modeling Platform (IMP)	2.14.0	integrative model building	https://integrativemodeling.org

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).

Crosslinking-MS dataset is not available in the PRIDE Crosslinking database.

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.

4.1a. Excluded Volume Analysis

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

Model ID	Analysed	Number of violations	Excluded Volume Satisfaction (%)
1	56323191	25186	99.96

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 9936 crosslinking restraints combined in 414 restraint groups.

Linker	Residue 1	Atom 1	Residue 2	Atom 2	Restraint type	Distance, Å	Count
LCSDA	LYS	coarse-grained	PRO	coarse-grained	upper bound	30.00	96
LCSDA	GLU	coarse-grained	LYS	coarse-grained	upper bound	30.00	1080
LCSDA	GLN	coarse-grained	LYS	coarse-grained	upper bound	30.00	168
LCSDA	LEU	coarse-grained	LYS	coarse-grained	upper bound	30.00	264
LCSDA	ILE	coarse-grained	LYS	coarse-grained	upper bound	30.00	240
LCSDA	GLU	CA	LYS	CA	upper bound	30.00	456

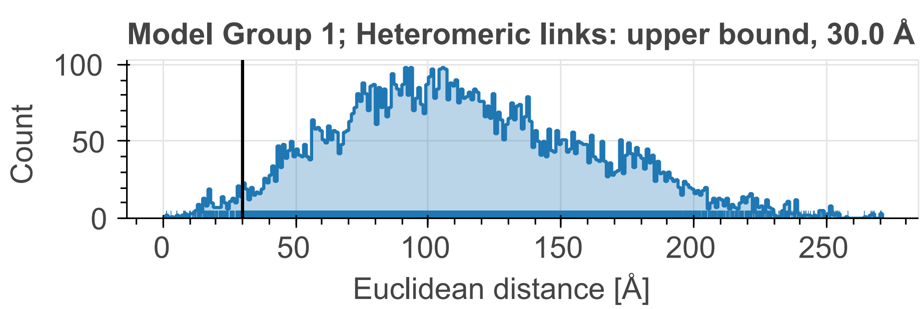
Linker	Residue 1	Atom 1	Residue 2	Atom 2	Restraint type	Distance, Å	Count
LCSDA	LYS	CA	TYR	CA	upper bound	30.00	168
LCSDA	ASP	CA	LYS	CA	upper bound	30.00	120
LCSDA	LYS	CA	THR	CA	upper bound	30.00	120
LCSDA	GLY	CA	LYS	CA	upper bound	30.00	288
LCSDA	HIS	CA	LYS	CA	upper bound	30.00	144
LCSDA	ALA	CA	LYS	CA	upper bound	30.00	168
LCSDA	LEU	CA	LYS	CA	upper bound	30.00	216
LCSDA	LYS	CA	SER	CA	upper bound	30.00	96
LCSDA	ALA	coarse-grained	TYR	coarse-grained	upper bound	30.00	48
LCSDA	ALA	coarse-grained	THR	coarse-grained	upper bound	30.00	96
LCSDA	THR	coarse-grained	TYR	coarse-grained	upper bound	30.00	24
LCSDA	SER	coarse-grained	TYR	coarse-grained	upper bound	30.00	48
LCSDA	THR	coarse-grained	THR	coarse-grained	upper bound	30.00	24
LCSDA	SER	coarse-grained	THR	coarse-grained	upper bound	30.00	24
LCSDA	GLU	coarse-grained	THR	coarse-grained	upper bound	30.00	48
LCSDA	GLU	coarse-grained	SER	coarse-grained	upper bound	30.00	96
LCSDA	GLY	coarse-grained	THR	coarse-grained	upper bound	30.00	24
LCSDA	GLY	coarse-grained	SER	coarse-grained	upper bound	30.00	24
LCSDA	ALA	coarse-grained	SER	coarse-grained	upper bound	30.00	48
LCSDA	ASP	coarse-grained	LYS	coarse-grained	upper bound	30.00	432
LCSDA	LYS	coarse-grained	TYR	coarse-grained	upper bound	30.00	360
LCSDA	LYS	coarse-grained	THR	coarse-grained	upper bound	30.00	168
LCSDA	GLY	coarse-grained	LYS	coarse-grained	upper bound	30.00	264
LCSDA	HIS	coarse-grained	LYS	coarse-grained	upper bound	30.00	336
LCSDA	ALA	coarse-grained	LYS	coarse-grained	upper bound	30.00	288
LCSDA	THR	CA	THR	CA	upper bound	30.00	48
LCSDA	GLY	CA	THR	CA	upper bound	30.00	192
LCSDA	SER	CA	THR	CA	upper bound	30.00	96
LCSDA	GLY	CA	SER	CA	upper bound	30.00	96
LCSDA	GLU	CA	THR	CA	upper bound	30.00	48
LCSDA	CYS	CA	THR	CA	upper bound	30.00	72
LCSDA	ASP	CA	THR	CA	upper bound	30.00	120
LCSDA	LEU	CA	THR	CA	upper bound	30.00	192
LCSDA	GLN	CA	THR	CA	upper bound	30.00	72
LCSDA	PHE	CA	THR	CA	upper bound	30.00	48

Linker	Residue 1	Atom 1	Residue 2	Atom 2	Restraint type	Distance, Å	Count
LCSDA	HIS	CA	THR	CA	upper bound	30.00	24
LCSDA	ALA	CA	THR	CA	upper bound	30.00	72
LCSDA	ALA	CA	TYR	CA	upper bound	30.00	120
LCSDA	GLN	coarse-grained	SER	coarse-grained	upper bound	30.00	48
LCSDA	SER	coarse-grained	SER	coarse-grained	upper bound	30.00	24
LCSDA	GLN	coarse-grained	TYR	coarse-grained	upper bound	30.00	24
LCSDA	PHE	coarse-grained	SER	coarse-grained	upper bound	30.00	24
LCSDA	LYS	coarse-grained	SER	coarse-grained	upper bound	30.00	264
LCSDA	LYS	coarse-grained	PHE	coarse-grained	upper bound	30.00	288
LCSDA	LYS	coarse-grained	TRP	coarse-grained	upper bound	30.00	24
LCSDA	ILE	CA	LYS	CA	upper bound	30.00	48
LCSDA	ARG	coarse-grained	LYS	coarse-grained	upper bound	30.00	72
LCSDA	HIS	coarse-grained	SER	coarse-grained	upper bound	30.00	48
LCSDA	ILE	CA	THR	CA	upper bound	30.00	48
LCSDA	ARG	CA	THR	CA	upper bound	30.00	48
LCSDA	THR	CA	TYR	CA	upper bound	30.00	24
LCSDA	MET	CA	THR	CA	upper bound	30.00	24
LCSDA	GLN	CA	TYR	CA	upper bound	30.00	96
LCSDA	CYS	CA	TYR	CA	upper bound	30.00	72
LCSDA	LEU	CA	TYR	CA	upper bound	30.00	120
LCSDA	HIS	CA	TYR	CA	upper bound	30.00	48
LCSDA	ASP	CA	TYR	CA	upper bound	30.00	144
LCSDA	PHE	CA	TYR	CA	upper bound	30.00	48
LCSDA	GLY	CA	TYR	CA	upper bound	30.00	120
LCSDA	LYS	coarse-grained	MET	coarse-grained	upper bound	30.00	264
LCSDA	LYS	coarse-grained	LYS	coarse-grained	upper bound	30.00	24
LCSDA	MET	coarse-grained	SER	coarse-grained	upper bound	30.00	24
LCSDA	PRO	CA	THR	CA	upper bound	30.00	24
LCSDA	ASN	CA	THR	CA	upper bound	30.00	24
LCSDA	ASN	coarse-grained	LYS	coarse-grained	upper bound	30.00	144
LCSDA	LYS	CA	PRO	CA	upper bound	30.00	24
LCSDA	TYR	CA	TYR	CA	upper bound	30.00	24
LCSDA	ILE	CA	TYR	CA	upper bound	30.00	48
LCSDA	ASN	CA	TYR	CA	upper bound	30.00	24
LCSDA	TRP	CA	TYR	CA	upper bound	30.00	24

Linker	Residue 1	Atom 1	Residue 2	Atom 2	Restraint type	Distance, Å	Count
LCSDA	GLU	CA	TYR	CA	upper bound	30.00	48
LCSDA	ARG	coarse-grained	THR	coarse-grained	upper bound	30.00	24
LCSDA	CYS	coarse-grained	LYS	coarse-grained	upper bound	30.00	48
LCSDA	THR	coarse-grained	TRP	coarse-grained	upper bound	30.00	24
LCSDA	SER	coarse-grained	TRP	coarse-grained	upper bound	30.00	24
LCSDA	CYS	coarse-grained	THR	coarse-grained	upper bound	30.00	24
LCSDA	CYS	coarse-grained	SER	coarse-grained	upper bound	30.00	24
LCSDA	GLU	coarse-grained	TYR	coarse-grained	upper bound	30.00	24
LCSDA	ASN	coarse-grained	TYR	coarse-grained	upper bound	30.00	24
LCSDA	GLU	CA	SER	CA	upper bound	30.00	24
LCSDA	MET	CA	SER	CA	upper bound	30.00	24
LCSDA	LYS	CA	MET	CA	upper bound	30.00	24
LCSDA	LYS	CA	PHE	CA	upper bound	30.00	24
LCSDA	ALA	CA	ASP	CA	upper bound	30.00	24
LCSDA	ALA	CA	ALA	CA	upper bound	30.00	24
LCSDA	ALA	CA	LEU	CA	upper bound	30.00	24
LCSDA	ASN	CA	LYS	CA	upper bound	30.00	24

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.



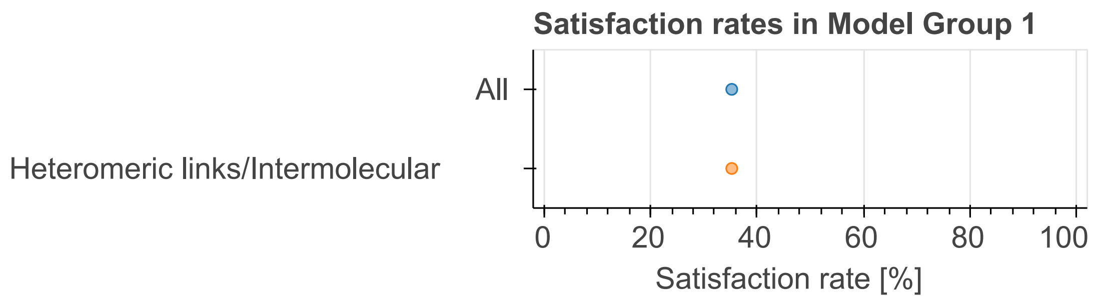
5.2.2. Satisfaction of restraints

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=414)
1	1	1	1/30000	All	35.27	64.73	414
				Heteromeric links/ Intermolecular	35.27	64.73	414

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.

Acknowledgments

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