

# 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*

PDB ID	9A3X   pdb_00009a3x
PDB-Dev ID	PDBDEV_00000218
Structure Title	Predicted model of tissue transglutaminase 2 (TG2) in complex with plasma fibronectin type I modules 2 and 3 (FNI2-3)
Structure Authors	Selcuk, K.; Leitner, A.; Le Blanc, F.
Deposited on	2023-10-04

*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

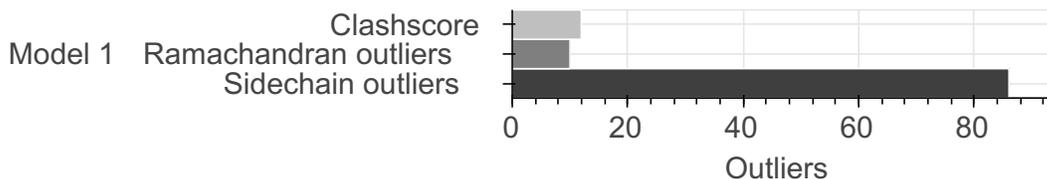
*This entry consists of 1 model(s). A total of 3 dataset(s) were used to build this entry.*

Name	Type	Count
Crosslinking-MS data	Experimental data	1
Experimental model	Starting model	2

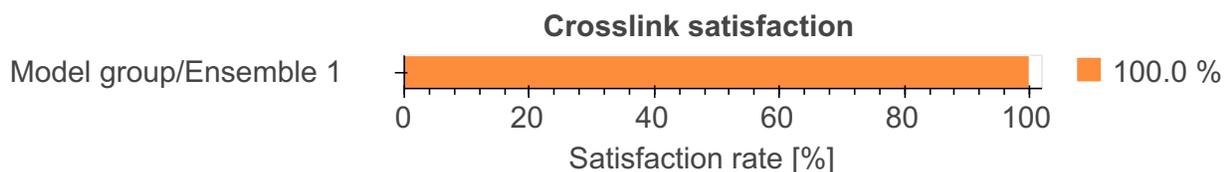
### 1.2. Overall quality

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 [?](#)



### 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	Protein-glutamine gamma-glutamyltransferase 2	A	687	-	1-687	100.00 / 100.00	Atomic
		2	Fibronectin	B	90	-	1-90	100.00 / 100.00	Atomic

### 2.3. Datasets used for modeling [?](#)

There are 3 unique datasets used to build the models in this entry.

ID	Dataset type	Database name	Data access code
1	Crosslinking-MS data	PRIDE	<a href="#">PXD043976</a>
2	Experimental model	PDB	<a href="#">pdb_00004pyg</a>
3	Experimental model	PDB	<a href="#">pdb_00002cg7</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	Refinement	Iterative Threading ASSEmblY Refinement	structural refinement of starting models guided by experimental crosslinks	Not available	False	False
2	1	satisfied/violated crosslinks identification	Validate measured chemical crosslinks on a protein 3D structure	calculation of Euclidean distances between crosslinked residues	Not available	False	False
3	1	calculation of accessible area	calculates the atomic accessible area when a probe is rolled around the Van der Waal's surface of a macromolecule	calculation of accessible area	Not available	False	False
4	1	accessible interaction space	Not available	determine the number of complexes consistent with the restraints	Not available	False	False
5	1	docking	data-driven biomolecular docking	generates predicted model of a protein complex	Not available	False	False

There are 5 software packages reported in this entry.

ID	Software name	Software version	Software classification	Software location
1	<a href="https://zhanggroup.org/I-TASSER/">I-TASSER</a>	Not available	structure refinement	<a href="https://zhanggroup.org/I-TASSER/">https://zhanggroup.org/I-TASSER/</a>
3	<a href="https://www.xwalk.org/home.cgi">Xwalk</a>	Not available	Euclidean distances calculation	<a href="https://www.xwalk.org/home.cgi">https://www.xwalk.org/home.cgi</a>
2	<a href="http://www.bioinf.manchester.ac.uk/naccess/">NACCESS</a>	Not available	solvent accessibility	<a href="http://www.bioinf.manchester.ac.uk/naccess/">http://www.bioinf.manchester.ac.uk/naccess/</a>
4	<a href="https://wenmr.science.uu.nl/disvis/">DisVis</a>	Not available	accessible interaction space	<a href="https://wenmr.science.uu.nl/disvis/">https://wenmr.science.uu.nl/disvis/</a>
5	<a href="https://wenmr.science.uu.nl/haddock2.4/">HADDOCK</a>	Not available	protein-protein docking	<a href="https://wenmr.science.uu.nl/haddock2.4/">https://wenmr.science.uu.nl/haddock2.4/</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).

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.

### 4.1b. 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 no bond length outliers.

#### Standard geometry: angle outliers

There are no bond angle outliers.

#### 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	11.96	145

There are 145 clashes. The table below contains the detailed list of all clashes based on a MolProbity analysis. Bad clashes are  $\geq 0.4$  Angstrom. The output is limited to 100 rows.

Atom 1	Atom 2	Clash(Å)	Model ID (Worst)	Models (Total)
A:249:VAL:HG22	B:24:ASP:HA	0.95	1	1
A:11:ASP:HB3	A:42:THR:HB	0.89	1	1
A:361:PRO:HA	A:369:TYR:HB3	0.88	1	1
A:514:VAL:HG21	A:562:LYS:HB2	0.83	1	1
A:641:PRO:HG3	B:39:ARG:HG3	0.81	1	1
A:62:VAL:HG13	A:67:PRO:HB3	0.74	1	1
A:483:MET:HB2	A:584:LEU:HD23	0.73	1	1
A:12:LEU:HB3	A:31:LEU:HD22	0.73	1	1
A:499:THR:HG23	A:501:GLU:H	0.72	1	1
B:27:ILE:HG12	B:54:SER:HB3	0.69	1	1
A:379:ILE:HD13	A:393:VAL:HG12	0.68	1	1
A:514:VAL:HG13	A:518:GLY:HA2	0.66	1	1
A:606:GLU:HB3	A:651:ARG:HG3	0.65	1	1
A:81:ASP:HA	A:92:VAL:HG22	0.65	1	1
A:617:LEU:HD11	A:668:PHE:HZ	0.65	1	1
A:200:ASN:HA	A:227:MET:SD	0.64	1	1

Atom 1	Atom 2	Clash(Å)	Model ID (Worst)	Models (Total)
A:460:ASN:HB3	A:464:LYS:HB2	0.63	1	1
A:158:GLU:HA	A:162:THR:OG1	0.62	1	1
A:599:GLN:HG3	A:600:LYS:HG2	0.62	1	1
A:262:ARG:HD2	A:632:GLU:HG2	0.62	1	1
A:504:VAL:HA	A:533:ASN:HA	0.61	1	1
A:374:VAL:HG21	A:390:ALA:HA	0.61	1	1
A:259:ASP:O	A:263:ARG:HG2	0.60	1	1
A:668:PHE:HB3	A:676:VAL:HB	0.58	1	1
A:495:ILE:HD11	A:507:LEU:HD22	0.58	1	1
A:276:GLN:HG2	A:278:TRP:CZ3	0.58	1	1
A:196:LEU:HD12	A:227:MET:HB3	0.58	1	1
A:167:ILE:HB	A:178:ILE:HG23	0.58	1	1
A:559:ASN:HB3	A:584:LEU:HB2	0.57	1	1
A:355:GLN:HB3	A:373:PRO:HB2	0.57	1	1
A:236:VAL:HG23	A:237:LEU:HD12	0.56	1	1
A:260:ILE:HG23	A:272:VAL:HG21	0.56	1	1
A:567:LEU:HB3	A:576:LEU:HB2	0.56	1	1
A:343:THR:HG22	A:352:GLU:HG3	0.56	1	1
A:565:ALA:HB3	A:578:ALA:HB3	0.56	1	1
B:72:LEU:HB3	B:86:CYS:SG	0.55	1	1
A:186:GLU:HB3	A:189:ILE:HG12	0.55	1	1
A:26:LEU:HD22	A:185:PHE:HA	0.54	1	1
A:59:PHE:HB2	A:77:PHE:CE2	0.54	1	1
A:179:PRO:HG3	A:679:PHE:HB3	0.54	1	1
A:416:ILE:HD12	A:469:GLU:HG2	0.53	1	1
A:9:ARG:HB2	A:44:HIS:HB3	0.53	1	1
A:307:GLN:HE22	A:311:LEU:HA	0.53	1	1
A:85:GLU:H	A:89:THR:HG21	0.52	1	1
A:153:GLU:O	A:156:ARG:HG2	0.52	1	1
A:513:THR:HG23	A:555:LEU:HD23	0.52	1	1
A:249:VAL:HG13	B:24:ASP:HB3	0.51	1	1
A:311:LEU:HD22	A:395:ALA:HB2	0.51	1	1
A:624:VAL:HG12	A:666:VAL:HG12	0.51	1	1
B:5:PHE:HD2	B:7:LYS:HE2	0.51	1	1
A:445:TYR:HB2	A:452:GLU:HB3	0.51	1	1

Atom 1	Atom 2	Clash(Å)	Model ID (Worst)	Models (Total)
A:4:GLU:HG2	A:123:THR:HB	0.50	1	1
A:50:TYR:HE1	A:57:LEU:HB2	0.50	1	1
A:323:ILE:HG12	A:325:GLY:H	0.50	1	1
A:342:MET:HG2	A:355:GLN:HG3	0.50	1	1
A:343:THR:HA	A:352:GLU:HG3	0.50	1	1
A:14:LEU:H	A:14:LEU:HD12	0.49	1	1
A:112:ILE:H	A:112:ILE:HD13	0.49	1	1
B:60:THR:HG23	B:75:VAL:HB	0.49	1	1
A:433:ARG:HB2	A:435:GLU:OE1	0.49	1	1
A:56:SER:HB3	A:122:SER:HB2	0.49	1	1
A:548:TYR:HA	A:551:TYR:CE2	0.49	1	1
A:67:PRO:HB2	A:74:LYS:HB2	0.49	1	1
A:36:GLY:H	A:106:THR:HB	0.49	1	1
A:491:VAL:HB	A:544:LEU:HB2	0.48	1	1
A:587:PRO:HG2	A:673:LEU:HD21	0.48	1	1
A:509:LEU:HB2	A:527:LYS:HB2	0.48	1	1
A:154:GLU:HB2	A:431:VAL:HG11	0.47	1	1
A:445:TYR:HB3	A:446:PRO:HD2	0.47	1	1
A:61:VAL:O	A:74:LYS:HA	0.47	1	1
A:532:LEU:H	A:532:LEU:HD22	0.47	1	1
A:639:PRO:HA	B:43:THR:OG1	0.47	1	1
A:623:THR:HB	A:635:THR:HG23	0.47	1	1
A:21:HIS:CE1	A:37:GLN:HB3	0.47	1	1
A:618:GLU:CB	B:40:ILE:HG13	0.47	1	1
A:425:LYS:HA	A:425:LYS:HD3	0.47	1	1
A:430:SER:HB2	A:433:ARG:HG3	0.47	1	1
A:255:ILE:HD12	A:625:GLU:HG2	0.46	1	1
A:623:THR:HA	A:635:THR:HA	0.46	1	1
A:244:ASN:HD21	B:10:GLY:HA3	0.46	1	1
A:13:GLU:HG3	A:16:THR:HB	0.46	1	1
A:294:PRO:HB2	A:341:TRP:HB3	0.46	1	1
A:201:PRO:O	A:205:LYS:HG2	0.46	1	1
A:195:ILE:O	A:199:VAL:HG23	0.45	1	1
A:193:CYS:HB3	A:287:VAL:HG13	0.45	1	1
A:328:SER:HB3	A:519:ILE:HA	0.45	1	1

Atom 1	Atom 2	Clash(Å)	Model ID (Worst)	Models (Total)
A:593:ILE:HD13	A:680:ARG:HD2	0.45	1	1
A:387:LYS:O	A:388:TYR:HB2	0.45	1	1
A:497:ASN:OD1	A:499:THR:HG22	0.45	1	1
A:471:THR:HG22	A:574:SER:HB3	0.45	1	1
A:61:VAL:HB	A:115:TYR:HD2	0.44	1	1
A:447:GLU:HA	A:452:GLU:OE1	0.44	1	1
A:343:THR:HG22	A:352:GLU:CG	0.44	1	1
A:362:GLN:HG3	A:392:PHE:CZ	0.44	1	1
A:456:PHE:O	A:460:ASN:HB2	0.44	1	1
A:492:PHE:CZ	A:543:PRO:HB3	0.44	1	1
A:299:THR:HG23	A:336:CYS:SG	0.44	1	1
A:505:CYS:HB2	A:567:LEU:HD11	0.44	1	1
A:569:GLU:OE1	A:571:VAL:HG13	0.44	1	1
A:81:ASP:CG	A:82:ALA:H	0.43	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	773	682	81	10

There are 10 unique backbone outliers. Detailed list of outliers are tabulated below.

Chain	Res	Type	Models (Total)
A	47	GLY	1
A	81	ASP	1
A	93	VAL	1
A	108	ALA	1
A	230	CYS	1
A	421	ILE	1
A	431	VAL	1
A	465	LEU	1
A	525	GLY	1
B	37	ARG	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	671	459	126	86

There are 86 unique sidechain outliers. Detailed list of outliers are tabulated below.

Chain	Res	Type	Models (Total)
A	26	LEU	1
A	29	GLU	1
A	46	GLU	1
A	56	SER	1
A	58	THR	1
A	73	THR	1
A	84	GLU	1
A	94	ASP	1
A	100	LEU	1
A	103	GLN	1
A	112	ILE	1
A	118	SER	1
A	129	SER	1
A	151	ASP	1
A	157	GLN	1
A	163	GLN	1
A	164	GLN	1
A	166	PHE	1
A	184	GLN	1
A	186	GLU	1
A	209	ARG	1
A	211	CYS	1
A	215	SER	1
A	216	SER	1
A	225	SER	1
A	238	LEU	1
A	250	SER	1
A	255	ILE	1
A	257	SER	1
A	271	ARG	1
A	279	VAL	1

Chain	Res	Type	Models (Total)
A	298	VAL	1
A	305	HIS	1
A	307	GLN	1
A	312	LEU	1
A	313	ILE	1
A	314	GLU	1
A	347	LEU	1
A	362	GLN	1
A	364	LYS	1
A	365	SER	1
A	381	GLU	1
A	419	SER	1
A	422	VAL	1
A	431	VAL	1
A	442	THR	1
A	447	GLU	1
A	478	ARG	1
A	483	MET	1
A	491	VAL	1
A	496	THR	1
A	503	TYR	1
A	524	CYS	1
A	526	THR	1
A	531	ASN	1
A	532	LEU	1
A	533	ASN	1
A	549	GLU	1
A	556	THR	1
A	560	LEU	1
A	571	VAL	1
A	577	LEU	1
A	608	SER	1
A	617	LEU	1
A	618	GLU	1
A	621	THR	1

Chain	Res	Type	Models (Total)
A	631	GLU	1
A	632	GLU	1
A	653	ASP	1
A	657	LEU	1
A	659	MET	1
A	664	LEU	1
B	3	THR	1
B	7	LYS	1
B	9	THR	1
B	12	THR	1
B	13	TYR	1
B	24	ASP	1
B	29	ASP	1
B	40	ILE	1
B	56	LYS	1
B	60	THR	1
B	63	ARG	1
B	67	THR	1
B	74	CYS	1
B	85	THR	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.

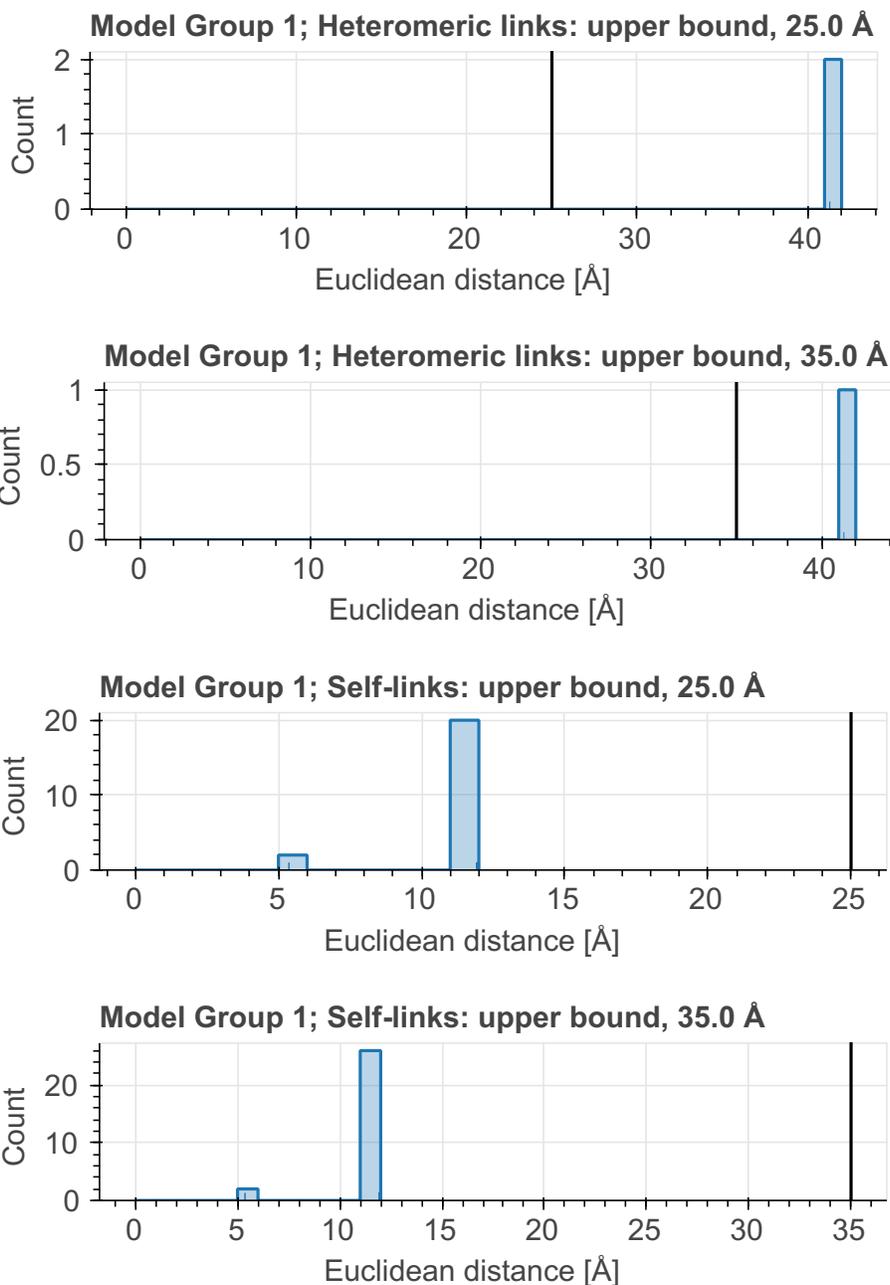
There are 53 crosslinking restraints combined in 1 restraint groups.

Linker	Residue 1	Atom 1	Residue 2	Atom 2	Restraint type	Distance, Å	Count
DMTMM	GLU	CA	LYS	CA	upper bound	25.00	24
DMTMM	GLU	CA	LYS	CA	upper bound	35.00	29

#### 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 histogram 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	100.00	0.00	1
				Ambiguous entity/ Ambiguous	100.00	0.00	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.

### Acknowledgments

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*Members of the [wwPDB Integrative/Hybrid Methods Task Force](#) provided recommendations and community support for the project.*