

# Integrative Structure Validation Report ?

September 24, 2026 - 12:51 PM PDT

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

*IHMValidation Version 3.2*

*Python-IHM Version 2.9*

*MolProbity Version 4.5.2*

|                   |                                                        |
|-------------------|--------------------------------------------------------|
| PDB ID            | 9AAS   pdb_00009aas                                    |
| Structure Title   | CYP2E-CYP3A4 (distal side) complex                     |
| Structure Authors | Davydov, D.R.; Singh, D.K.; Guha Neogi, A.; Prasad, B. |
| Deposited on      | 2026-06-09                                             |

*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 ?

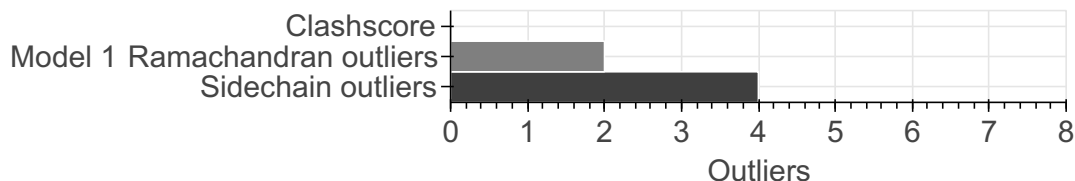
*This entry consists of 1 model(s). A total of 3 dataset(s) were used to build this entry.*

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

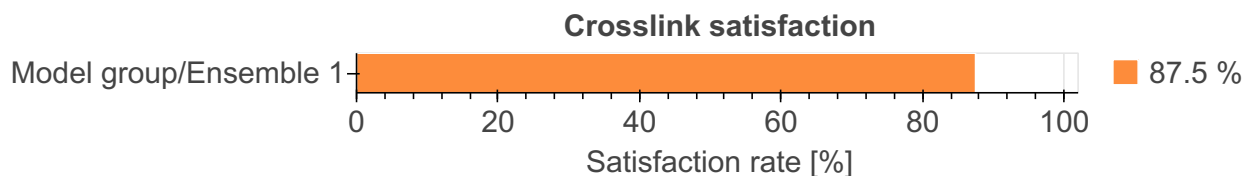
### 1.2. Overall quality ?

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         | Cytochrome P450 2E1             | A               | 493            | 1-493          | -                 | 100.00 / 100.00                             | Atomic |
|    |          | 2         | Cytochrome P450 3A4             | B               | 503            | 1-503          | -                 | 100.00 / 100.00                             | Atomic |
|    |          | 3         | PROTOPORPHYRIN IX CONTAINING FE | C [A]<br>D [B]  | Non-polymeric  | -              | -                 | Not available / Not available               | 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="#">PXD079247</a> |
| 2  | De Novo model        | AlphaFoldDB   | AF-P05181-F1-v6           |
| 3  | De Novo model        | AlphaFoldDB   | AF-P08684-F1-v6           |

## 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           | Step 1      | Manual selection of the initial pose     | Selection of the initial pose for proper orientation of both molecules in the membrane and to position some of the surface-exposed cysteines of CYP2E1 in proximity to the TFMD-tagged regions of CYP3A4          | Not available             | False                | False                |
| 2           | 1           | Step 2      | Restrained docking using HEX 8.0.0       | Applied restrains: 15 deg. turning-angle range for both the receptor (CYP2E1) and the ligand (CYP3A4), and a 0 deg. twist range. Docking was based on the combined optimization of shape and DARS potential.      | 100                       | False                | False                |
| 3           | 1           | Step 3      | Restrained docking with HADDOCK 2.4      | Active residues: CYP2E1 cysteine(s) closest to the contact region and the closest TFMD-tagged residues in CYP3A4. The passive residues were automatically selected within a 12 Å zone around the active residues. | 100                       | False                | False                |
| 4           | 1           | Step 4      | Model refinement with AlphaFold-Multimer | The final, AlphaFold-refined model is characterized with ipTM score of 0.8748                                                                                                                                     | 1                         | False                | False                |

*There are 4 software packages reported in this entry.*

| ID | Software name                          | Software version | Software classification                          | Software location                                                                             |
|----|----------------------------------------|------------------|--------------------------------------------------|-----------------------------------------------------------------------------------------------|
| 1  | UCSF Chimera                           | 1.19             | Protein structure manipulation and visualization | <a href="https://www.rbvi.ucsf.edu/chimera/">https://www.rbvi.ucsf.edu/chimera/</a>           |
| 2  | HEX 8.0.0                              | 8.0.0            | Protein docking                                  | <a href="https://hex.loria.fr/">https://hex.loria.fr/</a>                                     |
| 3  | HADDOCK                                | 2.40             | Protein docking                                  | <a href="https://wenmr.science.uu.nl/haddock2.4/">https://wenmr.science.uu.nl/haddock2.4/</a> |
| 4  | Unmasked version of AlphaFold-Multimer | Not available    | Protein structure modelling                      | <a href="https://github.com/clami66/AF_unmasked">https://github.com/clami66/AF_unmasked</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 1 bond length outliers in this entry (0.01% of 8361 assessed bonds). A summary is provided below.

| Chain | Res | Type | Atoms   | Z    | Observed (Å) | Ideal (Å) | Model ID (Worst) | Models (Total) |
|-------|-----|------|---------|------|--------------|-----------|------------------|----------------|
| C     | 1   | HEM  | C2D-C3D | 7.31 | 1.48         | 1.33      | 1                | 1              |

#### Standard geometry: angle outliers ?

There are 28 bond angle outliers in this entry (0.25% of 11356 assessed bonds). A summary is provided below.

| Chain | Res | Type | Atoms      | Z    | Observed (Å) | Ideal (Å) | Model ID (Worst) | Models (Total) |
|-------|-----|------|------------|------|--------------|-----------|------------------|----------------|
| A     | 249 | ARG  | NE-CZ-NH2  | 5.86 | 124.47       | 119.20    | 1                | 1              |
| A     | 405 | ASP  | CA-CB-CG   | 5.60 | 118.20       | 112.60    | 1                | 1              |
| B     | 484 | GLN  | OE1-CD-NE2 | 4.99 | 117.61       | 122.60    | 1                | 1              |
| A     | 345 | GLN  | OE1-CD-NE2 | 4.97 | 117.63       | 122.60    | 1                | 1              |
| B     | 201 | ASP  | CA-CB-CG   | 4.56 | 108.04       | 112.60    | 1                | 1              |
| A     | 255 | GLN  | OE1-CD-NE2 | 4.55 | 118.05       | 122.60    | 1                | 1              |
| B     | 200 | GLN  | OE1-CD-NE2 | 4.52 | 118.08       | 122.60    | 1                | 1              |
| A     | 295 | ASP  | CA-CB-CG   | 4.52 | 117.12       | 112.60    | 1                | 1              |
| A     | 400 | ASN  | OD1-CG-ND2 | 4.49 | 118.11       | 122.60    | 1                | 1              |
| A     | 47  | GLN  | OE1-CD-NE2 | 4.48 | 118.12       | 122.60    | 1                | 1              |
| B     | 332 | GLN  | OE1-CD-NE2 | 4.44 | 118.16       | 122.60    | 1                | 1              |
| A     | 254 | HIS  | CB-CG-CD2  | 4.37 | 125.52       | 131.20    | 1                | 1              |
| B     | 265 | GLN  | OE1-CD-NE2 | 4.32 | 118.28       | 122.60    | 1                | 1              |
| B     | 328 | GLN  | OE1-CD-NE2 | 4.32 | 118.28       | 122.60    | 1                | 1              |
| A     | 220 | ASN  | OD1-CG-ND2 | 4.29 | 118.31       | 122.60    | 1                | 1              |
| B     | 159 | ASN  | OD1-CG-ND2 | 4.25 | 118.35       | 122.60    | 1                | 1              |
| A     | 216 | GLN  | OE1-CD-NE2 | 4.24 | 118.36       | 122.60    | 1                | 1              |
| B     | 270 | ASP  | CA-CB-CG   | 4.24 | 116.84       | 112.60    | 1                | 1              |
| A     | 81  | HIS  | CB-CG-CD2  | 4.21 | 125.73       | 131.20    | 1                | 1              |
| A     | 337 | ARG  | NE-CZ-NH1  | 4.19 | 125.69       | 121.50    | 1                | 1              |

| Chain | Res | Type | Atoms      | Z    | Observed (Å) | Ideal (Å) | Model ID (Worst) | Models (Total) |
|-------|-----|------|------------|------|--------------|-----------|------------------|----------------|
| B     | 237 | ASN  | OD1-CG-ND2 | 4.15 | 118.45       | 122.60    | 1                | 1              |
| A     | 435 | ARG  | CD-NE-CZ   | 4.15 | 130.21       | 124.40    | 1                | 1              |
| A     | 162 | GLN  | OE1-CD-NE2 | 4.14 | 118.46       | 122.60    | 1                | 1              |
| A     | 238 | ASN  | CA-CB-CG   | 4.13 | 116.73       | 112.60    | 1                | 1              |
| A     | 141 | GLN  | OE1-CD-NE2 | 4.11 | 118.49       | 122.60    | 1                | 1              |
| B     | 370 | ALA  | C-N-CA     | 4.10 | 129.07       | 121.70    | 1                | 1              |
| A     | 456 | GLN  | OE1-CD-NE2 | 4.02 | 118.58       | 122.60    | 1                | 1              |
| B     | 151 | GLN  | OE1-CD-NE2 | 4.01 | 118.59       | 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        | 0.00        | 0                 |

There are no too-close contacts.

### 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        | 992      | 962     | 28      | 2        |

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

| Chain | Res | Type | Models (Total) |
|-------|-----|------|----------------|
| B     | 6   | ASP  | 1              |
| B     | 502 | GLY  | 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        | 899      | 885     | 10      | 4        |

There are 4 unique sidechain outliers. Detailed list of outliers are tabulated below.

| Chain | Res | Type | Models (Total) |
|-------|-----|------|----------------|
| A     | 249 | ARG  | 1              |
| B     | 3   | LEU  | 1              |
| B     | 290 | LEU  | 1              |

| Chain | Res | Type | Models (Total) |
|-------|-----|------|----------------|
| B     | 499 | THR  | 1              |

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

### 5.2. Crosslinking-MS ?

#### 5.2.1. Restraint types ?

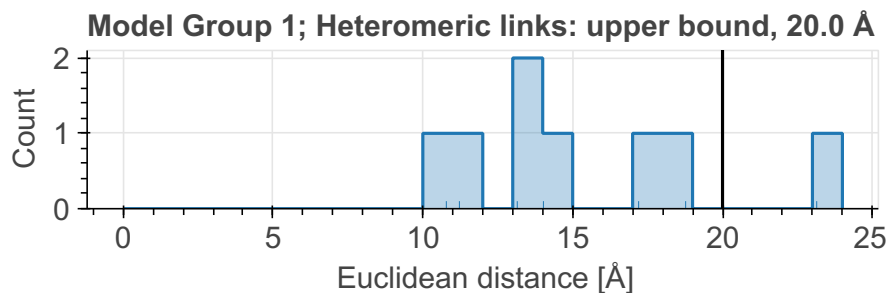
This table summarizes information about crosslinker(s) used for data generation, and how crosslinking information was translated into actual modeling restraints. Restraints assigned "by-residue" are interpreted as between CA atoms. Restraints between coarse-grained beads are indicated as "coarse-grained".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

There are 8 crosslinking restraints combined in 8 restraint groups.

| Linker | Residue 1 | Atom 1 | Residue 2 | Atom 2 | Restraint type | Distance, Å | Count |
|--------|-----------|--------|-----------|--------|----------------|-------------|-------|
| Other  | CYS       | CA     | VAL       | CA     | upper bound    | 20.00       | 3     |
| Other  | CYS       | CA     | THR       | CA     | upper bound    | 20.00       | 2     |
| Other  | CYS       | CA     | ILE       | CA     | upper bound    | 20.00       | 1     |
| Other  | CYS       | CA     | GLU       | CA     | upper bound    | 20.00       | 2     |

#### 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.



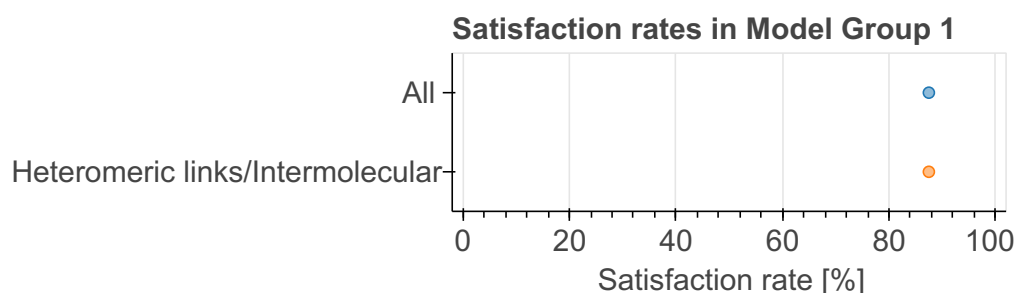
#### 5.2.2. Satisfaction of restraints ?

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=8) |
|-------------|-------|-------------|-----------------------------|-----------------------------------|---------------|--------------|-----------------|
| 1           | 1     | 1           | 1/1                         | All                               | 87.50         | 12.50        | 8               |
|             |       |             |                             | Heteromeric links/ Intermolecular | 87.50         | 12.50        | 8               |

#### 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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