

Integrative Structure Validation Report

October 09, 2025 - 04:40 PM PDT

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 | 9A22 pdb_00009a22 |
| PDB-Dev ID | PDBDEV_00000139 |
| Structure Title | Photoinduced intermediate J' of bacteriorhodopsin from 0.5 to 2 picosecond immediately after photoisomerization |
| Structure Authors | Ren, Z. |
| Deposited on | 2022-07-15 |

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

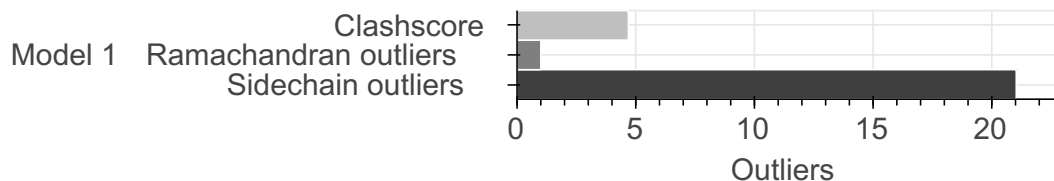
This entry consists of 1 model(s). A total of 21 dataset(s) were used to build this entry.

| Name | Type | Count |
|------------------------|-------------------|-------|
| X-ray diffraction data | Experimental data | 20 |
| Experimental model | Starting model | 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 ?



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 | BACTERIORHODOPSIN | A | 248 | - | 1-248 | 100.00 / 100.00 | Atomic |
| | | 2 | RETINAL | B [A] | Non-polymeric | - | - | Not available / Not available | Atomic |
| | | 3 | water | C [A] | Non-polymeric | - | - | Not available / Not available | Atomic |

2.3. Datasets used for modeling ?

There are 21 unique datasets used to build the models in this entry.

| ID | Dataset type | Database name | Data access code |
|----|------------------------|---------------|------------------------------|
| 1 | Experimental model | PDB | pdb_00006g7h |
| 2 | X-ray diffraction data | PDB | pdb_00006g7h |
| 3 | X-ray diffraction data | PDB | pdb_00006g7i |
| 4 | X-ray diffraction data | PDB | pdb_00006g7j |
| 5 | X-ray diffraction data | PDB | pdb_00006g7k |
| 6 | X-ray diffraction data | PDB | pdb_00006ga2 |
| 7 | X-ray diffraction data | PDB | pdb_00006ga4 |
| 8 | X-ray diffraction data | PDB | pdb_00006ga5 |
| 9 | X-ray diffraction data | PDB | pdb_00006ga6 |

| ID | Dataset type | Database name | Data access code |
|----|------------------------|---------------|------------------------------|
| 10 | X-ray diffraction data | PDB | pdb_00006ga7 |
| 11 | X-ray diffraction data | PDB | pdb_00006ga8 |
| 12 | X-ray diffraction data | PDB | pdb_00006ga9 |
| 13 | X-ray diffraction data | PDB | pdb_00006gaa |
| 14 | X-ray diffraction data | PDB | pdb_00006gab |
| 15 | X-ray diffraction data | PDB | pdb_00006gac |
| 16 | X-ray diffraction data | PDB | pdb_00006gad |
| 17 | X-ray diffraction data | PDB | pdb_00006gae |
| 18 | X-ray diffraction data | PDB | pdb_00006gaf |
| 19 | X-ray diffraction data | PDB | pdb_00006gag |
| 20 | X-ray diffraction data | PDB | pdb_00006gah |
| 21 | X-ray diffraction data | PDB | pdb_00006gai |

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 | Singular value decomposition analysis of difference Fourier maps | Singular value decomposition | Not available | 1 | False | False |

There are 2 software packages reported in this entry.

| ID | Software name | Software version | Software classification | Software location |
|----|------------------------|------------------|-------------------------|---|
| 1 | PHENIX | (1.13_2998: ???) | refinement | https://phenix-online.org/ |
| 2 | dynamiX | Not available | Data reduction | Not available |

3. Data quality ?

3.4. X-ray diffraction ?

Validation for this section is under development.

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 | 4.68 | 17 |

There are 17 clashes. The table below contains the detailed list of all clashes based on a MolProbity analysis. Bad clashes are ≥ 0.4 Angstrom.

| Atom 1 | Atom 2 | Clash(Å) | Model ID (Worst) | Models (Total) |
|----------------|----------------|----------|------------------|----------------|
| A:159:LYS:O | A:162:SER:OG | 0.71 | 1 | 1 |
| A:156:PHE:HB3 | A:171:PHE:CZ | 0.62 | 1 | 1 |
| A:121:THR:HG23 | A:137:TRP:HE3 | 0.54 | 1 | 1 |
| A:194:GLU:OE2 | C:5:HOH:O | 0.48 | 1 | 1 |
| A:153:PHE:CE2 | A:179:VAL:HG21 | 0.48 | 1 | 1 |
| A:98:ALA:HB1 | A:108:ILE:HG12 | 0.46 | 1 | 1 |
| A:104:ASP:OD1 | A:107:THR:OG1 | 0.45 | 1 | 1 |
| A:16:GLY:O | A:20:MET:HG2 | 0.44 | 1 | 1 |
| A:152:LEU:O | A:157:THR:HG22 | 0.44 | 1 | 1 |
| A:107:THR:O | A:111:LEU:HB2 | 0.43 | 1 | 1 |
| A:111:LEU:HA | A:111:LEU:HD12 | 0.41 | 1 | 1 |
| A:156:PHE:HB3 | A:171:PHE:HZ | 0.41 | 1 | 1 |
| A:87:LEU:HD23 | A:88:PHE:CE2 | 0.41 | 1 | 1 |
| A:15:LEU:HD23 | A:209:MET:HE1 | 0.40 | 1 | 1 |
| A:174:LEU:HD21 | A:222:ILE:HB | 0.40 | 1 | 1 |
| A:69:VAL:HG12 | A:71:PHE:HD1 | 0.40 | 1 | 1 |
| A:12:TRP:CZ2 | A:206:LEU:HD12 | 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 | 228 | 219 | 8 | 1 |

There are 1 unique backbone outliers. Detailed list of outliers are tabulated below.

| Chain | Res | Type | Models (Total) |
|-------|-----|------|----------------|
| A | 36 | 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 | 181 | 148 | 12 | 21 |

There are 21 unique sidechain outliers. Detailed list of outliers are tabulated below.

| Chain | Res | Type | Models (Total) |
|-------|-----|------|----------------|
| A | 11 | ILE | 1 |
| A | 20 | MET | 1 |
| A | 28 | LEU | 1 |
| A | 29 | VAL | 1 |
| A | 30 | LYS | 1 |
| A | 40 | LYS | 1 |
| A | 55 | THR | 1 |
| A | 61 | LEU | 1 |
| A | 66 | LEU | 1 |
| A | 78 | ILE | 1 |
| A | 111 | LEU | 1 |
| A | 119 | ILE | 1 |
| A | 127 | LEU | 1 |
| A | 128 | THR | 1 |
| A | 129 | LYS | 1 |
| A | 145 | MET | 1 |
| A | 157 | THR | 1 |
| A | 169 | SER | 1 |
| A | 173 | VAL | 1 |
| A | 222 | ILE | 1 |
| A | 229 | ILE | 1 |

5. Fit to Data Used for Modeling Assessment ?

5.4. X-ray diffraction ?

Validation for this section is under development.

6. Fit to Data Used for Validation Assessment

Validation for this section is under development.

Acknowledgments

The development of integrative model validation metrics, implementation of a model validation pipeline, and creation of a validation report for integrative structures are funded by NSF awards to the [PDB-IHM team](#) (DBI-1756248, DBI-2112966, DBI-2112967, DBI-2112968, and DBI-1756250) and awards from NSF, NIH, and DOE to the [RCSB PDB](#) (DBI-2321666, R01GM157729, and DE-SC0019749). The PDB-IHM team and members of the [Sali lab](#) contributed model validation metrics and software packages.

Dr. Jill Trewhella, Dr. Dina Schneidman, and members of the [SASBDB](#) repository are acknowledged for their advice and support in implementing SAS validation methods. Team members from the labs of Dr. Juri Rappsilber, Dr. Alexander Leitner, Dr. Andrea Graziadei, and members of [PRIDE](#) database are acknowledged for their advice and support in implementing crosslinking-MS validation methods. We are grateful to Dr. Shruthi Viswanath for discussions about uncertainty assessment of integrative structural models.

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