Full wwPDB X-ray Structure Validation Report ⓘ

Mar 25, 2025 – 04:06 PM EDT

PDB ID	:	9EIS
Title	:	Ethylene forming enzyme in complex with manganese and 2-oxoglutarate from Penicillium digitatum
Authors	:	Chatterjee, S.; Rankin, J.A.; Farrugia, M.A.; Hu, J.; Hausinger, R.P.
Deposited on	:	2024-11-26
Resolution	:	2.80 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

We welcome your comments at *validation@mail.wwpdb.org*
A user guide is available at
https://www.wwpdb.org/validation/2017/XrayValidationReportHelp
with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at
http://www.wwpdb.org/validation/2017/FAQs#types.

The following versions of software and data (see references ⓘ) were used in the production of this report:

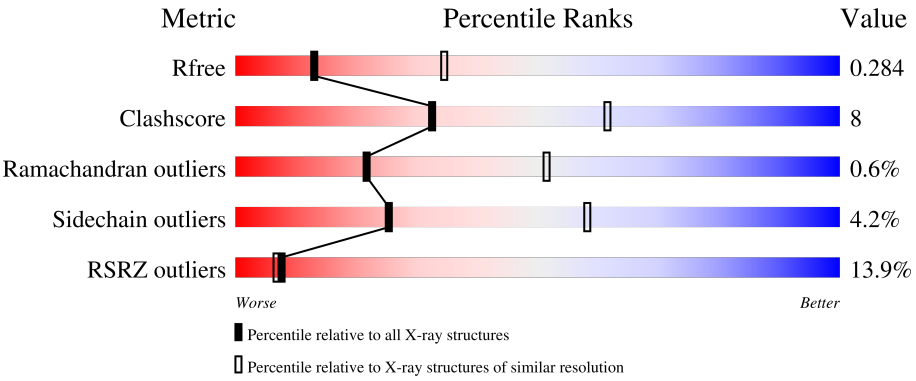
MolProbity	:	4.02b-467
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	1.21
EDS	:	3.0
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.004 (Gargrove)
Density-Fitness	:	1.0.11
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.41.4

1 Overall quality at a glance

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.80 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	164625	3657 (2.80-2.80)
Clashscore	180529	4123 (2.80-2.80)
Ramachandran outliers	177936	4071 (2.80-2.80)
Sidechain outliers	177891	4073 (2.80-2.80)
RSRZ outliers	164620	3659 (2.80-2.80)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for >=3, 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions <=5% The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	407	2% 67% 13% 19%
1	B	407	3% 68% 12% 19%
1	C	407	3% 71% 11% 18%
1	D	407	36% 61% 14% 24%

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard

residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
2	AKG	A	501	-	-	X	-

2 Entry composition

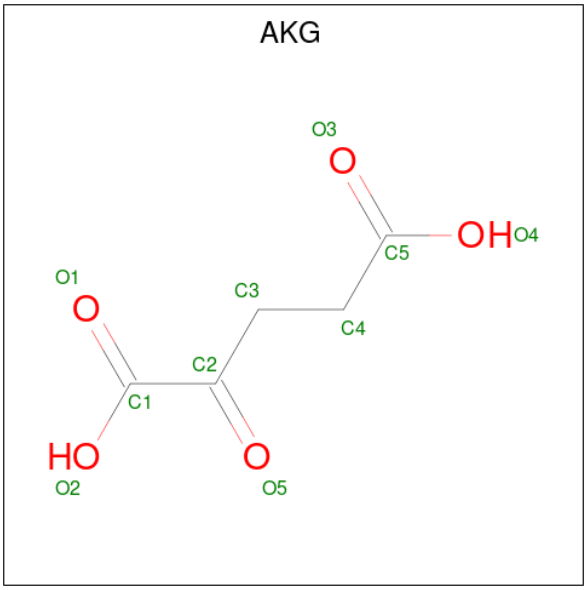
There are 6 unique types of molecules in this entry. The entry contains 10275 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

- Molecule 1 is a protein called 2-oxoglutarate-dependent ethylene/succinate-forming enzyme.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	328	Total	C	N	O	S	0	2	0
			2559	1640	441	464	14			
1	B	329	Total	C	N	O	S	0	0	0
			2563	1638	441	470	14			
1	C	335	Total	C	N	O	S	0	0	0
			2578	1652	443	469	14			
1	D	310	Total	C	N	O	S	0	0	0
			2233	1420	389	412	12			

- Molecule 2 is 2-OXOGLUTARIC ACID (three-letter code: AKG) (formula: $C_5H_6O_5$) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			10	5	5		
2	C	1	Total	C	O	0	0
			10	5	5		

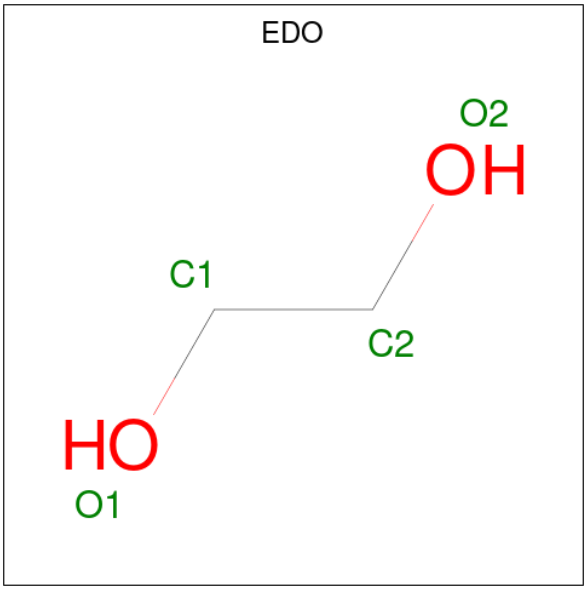
- Molecule 3 is MANGANESE (II) ION (three-letter code: MN) (formula: Mn).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total Mn 1 1	0	0
3	B	1	Total Mn 1 1	0	0
3	C	1	Total Mn 1 1	0	0
3	D	1	Total Mn 1 1	0	0

- Molecule 4 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	B	1	Total Cl 1 1	0	0
4	C	1	Total Cl 1 1	0	0

- Molecule 5 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: $C_2H_6O_2$).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	D	1	Total C O 4 2 2	0	0

- Molecule 6 is water.

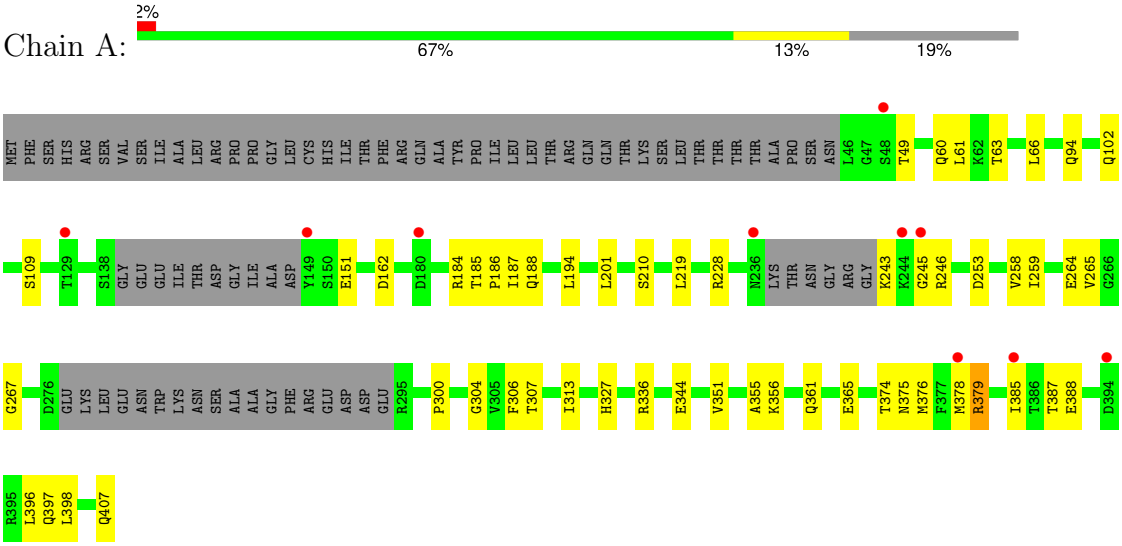
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
6	A	94	Total O 94 94	0	0
6	B	94	Total O 94 94	0	0
6	C	78	Total O 78 78	0	0
6	D	46	Total O 46 46	0	0

3 Residue-property plots (i)

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red dot above a residue indicates a poor fit to the electron density (RSRZ > 2). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

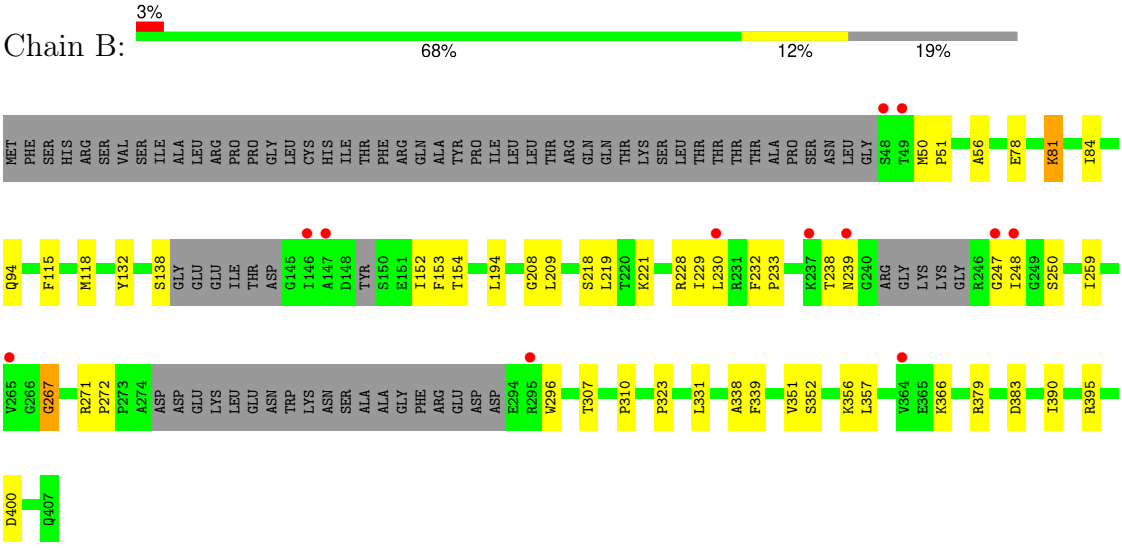
• Molecule 1: 2-oxoglutarate-dependent ethylene/succinate-forming enzyme

Chain A:



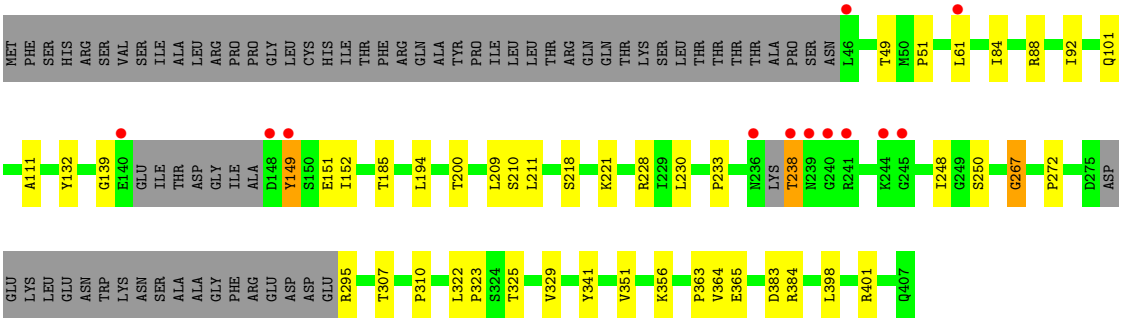
• Molecule 1: 2-oxoglutarate-dependent ethylene/succinate-forming enzyme

Chain B:



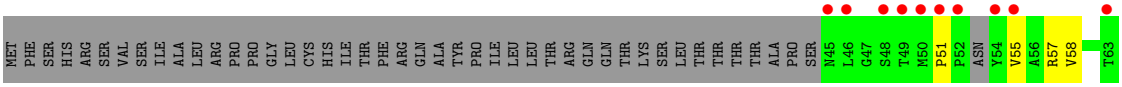
• Molecule 1: 2-oxoglutarate-dependent ethylene/succinate-forming enzyme

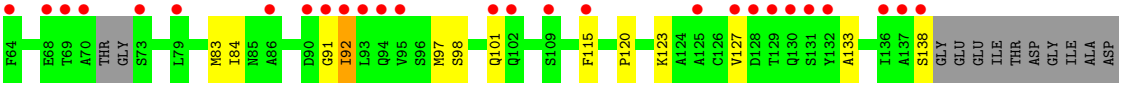
Chain C:

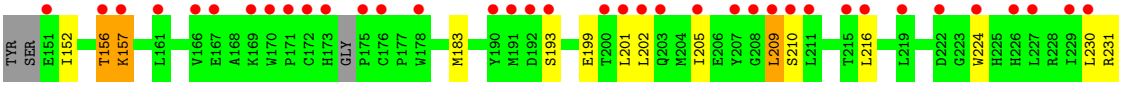


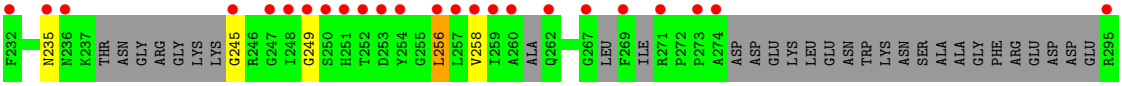
• Molecule 1: 2-oxoglutarate-dependent ethylene/succinate-forming enzyme

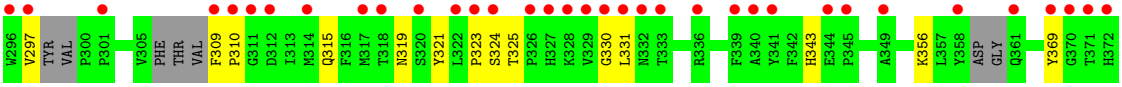
Chain D:

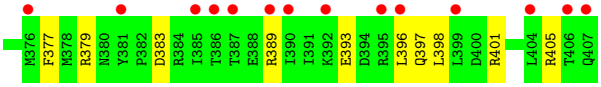












4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	104.16Å 117.40Å 140.74Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	22.85 – 2.80 22.85 – 2.80	Depositor EDS
% Data completeness (in resolution range)	99.3 (22.85-2.80) 99.2 (22.85-2.80)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.89 (at 2.82Å)	Xtriage
Refinement program	PHENIX 1.19_4092	Depositor
R, R_{free}	0.250 , 0.286 0.250 , 0.284	Depositor DCC
R_{free} test set	2094 reflections (4.86%)	wwPDB-VP
Wilson B-factor (Å^2)	39.9	Xtriage
Anisotropy	0.876	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.29 , 39.1	EDS
L-test for twinning[2]	$< \|L\| > = 0.47$, $< L^2 > = 0.30$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.88	EDS
Total number of atoms	10275	wwPDB-VP
Average B, all atoms (Å^2)	47.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.85% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: MN, EDO, CL, AKG

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 5$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	#$\|Z\|>5$	RMSZ	#$\|Z\|>5$
1	A	0.42	1/2632 (0.0%)	0.66	0/3587
1	B	0.37	0/2635	0.61	0/3587
1	C	0.48	1/2652 (0.0%)	0.71	0/3613
1	D	0.53	0/2290	0.85	0/3121
All	All	0.45	2/10209 (0.0%)	0.71	0/13908

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	250	SER	C-N	-5.29	1.21	1.34
1	A	355	ALA	C-N	-5.25	1.22	1.34

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	2559	0	2456	39	0
1	B	2563	0	2468	41	0
1	C	2578	0	2463	32	0
1	D	2233	0	1944	40	0
2	A	10	0	4	4	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	C	10	0	4	1	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
3	C	1	0	0	0	0
3	D	1	0	0	0	0
4	B	1	0	0	1	0
4	C	1	0	0	1	0
5	D	4	0	6	0	0
6	A	94	0	0	8	0
6	B	94	0	0	3	0
6	C	78	0	0	6	0
6	D	46	0	0	10	0
All	All	10275	0	9345	151	0

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 8.

All (151) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:219:LEU:HD23	1:A:351:VAL:HG22	1.23	1.20
1:A:219:LEU:CD2	1:A:351:VAL:HG22	1.73	1.19
1:B:230:LEU:HD13	1:B:232:PHE:CE2	1.81	1.15
1:D:258:VAL:HG23	6:D:632:HOH:O	1.68	0.93
1:B:230:LEU:CD1	1:B:232:PHE:CE2	2.56	0.89
1:A:378:MET:HG3	1:A:387:THR:HG23	1.53	0.88
1:A:184:ARG:O	1:A:188:GLN:HG2	1.72	0.88
1:A:219:LEU:HD23	1:A:351:VAL:CG2	2.05	0.85
1:C:152:ILE:HD11	1:C:228:ARG:HB3	1.58	0.85
1:B:230:LEU:HD12	1:B:230:LEU:O	1.75	0.84
1:D:330:GLY:O	1:D:331:LEU:HG	1.77	0.84
1:A:336:ARG:HH22	2:A:501:AKG:C1	1.93	0.81
1:B:229:ILE:HG22	1:B:339:PHE:CE1	2.15	0.81
1:B:379:ARG:HD3	6:B:628:HOH:O	1.82	0.80
1:D:97:MET:HE1	6:D:639:HOH:O	1.84	0.78
1:B:229:ILE:HG22	1:B:339:PHE:CD1	2.21	0.76
1:C:248:ILE:HG22	1:C:329:VAL:HB	1.68	0.74
1:B:230:LEU:HD11	1:B:338:ALA:HB3	1.73	0.70
1:B:219:LEU:HD13	1:B:351:VAL:HG22	1.74	0.69
1:A:336:ARG:NH1	2:A:501:AKG:O1	2.23	0.69
1:C:200:THR:HA	6:C:622:HOH:O	1.92	0.69

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:264:GLU:HG3	6:A:622:HOH:O	1.95	0.67
1:D:224:TRP:HB3	1:D:369:TYR:HE2	1.61	0.66
1:B:51:PRO:HG2	1:B:267:GLY:HA2	1.76	0.65
1:B:272:PRO:HG3	6:B:607:HOH:O	1.97	0.65
1:D:55:VAL:O	1:D:55:VAL:HG12	1.96	0.65
1:C:132:TYR:O	4:C:503:CL:CL	2.53	0.63
1:C:139:GLY:HA3	1:C:149:TYR:HB3	1.81	0.62
1:D:51:PRO:HG2	1:D:235:ASN:HB3	1.82	0.62
1:B:390:ILE:HG23	1:B:395:ARG:HB2	1.82	0.62
1:B:230:LEU:HD13	1:B:232:PHE:CZ	2.32	0.60
1:B:218:SER:HA	1:B:221:LYS:HE2	1.84	0.60
1:C:210:SER:O	1:C:356:LYS:NZ	2.35	0.60
1:D:101:GLN:HG2	1:D:193:SER:OG	2.03	0.59
1:B:230:LEU:CD1	1:B:232:PHE:HE2	2.10	0.59
1:A:378:MET:CG	1:A:387:THR:HG23	2.31	0.59
1:B:50:MET:HE3	1:B:56:ALA:HB3	1.85	0.59
1:B:209:LEU:O	1:B:356:LYS:NZ	2.30	0.58
1:B:154:THR:OG1	1:B:228:ARG:NH2	2.35	0.58
1:D:224:TRP:HB3	1:D:369:TYR:CE2	2.39	0.57
1:A:219:LEU:HD21	1:A:351:VAL:HG22	1.77	0.56
1:A:184:ARG:HG2	1:A:188:GLN:OE1	2.05	0.56
1:B:229:ILE:HG22	1:B:339:PHE:HE1	1.66	0.56
1:C:139:GLY:HA3	1:C:149:TYR:CG	2.40	0.56
1:B:238:THR:O	1:B:239:ASN:OD1	2.23	0.56
1:B:78:GLU:HA	1:B:81:LYS:NZ	2.21	0.56
1:D:152:ILE:HA	6:D:610:HOH:O	2.06	0.56
1:D:315:GLN:NE2	6:D:605:HOH:O	2.38	0.55
1:B:219:LEU:HD22	1:B:351:VAL:HG22	1.87	0.55
1:D:324:SER:CB	6:D:605:HOH:O	2.55	0.55
1:A:300:PRO:HD2	6:A:614:HOH:O	2.05	0.55
1:B:356:LYS:HG2	1:B:357:LEU:HD12	1.87	0.55
1:C:398:LEU:HD23	1:C:401:ARG:HD2	1.88	0.55
1:D:83:MET:HE1	1:D:201:LEU:HD23	1.89	0.55
1:D:258:VAL:CG2	6:D:632:HOH:O	2.37	0.55
1:B:78:GLU:HA	1:B:81:LYS:HZ3	1.73	0.54
1:C:139:GLY:HA3	1:C:149:TYR:CB	2.38	0.54
1:D:92:ILE:HG22	1:D:309:PHE:HB3	1.89	0.53
1:C:398:LEU:HD23	1:C:401:ARG:HE	1.74	0.53
1:A:374:THR:HG22	1:A:378:MET:HE3	1.90	0.52
1:A:376:MET:O	1:A:379:ARG:HB3	2.09	0.52
1:D:120:PRO:HA	1:D:123:LYS:HE3	1.90	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:94:GLN:NE2	6:A:614:HOH:O	2.43	0.52
1:D:245:GLY:HA2	1:D:249:GLY:HA2	1.91	0.52
1:C:398:LEU:HD23	1:C:401:ARG:NE	2.24	0.52
1:A:94:GLN:HG2	1:A:307:THR:HG22	1.91	0.51
1:A:264:GLU:CG	6:A:622:HOH:O	2.56	0.51
1:C:139:GLY:HA3	1:C:149:TYR:CD2	2.46	0.51
1:B:94:GLN:HG2	1:B:307:THR:HG22	1.92	0.50
1:D:199:GLU:HG3	1:D:343:HIS:NE2	2.27	0.50
1:C:111:ALA:CB	6:C:607:HOH:O	2.60	0.50
1:D:330:GLY:O	1:D:331:LEU:CG	2.55	0.50
1:A:210:SER:O	1:A:356:LYS:NZ	2.45	0.49
1:C:307:THR:CG2	6:C:611:HOH:O	2.60	0.49
1:D:230:LEU:HA	6:D:610:HOH:O	2.12	0.49
1:B:310:PRO:HG2	1:B:323:PRO:O	2.12	0.49
1:D:57:ARG:O	1:D:58:VAL:C	2.52	0.49
1:C:398:LEU:CD2	1:C:401:ARG:HD2	2.42	0.49
1:C:351:VAL:HA	6:C:608:HOH:O	2.14	0.48
1:D:57:ARG:O	1:D:57:ARG:HG2	2.13	0.48
1:B:379:ARG:HB3	6:B:628:HOH:O	2.13	0.48
1:C:194:LEU:HD13	1:C:341:TYR:HB2	1.96	0.48
1:D:97:MET:CE	6:D:639:HOH:O	2.50	0.48
1:C:209:LEU:HB2	1:C:211:LEU:HG	1.95	0.48
1:C:398:LEU:HD23	1:C:401:ARG:CD	2.43	0.48
1:C:51:PRO:HG2	1:C:267:GLY:HA2	1.95	0.48
1:A:219:LEU:HD21	1:A:351:VAL:HA	1.96	0.48
1:B:219:LEU:HD13	1:B:351:VAL:CG2	2.43	0.47
1:B:153:PHE:HB3	1:B:229:ILE:HD11	1.97	0.47
1:C:61:LEU:HD21	1:C:92:ILE:HG23	1.95	0.47
1:A:162:ASP:OD1	1:A:162:ASP:N	2.36	0.47
1:A:344:GLU:HA	1:A:344:GLU:OE1	2.15	0.47
1:D:84:ILE:HD13	1:D:209:LEU:HD13	1.96	0.47
1:A:336:ARG:NH2	2:A:501:AKG:O1	2.48	0.47
1:B:233:PRO:O	1:B:331:LEU:HD22	2.14	0.47
1:A:194:LEU:HD22	1:A:259:ILE:HG21	1.96	0.46
1:D:91:GLY:CA	1:D:325:THR:HG21	2.45	0.46
1:B:230:LEU:CD1	1:B:338:ALA:HB3	2.43	0.46
1:C:310:PRO:HG2	1:C:323:PRO:O	2.16	0.46
1:D:115:PHE:CD1	1:D:183:MET:HE1	2.51	0.46
1:B:132:TYR:O	4:B:502:CL:CL	2.71	0.46
1:D:310:PRO:HB2	1:D:323:PRO:O	2.15	0.46
1:C:272:PRO:HD2	1:C:295:ARG:O	2.16	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:102:GLN:OE1	1:A:304:GLY:HA2	2.16	0.45
1:D:389:ARG:O	1:D:393:GLU:HB2	2.16	0.45
1:B:229:ILE:HG22	1:B:339:PHE:HD1	1.78	0.45
1:D:209:LEU:HD11	1:D:321:TYR:CE2	2.52	0.45
1:C:363:PRO:HB2	1:C:365:GLU:HG2	1.98	0.45
1:B:84:ILE:HD12	1:B:208:GLY:HA3	1.98	0.45
1:D:157:LYS:HB3	1:D:157:LYS:HE2	1.78	0.44
1:A:243:LYS:HB3	1:A:246:ARG:HG2	1.98	0.44
1:C:111:ALA:HA	6:C:607:HOH:O	2.16	0.44
1:D:91:GLY:HA3	1:D:325:THR:HG21	1.99	0.44
1:C:233:PRO:HB2	1:C:238:THR:HG21	1.98	0.44
1:A:265:VAL:HB	1:A:336:ARG:HG3	1.99	0.44
1:B:250:SER:HB2	1:B:296:TRP:HZ2	1.83	0.44
1:A:259:ILE:HG23	1:A:306:PHE:CD1	2.53	0.44
1:A:66:LEU:HD11	1:A:201:LEU:HG	2.00	0.44
1:A:375:ASN:O	1:A:379:ARG:HB2	2.18	0.44
1:C:51:PRO:CG	1:C:267:GLY:HA2	2.47	0.44
1:C:101:GLN:HB3	6:C:639:HOH:O	2.18	0.43
1:D:202:LEU:HD22	1:D:216:LEU:HD13	2.00	0.43
1:A:365:GLU:HG3	1:C:185:THR:HG21	1.99	0.43
1:B:154:THR:HG1	1:B:228:ARG:HH21	1.61	0.43
1:B:194:LEU:HD22	1:B:259:ILE:HG21	2.00	0.43
1:A:253:ASP:OD2	1:A:258:VAL:HG21	2.18	0.43
1:A:375:ASN:HA	6:A:616:HOH:O	2.18	0.43
1:D:256:LEU:HD23	1:D:256:LEU:HA	1.80	0.43
1:B:229:ILE:CG2	1:B:339:PHE:HE1	2.31	0.43
1:B:352:SER:HB3	1:B:366:LYS:HE3	2.01	0.43
1:A:407:GLN:NE2	6:A:620:HOH:O	2.52	0.42
1:C:218:SER:HA	1:C:221:LYS:HD2	2.00	0.42
1:A:253:ASP:OD1	1:A:327:HIS:CE1	2.71	0.42
1:D:231:ARG:N	6:D:610:HOH:O	2.53	0.42
1:D:210:SER:HB3	1:D:356:LYS:NZ	2.34	0.42
1:B:153:PHE:O	1:B:229:ILE:HG12	2.19	0.41
1:D:133:ALA:HB2	1:D:156:THR:H	1.85	0.41
1:C:230:LEU:HD13	2:C:501:AKG:H31	2.02	0.41
1:D:84:ILE:HD11	1:D:205:ILE:HA	2.02	0.41
1:D:398:LEU:HA	1:D:401:ARG:HG3	2.02	0.41
1:B:115:PHE:O	1:B:118:MET:HB2	2.20	0.41
1:A:63:THR:N	6:A:617:HOH:O	2.46	0.41
1:D:209:LEU:HA	1:D:209:LEU:HD12	1.67	0.41
1:A:361:GLN:CB	6:A:603:HOH:O	2.68	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:51:PRO:CG	1:B:267:GLY:HA2	2.48	0.40
1:D:57:ARG:H	1:D:297:VAL:HA	1.87	0.40
1:A:61:LEU:HD23	1:A:94:GLN:HG3	2.03	0.40
1:A:336:ARG:CZ	2:A:501:AKG:O1	2.70	0.40
1:A:396:LEU:HD23	1:A:396:LEU:HA	1.87	0.40
1:C:84:ILE:O	1:C:88:ARG:HG3	2.22	0.40
1:D:319:ASN:HB3	6:D:602:HOH:O	2.22	0.40

There are no symmetry-related clashes.

5.3 Torsion angles (i)

5.3.1 Protein backbone (i)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
1	A	322/407 (79%)	307 (95%)	12 (4%)	3 (1%)	14 42
1	B	319/407 (78%)	306 (96%)	11 (3%)	2 (1%)	22 51
1	C	327/407 (80%)	312 (95%)	13 (4%)	2 (1%)	22 51
1	D	285/407 (70%)	256 (90%)	29 (10%)	0	100 100
All	All	1253/1628 (77%)	1181 (94%)	65 (5%)	7 (1%)	22 51

All (7) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	364	VAL
1	A	379	ARG
1	A	267	GLY
1	B	267	GLY
1	C	267	GLY
1	A	245	GLY
1	B	247	GLY

5.3.2 Protein sidechains (i)

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
1	A	268/352 (76%)	254 (95%)	14 (5%)	19 50
1	B	272/352 (77%)	265 (97%)	7 (3%)	41 75
1	C	267/352 (76%)	259 (97%)	8 (3%)	36 70
1	D	205/352 (58%)	191 (93%)	14 (7%)	13 38
All	All	1012/1408 (72%)	969 (96%)	43 (4%)	25 58

All (43) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	49	THR
1	A	60	GLN
1	A	109	SER
1	A	151	GLU
1	A	185	THR
1	A	186	PRO
1	A	187	ILE
1	A	228[A]	ARG
1	A	228[B]	ARG
1	A	313	ILE
1	A	385	ILE
1	A	388	GLU
1	A	397	GLN
1	A	398	LEU
1	B	81	LYS
1	B	138	SER
1	B	152	ILE
1	B	248	ILE
1	B	271	ARG
1	B	383	ASP
1	B	400	ASP
1	C	49	THR
1	C	149	TYR
1	C	151	GLU

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Mol	Chain	Res	Type
1	C	238	THR
1	C	322	LEU
1	C	325	THR
1	C	383	ASP
1	C	384	ARG
1	D	92	ILE
1	D	98	SER
1	D	127	VAL
1	D	138	SER
1	D	156	THR
1	D	157	LYS
1	D	209	LEU
1	D	256	LEU
1	D	377	PHE
1	D	379	ARG
1	D	383	ASP
1	D	396	LEU
1	D	397	GLN
1	D	405	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (7) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	60	GLN
1	A	94	GLN
1	A	236	ASN
1	A	407	GLN
1	D	101	GLN
1	D	188	GLN
1	D	368	HIS

5.3.3 RNA (i)

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains (i)

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates (i)

There are no oligosaccharides in this entry.

5.6 Ligand geometry (i)

Of 9 ligands modelled in this entry, 6 are monoatomic - leaving 3 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\| > 2$	Counts	RMSZ	$\#\|Z\| > 2$
2	AKG	A	501	3	9,9,9	2.44	2 (22%)	11,11,11	2.28	4 (36%)
5	EDO	D	501	-	3,3,3	0.13	0	2,2,2	0.08	0
2	AKG	C	501	3	9,9,9	1.34	1 (11%)	11,11,11	2.51	2 (18%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	AKG	A	501	3	-	0/9/9/9	-
5	EDO	D	501	-	-	0/1/1/1	-
2	AKG	C	501	3	-	4/9/9/9	-

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	501	AKG	C2-C1	-6.28	1.44	1.53
2	A	501	AKG	O2-C1	-2.85	1.22	1.30
2	C	501	AKG	O2-C1	-2.78	1.23	1.30

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	C	501	AKG	C3-C2-C1	6.81	127.42	115.86

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	A	501	AKG	C3-C2-C1	4.59	123.66	115.86
2	A	501	AKG	O1-C1-C2	-3.74	117.16	121.81
2	C	501	AKG	O5-C2-C1	-3.20	115.10	119.67
2	A	501	AKG	O4-C5-C4	2.58	122.16	114.00
2	A	501	AKG	O5-C2-C1	-2.08	116.70	119.67

There are no chirality outliers.

All (4) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	C	501	AKG	O2-C1-C2-C3
2	C	501	AKG	O1-C1-C2-O5
2	C	501	AKG	O1-C1-C2-C3
2	C	501	AKG	O2-C1-C2-O5

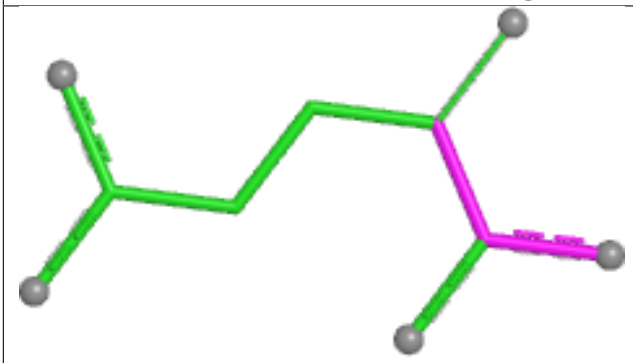
There are no ring outliers.

2 monomers are involved in 5 short contacts:

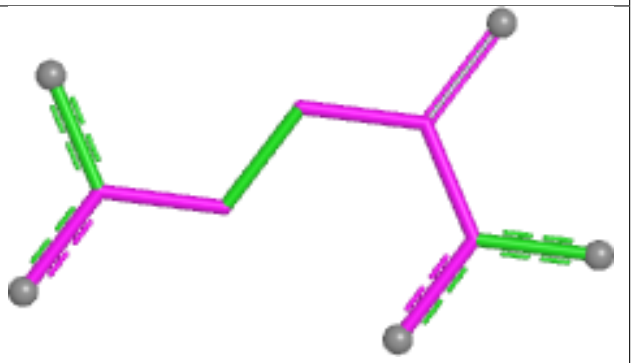
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	501	AKG	4	0
2	C	501	AKG	1	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less then 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.

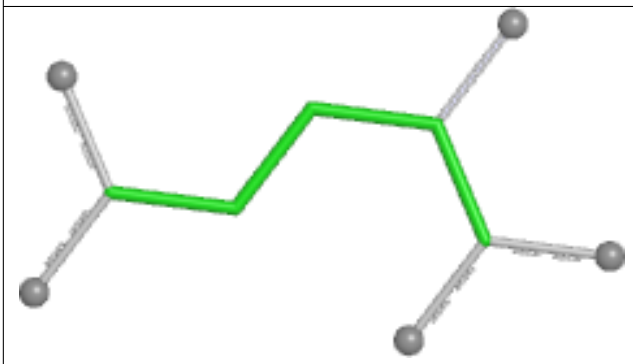
Ligand AKG A 501



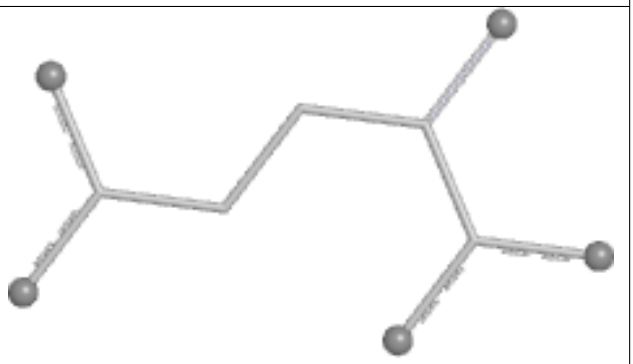
Bond lengths



Bond angles

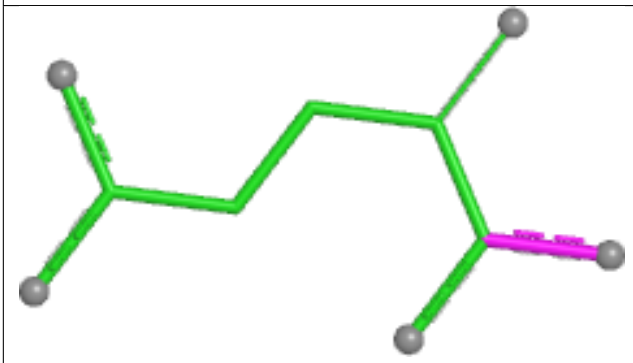


Torsions

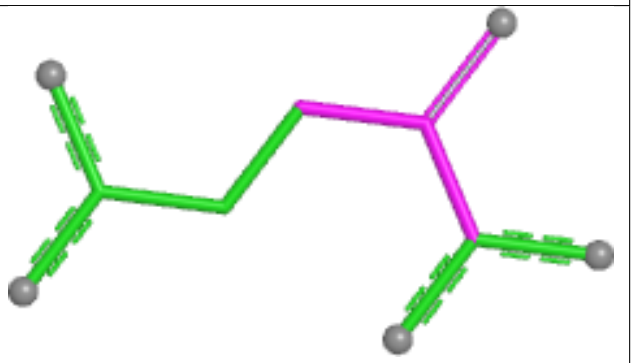


Rings

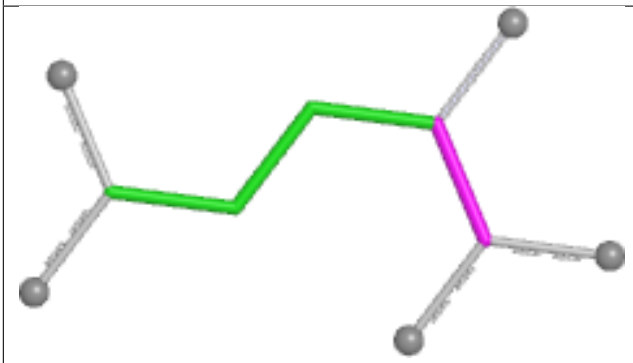
Ligand AKG C 501



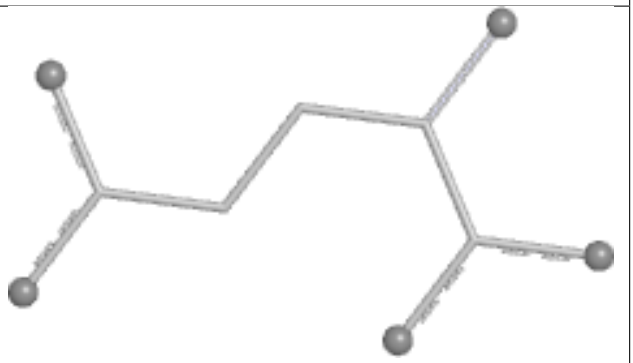
Bond lengths



Bond angles



Torsions



Rings

5.7 Other polymers (i)

There are no such residues in this entry.

5.8 Polymer linkage issues (i)

There are no chain breaks in this entry.

6 Fit of model and data

6.1 Protein, DNA and RNA chains

In the following table, the column labelled '#RSRZ> 2' contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95^{th} percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled 'Q< 0.9' lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å^2)	Q<0.9
1	A	328/407 (80%)	0.10	10 (3%) 52 44	16, 35, 66, 98	2 (0%)
1	B	329/407 (80%)	0.04	12 (3%) 46 38	23, 35, 66, 130	0
1	C	335/407 (82%)	0.20	12 (3%) 46 38	21, 38, 80, 133	0
1	D	310/407 (76%)	2.01	147 (47%) 0 1	48, 75, 102, 128	0
All	All	1302/1628 (79%)	0.56	181 (13%) 7 7	16, 41, 92, 133	2 (0%)

All (181) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	241	ARG	5.0
1	C	238	THR	4.7
1	D	207	TYR	4.7
1	C	245	GLY	4.6
1	D	310	PRO	4.5
1	D	205	ILE	4.5
1	D	256	LEU	4.4
1	C	239	ASN	4.4
1	D	49	THR	4.4
1	D	331	LEU	4.4
1	D	259	ILE	4.3
1	B	295	ARG	4.3
1	D	257	LEU	4.3
1	D	253	ASP	4.3
1	C	240	GLY	4.3
1	D	309	PHE	4.3
1	D	70	ALA	4.3
1	D	329	VAL	4.2
1	D	339	PHE	4.2
1	D	399	LEU	4.2
1	C	148	ASP	4.1

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Mol	Chain	Res	Type	RSRZ
1	C	244	LYS	4.1
1	D	50	MET	4.1
1	D	236	ASN	4.1
1	D	156	THR	4.1
1	D	254	TYR	4.0
1	D	248	ILE	3.8
1	B	230	LEU	3.8
1	D	404	LEU	3.8
1	A	149	TYR	3.8
1	D	235	ASN	3.8
1	D	330	GLY	3.8
1	D	208	GLY	3.7
1	D	52	PRO	3.6
1	D	172	CYS	3.6
1	D	129	THR	3.6
1	D	90	ASP	3.6
1	D	250	SER	3.6
1	D	389	ARG	3.5
1	D	201	LEU	3.5
1	D	192	ASP	3.5
1	D	245	GLY	3.5
1	D	274	ALA	3.5
1	D	95	VAL	3.4
1	D	93	LEU	3.4
1	D	51	PRO	3.4
1	B	48	SER	3.4
1	D	295	ARG	3.4
1	D	324	SER	3.3
1	D	138	SER	3.3
1	D	125	ALA	3.3
1	D	361	GLN	3.3
1	D	45	ASN	3.3
1	C	149	TYR	3.3
1	D	336	ARG	3.3
1	D	314	MET	3.3
1	D	173	HIS	3.2
1	A	244	LYS	3.2
1	D	200	THR	3.2
1	D	252	THR	3.2
1	D	301	PRO	3.2
1	B	146	ILE	3.2
1	D	136	ILE	3.1

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Mol	Chain	Res	Type	RSRZ
1	D	215	THR	3.1
1	B	147	ALA	3.1
1	D	262	GLN	3.0
1	A	245	GLY	3.0
1	D	371	THR	3.0
1	C	46	LEU	3.0
1	D	46	LEU	3.0
1	B	239	ASN	3.0
1	D	269	PHE	3.0
1	D	332	ASN	3.0
1	D	219	LEU	3.0
1	B	237	LYS	3.0
1	D	385	ILE	2.9
1	D	202	LEU	2.9
1	D	216	LEU	2.9
1	D	258	VAL	2.9
1	D	297	VAL	2.9
1	D	296	TRP	2.9
1	D	271	ARG	2.9
1	D	131	SER	2.8
1	D	157	LYS	2.8
1	D	407	GLN	2.8
1	D	349	ALA	2.8
1	D	390	ILE	2.8
1	B	247	GLY	2.8
1	D	91	GLY	2.8
1	D	323	PRO	2.8
1	D	396	LEU	2.8
1	C	236	ASN	2.7
1	D	224	TRP	2.7
1	A	378	MET	2.7
1	D	102	GLN	2.7
1	D	320	SER	2.7
1	D	230	LEU	2.7
1	D	386	THR	2.7
1	D	317	MET	2.7
1	D	232	PHE	2.7
1	D	327	HIS	2.7
1	D	249	GLY	2.7
1	D	137	ALA	2.7
1	A	385	ILE	2.7
1	D	229	ILE	2.7

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Mol	Chain	Res	Type	RSRZ
1	D	54	TYR	2.7
1	D	358	TYR	2.7
1	D	64	PHE	2.6
1	D	170	TRP	2.6
1	B	364	VAL	2.6
1	D	178	TRP	2.6
1	D	345	PRO	2.6
1	D	92	ILE	2.5
1	D	387	THR	2.5
1	D	260	ALA	2.5
1	A	180	ASP	2.5
1	D	392	LYS	2.5
1	D	376	MET	2.5
1	D	311	GLY	2.5
1	D	63	THR	2.5
1	D	132	TYR	2.5
1	D	190	TYR	2.5
1	D	251	HIS	2.4
1	D	73	SER	2.4
1	D	273	PRO	2.4
1	D	369	TYR	2.4
1	D	171	PRO	2.4
1	D	128	ASP	2.4
1	D	312	ASP	2.4
1	D	247	GLY	2.4
1	C	61	LEU	2.4
1	D	55	VAL	2.4
1	D	48	SER	2.3
1	D	395	ARG	2.3
1	D	130	GLN	2.3
1	D	267	GLY	2.3
1	D	210	SER	2.3
1	D	211	LEU	2.3
1	D	227	LEU	2.3
1	B	49	THR	2.3
1	D	169	LYS	2.3
1	D	333	THR	2.3
1	D	406	THR	2.3
1	B	248	ILE	2.2
1	D	166	VAL	2.2
1	A	48	SER	2.2
1	D	209	LEU	2.2

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Mol	Chain	Res	Type	RSRZ
1	D	94	GLN	2.2
1	D	101	GLN	2.2
1	D	79	LEU	2.2
1	D	193	SER	2.2
1	D	127	VAL	2.2
1	D	372	HIS	2.2
1	D	175	PRO	2.2
1	D	370	GLY	2.2
1	D	203	GLN	2.2
1	D	115	PHE	2.2
1	D	341	TYR	2.2
1	D	151	GLU	2.2
1	D	344	GLU	2.2
1	D	326	PRO	2.2
1	D	222	ASP	2.2
1	D	109	SER	2.2
1	D	191	MET	2.1
1	D	86	ALA	2.1
1	D	161	LEU	2.1
1	D	322	LEU	2.1
1	D	340	ALA	2.1
1	B	265	VAL	2.1
1	A	129	THR	2.1
1	D	68	GLU	2.1
1	C	140	GLU	2.1
1	D	167	GLU	2.1
1	D	69	THR	2.1
1	D	226	HIS	2.1
1	A	394	ASP	2.0
1	D	318	THR	2.0
1	D	381	TYR	2.0
1	A	236	ASN	2.0
1	D	328	LYS	2.0
1	D	176	CYS	2.0

6.2 Non-standard residues in protein, DNA, RNA chains (i)

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates (i)

There are no monosaccharides in this entry.

6.4 Ligands (i)

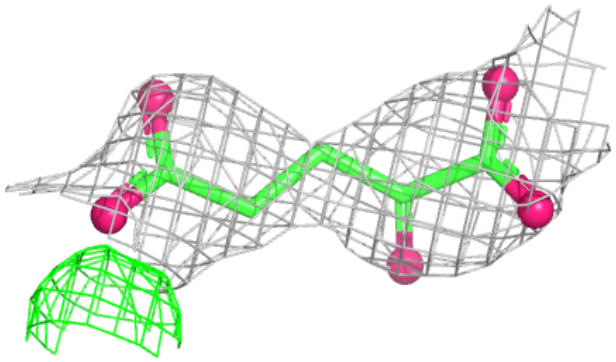
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95^{th} percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

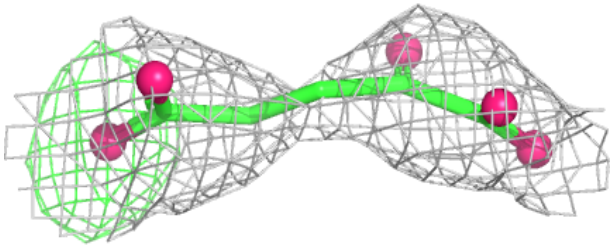
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
5	EDO	D	501	4/4	0.76	0.24	58,59,60,72	0
4	CL	B	502	1/1	0.77	0.15	42,42,42,42	1
2	AKG	C	501	10/10	0.80	0.17	41,46,48,53	0
3	MN	C	502	1/1	0.80	0.10	36,36,36,36	0
3	MN	D	502	1/1	0.83	0.12	80,80,80,80	0
4	CL	C	503	1/1	0.85	0.16	41,41,41,41	1
2	AKG	A	501	10/10	0.86	0.19	31,41,48,52	0
3	MN	B	501	1/1	0.92	0.10	35,35,35,35	0
3	MN	A	502	1/1	0.92	0.06	25,25,25,25	0

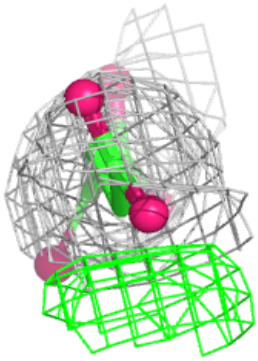
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.

Electron density around AKG C 501:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

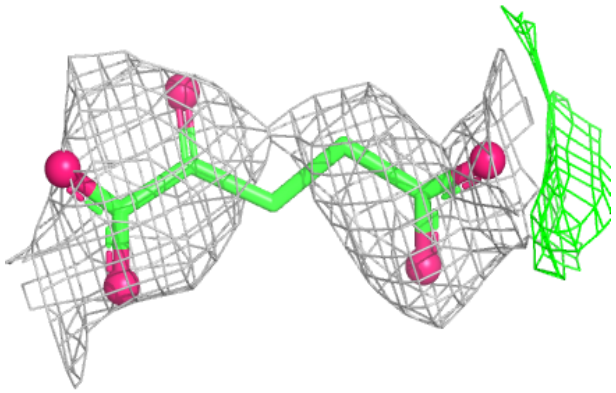


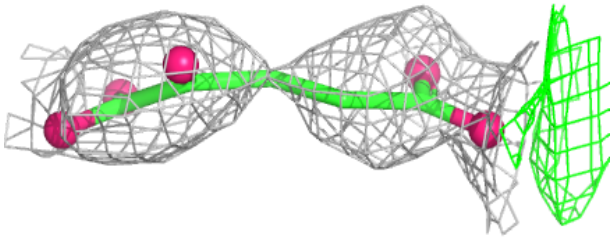


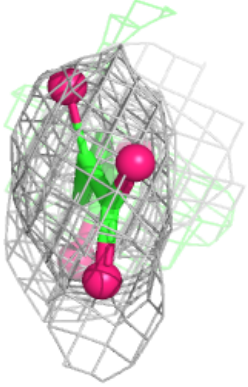


Electron density around AKG A 501:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)







6.5 Other polymers (i)

There are no such residues in this entry.