



# wwPDB X-ray Structure Validation Summary Report

Feb 28, 2014 – 04:39 AM GMT

PDB ID : 3KBU  
Title : Crystal structure of the ankyrin binding domain of human erythroid beta spectrin (repeats 13-15) in complex with the spectrin binding domain of human erythroid ankyrin (ZU5-ANK), EMTS derivative  
Authors : Ipsaro, J.J.; Mondragon, A.  
Deposited on : 2009-10-20  
Resolution : 2.75 Å(reported)

This is a wwPDB validation summary report for a publicly released PDB entry.  
We welcome your comments at [validation@mail.wwpdb.org](mailto:validation@mail.wwpdb.org)  
A user guide is available at <http://wwpdb.org/ValidationPDFNotes.html>

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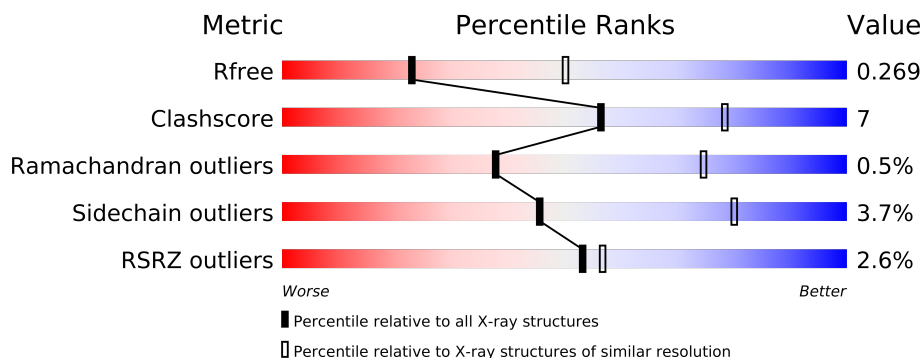
The following versions of software and data (see [references](#)) were used in the production of this report:

MolProbity : 4.02b-467  
Mogul : 1.15 2013  
Xtriage (Phenix) : dev-1323  
EDS : stable22639  
Percentile statistics : 21963  
Refmac : 5.8.0049  
CCP4 : 6.3.0 (Settle)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et. al. (1996)  
Validation Pipeline (wwPDB-VP) : stable22683

# 1 Overall quality at a glance

The reported resolution of this entry is 2.75 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))
$R_{free}$	66092	2406 (2.80-2.72)
Clashscore	79885	2995 (2.80-2.72)
Ramachandran outliers	78287	2941 (2.80-2.72)
Sidechain outliers	78261	2944 (2.80-2.72)
RSRZ outliers	66119	2409 (2.80-2.72)

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 on the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density.

Mol	Chain	Length	Quality of chain
1	A	326	
1	B	326	
2	C	161	
2	D	161	

The following table lists non-polymeric compounds that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Geometry	Electron density
3	HG	C	6	-	X

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 7125 atoms, of which 0 are hydrogen and 0 are deuterium.

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 Spectrin beta chain, erythrocyte.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	285	Total	C	N	O	S	0	0	0
			2313	1446	409	452	6			
1	B	298	Total	C	N	O	S	0	0	0
			2402	1502	423	471	6			

There are 10 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1581	SER	-	EXPRESSION TAG	UNP P11277
A	1582	ASN	-	EXPRESSION TAG	UNP P11277
A	1680	CYS	GLU	ENGINEERED	UNP P11277
A	1844	ASP	GLU	SEE REMARK 999	UNP P11277
A	1845	VAL	LEU	SEE REMARK 999	UNP P11277
B	1581	SER	-	EXPRESSION TAG	UNP P11277
B	1582	ASN	-	EXPRESSION TAG	UNP P11277
B	1680	CYS	GLU	ENGINEERED	UNP P11277
B	1844	ASP	GLU	SEE REMARK 999	UNP P11277
B	1845	VAL	LEU	SEE REMARK 999	UNP P11277

- Molecule 2 is a protein called Ankyrin-1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	C	153	Total	C	N	O	S	0	0	0
			1188	750	215	216	7			
2	D	156	Total	C	N	O	S	0	0	0
			1214	766	219	222	7			

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
C	908	SER	-	EXPRESSION TAG	UNP P16157
C	909	ASN	-	EXPRESSION TAG	UNP P16157

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Chain	Residue	Modelled	Actual	Comment	Reference
C	910	ALA	-	EXPRESSION TAG	UNP P16157
D	908	SER	-	EXPRESSION TAG	UNP P16157
D	909	ASN	-	EXPRESSION TAG	UNP P16157
D	910	ALA	-	EXPRESSION TAG	UNP P16157

- Molecule 3 is MERCURY (II) ION (three-letter code: HG) (formula: Hg).

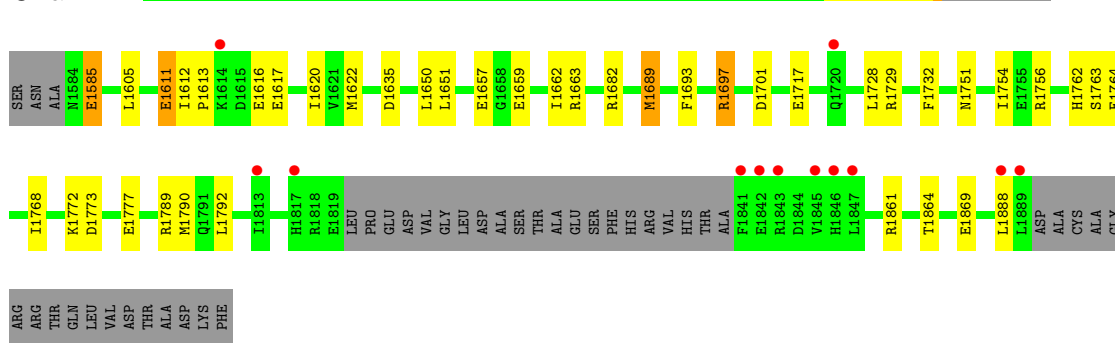
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	B	1	Total Hg 1 1	0	0
3	A	1	Total Hg 1 1	0	0
3	D	3	Total Hg 3 3	0	0
3	C	3	Total Hg 3 3	0	0

### 3 Residue-property plots

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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.

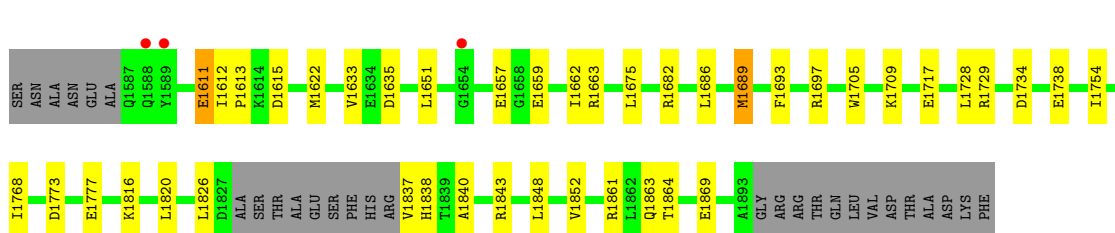
- Molecule 1: Spectrin beta chain, erythrocyte

Chain A:



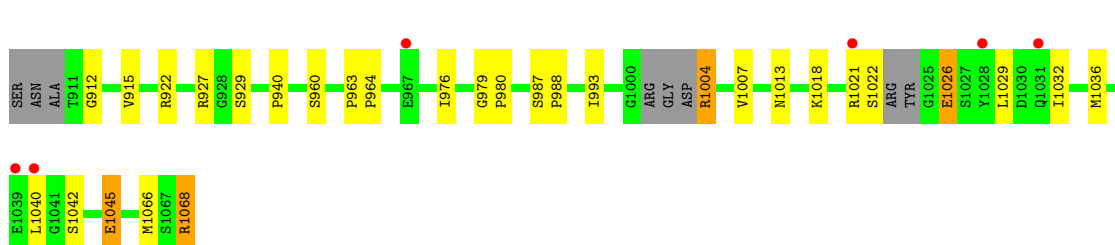
- Molecule 1: Spectrin beta chain, erythrocyte

Chain B:



- Molecule 2: Ankyrin-1

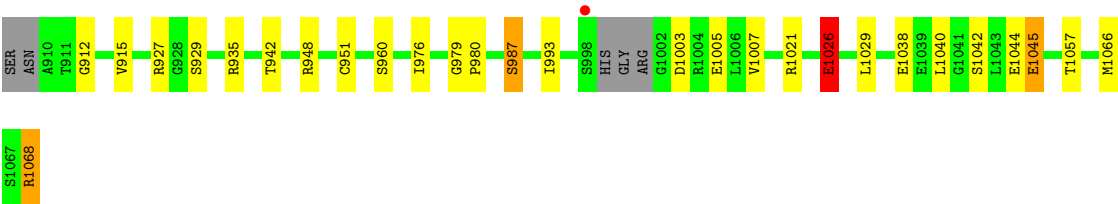
Chain C:



- Molecule 2: Ankyrin-1

Chain D:





## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	90.13Å 98.54Å 137.93Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	37.82 – 2.75 37.82 – 2.75	Depositor EDS
% Data completeness (in resolution range)	99.8 (37.82-2.75) 99.8 (37.82-2.75)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	0.06	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	3.94 (at 2.77Å)	Xtriage
Refinement program	REFMAC 5.5.0088	Depositor
R, $R_{free}$	0.225 , 0.277 0.222 , 0.269	Depositor DCC
$R_{free}$ test set	1681 reflections (5.45%)	DCC
Wilson B-factor (Å <sup>2</sup> )	53.2	Xtriage
Anisotropy	0.411	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.29 , 16.7	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.32$	Xtriage
Outliers	0 of 32524 reflections	Xtriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	7125	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	27.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.05% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

## 5 Model quality

### 5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: HG

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	0.80	0/2351	0.82	6/3168 (0.2%)
1	B	0.82	0/2442	0.88	5/3295 (0.2%)
2	C	0.73	0/1210	0.88	2/1633 (0.1%)
2	D	0.75	1/1237 (0.1%)	0.94	2/1671 (0.1%)
All	All	0.79	1/7240 (0.0%)	0.87	15/9767 (0.2%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	D	951	CYS	CB-SG	-7.17	1.70	1.82

The worst 5 of 15 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	1068	ARG	NE-CZ-NH1	8.10	124.35	120.30
2	C	1068	ARG	NE-CZ-NH2	7.58	124.09	120.30
1	B	1697	ARG	NE-CZ-NH1	7.05	123.82	120.30
1	B	1729	ARG	NE-CZ-NH2	-6.71	116.94	120.30
2	D	1068	ARG	NE-CZ-NH2	-6.62	116.99	120.30

There are no chirality outliers.

There are no planarity outliers.

### 5.2 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 hydrogens added by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, and the number in parentheses is this value normalized per 1000 atoms of the molecule in the



chain. The Symm-Clashes column gives symmetry related clashes, in the same way as for the Clashes column.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	2313	0	2234	23	0
1	B	2402	0	2316	27	0
2	C	1188	0	1209	25	0
2	D	1214	0	1234	21	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
3	C	3	0	0	0	0
3	D	3	0	0	0	0
All	All	7125	0	6993	92	0

Clashscore is defined as the number of clashes calculated for the entry per 1000 atoms (including hydrogens) of the entry. The overall clashscore for this entry is 7.

The worst 5 of 92 close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
2:C:1004:ARG:HH11	2:C:1004:ARG:HG3	1.31	0.93
2:C:1042:SER:HB2	2:C:1045:GLU:HB2	1.59	0.82
1:A:1622:MET:HE3	1:A:1682:ARG:HH22	1.48	0.79
1:B:1861:ARG:O	1:B:1864:THR:HB	1.82	0.79
2:D:1003:ASP:O	2:D:1068:ARG:O	2.05	0.74

There are no symmetry-related clashes.

## 5.3 Torsion angles

### 5.3.1 Protein backbone ⓘ

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	281/326 (86%)	278 (99%)	2 (1%)	1 (0%)	43	79
1	B	294/326 (90%)	289 (98%)	5 (2%)	0	100	100
2	C	147/161 (91%)	141 (96%)	5 (3%)	1 (1%)	30	67
2	D	152/161 (94%)	146 (96%)	4 (3%)	2 (1%)	18	47
All	All	874/974 (90%)	854 (98%)	16 (2%)	4 (0%)	38	74

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	1763	SER
2	D	1026	GLU
2	C	915	VAL
2	D	915	VAL

### 5.3.2 Protein sidechains ⓘ

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	237/269 (88%)	229 (97%)	8 (3%)	49	83
1	B	246/269 (91%)	239 (97%)	7 (3%)	56	87
2	C	132/138 (96%)	125 (95%)	7 (5%)	32	65
2	D	134/138 (97%)	128 (96%)	6 (4%)	38	72
All	All	749/814 (92%)	721 (96%)	28 (4%)	45	80

5 of 28 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	1826	LEU
2	C	929	SER
2	D	1026	GLU
1	B	1863	GLN
1	B	1869	GLU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 8 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	1667	GLN
2	D	984	GLN
2	C	931	HIS
1	A	1863	GLN
1	B	1694	GLN

### 5.3.3 RNA ⓘ

There are no RNA chains in this entry.

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

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

## 5.5 Carbohydrates ⓘ

There are no carbohydrates in this entry.

## 5.6 Ligand geometry ⓘ

Of 8 ligands modelled in this entry, 8 are monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

## 5.7 Other polymers ⓘ

There are no such residues in this entry.

## 5.8 Polymer linkage issues

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<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	285/326 (87%)	0.14	12 (4%) 35 37	13, 26, 38, 62	0
1	B	298/326 (91%)	0.01	3 (1%) 79 81	12, 26, 38, 71	0
2	C	153/161 (95%)	-0.04	6 (3%) 37 40	6, 29, 39, 51	0
2	D	156/161 (96%)	-0.04	1 (0%) 86 89	17, 29, 41, 75	0
All	All	892/974 (91%)	0.03	22 (2%) 53 58	6, 27, 39, 75	0

The worst 5 of 22 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	1845	VAL	5.0
1	A	1843	ARG	4.8
1	A	1720	GLN	4.6
1	A	1842	GLU	4.2
1	A	1841	PHE	4.2

### 6.2 Non-standard residues in protein, DNA, RNA chains

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

### 6.3 Carbohydrates

There are no carbohydrates in this entry.

### 6.4 Ligands

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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. The B-factors column lists the minimum, median, 95<sup>th</sup> 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	RSR	LLDF	B-factors( $\text{\AA}^2$ )	Q<0.9
3	HG	C	6	1/1	0.34	3.94	89,89,89,89	1
3	HG	B	8	1/1	0.12	-1.25	130,130,130,130	0
3	HG	C	1	1/1	0.04	-2.83	73,73,73,73	0
3	HG	A	7	1/1	0.08	-3.70	123,123,123,123	0
3	HG	D	2	1/1	0.07	-4.18	78,78,78,78	0
3	HG	D	3	1/1	0.04	-4.33	69,69,69,69	0
3	HG	D	4	1/1	0.05	-4.55	67,67,67,67	0
3	HG	C	5	1/1	0.04	-4.76	100,100,100,100	0

## 6.5 Other polymers ⓘ

There are no such residues in this entry.