An $n \rightarrow \pi^*$ Interaction in the Bound Substrate of Aspartic Proteases Replicates the Oxyanion Hole

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Table S1 Measured Parameters from PDB Entries

PDB ID	Res. (Å)	sequence	chain	P1		P1′			
				ϕ (°)	ψ (°)	ϕ (°)	ψ (°)	d (Å)	θ (°)
1f7a	2.00	KARVL/AEAM	P	−88.4	51.7	−69.9	147	2.9	97.4
1kj4	2.90	VSQNY/PIVQ	P	−107.1	58.7	−79.9	147.4	3.0	103.5
—	—	VSQNY/PIV	S	−108.1	47.8	−73.1	133.8	3.0	110.2
1kj7	2.00	ATIM/MQRG	P	−88.5	40.8	−68.2	138.7	2.9	103
1kjf	2.00	RPGNF/LQSRP	P	−97.9	47.1	−57.8	145.4	2.8	90.6
1kjg	2.00	AETF/YVDGA	P	−92	55.5	−74.9	138.5	3.1	105.1
1kjh	2.00	IRKIL/FLDGI	P	−92.5	49.4	−68.7	146.5	3.0	95.4
1mt7	1.90	VSQNY/PIV	P	−107.5	48.7	−77.6	148.6	3.0	101.4
1mt8	1.85	ARVL/AEAM	P	−88.6	52.1	−68.9	147	2.9	96.3
1mt9	2.00	RPGNF/LQSRP	P	−92.9	44.6	−58.3	149.4	2.8	88.3
1tsq	2.00	RQVN/FLGKIN	P	−78.4	77	−92.7	143.6	3.4	109
1tsu	2.10	RQAN/FLGK	P	−61.3	34.4	−50.4	152.7	2.8	79.8
2fns	1.85	RQAN/FLG	P	−84.4	13.5	−54.8	154.5	2.9	82.6
2fnt	1.44	RQVN/FLG	P,AltA	−90.9	38.7	−46.9	157.2	2.8	78.6
2nxd	2.00	ADIF/YLDG	P	−99.8	58.9	−63.5	141.2	3.2	101.3
2nxl	2.00	AEVF/YVDGA	P	−93	51.6	−56.2	137	3.0	102.9
2nxm	2.25	AQTF/YVDG	P	−101.7	47.6	−54.3	126.4	3.0	107.5
3bxr	1.60	macrocycle	B	−101.4	50	−72.3	142.5	3.1	100.2
3d3t	2.80	GNF/LQSRP	P	−96	65.2	−58.2	146.9	3.0	95.4
3fiv	1.85	NalVL/AENal	C	−75.1	47.4	−73.7	151.5	3.0	94.1
—	—	NalVL/AENal	D	−75.3	47.5	−73.7	151.6	3.0	94.7
4fae	2.30	TIM/MQRG	D	−85.3	58.5	−86.6	132.3	3.4	113.3
4faf	2.10	RVL/FEAM	D	−90.7	54.7	−60.3	137.8	3.0	98.7
4obd	1.90	PGNF/FQNRP	E	−105.4	33.9	−45.2	136.5	2.8	93.1
—	—	PGNF/FQNR	F	−103.1	36.7	−41.6	131.3	2.8	94
4obf	1.68	RPGNF/LQNRP	E	−105.2	40	−41.1	134.5	2.8	93.1
—	—	GNF/LQNR	F	−98.3	45	−39.9	134.6	2.9	100.6
4obg	1.78	RPGNF/LQSRP	E	−110.6	38.9	−43.4	135.6	2.8	94.3
—	—	RPGNF/LQSR	F	−93.6	44.6	−44.8	135.4	2.9	100.1
4obh	1.85	RPGNF/FQSRP	E	−101.1	38.8	−47.4	136.3	2.8	93.1
—	—	RPGNF/FQSRP	F	−107.6	33.8	−45.1	135.6	2.8	91.3
4obj	1.75	RPGNF/LQNRP	C	−101	37.1	−41.2	139	2.7	94.3
4obk	1.65	RPGNF/FQNRP	C	−100.3	34.4	−45.8	139.2	2.8	93.6
4qj6	1.50	RPGNF/FQSRP	E	−101.6	36.9	−48.1	136.7	2.8	95
—	—	PGNF/FQSR	F	−97.6	39.8	−43.5	132	2.9	97.1
4qj7	1.67	PGNF/LQSS	E	−91.6	38	−43.5	138.7	2.8	96.3
—	—	PGNF/LQSSP	F	−101.5	39	−41.1	130.4	2.7	97.6
4qj8	2.00	RPGNF/LQSRL	E	−102.2	42.2	−41.6	130.2	2.7	98.3
—	—	RPGNF/LQSRL	F	−105.3	36.4	−40.9	132.4	2.7	95.7
4qj9	1.83	RPGNF/LQSSP	P	−93.7	44.2	−45	131.2	2.8	97.1
4qja	1.54	RPGNF/LQSRL	P	−99.5	36.1	−40.7	135.3	2.7	95.3
6bra	1.11	SGIF/LETS	S, AltA	−95.4	43.2	−48.7	137.1	2.9	96.8
—	—	SGIF/LETS	S, AltB	−96.3	49.1	−52.9	139.9	2.9	96.9
			Mean ± SD	−95.5 ± 10.1	44.9 ± 10.4	−56.3 ± 14.5	140.0 ± 7.5	2.9 ± 0.2	96.8 ± 7.0

Table S2 Measured Parameters from CSD Entry SOWJUL

Residue	ϕ (°)	ψ (°)	d (Å)	θ (°)
1	–67.1	146.5	3.0	102.9
2	–65.7	138.4	2.9	106.5
3	–73.1	163.9	3.1	89.8
4	–72.8	152.0	3.1	98.9
5	–72.5	165.7	3.2	88.2
6	–69.0	152.5	3.0	98.2
Mean ± SD	−70.0 ± 3.2	153.2 ± 10.4	3.1 ± 0.1	97.4 ± 7.2

Table S3 Coordinates Extracted from PDB Entry 6bra and Optimized Hydrogen Atoms

C	-7.24337900	2.59174500	1.99204500
C	-5.80699300	3.00454000	2.28006000
C	-4.80021800	2.07042100	1.67115000
N	-5.29355300	1.02813500	0.99541800
O	-3.59684100	2.25559400	1.80822700
H	-6.27593900	0.91422300	0.81765900
H	-7.93901300	3.29107100	2.45871600
H	-5.61028800	3.03497800	3.35413500
H	-4.68357900	0.41438400	0.46742400
H	-7.46746800	1.60338000	2.39704200
H	-5.59438500	4.00312000	1.89160800
H	-7.45921900	2.59959500	0.92192100
C	4.50315700	-2.66943900	2.17954400
C	5.34987000	-2.76866700	0.93273200
O	6.51272000	-3.17583400	0.99610700
H	4.34284600	-3.67535700	2.57149200
H	3.53591100	-2.19653500	2.00480300
H	5.05432100	-2.10169600	2.92973800
N	4.77913200	-2.39460500	-0.21005500
C	5.56086300	-2.34637600	-1.43920100
H	5.95538000	-3.33569000	-1.67071400
H	3.93643300	-1.82897900	-0.17010400
H	6.39949100	-1.65184500	-1.34663600
H	4.91144200	-2.02229800	-2.24986800
C	-7.17082300	-2.71314600	-1.97665500
C	-5.71364400	-3.06179800	-2.23923800
C	-4.76266000	-2.06995400	-1.63863300
N	-3.48856200	-2.42722900	-1.59960800
O	-5.15569000	-0.99479400	-1.19167900
H	-3.20799100	-3.31462600	-1.98804600
H	-7.41367500	-1.73125900	-2.38298500
H	-5.51747800	-3.09730000	-3.31616500
H	-2.75724100	-1.79518600	-1.28692500
H	-7.38023900	-2.69378500	-0.90596000
H	-5.47457500	-4.05755700	-1.85569700
H	-7.82677400	-3.45107700	-2.44070200
C	4.52378900	1.88530200	-2.31648200
C	4.93144200	2.64633800	-1.07263700
O	5.58118200	3.69005200	-1.17225000
H	3.99335200	0.96025000	-2.09544400
H	5.42117400	1.66649000	-2.89670200
H	3.88180200	2.52963400	-2.91957800
N	4.55309600	2.13944900	0.10396200
C	4.86999500	2.83393300	1.35144600
H	3.98285400	1.29349900	0.11926800
H	4.44948800	2.26431000	2.17818500
H	4.44474300	3.83947800	1.35268200
H	5.95014200	2.91615100	1.48438200
C	0.37023400	-0.69843300	4.53408000
C	0.55234200	-0.77105800	3.02613400
O	1.58140000	-0.34060000	2.48460900
H	-0.64297900	-0.94420600	4.84685400
H	0.63145600	0.30418000	4.86950200
H	1.06865400	-1.40411200	4.98740700
N	-0.44006000	-1.32007100	2.32905700
C	-0.28425800	-1.67021900	0.91765700
C	-0.78651700	-0.59667800	-0.03793000
O	-1.45469300	-0.87688100	-1.03801600
C	-0.87481900	-3.04365700	0.63709600
H	-1.26292600	-1.65377400	2.81151900
H	0.79572600	-1.71863800	0.73918500
H	-0.70112300	-3.31902500	-0.40232900
H	-1.95233900	-3.05404000	0.81701100
H	-0.39749100	-3.77902000	1.28423600
N	-0.46524300	0.65705400	0.26996700
C	-0.51283400	1.71399800	-0.72645700
C	0.20929500	1.25997600	-1.98784400
O	1.28031800	0.64941900	-1.92448200
C	0.20290400	2.94305100	-0.16463900
H	0.15368400	0.80157600	1.06044800
H	-1.55446100	1.94616800	-0.95849300
H	-0.28975000	3.27555300	0.74989100
H	0.18051100	3.75739200	-0.88895200
H	1.24559700	2.69881400	0.05629500
N	-0.38855800	1.54876300	-3.13939800
C	0.28427600	1.30047600	-4.40653100
H	-1.27192200	2.03568500	-3.13055400
H	0.46696000	0.23282300	-4.53155200
H	1.23860500	1.82752000	-4.43859500
H	-0.35268900	1.65364200	-5.21321200
O	2.89409100	-0.05139800	-0.03173400
H	2.20889600	0.20227300	-0.69019900
H	2.43829800	-0.14724500	0.82216300

Table S4 Coordinates Extracted from PDB Entry 3b80 and Optimized Hydrogen Atoms

C	7.14445100	2.43465000	-2.11890900
C	5.69556400	2.77521500	-2.39618600
C	4.74001900	1.82177400	-1.71029600
O	5.18507200	0.74213900	-1.22960900
O	3.51274800	2.15873700	-1.64786200
H	5.52441200	2.72995800	-3.47221500
H	7.77072100	2.82584900	-2.91984800
H	5.50665300	3.77476300	-2.00507900
H	7.26011800	1.35250900	-2.06190000
H	7.44646700	2.88159300	-1.17077000
C	-4.88670300	-2.90194400	-1.80800600
C	-5.84044200	-3.11528900	-0.66000300
O	-7.01061400	-3.45335100	-0.79196300
H	-4.93341000	-1.86292900	-2.13138800
H	-5.16320200	-3.55427200	-2.63690200
H	-3.87256400	-3.13656200	-1.48525200
N	-5.24390200	-2.88638700	0.49658700
C	-6.09137500	-2.81548900	1.64424100
H	-5.91998700	-3.68547000	2.27772000
H	-4.24254800	-2.76818000	0.56588200
H	-7.13316700	-2.79615400	1.32537000
H	-5.86643000	-1.90824500	2.20535200
C	7.10429200	-2.47808900	2.05625800
C	5.62292600	-2.76242500	2.30263900
C	4.66493700	-1.81667600	1.58771000
O	5.15361900	-0.78549200	1.05474800
O	3.44704900	-2.16615000	1.60122500
H	5.43685800	-2.69045600	3.37416900
H	7.20611900	-1.57263600	1.45829500
H	5.43158100	-3.75738300	1.90040900
H	7.55268100	-3.31695200	1.52501000
H	7.61095500	-2.34004000	3.01213700
C	-4.58914100	2.26579600	1.62190200
C	-5.38652300	2.91155000	0.48866100
O	-6.34267800	3.64703200	0.71774500
H	-3.68157000	1.81645800	1.21874000
H	-5.19536800	1.49604800	2.10053500
H	-4.32201100	3.02613000	2.35696300
N	-4.95617200	2.60833500	-0.70598800
C	-5.54338400	3.23169700	-1.88395000
H	-4.84241500	3.17074400	-2.71595700
H	-4.20955300	1.93674000	-0.81436400
H	-5.76467600	4.27777300	-1.67027700
H	-6.46494400	2.71239500	-2.14718700
C	-0.07444500	-1.49178600	-4.33948300
C	-0.21829900	-1.23103700	-2.84087100
O	-1.29611300	-0.81880500	-2.38899200
H	0.53925700	-2.37894500	-4.49753300
H	0.39939600	-0.63248900	-4.81469400
H	-1.06016300	-1.64990100	-4.77640400
C	0.78858200	-1.60992200	-0.62679200
C	-0.32451500	1.31556500	2.05381900
O	-1.37205900	0.69171300	1.92693100
N	0.88086400	-1.48066500	-2.08706900
C	1.38312700	-0.36281400	0.08419500
C	1.43052300	-2.95758000	-0.23187100
O	1.44643300	-0.75256400	1.44040900
O	2.73249800	-0.08315800	-0.31069000
N	0.57809200	0.83528700	-0.19844500
C	0.53812600	1.82842600	0.87266300
C	-0.03958500	3.25192200	0.55723400
H	-0.89314300	3.15912100	-0.11389600
H	-0.30816300	0.73948100	-0.76219500
H	2.07817300	-1.46921800	1.53874300
H	0.72722500	3.86119100	0.07996200
H	-0.24818500	-1.63137000	-0.29043400
H	1.77941000	-1.57861400	-2.53731600
H	1.68643100	-2.92308000	0.82687300
H	3.33785900	-0.45163000	0.33719500
H	1.60183200	1.95056900	1.07578900
H	-0.35618100	3.72308800	1.48799300
H	0.75361000	-3.79904400	-0.38138200
H	2.31059500	-3.09452700	-0.86049600
N	0.26264200	1.66336300	3.24510200
C	-0.69001100	1.70607100	4.37081100
H	-0.57674700	0.80736700	4.97719000
H	1.24667100	1.86890800	3.34020200
H	-1.70767400	1.75774000	3.98443900
H	-0.48838800	2.58468900	4.98273100
O	-2.68350000	0.03434700	-0.30178000
H	-2.11674400	-0.26596800	-1.01606200
H	-2.14638800	0.25218700	0.46350200
H	2.90752400	1.66595800	-1.0888690