

Publications

David Fushman

Articles:

1. B. Lemma, D. Zhang, G. B. Vamiseti, B. G. Wentz, H. Suga, A. Brik, J. Lubkowski, D. Fushman, "Mechanism of selective recognition of Lys48-linked polyubiquitin by macrocyclic peptide inhibitors of proteasomal degradation", **Nature Communications** (2023) 14, 7212. <https://doi.org/10.1038/s41467-023-43025-4>
2. R. Dani, W. Pawloski, D. K. Chaurasiya, N. Srilatha, S. Agarwal, D. Fushman, A. Naganathan, "Conformational Tuning Shapes the Balance between Functional Promiscuity and Specialization in Paralogous Plasmodium Acyl-CoA Binding Proteins", **Biochemistry** (2023) 62, 2982-2996. <https://doi.org/10.1021/acs.biochem.3c00449>
3. P. M. Wydorski, J. Osipiuk, B. T. Lanham, C. Tesar, M. Endres, E. Engle, R. Jedrzejczak, V. Mullapudi, K. Michalska, K. Fidelis, D. Fushman, A. Joachimiak, L. A. Joachimiak, "Dual domain recognition determines SARS-CoV-2 PLpro selectivity for human ISG15 and K48-linked di-ubiquitin", **Nature Communications** (2023) 14, 2366. <https://doi.org/10.1038/s41467-023-38031-5>
4. R. Gama Lima Costa, D. Fushman, "Reweighting methods for elucidation of conformation ensembles of proteins", **Current Opinion in Structural Biology** (2022) 77, 102470. <https://doi.org/10.1016/j.sbi.2022.102470>
5. T. E. O'Brien, L. B. Ioffe, Y. Su, D. Fushman, H. Neven, R. Babbush, V. Smelyanskiy, "Quantum computation of molecular structure using data from challenging-to-classically-simulate nuclear magnetic resonance experiments", **PRX Quantum** (2022) 3, 030345. <https://doi.org/10.1103/PRXQuantum.3.030345>
6. W. Pawloski, T. Komiyama, C. Kougentakis, A. Majumdar, D. Fushman, "Site-specific detection and characterization of ubiquitin carbamylation", **Biochemistry** (2022) 61, 712-721. <https://doi.org/10.1021/acs.biochem.2c00085>
7. S. M. Bonn, D. Fushman, "Backbone NMR resonance assignment of the intrinsically disordered UBact protein from *Nitrospira nitrosa*", **Biomolecular NMR Assignments** (2022) 16, 129-134. <https://doi.org/10.1007/s12104-022-10070-x>
8. A. Song, Z. Hazlett, D. Abeykoon, J. Dortch, A. Dillon, J. Curtiss, S. Bollinger Martinez, C. P. Hill, C. Yu, L. Huang, D. Fushman, R. E. Cohen, T. Yao, "Branched ubiquitin chain binding and deubiquitination by UCH37 facilitate proteasome clearance of stress-induced inclusions", **eLife** (2021) 10:e72798. <https://doi.org/10.7554/eLife.72798>

9. M. Strickland, S. Watanabe, S. M. Bonn, C. M. Camara, M. R. Starich, D. Fushman, C. A. Carter, N. Tjandra, "Tsg101/ESCRT-I Recruitment Regulated by the Dual Binding Modes of K63-Linked Diubiquitin", **Structure** (2021) 30, 289-299. <https://doi.org/10.1016/j.str.2021.09.006>
10. V. L. Linthwaite, W. Pawloski, H. B. Pegg, P. D. Townsend, M. J. Thomas, V. K. H. So, A. P. Brown, D. R. W. Hodgson, G. H. Lorimer, D. Fushman, M. J. Cann, "Ubiquitin is a carbon dioxide-binding protein", **Science Advances** (2021) 7, eabi5507. <https://doi.org/10.1126/sciadv.abi5507>
11. A. J. Boughton, L. Liu, T. Lavy, O. Kleifeld, D. Fushman, "A novel recognition site for polyubiquitin and ubiquitin-like signals in an unexpected region of proteasomal subunit Rpn1", **J Biol Chem** (2021) 297, 101052. <https://doi.org/10.1016/j.jbc.2021.101052>
12. C. Wiedemann, D. Fushman, F. Bordusa, "15N NMR studies provide insights into physico-chemical properties of room-temperature ionic liquids", **Phys Chem Chem Phys** (2021) 23, 12395-12407. <https://doi.org/10.1039/D1CP01492G>
13. A. J. Boughton, D. Zhang, R. K. Singh, D. Fushman, "Polyubiquitin and ubiquitin-like signals share common recognition sites on proteasomal subunit Rpn1", **J Biol Chem** (2021) 296, 100450. <https://doi.org/10.1016/j.jbc.2021.100450>.
14. J. Rogers, M. Nawatha, B. Lemma, G.B. Vamisetti, I. Livneh, U. Barash, I. Vlodaysky, A. Ciechanover, D. Fushman, H. Suga, A. Brik, "In vivo modulation of ubiquitin chains by N-methylated non-proteinogenic cyclic peptides", **RSC Chem. Biol.** (2021) 2, 513-522. <https://doi.org/10.1039/d0cb00179a>
15. T.-J. Liao, H. Jang, D. Fushman, R. Nussinov, "SOS1 interacts with Grb2 through regions that induce closed nSH3 conformations", **J Chem Phys** (2020) 153, 045106; <https://doi.org/10.1063/5.0013926>.
16. J. Lubkowski, J. Vanegas, W.-K. Chan, P. L. Lorenzi, J. N. Weinstein, S. Sukharev, D. Fushman, S. Rempe, A. Anishkin, A. Wlodawer, "Mechanism of Catalysis by L-Asparaginase", **Biochemistry** (2020) 59, 1927-1945. <https://doi.org/10.1021/acs.biochem.0c00116>
17. H. M. Magnussen, S. F. Ahmed, G. J. Sibbet, V. A. Hristova, K. Nomura, A. K. Hock, L. J. Archibald, A. G. Jamieson, D. Fushman, K. H. Vousden, A. M. Weissman, D. T. Huang, "Structural basis for DNA damage-induced phosphoregulation of MDM2 RING domain", **Nature Communications** (2020) 11, Article # 2094. <https://doi.org/10.1038/s41467-020-15783-y>.
18. T.-J. Liao, H. Jang, R. Nussinov, D. Fushman, "High-affinity Interactions of the nSH3/cSH3 Domains of Grb2 with the C-terminal Proline-rich Domain of SOS1", **J Am Chem Soc** (2020), 142, 3401-3411. <http://dx.doi.org/10.1021/jacs.9b10710>.

19. A. J. Boughton, S. Krueger, D. Fushman, "Branching via K11 and K48 Bestows Ubiquitin Chains with a Unique Interdomain Interface and Enhanced Affinity for Proteasomal Subunit Rpn1", **Structure** (2020) 28, 29-43. <https://doi.org/10.1016/j.str.2019.10.008>.
20. X. Wu, S. Liu, C. Sagum, J. Chen, R. Singh, A. Chaturvedi, J. R Horton, T. R. Kashyap, D. Fushman, X. Cheng, M. T. Bedford, B. Wang, "Crosstalk between Lys63- and Lys11-polyubiquitin signaling at DNA damage sites is driven by Cezanne", **Genes & Development**, (2019) 33, 1702-1717. doi:10.1101/gad.332395.119.
21. Y. Chen, C. Jeong, A. Savelyev, S. Krueger, J. E. Curtis, E. H. Brookes, D. Fushman, "ROTDIF-web and ALTENS: GenApp-based Science Gateways for Biomolecular Nuclear Magnetic Resonance (NMR) Data Analysis and Structure Modeling", **Gateways 2019**, San Diego. DOI: 10.17605/OSF.IO/T4GKH
22. M. Nawatha, J. Rogers, S. M. Bonn, I. Livneh, B. Lemma, S. M. Mali, G. B. Vamisetti, H. Sun, B. Bercovich, Y. Huang, A. Ciechanover, D. Fushman, H. Suga, A. Brik, "De novo macrocyclic peptides that specifically modulate Lys48-linked ubiquitin chains", **Nature Chemistry** (2019) 11, 644-652.
23. A. Narayan, S. Gopi, D. Fushman, A. N. Naganathan, "A Binding Cooperativity Switch Driven by Synergistic Structural Swelling of an Osmo-Regulatory Protein Pair", **Nature Communications** (2019) 10, Article #1995. <https://doi.org/10.1038/s41467-019-10002-9>.
24. C. N. Braxton, E. Quartner, W. Pawloski, D. Fushman, T. A. Cropp, "Ubiquitin chains bearing genetically encoded photo-crosslinkers enable efficient covalent capture of (poly)ubiquitin-binding domains", **Biochemistry** (2019) 58, 883-886. DOI: 10.1021/acs.biochem.8b01089
25. Ashkar, R.; Bilheux, H.; Bordallo, H.; Briber, R.; Callaway, D.; Cheng, X.; Chu, X.-Q.; Curtis, J.; Dadmun, M.; Fenimore, P.; Fushman, D.; Gabel, F.; Gupta, K.; Herberle, F.; Heinrich, F.; Hong, L.; Katsaras, J.; Kelman, Z.; Kharlampieva, E.; Kneller, G.R.; Kovalevskyi, A.; Krueger, S.; Langan, P.; Libermann, R.; Liu, Y.; Losche, M.; Lyman, E.; Mao, Y.; Marino, J.; Mattos, C.; Meilleur, F.; Moody, P.; Nickels, J.D.; O'Dell, W.; O'Neill, H.; Perez-Salas, U.; Peters, J.; Petridis, L.; Sokolov, A.; Stanley, C.; Wagner, N.; Weinrich, M.; Weiss, K.; Wymore, T.; Zhang, Y.; Smith, J.C., "Neutron scattering in the biological sciences: progress and prospects", **Acta Cryst D** (2018) D74, 1129-1168, <https://doi.org/10.1107/S2059798318017503>
26. F. Gomes, B. Lemma, D. Abeykoon, D. Chen, Y. Wang, D. Fushman, C. Fenselau, "Top-down Analysis of Novel Synthetic Branched Proteins", **J Mass Spectrom** (2019) 54, 19-25. doi: 10.1002/jms.4303.
27. R. Nussinov, M. Zhang, C.-J. Tsai, T.-J. Liao, D. Fushman, H. Jang, "Autoinhibition in Ras effectors Raf, PI3Ka and RASSF5: A comprehensive review

- underscoring the challenges in pharmacological intervention”, **Biophysical Reviews** (2018) 5, 1263-1282. DOI: 10.1007/s12551-018-0461-0.
28. T.-J. Liao, H. Jang, D. Fushman, R. Nussinov, “Allosteric KRas4B can Modulate SOS1 Fast and Slow Ras Activation Cycles”, **Biophys J** (2018), 115, 629-641. DOI: 10.1016/j.bpj.2018.07.016.
 29. D. Chen, F. Gomes, D. Abeykoon, B. Lemma, Y. Wang, D. Fushman, C. Fenselau, “Top-down analysis of branched proteins using mass spectrometry”, **Anal Chem** (2018) 90, 4032–4038.
 30. Y. Kazansky, M.-Y. Lai, R. K. Singh, D. Fushman, “Impact of different ionization states of phosphorylated Serine-65 on ubiquitin structure and interactions”, **Sci Reports** (2018) 8, 2651.
 31. M. A. Nakasone, T. A. Lewis, O. Walker, A. Thakur, W. Mansour, C. A. Castañeda, J. L. Goeckeler-Fried, F. Parlatti, T.-F. Chou, O. Hayat, D. Zhang, C. M. Camara, S. M. Bonn, U. K. Nowicka, S. Krueger, M. H. Glickman, J. L. Brodsky, R. J. Deshaies, D. Fushman, “Structural basis for the inhibitory effects of ubistatins in the ubiquitin-proteasome pathway”, **Structure** (2017) 25, 1839-1855.
 32. R. K Singh, Y. Kazansky, D. Wathieu, D. Fushman, “The Hydrophobic Patch of Ubiquitin is Important for its Optimal Activation by Ubiquitin Activating Enzyme E1”, **Anal Chem** (2017) 89, 7852-7860. DOI: 10.1021/acs.analchem.6b04194.
 33. R. Nussinov, H. Jang, C.-J. Tsai, T.-J. Liao, S. Li, D. Fushman, J. Zhang, “Intrinsic protein disorder in oncogenic KRAS signaling”, **Cell. Mol. Life. Sci.**, (2017) 74, 3245-3261. DOI: 10.1007/s00018-017-2564-3.
 34. A. Ceccon, V. Tugarinov, A. Boughton, D. Fushman, G.M. Clore, “Probing the Binding Modes of a Multi-Domain Protein to Lipid-Based Nanoparticles by Relaxation-Based NMR”, **J Phys Chem Lett** (2017) 8, 2535-2540.
 35. F. Munari, A. Bortot, S. Zanzoni, M. D’Onofrio, D. Fushman, M. Assfalg, “Identification of primary and secondary UBA footprints on the surface of ubiquitin in cell-mimicking crowded solution”, **FEBS Lett.** (2017) 591, 979-990. DOI: 10.1002/1873-3468.12615.
 36. M. Chojnacki, W. Mansour, D. S. Hameed, R. K. Singh, F El Oualid, R. Rosenzweig, M. A. Nakasone, Z. Yu, F. Glaser, L. E. Kay, D. Fushman, H. Ovaa, M. H. Glickman, “Polyubiquitin-photoactivatable crosslinking reagents for mapping ubiquitin interactome identify Rpn1 as a proteasome ubiquitin-associating subunit”, **Cell Chem Biol** (2017) 24, 1-15.
 37. T.-J. Liao, H. Jang, C.-J. Tsai, D. Fushman, R. Nussinov, “The dynamic mechanism of RASSF5 and MST kinase activation by Ras”, **Phys Chem Chem Phys** (2017) 19, 6470-6480. DOI: 10.1039/C6CP08596B.
 38. D. Fushman, "Exploring Polyubiquitin as a Flexible Multiple-Ligand Binding Platform", **Structure** (2017) 25, 1-3. DOI:

<http://dx.doi.org/10.1016/j.str.2016.12.010>

39. A. Narayan, L. A. Campos, S. Bhatia, D. Fushman, A. N. Naganathan, "Graded Structural Polymorphism in a Bacterial Thermosensor Protein", **J. Am. Chem. Soc.** (2017) *139*, 792-802. DOI: 10.1021/jacs.6b10608
40. M. Chojnacki, D. Zhang, M. Talarowska, P. Gałeczki, J. Szemraj, D. Fushman, M. A. Nakasone, "Characterizing polyubiquitinated forms of the neurodegenerative ubiquitin mutant UBB+1", **FEBS Lett.** (2016) *590*, 4573-4585.
41. T-J. Liao, C.-J. Tsai, H. Jang, D. Fushman, R. Nussinov, "RASSF5: MST activator and tumor suppressor *in vivo* but opposite *in vitro*", **Cur Opin Struct Biol** (2016) *41*, 217-224. DOI: 10.1016/j.sbi.2016.09.001.
42. A. E. Lee, L. Geis-Asteggiate, E. K. Dixon, M. Miller, Y. Wang, D. Fushman, C. Fenselau, "Preparing to Read the Ubiquitin Code: Top-down analysis of unanchored ubiquitin tetramers", **J Mass Spectrom** (2016) *51*, 629-637. DOI: 10.1002/jms.3787.
43. A. E. Lee, L. Geis-Asteggiate, E. K. Dixon, Y. Kim, T. R. Kashyap, Y. Wang, D. Fushman, C. Fenselau, "Preparing to Read the Ubiquitin Code: Characterization of Ubiquitin trimers by Top-down Mass Spectrometry", **J Mass Spectrom** (2016) *51*, 315-321.
44. C. A. Castañeda, E. Dixon, O. Walker, A. Chaturvedi, M. A. Nakasone, J.E. Curtis, M. R. Reed, S. Krueger, T. A. Cropp, D. Fushman, "Linkage via K27 bestows ubiquitin chains with unique properties among polyubiquitins", **Structure** (2016) *24*, 423-436.
45. C. A. Castañeda, A. Chaturvedi, C. M. Camara, J.E. Curtis, S. Krueger, D. Fushman, "Linkage-specific conformational ensembles of non-canonical polyubiquitin chains", **Phys Chem Chem Phys** (2016) *18*, 5771 - 5788. DOI: 10.1039/C5CP04601G.
46. M. C. Burke, Y. Wang, A. E. Lee, E. K. Dixon, C. A. Castañeda, D. Fushman, C. Fenselau, "Unexpected trypsin cleavage at ubiquitinated lysines", **Anal Chem** (2015) *87*, 8144-8148. DOI: 10.1021/acs.analchem.5b01960
47. W. Andrałojć, K. Berlin, D. Fushman, C. Luchinat, G. Parigi, E. Ravera, L. Sgheri, "Information content of long-range NMR data for the characterization of conformational heterogeneity", **J Biomol NMR** (2015) *62*, 353-371. DOI: 10.1007/s10858-015-9951-6.
48. F. H. Schumann, R. Varadan, P. P. Tayakuniyil, J. H. Grossman, J. A. Camarero, D. Fushman, "Changing the topology of protein backbone: the effect of backbone cyclization on the structure and dynamics of a SH3 domain", **Frontiers in Chemistry** (2015) *3*, article 26; doi: 10.3389/fchem.2015.00026.
49. S. Zanzoni, A. Ceccon, M. Assfalg, R. K. Singh, D. Fushman, M. D'Onofrio, "Polyhydroxylated [60]Fullerene Binds Specifically to Functional Recognition Sites

on Monomeric and Dimeric Ubiquitin", **Nanoscale** (2015) 7, 7197-7205. DOI: 10.1039/c5nr00539f.

50. Z. Yu, N. Livnat-Levanon, O. Kleifeld, W. Mansour, M. A. Nakasone, C. A. Castañeda, E. K. Dixon, D. Fushman, N. Reis, E. Pick, M. H. Glickman, "Base-CP proteasome can serve as a platform for stepwise lid formation", **Bioscience Reports** (2015) 35(3):art:e00194. DOI:10.1042/BSR20140173.
51. U. Nowicka, D. Zhang, O. Walker, D. Krutauz, C. A. Castañeda, A. Chaturvedi, T. Y. Chen, N. Reis, M. H. Glickman, D. Fushman, "DNA-damage-inducible 1 protein (Ddi1) contains an uncharacteristic ubiquitin-like domain that binds ubiquitin", **Structure** (2015) 23, 542-557.
52. W. Mansour, M. A. Nakasone, M. von Delbrück, Z. Yu, D. Krutauz, N. Reis, O. Kleifeld, T. Sommer, D. Fushman, M. H. Glickman, "Disassembly of Lys11- and mixed-linkage polyubiquitin conjugates provide insights into function of proteasomal deubiquitinases Rpn11 and Ubp6", **J Biol Chem.** (2015) 290, 4688-704.
53. A. E. Lee, C. A. Castañeda, Y. Wang, D. Fushman, C. Fenselau, "Preparing to read the ubiquitin code: A middle-out strategy for characterization of all lysine-linked diubiquitins", **J Mass Spectrom** (2014) 49, 1272-1278.
54. D. Krutauz, N. Reis, M. A. Nakasone, P. Siman, D. Zhang, D. S. Kirkpatrick, S. P. Gygi, A. Brik, D. Fushman, M. H. Glickman, "Extended ubiquitin species are protein-based DUB inhibitors", **Nature Chemical Biology** (2014) 10, 664-670.
55. K. Berlin, N. A. Gumerov, D. Fushman, R. Duraiswami, "Hierarchical O(N) Computation of Small-Angle Scattering Profiles and their Associated Derivatives", **J Appl Cryst** (2014), 47, 755-761. DOI:10.1107/S1600576714004671.
56. R. K. Singh, A. Sundar, D. Fushman, "Nonenzymatic Rubylation and Ubiquitination of Proteins for Structural and Functional Studies", **Angew Chem Int Ed Engl** (2014), 53, 6120-6125. DOI: 10.1002/anie.201402642.
57. S. Y. Lee, L. Pullen, D. J. Virgil, C. A. Castañeda, D. Abeykoon, D. N. A. Bolon, D. Fushman, "Alanine scan of core positions in ubiquitin reveals links between dynamics, stability, and function", **J Mol Biol** (2014) 426, 1377-1389.
58. K. Berlin, A. Longhini, T. K. Dayie, D. Fushman, "Deriving Quantitative Dynamics Information for Proteins and RNAs using ROTDIF with a Graphical User Interface", **J Biomol NMR** (2013), 57, 333-352.
59. K. Berlin, C. A. Castañeda, D. Schneidman-Duhovny, A. Sali, A. Nava-Tudela, and D. Fushman, "Recovering a Representative Conformational Ensemble from Underdetermined Macromolecular Structural Data", **J. Am. Chem. Soc.** (2013) 135, 16595-16609.
60. N. Haj-Yahya, M. Haj-Yahya, C. A. Castañeda, L. Spasser, H. P. Hemantha, M. Jbara, M. Penner, A. Ciechanover, D. Fushman, A. Brik, "Organic Chemistry

Applied to Synthetic Proteins: Modifying the Vicinity of the Isopeptide Bond Revealed Differential Behavior of Ubiquitin Chains with Ubiquitin Interacting Proteins", **Angew Chem Int Ed Engl** (2013), 52, 11149-11153.

61. C. A. Castañeda, T. R. Kashyap, M. A. Nakasone, S. Krueger, D. Fushman, "Unique structural, dynamical, and functional properties of K11-linked polyubiquitin chains", **Structure** (2013) 21, 1168-1181.
62. E. K. Dixon, C. A. Castañeda, T. Kashyap, Y. Wang, D. Fushman, "Nonenzymatic assembly of branched polyubiquitin chains for structural and biochemical studies", **Bioorganic & Medicinal Chemistry** (2013) 21, 3421-3429.
63. M. A. Nakasone, N. Livnat-Levanon, M. H. Glickman, R. E. Cohen, D. Fushman, "Mixed-linkage ubiquitin chains send mixed messages", **Structure** (2013) 21, 727-740.
64. B. P. Roscoe, K. M. Thayer, K. B. Zeldovich, D. Fushman, D. N. A. Bolon, "Analyses of the effects of all ubiquitin point mutants on yeast growth rate", **J. Mol. Biol.** (2013) 425, 1363-1377.
65. R. K. Singh, S. Zerath, O. Kleifeld, M. Scheffner, M. H. Glickman, D. Fushman, "Recognition and Cleavage of Rub1 and Rub1-Ubiquitin Chains by Components of the Ubiquitin-Proteasome System", **Mol Cell Proteomics** (2012) 11, 1595-611.
66. J. Cannon, M. Nakasone, D. Fushman, C. Fenselau, "Proteomic Identification and Analysis of K63-linked Ubiquitin Conjugates", **Anal Chem** (2012) 84, 10121-8.
67. M. D'Onofrio, E. Gianolio, A. Ceccon, F. Arena, S. Zanzoni, D. Fushman, S. Aime, H. Molinari, M. Assfalg, "High relaxivity supramolecular adducts between human liver fatty acid binding protein and amphiphilic Gd(III)-complexes: structural basis for the design of intracellular targeting MRI probes", **Chemistry – A European Journal** (2012) 18, 9919-9928.
68. N. A. Gumerov, K. Berlin, D. Fushman, R. Duraiswami, "A Hierarchical Algorithm for Fast Debye Summation with Applications to Small Angle Scattering", **J. Comput. Chem.** (2012) 33, 1981-1996.
69. M.-Y. Lai, D. Zhang, N. LaRonde-LeBlanc, D. Fushman (senior author), "Structural and biochemical studies of the open state of Lys48-linked diubiquitin", **BBA – Molecular Cell Research** (2012), 1823, 2046-2056.
70. A. Lange, C. A. Castañeda, D. Hoeller, J.-M. Lancelin, D. Fushman, O. Walker, "Evidence for cooperative and domain-specific binding of the signal transducing adaptor molecule 2 (STAM2) to Lys63-linked diubiquitin", **J. Biol. Chem.** (2012) 287, 18687-99.
71. R. Rosenzweig, V. Bronner, D. Zhang, D. Fushman, M. H. Glickman, "Rpn1

and Rpn2 coordinate ubiquitin processing factors at the proteasome", *J. Biol. Chem.* (2012) 287, 14659-71.

72. D. Fushman, K. D. Wilkinson, "Structure and recognition of polyubiquitin chains of different lengths and linkage", *F1000 Biol Rep* (2011) 3:26; DOI: 10.3410/B3-26. Specific URL: <http://f1000.com/reports/b/3/26>
73. C. A. Castañeda, J. Liu, A. Chaturvedi, U. Nowicka, T. A. Cropp, D. Fushman, "Nonenzymatic Assembly of Natural Polyubiquitin Chains of Any Linkage Composition and Isotopic Labeling Scheme", *J. Am. Chem. Soc.* (2011) 133, 17855-17868
74. C. A. Castañeda, L. Spasser, S. N. Bavikar, A. Brik, D. Fushman, "Segmental Isotopic Labeling of Ubiquitin Chains to Unravel Monomer- Specific Molecular Behavior", *Angew Chem Int Ed Engl* (2011) 50, 11210-11214
75. A. Bornet, P. Ahuja, R. Sarkar, L. Fernandes, S. Hadji, S. Y. Lee, A. Haririnia, D. Fushman, G. Bodenhausen, and P. R. Vasos, "Long-Lived States to Monitor Protein Unfolding by Proton NMR", *ChemPhysChem* (2011) 12, 2729-2734
76. K. Berlin, D. P. O'Leary, D. Fushman, "Fast Approximations of the Rotational Diffusion Tensor and their Application to Structural Assembly of Molecular Complexes", *Proteins* (2011) 79, 2268-2281
77. L. Cai, D. Kosov, D. Fushman, "Density functional calculations of backbone 15N shielding tensors in beta-sheet and turn residues of protein G" *J. Biomol. NMR* (2011) 50, 19-33
78. C. A. Castañeda, J. Liu, T. R. Kashyap, R. K. Singh, D. Fushman, T. A. Cropp, "Controlled Enzymatic Synthesis of Natural-Linkage, Defined-Length Polyubiquitin Chains Using Lysines with Removable Protecting Groups", *Chem. Commun.* (2011) 47, 2026-2028
79. A. Caceres, F. Shang, E. Wawrousek, Q. Liu, O. Avidan, A. Cvekl, Y. Yang, A. Haririnia, A. Storaska, D. Fushman, J. Kuszak, E. Dudek, D. Smith, A. Taylor, "Perturbing the Ubiquitin Pathway Reveals How Mitosis Is Hijacked to Denucleate and Regulate Cell Proliferation and Differentiation In Vivo", *PLoS One* (2010) 5, e13331
80. J. Liu, C. A. Castañeda, B. J. Wilkins, D. Fushman, T. A. Cropp, "Condensed E. coli cultures for highly efficient production of proteins containing unnatural amino acids", *Bioorganic & Medicinal Chemistry Letters* (2010) 20, 5613-5616
81. Y. Li, X. Yu, J. Ho, D. Fushman, N. M. Allewell, M. Tuchman, D. Shi, "Reversible Post-Translational Carboxylation Modulates the Enzymatic Activity of N-Acetyl-L-ornithine Transcarbamylase", *Biochemistry* (2010) 49, 6887-6895
82. D. Fushman, O. Walker "Exploring linkage dependence of polyubiquitin

- conformations using molecular modeling", *J. Mol. Biol.* (2010) 395, 803-814
83. D. Zhang, T. Chen, I. Ziv, R. Rosenzweig, V. Bronner, Y. Matiuhin, M. H. Glickman, D. Fushman "Together, Rpn10 and Dsk2 can serve as a polyubiquitin chain-length sensor", *Molecular Cell* (2009), 36, 1018-1033
 84. K. Berlin, D. P. O'Leary, D. Fushman "Improvement and Analysis of Computational Methods for Prediction of Residual Dipolar Couplings", *J. Magn. Reson* (2009) 201, 25-33
 85. L. Cai, D. Fushman, D. Kosov "Density functional calculations of ^{15}N chemical shifts in solvated dipeptides" *J. Biomol. NMR* (2009) 45, 245-253
 86. N. Zhang, Q. Wang, A. Ehlinger, L. Randles, J. W. Lary, Y. Kang, A. Haririnia, A. J. Storaska, J. L. Cole, D. Fushman, K. J. Walters "Structure of the S5a:K48 linked diubiquitin complex and its interactions with Rpn13", *Molecular Cell* (2009) 35, 280-290
 87. J. J. Sims, A. Haririnia, B. C. Dickinson, D. Fushman, R. E. Cohen "Avid interactions underlie the K63-linked polyubiquitin binding specificities observed for UBA domains" *Nature Structural & Molecular Biology* (2009) 16, 883-889
 88. T. Wang, L. Yin, E. M. Cooper, M.-Y. Lai, S. Dickey, C. M. Pickart, D. Fushman, K. D. Wilkinson, R. E. Cohen, C. Wolberger, "Evidence for bidentate substrate binding as the basis for the K48 linkage specificity of Otubain 1," *J. Mol. Biol.* (2009) 386, 1011-23
 89. T. Chen, D. Zhang, Y. Matiuhin, M. H. Glickman, D. Fushman. " ^1H , ^{13}C , and ^{15}N resonance assignment of the ubiquitin-like domain from Dsk2p," *Biomol NMR Assign* (2008) 2, 147-149
 90. L. Cai, D. Fushman, D. Kosov "Density functional calculations of ^{15}N chemical shifts in solvated dipeptides," *J. Biomol. NMR* (2008) 42, 77-88
 91. D. Zhang, S. Raasi, D. Fushman "Affinity makes the difference: non-selective interaction of the UBA domain of ubiquitin-1 with monomeric ubiquitin and polyubiquitin chains", *J. Mol. Biol.* (2008) 377, 162-180.
 92. A. Haririnia, R. Verma, N. Purohit, M.Z. Twarog, R.J. Deshaies, D. Bolon, D. Fushman "Mutations in the Hydrophobic Core of Ubiquitin Differentially Affect its Recognition by Receptor Proteins", *J. Mol. Biol.* (2008) 375, 979-996.
 93. Y. Ryabov, D. Fushman, "Structural assembly of multidomain proteins and protein complexes guided by the overall rotational diffusion tensor," *J. Am. Chem. Soc.* (2007) 129, 7894-7902.
 94. M. Sadqi, D. Fushman, V. Muñoz, "Analysis of 'downhill' protein folding; Analysis of protein-folding cooperativity (Reply)" *Nature*, (2007) 445, E17-E18.
 95. A. Haririnia, M. D'Onofrio, D. Fushman, "Mapping the interactions between Lys48- and Lys63-linked di-ubiquitins and a ubiquitin-interacting motif of S5a", *J.*

- Mol. Biol.** (2007), 368, 753-766.
96. M. J. Eddins, R. Varadan, D. Fushman, C. M. Pickart, C. Wolberger "Crystal structure and solution NMR studies of Lys48-linked tetraubiquitin at neutral pH", **J. Mol. Biol.** (2007) 367, 204-211.
 97. Ya. Ryabov, D. Fushman, "A Model of Interdomain Mobility in a Multi-Domain Protein", **J.Am.Chem.Soc.** (2007) 129, 3515-3527.
 98. B. Dickinson, R. Varadan, D. Fushman, "Effects of cyclization on conformational dynamics and binding properties of Lys48-linked di-ubiquitin", **Protein Science** (2007) 16, 369-378.
 99. Ya. Ryabov, C. Geraghty, A. Varshney, D. Fushman, "An efficient computational method for predicting rotational diffusion tensors of globular proteins using an ellipsoid representation" **J.Am.Chem.Soc.** (2006) 128, 15432-15444.
 100. P. R. Vasos, J. B. Hall, R. Kümmerle, D. Fushman "Measurement of ^{15}N relaxation in deuterated amide groups in proteins using direct nitrogen detection", **J. Biomol. NMR** (2006) 36, 27-36.
 101. M. Sadqi, D. Fushman, V. Muñoz "Atom-by-atom analysis of global downhill protein folding" **Nature** (2006) 442, 317-321.
 102. Ya. Ryabov, D. Fushman "Analysis of Interdomain Dynamics in a Two-Domain Protein Using Residual Dipolar Couplings Together with ^{15}N Relaxation Data" **Magnetic Resonance in Chemistry** (2006) 44, 143-151.
 103. J. B. Hall, D. Fushman "Variability of the ^{15}N Chemical Shielding Tensors in the B3 Domain of Protein G from ^{15}N Relaxation Measurements at Several Fields. Implications for Backbone Order Parameters" **J. Amer. Chem. Soc.** (2006) 128, 7855-7870.
 104. Ya. Ryabov, D. Fushman "Interdomain Mobility in Di-Ubiquitin Revealed by NMR" **Proteins: Structure, Function, and Bioinformatics** (2006) 63, 787-796.
 105. S. Raasi, R. Varadan, D. Fushman, C.M. Pickart. "Diverse polyubiquitin interaction properties of ubiquitin-associated domains" **Nature Struct Mol Biol** (2005) 12, 708-714.
 106. R. Varadan, M. Assfalg, S. Raasi, C. Pickart, D. Fushman "Structural determinants for selective recognition of a Lys48-linked polyubiquitin chain by a UBA domain" **Molecular Cell** (2005) 18, 687-698.
 107. A.D.J. van Dijk, D. Fushman, A.M.J.J. Bonvin, "Various strategies of using residual dipolar couplings in NMR-driven protein docking: application to Lys48-linked di-ubiquitin and validation against ^{15}N -relaxation data", **Proteins: Structure, Function, and Bioinformatics** (2005) 60, 367-381.
 108. P. R. Vasos, J. B. Hall, D. Fushman, "Spin-State Selection for Increased

- Confidence in Cross-Correlation Rates Measurements", **J. Biomol. NMR** (2005) 31, 146-154.
109. R. Verma, N.R. Peters, M. D'Onofrio, G.P. Tochtrop, K.M. Sakamoto, R. Varadan, M. Zhang, P. Coffino, D. Fushman, R.J. Deshaies, R.W. King "Ubistatins Inhibit Proteasome-Dependent Degradation by Binding the Ubiquitin Chain", **Science** (2004) 306, 117-120.
110. C. Pickart, D. Fushman "Polyubiquitin chains: polymeric protein signals", **Current Opinions in Chemical Biology** (2004) 8, 610-616.
111. O. Walker, R. Varadan, D. Fushman "Efficient and accurate determination of the overall rotational diffusion tensor of a molecule from ^{15}N relaxation data using computer program ROTDIF", **J. Magn. Reson.** (2004) 168, 336-345.
112. D. Fushman, R. Varadan, M. Assfalg, O. Walker "Determining domain orientation in macromolecules by using spin-relaxation and residual dipolar coupling measurements" **Progress NMR Spectroscopy**, (2004) 44, 189-214.
113. R. Varadan, M. Assfalg, A. Haririnia, S. Raasi, C. Pickart, D. Fushman "Solution conformation of Lys⁶³-linked di-ubiquitin chain provides clues to functional diversity of polyubiquitin signaling", **J. Biol. Chem.**, (2004) 279, 7055-7063.
114. J. B. Hall, and D. Fushman, "Direct measurement of the transverse and longitudinal ^{15}N CSA/dipolar cross-correlation rate constants using ^1H coupled HSQC spectra" **Magnetic Resonance in Chemistry** (2003) 41, 837-842.
115. J. B. Hall, and D. Fushman, "Characterization of the overall and local dynamics of a protein with intermediate rotational anisotropy: Differentiating between conformational exchange and anisotropic diffusion in the B3 domain of protein G" **J. Biomol. NMR** (2003) 27, 261-275.
116. J. B. Hall, K. T. Dayie, and D. Fushman, "Direct measurement of the ^{15}N CSA/dipolar relaxation interference from coupled HSQC spectra " **J. Biomol. NMR** (2003) 26, 181-186.
117. R. Varadan, O. Walker, C. Pickart, D. Fushman "Structural properties of polyubiquitin chains in solution" **J. Mol. Biol.** (2002) 324, 637-647.
118. J. A. Camarero, D. Fushman, D. Cowburn, T. W. Muir "Peptide chemical ligation inside living cells: *in vivo* generation circular protein domain" **Bioorg. Med. Chem.** (2001) 9, 2479-2484.
119. J. A. Camarero, D. Fushman, S. Sato, I. Girit, D. Cowburn, D. P. Raleigh, T. W. Muir "Rescuing a destabilized protein fold through backbone cyclization" **J. Mol. Biol.** (2001) 308, 1045-62.
120. R. Ghose, D. Fushman, D. Cowburn "Determination of the Rotational Diffusion Tensor of Macromolecules in Solution from NMR Relaxation Data with a

Combination of Exact and Approximate Methods - Application to the Determination of Interdomain Orientation in Multidomain Proteins." **J. Magn. Reson.** (2001) *149*, 204-217.

121. S. Pfeiffer, D. Fushman, D. Cowburn "Simulated and NMR derived backbone dynamics of a protein with significant flexibility: A comparison of spectral densities for the β ARK PH domain." **J. Amer. Chem. Soc.** (2001) *123*, 3021-36.
122. D. Fushman, R. Ghose, D. Cowburn "The effect of finite sampling on the determination of orientational properties: A theoretical treatment with application to interatomic vectors in proteins." **J. Amer. Chem. Soc.** (2000) *122*, 10640-9.
123. P. Nicholas, D. Fushman, V. Ruchinky, D. Cowburn "The Virtual NMR Spectrometer: A Computer Program for Efficient Simulation of NMR Experiments Involving Pulsed Field Gradients." **J. Magn. Reson.** (2000) *145*, 262-275.
124. D. Fushman, N. Tjandra, and D. Cowburn "An approach to direct determination of protein dynamics from ^{15}N NMR relaxation at multiple fields, independent of variable ^{15}N chemical shift anisotropy and chemical exchange contributions." **J. Amer. Chem. Soc.** (1999) *121*, 8577-8582.
125. D. Fushman, R. Xu, and D. Cowburn "Direct determination of changes in interdomain orientation in Abl SH(32) on ligation: Use of orientational dependence of ^{15}N NMR relaxation." **Biochemistry** **38** (1999) 10225-10230.
126. J. M. McDonnell, D. Fushman, C. L. Milliman, S. J. Korsmeyer, and D. Cowburn "Solution structure of the pro-apoptotic molecule, BID: a structural basis for apoptotic agonists and antagonists." **Cell** **96** (1999) 625-634.
127. S. Pfeiffer, D. Fushman, and D. Cowburn "Impact of Cl^- and Na^+ ions on simulated structure and dynamics of β ARK1 PH domain." **Proteins** **34** (1999) 206-217.
128. C. Lücke, D. Fushman, C. Ludwig, J. A. Hamilton, J. C. Sacchettini, and H. Rüterjans "A comparative study of the backbone dynamics of two closely related lipid binding proteins: bovine heart fatty acid binding protein and porcine ileal lipid binding protein." **Molecular and Cellular Biochemistry** **192** (1999) 109-121.
129. D. Fushman and D. Cowburn "The effect of noncollinearity of ^{15}N - ^1H dipolar and ^{15}N CSA tensors and rotational anisotropy on ^{15}N relaxation rates, CSA/dipolar cross correlation, and TROSY." **J. Biomol. NMR** **13** (1999) 139-147.
130. D. Fushman, N. Tjandra, and D. Cowburn "Direct measurement of ^{15}N chemical shift anisotropy in solution." **J. Amer. Chem. Soc.** **120** (1998) 10947-10952.
131. D. Fushman and D. Cowburn "Model-independent analysis of ^{15}N chemical shift anisotropy from NMR relaxation data. Ubiquitin as a test example." **J. Amer.**

Chem.Soc. 120 (1998) 7109-7110.

132. J. M. McDonnell, D. Fushman, S. M. Cahill, W. Zhou, A. Wolven, C. B. Wilson, T. D. Nelle, M. D. Resh, J. Wills, and D. Cowburn "Solution structure and dynamics of the bioactive retroviral M domain from Rous sarcoma virus." **J. Mol. Biol. 279** (1998) 921-928.
133. D. Fushman, T. Najmabadi-Haske, S. Cahill, J. Zheng, H. LeVine III, and D. Cowburn "The Solution Structure and Dynamics of the Pleckstrin Homology Domain of G Protein-Coupled Receptor Kinase 2 (β -Adrenergic Receptor Kinase 1): A binding partner of $G_{\beta\gamma}$ subunits." **J. Biol. Chem. 273** (1998) 2835-2843.
134. J. M. McDonnell, D. Fushman, S. Cahill, B. J. Sutton, D. Cowburn. "Designed Peptide Mimics of Fc ϵ RI: A Structural Comparison of Retroenantiomeric β -hairpin Peptides by NMR." In **Peptides 1996**. Eds. R.Ramage, R.Epton, Mayflower Scientific Ltd., 1998, p.627-628.
135. J. M. McDonnell, D. Fushman, S. Cahill, B. J. Sutton, D. Cowburn "Solution structures of Fc ϵ RI α -chain mimics: A β -hairpin peptide and its retroenantiomer." **J. Amer. Chem. Soc. 119** (1997) 5321-5328.
136. D. Fushman, S. Cahill, & D. Cowburn "The main chain dynamics of the dynamin Pleckstrin Homology (PH) domain in solution: analysis of ^{15}N relaxation with monomer/dimer equilibration." **J. Mol. Biol. 266** (1997) 173-194.
137. D. Fushman, R. Weisemann, H. Thüring, O. Ohlenschläger, H. Rüterjans "Backbone dynamics of proteins studied by two-dimensional heteronuclear NMR spectroscopy and molecular dynamics simulations." **Int. J. of Quant. Chem. 59** (1996) 291-300.
138. V. I. Shlenkin, D. Fushman, N. N. Vylegzhanina, L. O. Jagodina, A. E. Al'tshuler "Global and local conformational transitions during heat-induced unfolding of lysozyme and bacterial ribonuclease in solution as revealed by spin-label ESR using the two-motional model." **Molekulyarnaya Biologiya 30** (1996) 864-875 (in Russian)(English translation: **Molecular Biology 30** (1996), No.4, Part 2, 509-515).
139. J. Zheng, S. M. Cahill, M. Lemmon, D. Fushman, J. Schlessinger, D. Cowburn "Identification of the binding site for acidic phospholipids on the dynamin PH domain of dynamin: Implications for stimulation of GTPase activity." **J. Mol. Biol. 255** (1996) 14-21.
140. D. Fushman, S. M. Cahill, M. A. Lemmon, J. Schlessinger, D. Cowburn "Solution structure of Pleckstrin homology domain of dynamin by heteronuclear NMR." **Proc. Natl. Acad. Sci. USA 92** (1995) 816-820.
141. D. Fushman, O. Ohlenschläger, H. Rüterjans "Determination of the backbone mobility of ribonuclease T1 and its 2'GMP complex using molecular dynamics simulations and NMR relaxation data." **J. Biomol. Struct. & Dynamics 11**

(1994) 1377-1402.

142. D. Fushman, R. Weisemann, H. Thüring, H. Rüterjans "Backbone dynamics of ribonuclease T1 and its complex with 2'GMP studied by two-dimensional heteronuclear NMR spectroscopy." **J. Biomol. NMR** **4** (1994) 61-78.
143. V. I. Shlenkin, D. A. Fushman, N. N. Vylegzhanina, L. O. Jagodina, V. D. Fedotov "Investigation of the molecular motion of spin-labeled lysozyme in solution by the use of ESR spectra and electron-spin relaxation." **J. Appl. Magn. Reson.** **5** (1993) 249-261.
144. N. K. Balabaev, A. S. Lemak, D. A. Fushman, Yu. V. Mironova "Simulation of a spin label behavior on a model surface." **SPIE** **1402** (1990) 53-69.
145. D. A. Fushman "Surface fractality of proteins from theory and NMR data." **J. Biomol. Struct. & Dynamics** **7** (1990) 1333-1344.
146. N. K. Balabaev, D. A. Fushman, A. S. Lemak, Yu. V. Mironova "Molecular dynamics simulation of a spin label on a model surface." Preprint of the Scientific Centre for Biological Research USSR Acad. Sci., Pushchino, 1990 22 pp.
147. D. A. Fushman "Rotational diffusion of globular proteins in solutions: Influence of the roughness of protein globule surface." In *Modern Problems of Physico-Chemical Biology*. Kazan, 1988 p.13-22 (in Russian).
148. D. A. Fushman "To saturation of inhomogeneously broadened lines in disordered spin systems in presence of phonon bottleneck." **Radiospectroscopiya** (Perm') 1988p.67-74 (in Russian).
149. D. A. Fushman "Saturation of the two-level systems in glasses under phonon bottleneck conditions." Preprint VINITI No 939-85, (1985) 8 pp. (in Russian).
150. B. I. Kochelaev, D. A. Fushman "Sound absorption in glasses, caused by the interaction of two-level systems." Preprint VINITI No 697-85, (1985) 6 pp. (in Russian).
151. D. A. Fushman "To the theory of spectral diffusion in disordered spin systems with correlation." Preprint VINITI No 5155-84 (1984) 16 pp. (in Russian).
152. B. I. Kochelaev, D. A. Fushman "Sound absorption in glasses due to interaction of two-level systems." **Fizika Tverdogo Tela** **27** (1985) 2779-2781 (English translation: **Soviet Physics - Solid State** **27** (1985) 1670-1672).
153. A. A. Antipin, B. I. Kochelaev, S. B. Orlinskii, D. A. Fushman, V. I. Shlenkin "Influence of two-level systems on electron phase relaxation in phosphate glasses at low temperatures." **ZhETP** **88** (1985) 1001-1011 (English translation: **Soviet Physics -JETP** **61** (1985) 589-594).
154. D. A. Fushman "Saturation of tunneling states in glasses in the presence of the phonon bottleneck." **Physica Status Solidi (b)** **129** (1985) K21-K25.

155. D. A. Fushman "Kinetic properties of the two-level systems in glasses with account of tunneling." *Physica Status Solidi (b)* **127** (1985) 679-688.

Chapters in books:

156. D. Fushman and D. Cowburn "Studying protein dynamics with NMR relaxation." In: *Structure, Motion, Interaction and Expression of Biological Macromolecules*. Eds. R. H. Sarma, M. H. Sarma, Adenine Press, 1998, pp. 63-77.
157. D. Fushman and D. Cowburn "Nuclear Magnetic Resonance relaxation in determination of residue-specific ^{15}N chemical shift tensors in proteins in solution: protein dynamics and structure, and applications of Transverse Relaxation Optimized Spectroscopy." In: *Nuclear Magnetic Resonance of Biological Macromolecules*. Eds. T. L. James, V. Dötsch, and U. Schmitz. (Methods in Enzymology, vol. 339), Academic Press, 2001, pp. 109-126.
158. D. Fushman "Determination of protein dynamics using ^{15}N relaxation measurements." In: *BioNMR in drug research*, ed. O. Zerbe, VCH-Wiley, Ch.12, pp. 283-308, 2002.
159. D. Fushman and D. Cowburn "Characterization of Inter-Domain Orientations in Solution Using the NMR Relaxation Approach." In: *Protein NMR for the Millenium*. (Biological Magnetic Resonance vol. 20) Eds. N. R. Krishna, L. Berliner, Kluwer, pp, 53-78, 2003.
160. J. B. Hall, O. Walker, and D. Fushman "Characterization of the overall rotational diffusion of a protein from ^{15}N relaxation measurements and hydrodynamic calculations", In: *Protein NMR techniques (Methods in Molecular Biology, vol. 278)*, Ed. A. K. Downing, Humana Press Inc, (2004) Ch.10.
161. R. Varadan, M. Assfalg, and D. Fushman "Using NMR spectroscopy to monitor ubiquitin chain conformation and interactions with ubiquitin-binding domains" In: *Ubiquitin and Protein Degradation*, Ed. R.J.Deshaies (Methods in Enzymology, Vol.399, part B), 177-192, Elsevier Academic Press, 2005.
162. D. Fushman, "Determining protein dynamics from ^{15}N relaxation data by using DYNAMICS", in *Protein NMR Techniques*, Third Edition, Eds. A. Shekhtman, D. S. Burz, Humana Press Inc., 2012, Volume 831, 485-511, Springer Science, DOI: 10.1007/978-1-61779-480-3_24.