Raúl Padrón

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Biography

Raul Padrón is a Professor at the Radiology Department of UMass Medical School, Worcester, U.S.A. His work started at Cambridge´ MRC Laboratory of Molecular Biology. He founded the Department (now Center) of Structural Biology of the Venezuelan Institute for Scientific Research (IVIC), where he was an International Research Scholar of Howard Hughes Medical Institute between 1997-2011. His lab and collaborators found: (1) by cryo-EM that in thick filaments of tarantula muscle the two heads form the myosin interacting-heads motif (IHM), where both ATPases were inhibited explaining relaxation (Nature 436: 1195, 2005). (2) that IHM is conserved since before the origin of animals revealing IHM importance as a relaxation ATPase inhibition and ATP energy-saving mechanism. (3) that a cooperative phosphorylation activation mechanism explains potentiation and post-tetanic potentiation on tarantula contracting muscles. (4) that mutations of hypertrophic cardiomyopathy concentrate on human cardiac IHM intramolecular interactions accounting for altered contractility, reduced diastolic relaxation, and increased energy consumption. Honors: Polar Prize, CONICIT and FONACIT Biology Prizes and National Prize in Science and Technology of Venezuela. Elected member of Latin-American Academy of Sciences in 2002, elected member of The World Academy of Sciences (TWAS) in 2004 and elected International Member of the U.S. National Academy of Sciences in 2018.

Personal information

Emails

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Websites & social links

- Raúl Padrón web page (https://www.umassmed.edu/padron-craig/)

Other IDs

- Scopus Author ID: 7006981954 (http://www.scopus.com/inward/authorDetails.url?authorID=7006981954&partnerID=MN8TOARS)
- ResearcherID: E-5975-2010 (http://www.researcherid.com/rid/E-5975-2010)

Keywords

- myosin interacting-heads motif (IHM), muscle contraction, myosin, muscle regulation, myosin regulatory light chain, thick filament activaction, thick filaments, structural biology, Hypertrophic cardiomyopathy (HCM), Dilated cardiomyopathy (DCM), Super-relaxation (HRX), Hyper-relaxation (HRX), tarantula thick filaments

Countries

- United States

Activities

Employments (1)

- **UMass Chan Medical School**
  Organization address: Worcester, Massachusetts, US
  Start date: 2020-01-01
  Role title: Professor
  Department: Radiology
  URL: https://profiles.umassmed.edu/display/22222598

Works (85)

- **Thick filament molecular interfaces play a critical role in the pathogenesis of hypertrophic cardiomyopathy**
  Publication date: 2026-07-07
  Journal: Proceedings of the National Academy of Sciences
  Type: journal-article
  URL: https://doi.org/10.1073/pnas.2529234123
  doi: 10.1073/pnas.2529234123 (https://doi.org/10.1073/pnas.2529234123)
- **Comparing cryo-EM structures of the vertebrate cardiac muscle thick filament**
  Publication date: 2026-06
  Journal: Biophysical Reviews
  Type: journal-article
  URL: https://doi.org/10.1007/s12551-025-01393-9
  doi: 10.1007/s12551-025-01393-9 (https://doi.org/10.1007/s12551-025-01393-9)
- **Cryo-EM Reveals How Cardiomyopathy Therapeutic Drugs Modulate the Myosin Motors of the Heart**
  Publication date: 2026-04-29

Journal: Science Advances
Type: journal-article
URL: https://www.science.org/doi/10.1126/sciadv.aed6472
doi: 10.1126/sciadv.aed6472 (https://doi.org/10.1126/sciadv.aed6472)

- **Cryo-EM Reveals How Cardiomyopathy Therapeutic Drugs Modulate the Myosin Motors of the Heart**
  Publication date: 2025-10-29
  Type: preprint
  URL: https://doi.org/10.1101/2025.10.29.685122
  doi: 10.1101/2025.10.29.685122 (https://doi.org/10.1101/2025.10.29.685122)
- **“QuickStainer”: a rapid negative staining device for improved preservation of molecular structure**
  Publication date: 2025-10-13
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- **Thick filament molecular interfaces play a critical role in pathogenesis of hypertrophic and dilated cardiomyopathy**
  Publication date: 2025-10-04
  Type: preprint
  URL: https://doi.org/10.1101/2025.10.03.680256
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- **Dominant myosin storage myopathy mutations disrupt striated muscles in Drosophila and the myosin tail-tail interactome of human cardiac thick filaments.**
  Publication date: 2024-11-01
  Journal: Genetics
  Type: journal-article
  URL: https://doi.org/10.1093/genetics/iyae174
  pmid: 39485824 (https://pubmed.ncbi.nlm.nih.gov/39485824)
  doi: 10.1093/genetics/iyae174 (https://doi.org/10.1093/genetics/iyae174)
- **Cryo-EM structure of the human cardiac myosin filament**
  Publication date: 2023-11-23
  Journal: Nature
  Type: journal-article
  URL: https://doi.org/10.1038/s41586-023-06691-4
  doi: 10.1038/s41586-023-06691-4 (https://doi.org/10.1038/s41586-023-06691-4)

- **Cryo-EM structure of the human cardiac myosin filament**
  Publication date: 2023-04-12
  Type: preprint
  URL: https://doi.org/10.1101/2023.04.11.536274
  doi: 10.1101/2023.04.11.536274 (https://doi.org/10.1101/2023.04.11.536274)
- **Variants of the myosin interacting-heads motif**
  Publication date: 2023-01-02
  Journal: Journal of General Physiology
  Type: journal-article
  URL: https://doi.org/10.1085/jgp.202213249
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- **Interacting-heads motif explains the X-ray diffraction pattern of relaxed vertebrate skeletal muscle**
  Publication date: 2022-04
  Journal: Biophysical Journal
  Type: journal-article
  URL: http://dx.doi.org/10.1016/j.bpj.2022.03.023
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- **Structural basis of the super- and hyper-relaxed states of myosin II**
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  Journal: Journal of General Physiology
  Type: journal-article
  URL: https://doi.org/10.1085/jgp.202113012
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- **Relaxed tarantula skeletal muscle has two ATP energy-saving mechanisms**
  Publication date: 2021-03-01
  Journal: Journal of General Physiology
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  Journal: Nature
  Type: journal-article
  URL: https://doi.org/10.1038/s41586-020-3007-0

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- **The myosin interacting-heads motif present in live tarantula muscle explains tetanic and posttetanic phosphorylation mechanisms**
  Publication date: 2020-05-22
  Journal: Proceedings of the National Academy of Sciences
  Type: journal-article
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  doi: 10.1073/pnas.1921312117 (https://doi.org/10.1073/pnas.1921312117)
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- **Myosin Sequestration Regulates Sarcomere Function, Cardiomyocyte Energetics, and Metabolism, Informing the Pathogenesis of Hypertrophic Cardiomyopathy**
  Publication date: 2020-03-10
  Journal: Circulation
  Type: journal-article
  URL: http://dx.doi.org/10.1161/circulationaha.119.042339
  doi: 10.1161/circulationaha.119.042339 (https://doi.org/10.1161/circulationaha.119.042339)
  Part of issn: 0009-7322 (https://portal.issn.org/resource/ISSN/0009-7322)
  Part of issn: 1524-4539 (https://portal.issn.org/resource/ISSN/1524-4539)
- **18O labeling on Ser45 but not on Ser35 supports the cooperative phosphorylation mechanism on tarantula thick filament activation**
  Publication date: 2020-03
  Journal: Biochemical and Biophysical Research Communications
  Type: journal-article
  URL: https://doi.org/10.1016/j.bbrc.2020.01.044
  doi: 10.1016/j.bbrc.2020.01.044 (https://doi.org/10.1016/j.bbrc.2020.01.044)
- **Lessons from a tarantula: new insights into myosin interacting-heads motif evolution and its implications on disease**
  Publication date: 2018-10-04
  Journal: Biophysical Reviews
  Type: journal-article
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- **Interacting-heads motif has been conserved as a mechanism of myosin II inhibition since before the origin of animals**
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Type: journal-article
URL: http://www.pnas.org/content/115/9/E1991
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  Publication date: 2017-10-04
  Journal: Biophysical Reviews
  Type: journal-article
  URL: https://doi.org/10.1007/s12551-017-0295-1
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- **Effects of myosin variants on interacting-heads motif explain distinct hypertrophic and dilated cardiomyopathy phenotypes**
  Publication date: 2017-06-13
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- **Conserved intramolecular interactions maintain myosin interacting-heads motifs explaining tarantula muscle super-relaxed state structural basis**
  Publication date: 2016-02-02
  Journal: Journal of Molecular Biology
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  doi: http://dx.doi.org/10.1016/j.jmb.2016.01.027
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  Publication date: 2015-10-06
  Journal: Proceeding of the National Academy of Sciences
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  doi: 10.1073/pnas.1513439112
- **Tarantula Myosin Free Head Regulatory Light Chain Phosphorylation Stiffens N-terminal Extension Releasing it and Blocking its Docking Back**
  Publication date: 2015-05-02
  Type: journal-article
  doi: DOI:10.1039/C5MB00163C

- **Improved Imaging, 3D Reconstruction and Homology Modeling of Tarantula Thick Filaments**
  Publication date: 2015-01
  Journal: Biophysical Journal
  Type: journal-article
  doi: 10.1016/j.bpj.2014.11.3211
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  Publication date: 2015-01
  Journal: Biophysical Journal
  Type: journal-article
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- **Sequential myosin phosphorylation activates tarantula thick filament via a disorder–order transition**
  Publication date: 2015
  Type: journal-article
  URL: http://pubs.rsc.org/en/content/articlelanding/2015/mb/c5mb00162e#!divAbstract
  doi: DOI: 10.1039/C5MB00162E
- **Schistosome Muscles Contain Striated Muscle-Like Myosin Filaments in a Smooth Muscle-Like Architecture**
  Publication date: 2014-01
  Journal: Biophysical Journal
  Type: journal-article
  doi: 10.1016/j.bpj.2013.11.911
- **A Method for 3D-Reconstruction of a Muscle Thick Filament Using the Tilt Series Images of a Single Filament Electron Tomogram.**
  Publication date: 2014
  Type: journal-article
  doi: DOI:10.1016/j.jsb.2014.04.003
- **Erratum: A molecular model of phosphorylation-based activation and potentiation of tarantula muscle thick filaments (Journal of Molecular Biology (2011) 414 (44-61))**
  Publication date: 2014
  Journal: Journal of Molecular Biology
  Type: journal-article
  URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-84890856153&partnerID=MN8TOARS

doi: 10.1016/j.jmb.2013.11.004
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- **Different Head Environments in Tarantula Thick Filaments Support a Cooperative Activation Process**
  Publication date: 2013
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  doi: DOI:10.1016/j.bpj.2013.09.001
- **Re port of a new mutation (Val748Leu) associated with hypertophic miocardiopathy located in the C5 domain of the cardiac myosin binding protein-C (cMyBP-C) | Relatório de uma nova mutação (Val748Leu) associada com miocardiopatia hipertrófica situada no domínio C5 da proteína-c de união à miosina cardíaca (cMyBP-C)**
  Publication date: 2013
  Journal: Interciencia
  Type: journal-article
  URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-84888862747&partnerID=MN8TOARS
  eid: 2-s2.0-84888862747
- **Two and a half years at the LMB that imprinted my scientific career (1980-83)**
  Publication date: 2013
  Type: book-chapter
  Part of isbn: ISBN: 978-184831-646-1
- **The myosin interacting-heads motif is present in the relaxed thick filament of the striated muscle of scorpion**
  Publication date: 2012
  Journal: Journal of Structural Biology
  Type: journal-article
  URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-84866518451&partnerID=MN8TOARS
  doi: 10.1016/j.jsb.2012.08.010
- **A molecular model of phosphorylation-based activation and potentiation of tarantula muscle thick filaments**
  Publication date: 2011
  Journal: Journal of Molecular Biology
  Type: journal-article
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  Publication date: 2011
  Journal: Proceedings of the National Academy of Sciences of the United States of America
  Type: journal-article
  URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-79960996049&partnerID=MN8TOARS
  doi: 10.1073/pnas.1103216108
- **Matching structural densities from different biophysical origins with gain and bias**
  Publication date: 2011
  Journal: Journal of Structural Biology
  Type: journal-article
  URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-79851511116&partnerID=MN8TOARS
  doi: 10.1016/j.jsb.2010.09.012
- **Blebbistatin stabilizes the helical order of myosin filaments by promoting the switch 2 closed state**
  Publication date: 2008
  Journal: Biophysical Journal
  Type: journal-article
  URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-55949133242&partnerID=MN8TOARS
  doi: 10.1529/biophysj.108.137067
- **The molecular mechanism of the regulation of muscle contraction | El mecanismo molecular de la regulación de la contracción muscular**
  Publication date: 2008
  Journal: Archivos Venezolanos de Farmacologia y Terapeutica
  Type: journal-article
  URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-55349129651&partnerID=MN8TOARS
  eid: 2-s2.0-55349129651 (http://www.scopus.com/inward/record.url?eid=2-s2.0-55349129651&partnerID=MN8TOARS)
- **Three-Dimensional Reconstruction of Tarantula Myosin Filaments Suggests How Phosphorylation May Regulate Myosin Activity**
  Publication date: 2008

Journal: Journal of Molecular Biology
Type: journal-article
URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-56249115186&partnerID=MN8TOARS
doi: 10.1016/j.jmb.2008.10.013

- **Understanding the Organisation and Role of Myosin Binding Protein C in Normal Striated Muscle by Comparison with MyBP-C Knockout Cardiac Muscle**
  Publication date: 2008
  Journal: Journal of Molecular Biology
  Type: journal-article
  URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-54249124879&partnerID=MN8TOARS
  doi: 10.1016/j.jmb.2008.09.013
- **Electron tomography reveals the structure of the C-zone in striated muscle**
  Publication date: 2007-06
  Type: journal-article
  doi: 10.1016/j.yjmcc.2007.03.282
- **Atomic model of a myosin filament in the relaxed state**
  Publication date: 2005
  Journal: Nature
  Type: journal-article
  URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-24144484776&partnerID=MN8TOARS
  doi: 10.1038/nature03920
- **Familial hypertrophic cardiomyopathy: Genes, mutations and animal models. A review | Cardiomiopatía hipertrófica familiar: Genes, mutaciones y modelos animales. Revisión**
  Publication date: 2004
  Journal: Investigacion Clinica
  Type: journal-article
  URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-16544395823&partnerID=MN8TOARS
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  Publication date: 2004
  Journal: Journal of Molecular Biology

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- **Heterogeneity of Z-band structure within a single muscle sarcomere: Implications for sarcomere assembly**
  Publication date: 2003
  Journal: Journal of Molecular Biology
  Type: journal-article
  URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-0042235366&partnerID=MN8TOARS
  doi: 10.1016/S0022-2836(03)00883-0
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  Publication date: 2001-11
  Journal: Biophysical Journal
  Type: journal-article
  doi: 10.1016/s0006-3495(01)75923-1
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  Publication date: 2001
  Journal: Journal of Muscle Research and Cell Motility
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  doi: 10.1023/A:1010388103354
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  Publication date: 2001
  Journal: Biophysical Journal
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  URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-0034760845&partnerID=MN8TOARS
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  Publication date: 2000

Journal: Journal of Molecular Biology
Type: journal-article
URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-0034724568&partnerID=MN8TOARS
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- **Erratum: A new model for the surface arrangement of myosin molecules in Tarantula thick filaments (Journal of Molecular Biology (2000) 298 (239-260))**
  Publication date: 2000
  Journal: Journal of Molecular Biology
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  URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-0034665735&partnerID=MN8TOARS
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  Publication date: 1998
  Journal: Journal of Molecular Biology
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- **The action of local anesthetics on myelin structure and nerve conduction in toad sciatic nerve**
  Publication date: 1997
  Journal: Biophysical Journal
  Type: journal-article
  URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-0030922367&partnerID=MN8TOARS
  eid: 2-s2.0-0030922367 (http://www.scopus.com/inward/record.url?eid=2-s2.0-0030922367&partnerID=MN8TOARS)
- **Use of morphology index histograms to quantify populations of the fungal pathogen Paracoccidioides brasiliensis**
  Publication date: 1997
  Journal: Microbiology
  Type: journal-article
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- **Direct visualization of myosin filament symmetry in tarantula striated muscle by electron microscopy**
  Publication date: 1993
  Journal: Journal of Structural Biology
  Type: journal-article
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  doi: 10.1006/jsbi.1993.1031
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  Publication date: 1992
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Journal: Journal of Structural Biology
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URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-0026777862&partnerID=MN8TOARS
doi: 10.1016/1047-8477(92)90027-8

- **Direct determination of myosin filament symmetry in scallop striated adductor muscle by rapid freezing and freeze substitution**
  Publication date: 1991
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  Type: journal-article
  URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-0025887823&partnerID=MN8TOARS
  doi: 10.1016/0022-2836(91)90386-K
- **Method for direct determination of the rotational symmetry of thick muscle filaments by digital image processing | Método para la determinación directa de la simetría rotacional de filamentos gruesos de músculo por procesamiento digital de imágenes.**
  Publication date: 1991
  Journal: Acta Cientifica Venezolana
  Type: journal-article
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  URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-0024227169&partnerID=MN8TOARS
  eid: 2-s2.0-0024227169 (http://www.scopus.com/inward/record.url?eid=2-s2.0-0024227169&partnerID=MN8TOARS)
- **Analysis of the equatorial section of X-ray diffraction patterns of striated muscles of tarantulas under various experimental conditions | Análisis de la sección ecuatorial del patrón de difracción de rayos -X de músculos estriados de tarántula en diferentes condiciones experimentales.**
  Publication date: 1988
  Journal: Acta Cientifica Venezolana
  Type: journal-article
  URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-0024259611&partnerID=MN8TOARS
  eid: 2-s2.0-0024259611 (http://www.scopus.com/inward/record.url?eid=2-s2.0-0024259611&partnerID=MN8TOARS)
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  Publication date: 1988
  Journal: Acta Cientifica Venezolana
  Type: journal-article
  URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-0024250934&partnerID=MN8TOARS
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  Publication date: 1987
  Journal: Acta Cientifica Venezolana
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  URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-0023587460&partnerID=MN8TOARS
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  Publication date: 1987
  Journal: Journal of Cell Biology
  Type: journal-article
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  Publication date: 1987
  Journal: Acta Cientifica Venezolana
  Type: journal-article
  URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-19244379593&partnerID=MN8TOARS
  eid: 2-s2.0-19244379593 (http://www.scopus.com/inward/record.url?eid=2-s2.0-19244379593&partnerID=MN8TOARS)
- **Prediction of relative changes in the equatorial x-ray diffraction pattern of striated muscle caused by the activation of muscle contraction | Predicción de cambios relativos**

en el patrón ecuatorial de difracción de rayos-X de músculo estriado causados por la activación de la contracción muscular.
Publication date: 1986
Journal: Acta Cientifica Venezolana
Type: journal-article
URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-0022836777&partnerID=MN8TOARS
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  Publication date: 1985
  Journal: Journal of Molecular Biology
  Type: journal-article
  URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-0022419384&partnerID=MN8TOARS
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- **The effect of the ATP analogue AMPPNP on the structure of crossbridges in vertebrate skeletal muscles: X-ray diffraction and mechanical studies**
  Publication date: 1984
  Journal: Journal of Muscle Research and Cell Motility
  Type: journal-article
  URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-0021737395&partnerID=MN8TOARS
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  Publication date: 1984
  Journal: Nature
  Type: journal-article
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  Publication date: 1982

Journal: Biophysical Journal
Type: journal-article
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  Publication date: 1981
  Journal: Journal of Neuroscience Research
  Type: journal-article
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  Publication date: 1981
  Journal: Acta Cientifica Venezolana
  Type: journal-article
  URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-0019750725&partnerID=MN8TOARS
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  Publication date: 1980
  Journal: Biochimica et Biophysica Acta
  Type: journal-article
  URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-0019138274&partnerID=MN8TOARS
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  Publication date: 1980
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  Publication date: 1980
  Journal: Acta Cientifica Venezolana
  Type: journal-article
  URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-0019239189&partnerID=MN8TOARS
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  Publication date: 1979
  Journal: BBA - Biomembranes
  Type: journal-article
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Publication date: 1979
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Type: journal-article
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  Type: journal-article
  URL: http://www.scopus.com/inward/record.url?eid=2-s2.0-0018209492&partnerID=MN8TOARS
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Peer review (1 reviews for 1 publications/grants)

- **Science advances.** (1)