Sowgat Muzahid

Curriculum Vitae

Leiden Observatory
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Personal Information

Date of Birth	January 8th, 1984
Gender	Male
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Positions

2016–now Postdoctoral Research Associate, *Leiden Observatory*, The Netherlands

2013–2016 Postdoctoral Research Fellow, *The Pennsylvania State University*, USA

Education

2007–2013 **Ph.D., Astronomy & Astrophysics,** *IUCAA,* Pune, India
Dissertation topic: Physics of the IGM and Evolution of the High Redshift Universe
Advisor: Prof. R. Srianand

2005–2007 **M.Sc., Physics,** *Visva-Bharati University,* West Bengal, India
First class with Distinction

2002–2005 **B.Sc., Physics (Hons.),** *University of Burdwan,* West Bengal, India
First class

Academic Achievements and Awards

2017 LKBF Travel Grant, Leiden University

2009-2013 Council of Scientific & Industrial Research (CSIR), **Senior Research Fellowship**, India

2007-2009 **CSIR Junior Research Fellowship,** India

2008, 2009 Qualified the National Eligibility Test (NET), India

Research Interests

– (Diffuse) Gas Flows in Galaxies, The Circumgalactic Medium (CGM)
– 3D Spectroscopy, Lyα Emitters
– Lyα Forest and Metal Enrichment of the Intergalactic Medium (IGM)
– Damped Lyα Absorbers (DLAs)
– Outskirts of Galaxy Clusters
– Intrinsic QSO Absorbers, QSO Outflows and AGN Feedback

Technical Experience

Observation /Data reduction /Analysis

Ultraviolet Cosmic Origins Spectrograph (**COS**) aboard Hubble Space Telescope (HST)

Optical Multi Unit Spectroscopic Explorer (**MUSE**) and Ultraviolet and Visual Echelle Spectrograph (**UVES**) on Very Large Telescope (VLT), High Resolution Echelle Spectrometer (**HIRES**) on Keck telescope, Sloan Digital Sky Survey (**SDSS**), IUCAA-Girawali 2m Telescope (**IGO**)

Radio Giant Metrewave Radio Telescope (**GMRT**)

Software and tools

Advanced Photoionization simulation code **CLOUDY**, Software for 3D spectroscopy: **LSDCat** and **CubEx**, Voigt profile fitting program **VPFIT**, Interactive Data Language (**IDL**), Supermongo (**SM**), **ds9**, **QFitsView**, **LaTeX**

Basic C, Python, Image Reduction and Analysis Facility (**IRAF**), **WEKA** Data Mining Software

Publications (as of September, 2017)

Total Refereed Publications: 28

First Author Refereed Publications: 11

Total Citations: 237 (h-index: 11)

First Author Refereed Publications *(in reverse chronological order)*

1. **S. Muzahid**, G. Fonseca, A. Roberts, B. Rosenwasser, P. Richter, A. Narayanan, C. Churchill, and J. Charlton
   "COS-Weak: Probing the CGM using analogs of weak Mg II *absorbers at $z < 0.3$"*
   Submitted to MNRAS (arXiv:1709.03999)

2. **S. Muzahid**, J. Charlton, D. Nagai, J. Schaye, and R. Srianand
   "Discovery of an H I*-rich Gas Reservoir in the Outskirts of SZ-effect-selected Clusters"*
   APJL, 846, 8, 2017 (arXiv:1708.02600)

3. **S. Muzahid**, G. G. Kacprzak, J. C. Charlton, and C. W. Churchill
   "Molecular Hydrogen Absorption from the Halo of a $z \sim 0.4$ Galaxy"
   APJ, 832, 66, 2016 (arXiv:1601.06782)

4. **S. Muzahid**, R. Srianand, J. Charlton, and M. Eracleous
   "On the Covering Fraction Variability in an EUV Mini-BAL Outflow from PG 1206+459"
   MNRAS, 457, 2665–2674, 2016 (arXiv:1509.07850)

5. **S. Muzahid**, G. Kacprzak, C. Churchill, J. Charlton, N. Nielsen, N. Mathes, and T-G. Sebastian
   "An Extreme Metallicity, Large-scale Outflow from a Star-forming Galaxy at $z \sim 0.4$"
   APJ, 811, 132, 2015 (arXiv:1506.01028)

6. **S. Muzahid**, R. Srianand, and J. Charlton
   "An HST/COS Survey of Molecular Hydrogen in DLAs & sub-DLAs at $z < 1$: Molecular Fraction and Excitation Temperature"
   MNRAS, 448, 2840–2853, 2015 (arXiv:1410.3828)

7. **S. Muzahid**
   "Probing the Large and Massive CGM of a Galaxy at $z \sim 0.2$ Using a Pair of Quasars"
   APJ, 784, 5, 2014 (arXiv:1401.3340)

8. **S. Muzahid**, R. Srianand, N. Arav, B. D. Savage, and A. Narayanan
   "HST/COS Observations of a New Population of Associated QSO Absorbers"
   MNRAS, 431, 2885–2906, 2013 (arXiv:1302.5510)

9. **S. Muzahid**, R. Srianand, B. D. Savage, A. Narayanan, V. Mohan, and G. C. Dewangan
"Highly Ionized Collimated Outflow from HE 0238–1904"
MNRAS, 424, L59–L63, 2012 (arXiv:1203.3049)

10. **S. Muzahid**, R. Srianand, J. Bergeron, and P. Petitjean
"A High-resolution Study of Intergalactic O VI *Absorbers at $z \sim 2.3$"*
MNRAS, 421, 446–467, 2012 (arXiv:1112.1402)

11. **S. Muzahid**, R. Srianand and P. Petitjean
"Revisiting the He II *to H* I *Ratio in the Intergalactic Medium"*
MNRAS, 410, 2193–2202, 2011 (arXiv:1008.4132)

Co-authored Refereed Publications *(in reverse chronological order)*

1. B. Rosenwasser, **S. Muzahid**, J. Charlton, G. Kacprzak, B. Wakker, and C. Churchill
"Understanding the strongest intervening O VI absorber at $z \sim 0.93$ towards PG1206+459"
Submitted to MNRAS

2. R. Marino, S. Cantalupo, S. Lilly, S. Gallego, L. Straka, E. Borisova, R. Bacon, J. Brinchmann, N. Bouche, M. Carollo, J. Caruana, S. Conseil, T. Contini, D. Diener, H. Finley, H. Inami, F. Leclercq, M. Maseda, **S. Muzahid**, J. Richard, J. Schaye, M. Wendt, and L. Wisotzki
"Dark Galaxy Candidates at Redshift ~ 3.5 Detected with MUSE"
Submitted to ApJ (arXiv:1709.03522)

3. H. Finley, N. Bouche, T. Contini, M. Paalvast, M. Maseda, R. Bacon, J. Blaizot, J. Brinchmann, B. Epinat, A. Feltre, R. Marino, **S. Muzahid**, J. Richard, J. Schaye, A. Verhamme, P. Weilbacher, and L. Wisotzki
"The MUSE Hubble Ultra Deep Field Survey: VII. Fe II** Emission in Star-Forming Galaxies"*
Submitted to A & A

4. S. Pachat, A. Narayanan, V. Khaire, B. D. Savage, **S. Muzahid**, and B. P. Wakker
"Detection of two intervening Ne VIII *absorbers probing warm gas at $z \sim 0.6$"*
MNRAS, 471, 792, 2017 (arXiv:1706.04325)

5. S. Pointon, N. Nielsen, G. Kacprzak, **S. Muzahid**, C. Churchill, and J. Charlton
"The Impact of the Group Environment on the O VI *Circumgalactic Medium"*
APJ, 844, 23, 2017 (arXiv:1706.03895)

6. P. Richter, S. E. Nuza, A. J. Fox, B. P. Wakker, N. Lehner, N. Ben Bekhti, C. Fechner, M. Wendt, C. J. Howk, **S. Muzahid**, R. Ganguly, and J. C. Charlton
"An HST/COS legacy survey of high-velocity ultraviolet absorption in the Milky Way's circumgalactic medium and the Local Group"
Accepted in A & A, 2016 (arXiv:1611.07024)

7. T. Hussain, V. Khaire, R. Srianand, **S. Muzahid**, and A. Pathak
"Implications of an updated ultraviolet background for the ionization mechanisms of intervening Ne VIII *absorbers"*
MNRAS, 466, 3133–3142, 2017 (arXiv:1612.03178)

8. N. M. Nielsen, G. G. Kacprzak, **S. Muzahid**, C. W. Churchill, M. T. Murphy, and J. C. Charlton
"The Highly Ionized Circumgalactic Medium is Kinematically Uniform around Galaxies"
APJ, 834, 148, 2017 (arXiv:1611.07585)

9. B. Punsly, P. Marziani, S. Zhang, **S. Muzahid**, and C. P. O'Dea
"The Extreme Ultraviolet Variability of Quasars"
APJ, 830, 104, 2016 (arXiv:1608.02302)

10. S. Pachat, A. Narayanan, **S. Muzahid**, V. Khaire, R. Srianand, B. P. Wakker, and B. D. Savage
"A Pair of O VI *& Broad Lyα Absorbers Probing Warm gas in a Galaxy Group Environment at*

$z \sim 0.4$"
MNRAS, 458, 733-746, 2016 (arXiv:1601.05418)

11. G. G. Kacprzak, **S. Muzahid**, C. W. Churchill, J. C. Charlton, and N. M. Nielsen
"The Azimuthal Dependence of Outflows and Accretion Detected Using O VI *Absorption"*
APJ, 815, 22, 2015 (arXiv:1511.03275)

12. R. Dutta, R. Srianand, **S. Muzahid**, N. Gupta, E. Momjian, and J. Charlton
"Cold Parsec-scale Gas in a $z_{abs} \sim 0.1$ Sub-damped Lyα With Disparate H_2 and 21-cm Absorption"
MNRAS, 448, 3718–3730, 2015 (arXiv:1502.01354)

13. T. Hussain, **S. Muzahid**, A. Narayanan, R. Srianand, B.P. Wakker, J.C. Charlton, and A. Pathak
"HST/COS Detection of a Ne VIII *Absorber Towards PG 1407+265: An Unambiguous Tracer of Collisionally Ionized Hot Gas?"*
MNRAS, 446, 2444–2455, 2014 (arXiv:1410.7804)

14. R. Srianand, H. Rahmani, **S. Muzahid**, and V. Mohan
"Molecular Hydrogen from $z = 0.0963$ DLA Towards the QSO J 1619+3342"
MNRAS, 443, 3318–3326, 2014 (arXiv:1406.5517)

15. N. Mathes, C. Churchill, G. Kacprzak, N. Nielsen, T-G. Sebastian, J. Charlton, and **S. Muzahid**
"Halo Mass Dependence of H I *and O* VI *Absorption: Evidence for Differential Kinematics"*
APJ, 792, 128, 2014 (arXiv:1406.2314)

16. N. Gupta, R. Srianand, P. Noterdaeme, P. Petitjean, and **S. Muzahid**
"21-cm Absorption from Galaxies at $z \sim 0.3$"
A & A, 558, A84, 2013 (arXiv:1308.4141)

17. N. Gupta, R. Srianand, P. Petitjean, J. Bergeron, and **S. Muzahid**
"Search for Cold Gas in Strong Mg II *Absorbers at $0.5 < z < 1.5$: Nature and Evolution of 21-cm Absorbers"*
A & A, 544, A21, 2012 (arXiv:1205.4029)

Other Publications *(in reverse chronological order)*

1. N. Nielsen, G. Kacprzak, C. Churchill, M. Murphy, **S. Muzahid**, J. Charlton, and J. Evans
"Gas Kinematics in the Multiphase Circumgalactic Medium"
IAUS, 321, 345, 2017

2. G. Kacprzak, **S. Muzahid**, C. Churchill, N. Nielsen, and J. Charlton
"HST Observations Reveal the Curious Geometry of Circumgalactic Gas"
IAUS, 321, 342, 2017

3. G. Kacprzak, **S. Muzahid**, C. Churchill, N. Nielsen, and J. Charlton
"HST Observations Reveal the Curious Geometry of Circumgalactic Gas"
Conf. Proceeding, ILGP, 26, 2016

Observational Proposals

Successful Proposals as PI and Co-I

HST: "Probing Warm-Hot Gas in the Outskirts of Galaxy Clusters Using Quasar Absorption Lines", *15 orbits*, (GO-14655, PI)

HST: "Morphology and Orientation of QSO Absorber Host Galaxies at $z < 1.5$ Detected with VLT/MUSE", *5 orbits*, (GO-14660, Co-I)

HST: "The COS revolution of AGN outflow science", (AR-13233, Co-I)

GMRT: "Understanding the nature of 21-cm absorbers through observations of quasar and radio source-galaxy pairs at $z < 0.1$", *65 hrs*, (20_037, Co-I)

GMRT: "Monitoring of 21-cm absorption towards blazar with high jet proper motion", *12 hrs*, (22_016, Co-I)

GMRT: "H I observations of quasar-galaxy pairs at $z \sim 0.3$", *12 hrs*, (22_036, Co-I)

GMRT: "H I observations of quasar-galaxy pairs at $z \sim 0.1$", *30 hrs*, (24_033, Co-I)

VLA: "Physical conditions in a molecular hydrogen bearing sub-DLA at $z \sim 0.1$", *25 hrs*, (15A-265, Co-I)

VLBA: "Cold parsec-scale gas in a $z_{\rm abs} = 0.1$ sub-damped Lyα with disparate H_2 and 21-cm absorption", *1 hr*, (14B-460, Co-I)

Conferences, Workshops and Schools

2006 AKR School on General Relativity, SINP, Kolkata, India

2007 Radio Astronomy School, NCRA, Pune, India

Dec 2008 Cosmological evolution of diffuse baryons: Re-ionization epoch to present day, Coorg, India

Feb 2010 Cosmological Re-ionization, HRI, Allahabad, India

Sep 2010 Young Astronomer's Meet, PRL, Ahemdabad, India

Nov 2010 Workshop on data analysis, Burdwan University, Burdwan, India

Sep 2011 Young & Bright : Understanding High Redshift Structures, AIP, Potsdam, Germany

May 2012 Gas Flows in Galaxies, STScI, Baltimore, USA

Dec 2012 Galaxies in Absorption, IUCAA, Pune, India

Jan 2014 223 AAS winter meeting, Washington DC, USA

Jun 2014 Summer School in Statistics for Astronomers – X, PSU, State College, USA

Jun 2014 Intergalactic Matters, MPIA, Heidelberg, Germany

Mar 2015 2015 PHISCC Workshop: H I Surveys Get Real, Rutgers University, NJ, USA

Jan 2016 227 AAS winter meeting, Orlando, FL, USA

Apr 2016 GOTOQ 2016, Pittsburgh University, USA

Nov 2016 MUSE Busy Week, Semlin, Germany

Jun 2017 MUSE Busy Week, Spineto, Italy

Presentations

• Colloquia

Aug 2016 "Absorption Line Spectroscopy with the Hubble Space Telescope", NCRA, India

Nov 2014 "Search for cold gas at low-z using the HST/COS", NMSU, USA

• Invited Talks

Nov 2010 "Inter-Galactic Medium: the space between galaxies", Burdwan University, India

Jun 2010 "Probing the IGM using QSO absorption spectroscopy", Summer School, IUCAA, India

• Conference Contributed Talks

Apr 2016 "Molecular Gas in Low-redshift Galaxy Halos", Pittsburgh, USA

Jan 2016 "An HST/COS survey of H_2 in DLAs & sub-DLAs at $z < 1$", AAS meeting, Orlando, FL

Mar 2015 "An HST/COS survey of H_2 in DLAs & sub-DLAs at $z < 1$", Rutgers, USA

Sep 2014 "O VI absorbers over cosmic time", AAS dissertation talk, Washington DC, USA

Dec 2012 "Highly ionized absorbers (Intervening and Intrinsic)", IUCAA, India

Sep 2010 "Absorption spectroscopy of high redshift O VI absorbers", PRL, India

Feb 2010 "Probing the high redshift ($z \sim 2-3$) IGM using O VI absorption", HRI, India

Dec 2008 "O VI in the IGM", Coorg, India

- Seminars

Aug 2016 "The Circumgalactic Medium of Low-z Galaxies", IUCAA, India

Jun 2015 "An HST/COS survey of H_2 in DLAs & sub-DLAs at $z < 1$", IUCAA, India

- Lunch Talks and Others

Jun 2017 "The Circumgalactic Medium of Lyα Emitters", MUSE Busy Week, Spineto, Italy

Nov 2016 "Calibrating Redshifts of Lyα Emitters Using their CGM Absorption Maps", MUSE Busy Week, Semlin, Germany

Nov 2014 "Search for cold gas at low-z using the HST/COS", UCSC, USA

Aug 2014 "QSO absorption line spectroscopy with the HST/COS", Penn State, USA

May 2012 "High resolution study of intergalactic O VI absorbers at $z \sim 2.3$", University of Chicago, USA

May 2012 "High resolution study of intergalactic O VI absorbers at $z \sim 2.3$", University of Wisconsin-Madison, USA

- Posters

May 2012 "High resolution study of intergalactic O VI absorbers at $z \sim 2.3$", STScI, USA

Sep 2011 "High resolution study of intergalactic O VI absorbers at $z \sim 2.3$", AIP, Germany

Professional Services and Miscellaneous Activities

External Reviewer for the HST Telescope Allocation Committee

Mentoring Undergraduate and Graduate Students

2017 Observatory Seminar Committee, Leiden Observatory

2016–now Organizing Bi-weekly "MUSE lunch" Meeting, Leiden Observatory

2013–2014 Volunteering "Astro-Fest", Pennsylvania State University

2010 Instructor, Photometric & Spectroscopic Techniques, IUCAA Summer School

2008 Teaching Assistant, Stellar Physics, IUCAA Summer School

2008–2009 Science Day Poster Presentations for Public, IUCAA

References

(1) **Jane Charlton** *(jcc12@psu.edu)*
Professor
The Pennsylvania State University
525 Davey Laboratory, University Park
State College, PA, 16802, USA

(2) **Chris Churchill** *(cwc@nmsu.edu)*
Professor
The New Mexico State University
1320 Frenger Mall
Las Cruces, NM 88003-8001, USA

(3) **Daisuke Nagai** *(daisuke.nagai@yale.edu)*
Associate Professor
Department of Physics & Astronomy, Yale University

56 Hillhouse Avenue
New Haven, CT 06511, USA

(4) **Philipp Richter** *(prichter@astro.physik.uni-potsdam.de)*
Professor
Institute of Physics and Astronomy, University of Potsdam
Karl-Liebknecht-Str.24/25
14476 Potsdam/Golm, Germany

(5) **Joop Schaye** *(schaye@strw.leidenuniv.nl)*
Professor
Leiden Observatory
Niels Bohrweg 2
2333 CA Leiden, The Netherlands

(6) **Raghunathan Srianand** *(anand@iucaa.in)*
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Pune 411 007, India