Ivelina G. Momcheva

Address 3719 Beech Ave.
Baltimore, MD 21211
Phone (520) 271-2211
Citizenship USA, Bulgaria

ivelina.momcheva@gmail.com
Linked In
Professional Site
GitHub

Summary

A research astronomer with 11 years of post-PhD experience, highly technically-skilled in data management, data science and software development, with a strong understanding of current and emergent technologies in the field. Exceptional leadership and management experience. Expert in grism and multi-object spectroscopy with a scientific focus on galaxy evolution. Dedicated to creating equitable and inclusive communities. I bring focus, dedication, excitement and integrity to all that I do.

Education

- **University of Arizona, Department of Astronomy**   **Tucson, AZ**
  Ph.D., Astronomy   April 2009
  M.S., Astronomy   Feb 2005

- **St. Kliment Ohridsky University, Department of Physics**   **Sofia, Bulgaria**
  B.S., Physics with Honors   July 2002
  Majors: Astronomy, Optics & Spectroscopy

Employment

Space Telescope Science Institute (STScI, 750 employees)   **Baltimore, MD**

STScI is a government contractor responsible for the science operations of the Hubble Space Telescope. STScI will lead the science and mission operations for the James Webb Space Telescope (JWST) and WFIRST. We process and archive astronomical data, carry out scientific research and develop public outreach programs.

Mission Scientist, Data Science Mission Office   Jan 2017 – present
Full Time

- Worked with the Amazon Web Services (AWS) Public Dataset Program leadership on storing the Hubble Space Telescope (HST) data in commercial cloud. Made the case for AWS collaboration to STScI director which led us to sign a contract with AWS for the storage of 120 TB of HST data as a public dataset free of charge which then extended to storing data from three other missions. The HST public dataset on AWS is the first major astronomical dataset stored on commercial cloud and as such has allowed us to train the astronomical community in the use of commercial cloud resources. I ran several internal and external workshops and gave invited talks on using AWS for astronomical data management. I co-wrote (with the director of DSMO) two internal funding proposals which gave our team $\sim$ \$1.5M for projects to develop against this dataset. I am monitoring the use of the dataset via an AWS Athena database of the log files and gave reports to AWS and STScI leadership. Use of cloud resources across STScI was almost non-existent at the start of this project and now "cloud-first" is part of our strategic plan. Future missions, such as WFIRST, are considering data storage directly on AWS. I continue to maintain AWS-STScI relations.

- Lead a working group to compose a roadmap for the James Webb Space Telescope (JWST) data analysis tools. The work is crucial for enabling the community to maximize the scientific output of this \$10B mission. The roadmap covered the development of open-source Python libraries, Python-based visualization tools and Jupyter notebooks. I led the detailed prioritization of work, the creating of a time-line over a two-year period leading up to launch and the development of metrics. I built consensus among group members from different parts of the organization while pushing for novel solutions. I presented the final document to NASA stakeholders and community representatives. The roadmap has been approved and is now executed.

- Developed the concept of a "hosted data analysis environment" which allows scientists to access data and analysis tools through a browser window. Analyzed current and emergent technologies to identify the JupyterHub project as the best fit for the needs of the astronomical community. Co-led the development of a prototype hosted on AWS. This effort led to a contract with the JupyterHub project and the concept is now developed for use by several missions. I gave a keynote talk at a major industry conference on the topic in 2018 and wrote a technical paper.

- Brought from concept to market a new interface to Hubble Space Telescope (HST) datasets on distant galaxies: z.MAST. Developed a concept, collected requirements from the user community and worked with a UI/UX designer to carry out research and develop an interface concept. Presented to internal stakeholders and external user groups to gather feedback and get approval. Worked with Scrum team to develop tickets, prioritize and schedule work. Acted as a product owner in development phase. Demonstrated API and interface at a major industry conference and received enthusiastic feedback.

- Made major contributions to the launch extension contact following the JWST launch delay. Used technical and scientific expertise to develop a vision for new work based on recent developments in software and cloud capabilities. Developed high level description of work, operations concept and resource allocation (total of 10 FTE). Collaborated with systems engineers on requirements, including performance and security of a cloud hosted environment. Work was presented to NASA, approved and is now executed.

- Led cross-organizational effort to retire an outdated software library (IRAF) and replace it with Python. Organized three cross-functional hack-days with software developers and scientists to kick start the effort. Hack days also served as training for scientists in modern software engineering practices. Oversaw the creation of resources for external users transitioning to Python, including a GitHub repository, conference handouts and a newsletter article. Effort was a considered a major success.

- Developed concept, gathered organizational support and secured funding for the transition of an outdated Hubble Space Telescope (HST) data interface with a highly manual maintenance process to an automated pipeline which will deliver improved data products to the majority of users. Successfully navigated pushback to the project due to personal interests. Project is nearing completion.

- Managing director of the Data Science Innovation Initiative, an internal micro-grants program aimed at increasing our institutional expertise in data science. Ten programs covering topics such as GPU-aided computations, machine learning and software development received up to $20K were selected in 2019. Several projects used AWS services. I am providing recipients with technical, budget and logistics support.

- Led the STScI Space Astronomy Summer Program in 2017. This annual, 10-week long program, currently in its 25th year, brings 15 US and international students to STScI. Coordinator for student selection 2017-2020, implemented application assessment rubric to increase diversity of cohort. Extensive experience mentoring students. I oversaw the work of the first STScI Data Science Summer Intern in 2019. I worked with the student on creating a machine learning model for classification of Hubble images and connecting the model to a sequence of AWS Lambda functions to automatically classify images uploaded to an AWS bucket. In summer 2019 I mentored an Insight Fellowship student on using Natural Language Processing (NLP) to create a recommendation engine (AWS hosted) for similar datasets from the Hubble Space Telescope based on peer-reviewed journal articles associated with the data. Both projects resulted in functional prototypes which will be implemented in the STScI interfaces in the future. I have mentored six summer students on science projects.

- Extensive experience navigating large, complex organizations in situations with multiple stakeholders internally, with NASA and with other government contractors and academic institutions across the USA. Frequently lead and participate in discussions of joint projects with peer institutions. Served on multiple internal committees and cross-institutional panels, including STScI Research Computing Advisory Group, many hiring committees, the LSST-Euclid-WFIRST Join Processing Group (co-authored a white paper), the American Astronomical Society Demographics Committee (co-authored two reports), member of the organizing committees for four major astronomical conferences, member of review panels for NASA and NSF.

- Extensive experience communicating technical solutions with educated but non-technical audiences. I give over a dozen presentations annually to different internal and external groups in a variety of contexts. I create graphics and presentations to communicate complex concepts.

- Developed an institute-wide version control policy, presented it at a variety of venues to get buy in from scientists and engineers.

Space Telescope Science Institute   **Baltimore, MD**
Support Scientist, Wide Field Camera 3 Deputy Group Lead   Nov 2015 – Jan 2017
Full Time

- Invented, developed, characterized and made available for users an entirely new mode of observations with the Hubble Space Telescope. The "drift and shift" (DASH) technique allows users to gather data more efficiently for certain scientific purposes and has been used in several key discoveries. I co-led a successful proposal for a pilot program, wrote Python code to reduce pilot data and published results in a peer-reviewed journal. I worked with a team of scientific and technical experts to implement the technique for other users.
- As a deputy group lead, I represented the team in front of internal and external stakeholders, delivered presentations and write reports on the work of the team, organized weekly team meetings and worked with staff of setting goals and priorities.
- Worked with members of the community to do the technical planning for observations with the Hubble Space Telescope. Read technical documents and proposed plans to understand project goals. Contacted users with suggested improvements. Worked with STScI technical staff to implement observations.
- Developed new employee training materials and delivered training programs, including a monthly Python Lunch workshop.

Yale University, Department of Astronomy   **New Haven, CT**
My work at Yale University was supported by a $1.1M NASA grant for the execution of the 3D-HST program. 3D-HST is a large observing program carried out with the Hubble Space Telescope. The goal of this program was to measure the distances to and the properties of 250,000 galaxies in the distant universe in order to characterize how they evolve over cosmic time. The PI of the project was Dr. Pieter van Dokkum, a professor at the Yale University Department of Astronomy.

Associate Research Scientist   Apr 2014 – Oct 2015
Postdoctoral Researcher   Oct 2011 – Apr 2014
Full Time

- Project Manager for the 3D-HST Treasury Program. Lead and coordinated the day-to-day work of a geographically-distributed data team ($\sim$10 people worldwide). Set goals, assigned tasks, identified and resolved roadblocks, followed through to completion. Maintained the collaboration server, managed storage, software upgrades and user accounts.
- Managed the science and analysis work of ~ 40 scientists worldwide. Worked with researchers to understand their science goals and translate these into data product requirements. Created a productive environment for scientific research and a good working atmosphere. Enforced collaboration-wide policies on authorship, data-sharing, publications; resolved conflicts. Work resulted in over 60 peer-reviewed journal articles, three dissertations and thousands of citations. The scientific output per unit observing time on Hubble makes this one of the most successful projects in the 30-year life time of Hubble.
- Oversaw the development of a dedicated Python pipeline for the reduction of HST data. Carried out testing and debugging in tandem with the pipeline developer. Pipeline was released as open source software and used by other groups.
- Installed collaboration software stack on an Elastic Cloud Compute (EC2) machine on an Amazon Web Services (AWS) and prototyped data processing in the cloud in order to speed up reduction and allow flexibility to iterate and improve products. Presented concept to project PI and collaborators, with pricing and time savings estimates, for approval. Data was processed on AWS using 150 parallel processes in only 3 days, saving tens of thousands of dollars in salaries and compute, and shortening work by 3 to 6 months. This is one of the first uses of commercial cloud in astronomy.
- Produced and delivered seven internal and external data releases, and compiled accurate and comprehensive technical documentation for each one. Staged internal releases for download on a dedicated internal server. Set up and maintained a webpage for external data releases, including a mySQL database for user registration

and authentication. The final dataset is ~1TB. With over 1000 registered site users, this dataset is used by practically the whole community in this area of research and has become a benchmark in the field. I have given multiple invited presentations detailing the process and

Carnegie Institution of Washington, Carnegie Observatories   **Pasadena, CA**
Postdoctoral Researcher   May 2009 – Sept 2011
Full Time

- Led the technical implementation of a large project using the twin Magellan 6.5-meter telescopes in Chile. Reduced and analyzed data. Created a MySQL database with results. Delivered data to the collaboration. Authored and co-authored scientific publications using the data.
- Developed an independent scientific program which led to the discovery of the most distant cluster of galaxies at the time. Worked with science writer on a press release.

University of Arizona, Department of Astronomy   **Tucson, AZ**
Graduate Research Assistant   Aug 2002 – Apr 2009
20 hours/week

- Carried out a survey of distant galaxies which, due to their gravitational field, lens and magnify objects behind them. Wrote time and grant proposals. Carried out ~ 40 nights of observations with MMT (Arizona) and Magellan (Chile) telescopes, yielding ~10,000 unique new distances to galaxies. Collaborated on a pipeline to perform uniform analysis on data from four different spectrographs. Delivered catalogs of measurements to the collaboration, which have been used in the thesis work of two students. Wrote and published results in peer reviewed journals.

Technical Skills

- Proficient in Python, IDL, Perl, SQL, C. Can confidently write and read software in all. Solid understanding of object-oriented programing, testing, documentation and open-source development. I have developed Python training materials and delivered > 10 workshops.
- Proficient with version control systems git and svn, daily use of GitHub. I have delivered 5 git workshops.
- Experienced in web development with HTML, CSS, PHP, JS and Python. I have developed webpages from scratch or from a template, introduced custom style and functionality, implemented connections to a database. Basic experience with Flask. Familiar with content management systems.
- Can create, populate, edit and query MySQL, SQLite, Microsoft SQL Server and PostgreSQL relational databases as well as AWS Athena databases. Understanding of non-relational databases.
- Experienced in data management, including data organization, storage, pipeline processing and ingest. Extensive experience in creating technical documentation.
- Extensive experience in verifying, cleaning, analyzing and visualizing datasets in order to extract meaningful insights. Ability to formulate a question, collect data and produce quantitative answers and trends.
- Extensive experience with commercial cloud computing workflows and services. Have implemented and advised on AWS solutions for ~10 projects. Working towards an AWS Solutions Architect - Associate certification. I have taught 3 AWS workshops and written blog posts here and here. Experience with Google Cloud Platform.
- Familiarity (and increasing expertise) in data science methods, including machine learning and statistics.
- Expert in system administration of Mac OS X and Linux.

Training and Certification

- AWS Solutions Architect Udemy.com course, 80% complete, will take certification exam in 2020.
- The Carpentries Certified Trainer, April 2020. The Carpentries is an organization focused on enhancing the research computing skills of scientists worldwide.
- Alan Alda Center Science Communications Experience Workshop, a two day workshop to empower researchers to communicate more effectively, August 2017.

- Leading People and Teams Specialization, Ross School of Business, University of Michigan through Coursera, 2017.
- Leadership and Team-building for Astronomers, 1-day Workshop, 225th AAS Meeting, January, 2015
- Yale University Organizational Development & Learning Center workshops completed: "Project Management Lite", "Motivating and Energizing a Team", "Team Effectiveness", "Empowering Others Through Delegation", "Goal Setting and Feedback", 2012-2014
- Science writing workshop with NYT science writer Carl Zimmer, February 2012

Conferences and Research Talks (2015 to present)

- Invited Talk: "Long-term Trends in the Astronomical Workforce" — October, 2019
  Inclusive Astronomy 2 Workshop, Baltimore, MD
- Colloquium: "Science Results from Slitless Spectroscopy" — September, 2019
  Bulgarian Academy of Science, Sofia, Bulgaria
- Colloquium: "Results from the 3D-HST Survey" — November, 2018
  Penn State University
- Invited Talk: "Science Platforms" — October, 2018
  Astronomical Data Analysis Software and Systems Conference, Maryland, USA
- Colloquium: "Science Results from Grism Spectroscopy" — April, 2018
  National Optical Astronomical Observatory, Arizona, USA
- Contributed talk: "Data Science in Astronomy: from Henrietta Leavitt to HST" — October, 2017
  Grace Hopper Celebration for Women in Tech, Orlando, FL
- Invited talk: "Wide-field Slitless Spectroscopy from Space" — September, 2017
  Kavli Institute Workshop, Cambridge, UK
- Invited talk: "Software Engineering in Science" — May 2017
  IIT Mandi, India (delivered remotely)
- HotSci Talk: "Science results from the 3D-HST Survey" — August, 2016
  STScI, Baltimore, MD
- TIPS Talk: "A New Method for (Near-IR) Wide-Field Imaging" — June, 2016
  STScI, Baltimore, MD
- Colloquium: "Science results from the 3D-HST Survey" — March, 2016
  National Radio Astronomical Observatory, Green Bank
- Invited talk: "Near-IR Grism Spectroscopy with WFC3: Insights from the 3D-HST Survey" January, 2016
  American Astronomical Society Conference Special Session: Hubble Space Telescope: a Vision to 2020 and Beyond
- Invited talk: "The 3D-HST Survey" — November, 2015
  Census, Evolution, Physics Conference, New Haven, CT
- Invited talk: "Results from the 3D-HST Survey" — April, 2015
  Hubble's 25th Anniversary Symposium, Baltimore, MD

Public Speaking and Volunteer Work

As a scientist, I love communicating scientific discoveries to the public and increasing the scientific literacy at all ages. Here are highlights from activities over the last 10 years.

- Girls Who Code club instructor at a Baltimore City middle and high school starting Fall 2020.
- A volunteer presenter and a docent at Leitner Family Observatory and Planetarium, Yale University from 2013 to 2015. I gave weekly planetarium presentations to groups of the public (> 150 shows, $> 5,000$ visitors over 3 years), organized telescope viewing on clear nights and trained graduate students to use the equipment.

- Organized two Yuri's Night events in New Haven (2014, 2015). Total attendance > 500 people. Yuri's Night is a world-wide celebration of human space flight, marked on April 12th, the date of Yuri Gagarin's flight. The Yale University Astronomy Department had never hosted an event on Yuri's Night. I came up with the idea, recruited volunteers, created and distributed advertising materials, organized meetings to develop activities, gathered materials and ran the events themselves. The events were highly successful and the department continued to organize them after my departure.
- Regular presenter at Astronomy on Tap New Haven, Astronomy on Tap NYC and Nerd Nite Baltimore (2013-2019), 6 talks to a total audience of > 1000 including a ticketed event on the Intrepid Aircraft Carrier in April 2015, celebrating the 25th anniversary of the Hubble Space Telescope.
- TEDxBulgaria 2013 invited presenter, spoke about astronomy and the process of creating science in large collaborations in front of an audience of 3,000 people.

Publication Record

I have six first-author and 86 co-authored peer-reviewed publications as well as 88 non-refereed ones. A full list of my refereed publications is attached and can be also be found at here. These publications have been cited 7,844 times as of December 1st, 2020. My h-index is 47. Below I provide links and brief descriptions to several highlights of my publication record.

[1] **Momcheva, I.** & Smith, A., "Hubble in the Cloud: A Prototype of a Science Platform at STScI", 2019. A conference proceeding from the Astronomical Data Analysis Software and Systems Conference in 2018, this paper describes the detailed technical concept of a cloud hosted data analysis environment.

[2] **Momcheva, I.** "Working with the Hubble Space Telescope Public Data on Amazon Web Services", 2019. A conference proceeding from the Astronomical Data Analysis Software and Systems Conference in 2018, this paper summarizes a hands-on workshop on using the Hubble Space Telescope public dataset in AWS.

[3] **Momcheva, I.** et al., "Long-term Trends in the Astronomical Workforce: Analysis and Recommendations Based on the Publication Histories of >10,000 US Astronomy PhD Recipients", 2019. I carried out an analysis of the publication records of 10,000 astronomy PhD recipients over 40 years to examine long term trends in the field. A white paper submitted to the 2020 Decadal Survey on Astronomy and Astrophysics. Delivered a talk at the Inclusive Astronomy 2 conference in October 2019, expanding the analysis to quantify retention rate of PhD recipients from different races.

[4] Smith, A. et al., including **Momcheva, I.**, "Astronomy should be in the clouds", 2019. Contributed significantly to the ideas on the utilization of cloud computing for astronomy. A white paper submitted to the 2020 Decadal Survey on Astronomy and Astrophysics.

[5] Prichard, L. et al., including **Momcheva, I.**, "Enhancing Conference Participation to Bridge the Diversity Gap", 2019. A white paper submitted to the 2020 Decadal Survey on Astronomy and Astrophysics with recommendations on increasing diversity in astronomy by broadening conference participation of under-represented groups. Contributed to data collection and analysis.

[6] De Rosa, G. et al, including **Momcheva, I.**, "Increasing Gender Diversity and Inclusion in Scientific Committees and Related Activities at STScI", 2019. A white paper submitted to the 2020 Decadal Survey on Astronomy and Astrophysics with recommendations on tracking committee composition and outcomes in order to increase gender diversity and inclusion. Contributed to data collection and analysis.

[7] **Momcheva, I.**, "A New Method for Wide-field Near-IR Imaging with the Hubble Space Telescope", 2017. Paper presenting a new technique for observations with the Hubble Space Telescope.

[8] **Momcheva, I.**, Brammer, G. B., van Dokkum, P. G., Skelton, R. E., Whitaker, et al., "The 3D-HST Survey: Hubble Space Telescope WFC3/G141 grism spectra, redshifts, and emission line measurements for $\sim 100,000$ galaxies", 2016. The primary paper reporting on my technical work for the 3D-HST survey.

[9] **Momcheva, I.** & Tollerud, E., "Software Use in Astronomy: an Informal Survey", 2015. A white paper showing the results from an informal survey of software use of the astronomical community which demonstrated the rise of Python and the dire need for more software development training. This survey has been used to motivate improved funding for Python software and training.