2017 Spring Symposium on the Lifecycle of Metals Throughout the Universe: Celebrating 50 Years of UV Astronomy

Ori Fox, ofox[at]stsci.edu, Julia Roman-Duval, duval[at]stsci.edu and Andrew Fox, afox[at]stsci.edu

The Institute hosted a science symposium from April 24–27, 2017 on the *Lifecycle of Metals Throughout the Universe: Celebrating 50 Years of UV Astronomy*. This event focused on understanding metal production, transport, evolution, and distribution through the lens of UV astronomy, which originated with sounding rockets in the 1960s and looks forward to the launch of future missions such as the Large UV/Optical/InfraRed (LUVOIR) surveyor. The symposium featured 112 registered participants, 42 posters, 32 invited talks, 22 contributed talks, and a discussion on the status and future of UV astronomy.

Cosmic metals touch on a wide range of astrophysics, including stellar astrophysics, the physics of the interstellar and circumgalactic media, and galaxy evolution. Current generations of stars release metals and energy into the surrounding interstellar gas and sculpt the reservoir from which new stars are born. Within the Inter-Stellar Medium (ISM), metals can be transferred between the gas and dust phases, thus affecting the chemistry and thermal balance of galaxies. The cumulative mechanical, thermal, and radiative energy injection from massive stars drives large-scale, metal-rich gas flows both within and out of galaxies. While metals produced in stars are mixed and transported with the ISM and Circum-Galactic Medium (CGM), primordial gas can inflow into galaxies, thus sustaining the gas reservoir for star formation. Figure 1 summarizes the various processes involved in the lifecyle of metals in the Universe.

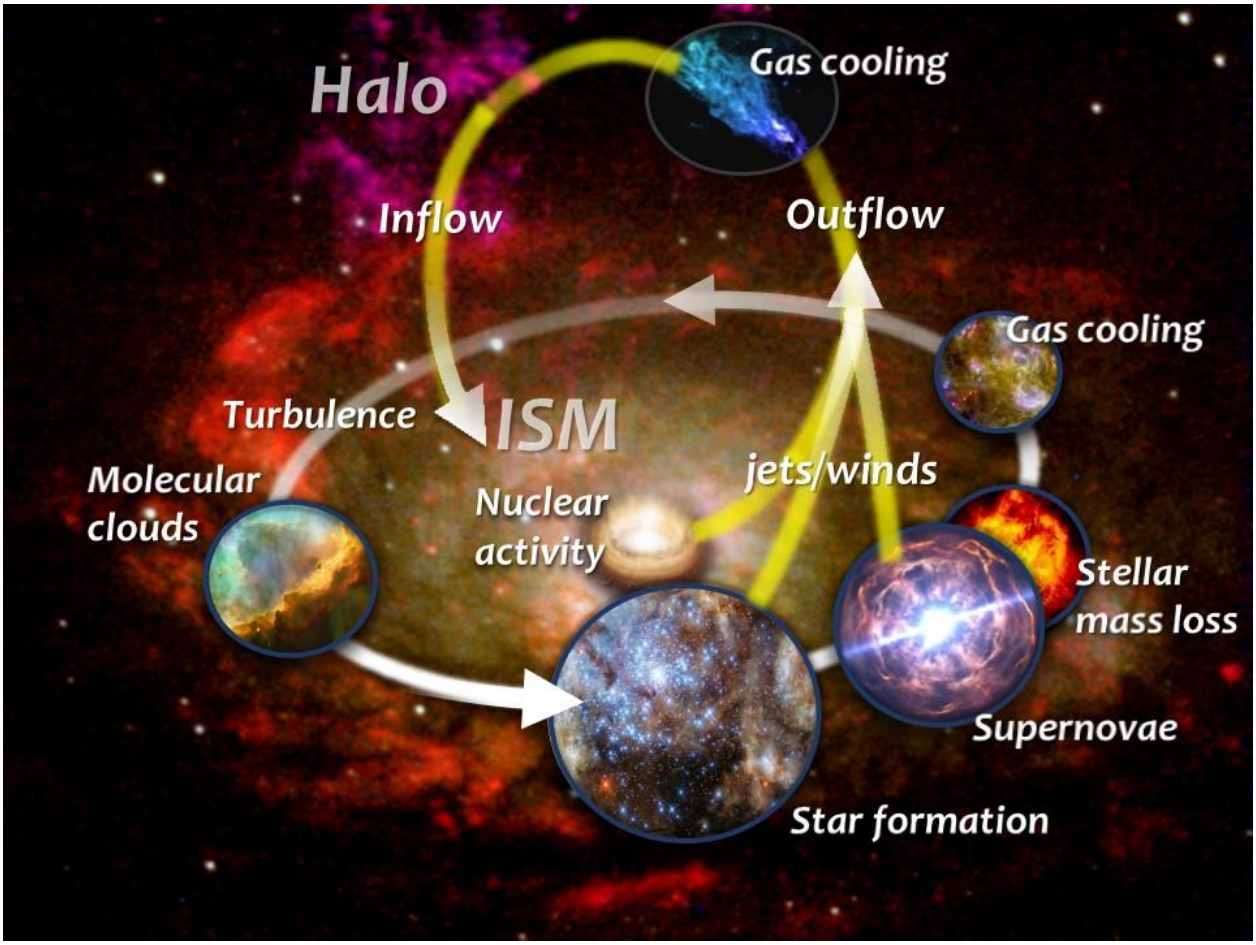

Figure 1: Schematic illustration of the role metals and dust play in the evolution of stars and galaxies. Star formation and stellar evolution lead to mass loss and SNe, seeding the ISM with dust, metals, and molecules. Starburst winds and jets from AGN provide feedback and launch outflows. Metal-enriched and pristine halo gas eventually cool and accrete in the disk to form new stars and feed the central black hole, starting the cycle again. Image Credit: www.spica-mission.org/science_galaxies.xhtml.

The UV offers an ideal probe of metals and dust, primarily via absorption line analysis. These wavelengths have been critical in studying the powerful mass-loss winds from O- and B-type stars, the discovery of interstellar molecular hydrogen, the H I column densities toward stars and their correlations with extinction, the depletions of gas-phase heavy atoms in the interstellar medium as they condense onto dust grains, the abundance ratio of atomic deuterium to hydrogen, and the pervasiveness of hot gases in space as revealed by absorption from interstellar O VI. Absorption features in the UV spectra of stars in our Galaxy teach us important lessons for interpreting the same transitions for gas systems at high redshift seen in QSO spectra at visible wavelengths.

At the symposium, recent progress in chemical evolution science was discussed, with a focus on UV astronomy contributions. Both observational and theoretical perspectives were included. The Scientific Organizing Committee was particularly interested in bringing together astronomers from both multi-wavelength and multi-discipline communities to understand metal production,

transport, evolution, and distribution, so that new collaborations might be sparked and each astrophysical sub-field might improve their understanding of sub-grid physics relevant to chemical evolution. In our selection of invited and contributed talks, we were keen to select a speaker list that reflected gender diversity and a good balance between junior and senior astronomers, and we are confident that we met these goals. The electronic poster session, in which posters were displayed electronically on flat-screen TVs, was set up to provide a relaxed environment where poster presenters had time to discuss their science with colleagues, and this was well received.

With a focus on over 50 years of UV astronomy, this Symposium also included a number of historical talks and a special guest of honor: Dr. Nancy Grace Roman is an American astronomer who was the first Chief of Astronomy at NASA and played a crucial role in planning the Hubble Space Telescope. Additional historical contributions were made by the Johns Hopkins University Astronomy Department, which played an important role in several UV-based space missions, including early sounding rockets, the Hopkins Ultraviolet Telescope (HUT), and the Far Ultraviolet Spectroscopic Explorer (FUSE).

Figure 2: Symposium chair Dr. Ori Fox with special guest Dr. Nancy Grace Roman.

We are grateful to the event coordinators Martha Devaud, Sherita Hanna, and Flory Hill, and to other members of the SOC (Julia Roman-Duval, Andrew Fox, Alessandra Aloisi, Gisella De Rosa, Karl Gordon, Anton Koekemoer, Anthony Marston, Cristina Oliveira, Molly Peeples, Paule Sonnetrucker, and Nolan Walborn), who made this event possible. We also thank the Bloomberg Center for Physics and Astronomy at the Johns Hopkins University, including Stephan McCandliss, Warren Moos, and Bill Blair, for hosting a reception.

Figure 3: Participants in the Spring Symposium *Lifecycles of Metals Throughout the Universe* assemble outside the Space Telescope Science Institute's Muller Building on the campus of the Johns Hopkins University in Baltimore, Maryland. The event ran from April 24–27, 2017, and included 112 registered participants.

The conference webpage is at:
2017 spring symposium lifecycle-of-metals-throughout-the-universe celebrating 50 years of uv astronomy

The schedule is located at:
Symposium agenda on cvent

Twitter is at:
twitter.com/hashtag/uvmetals?src=hash

Posters can be found at:
stsci.edu/~ofox/posters2017/

The webcast is at:
webcast.stsci.edu/