

Performing quality control on targeted proteomics assays using Skyline and Panorama

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<http://panoramaweb.org/>

Overview

Panorama's new quality control (QC) folder implements Statistical Process Control in Proteomics (SProCoP)-style quality control metrics and stores them over time, helping users efficiently identify and visualize assay performance issues and trends for liquid chromatography mass spectrometry (LC-MS) proteomics experiments. Close integration with the popular Skyline targeted mass spec desktop application running on an instrument control computer allows reliable and automated data processing. Additionally, Panorama captures information about instrumentation, reagent, process, or other changes to help correlate with changes in instrument performance. Developed as a module in the LabKey Server data management platform, Panorama is freely available, open source and may be installed and managed by any laboratory or organization. Free, hosted Panorama projects are available on panoramaweb.org.

Introduction

Automated Quality Control Workflow

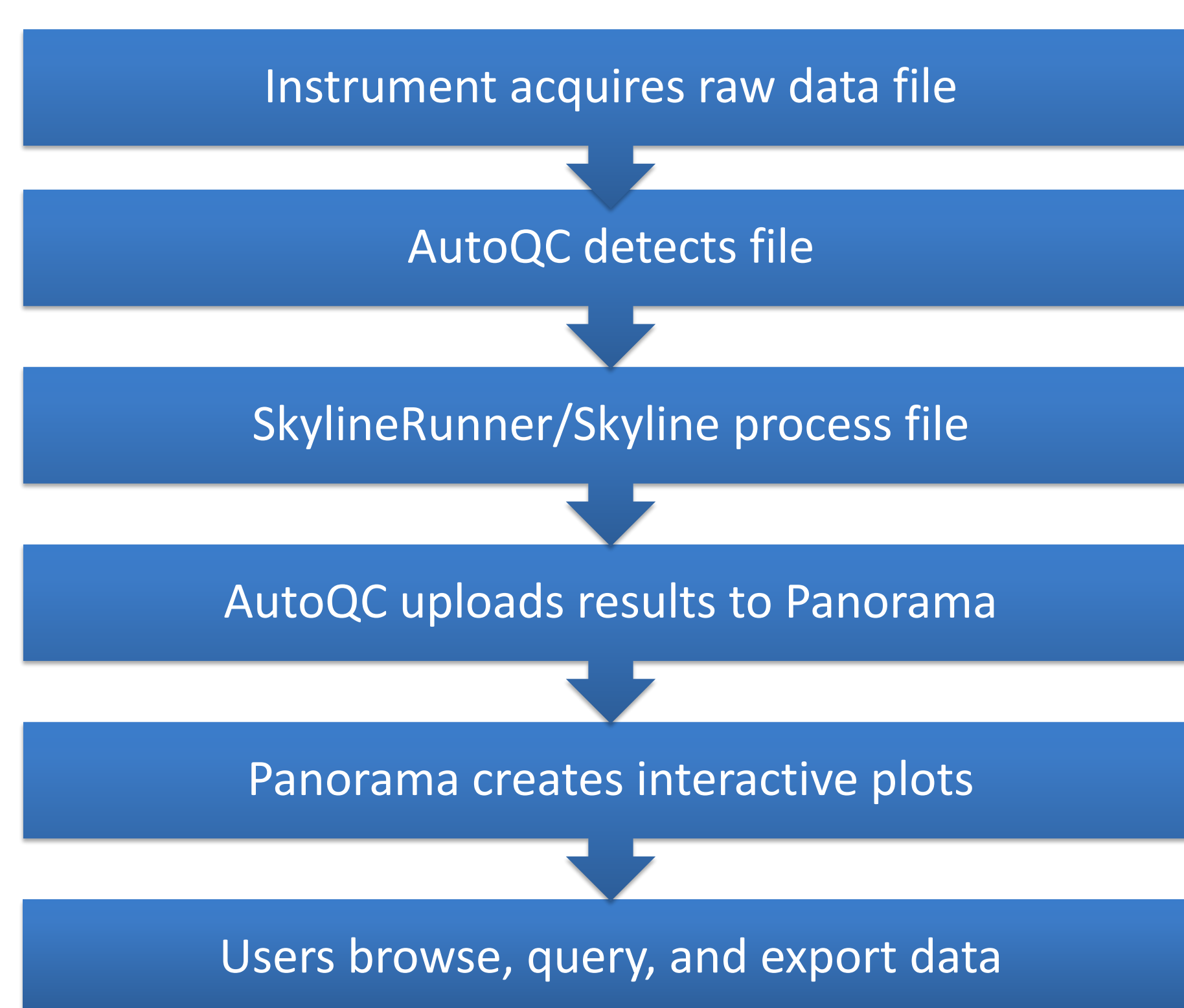


Figure 1: The workflow begins on the instrument computer. AutoQC monitors for new QC data files, runs Skyline, and uploads the results into Panorama. Users can then interactively plot and interact with the data.

Methods

Skyline and Panorama combine to provide a robust QC workflow for LCMS instrumentation used in proteomics experiments. AutoQC, a utility application, uses SkylineRunner to invoke Skyline without user interface for automated data processing. AutoQC can be run on an instrument control computer to capture new QC runs automatically, and add them to an existing Skyline document, where the information is archived for later use and transferred to Panorama. Panorama retains a full history of QC run performance, and presents users with interactive plots for key metrics including retention time and peak area. Additionally, users can add information about changes including instrumentation, maintenance, and reagents, which are overlaid on the plots, providing a convenient way to correlate cause and effect.

All tools are released as open source under Apache 2.0 License.

Results

Create Quality Control Folder in Panorama

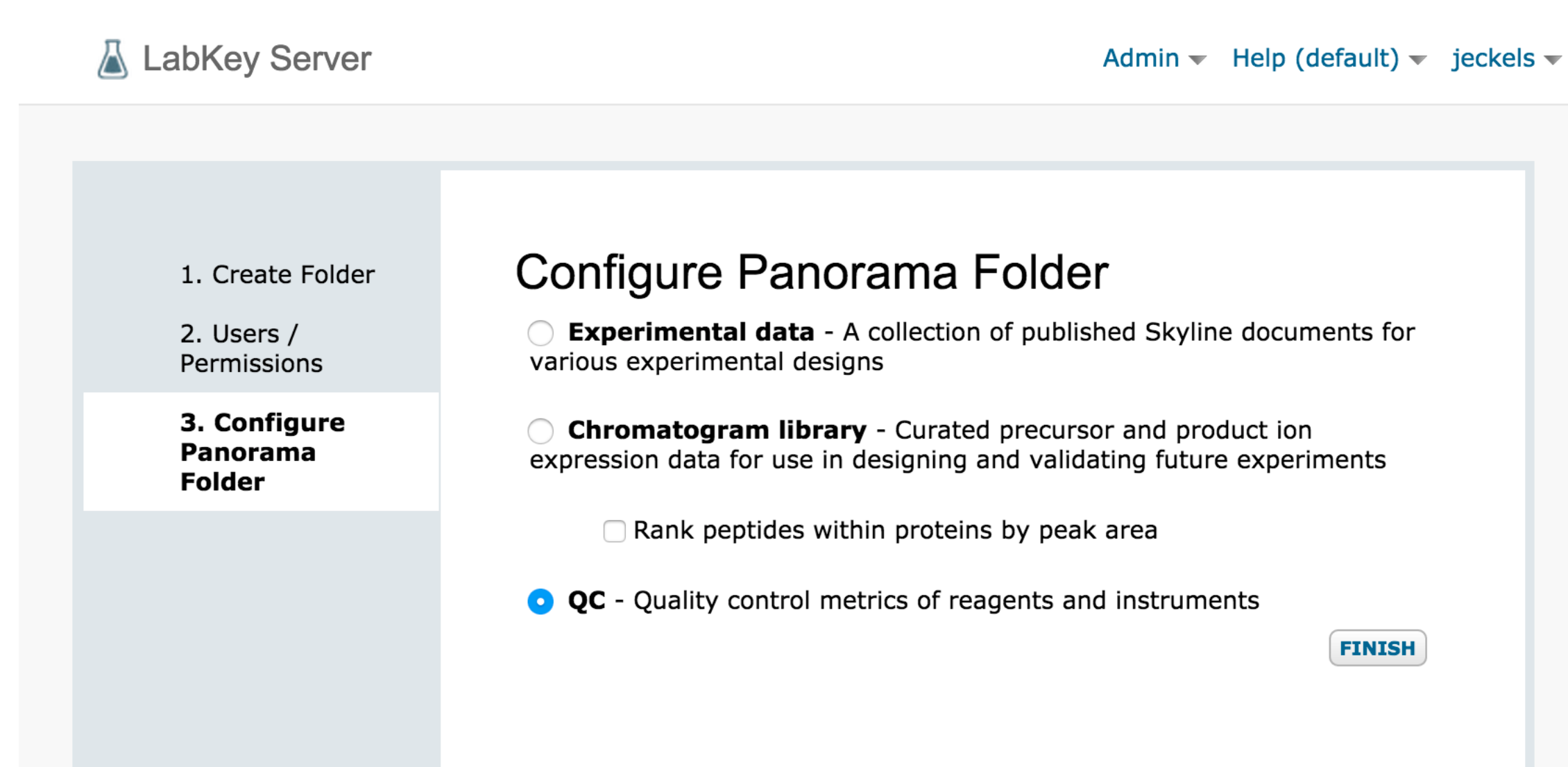


Figure 2: The user creates a Panorama quality control (QC) folder. A given folder might be scoped to a specific instrument or experiment.

Set Up AutoQC on Instrument Computer

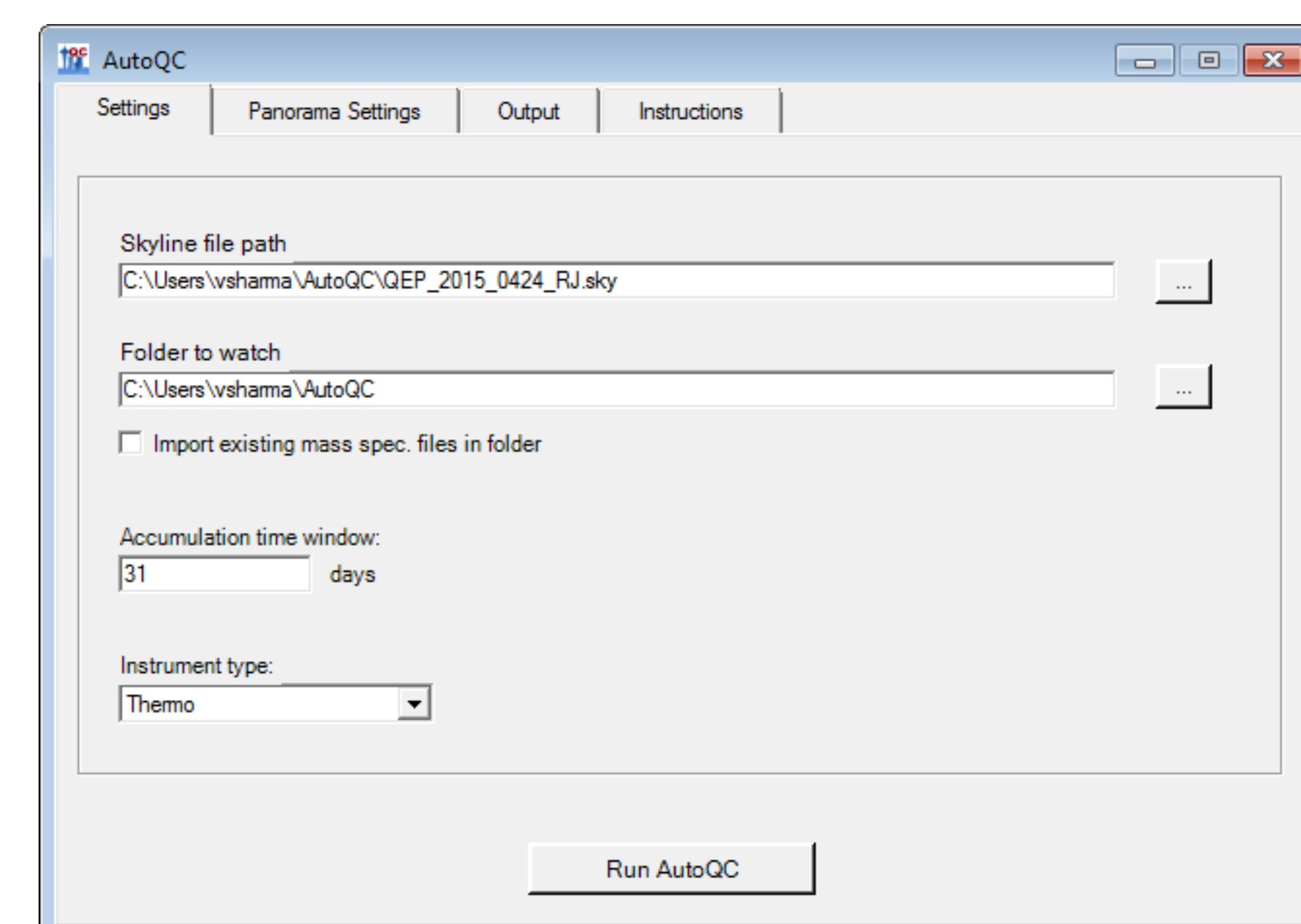


Figure 3: The user configures AutoQC to monitor a specific directory to monitor for newly acquired data, and to accumulate and archive in specific Skyline documents.

Configure Panorama Server in AutoQC

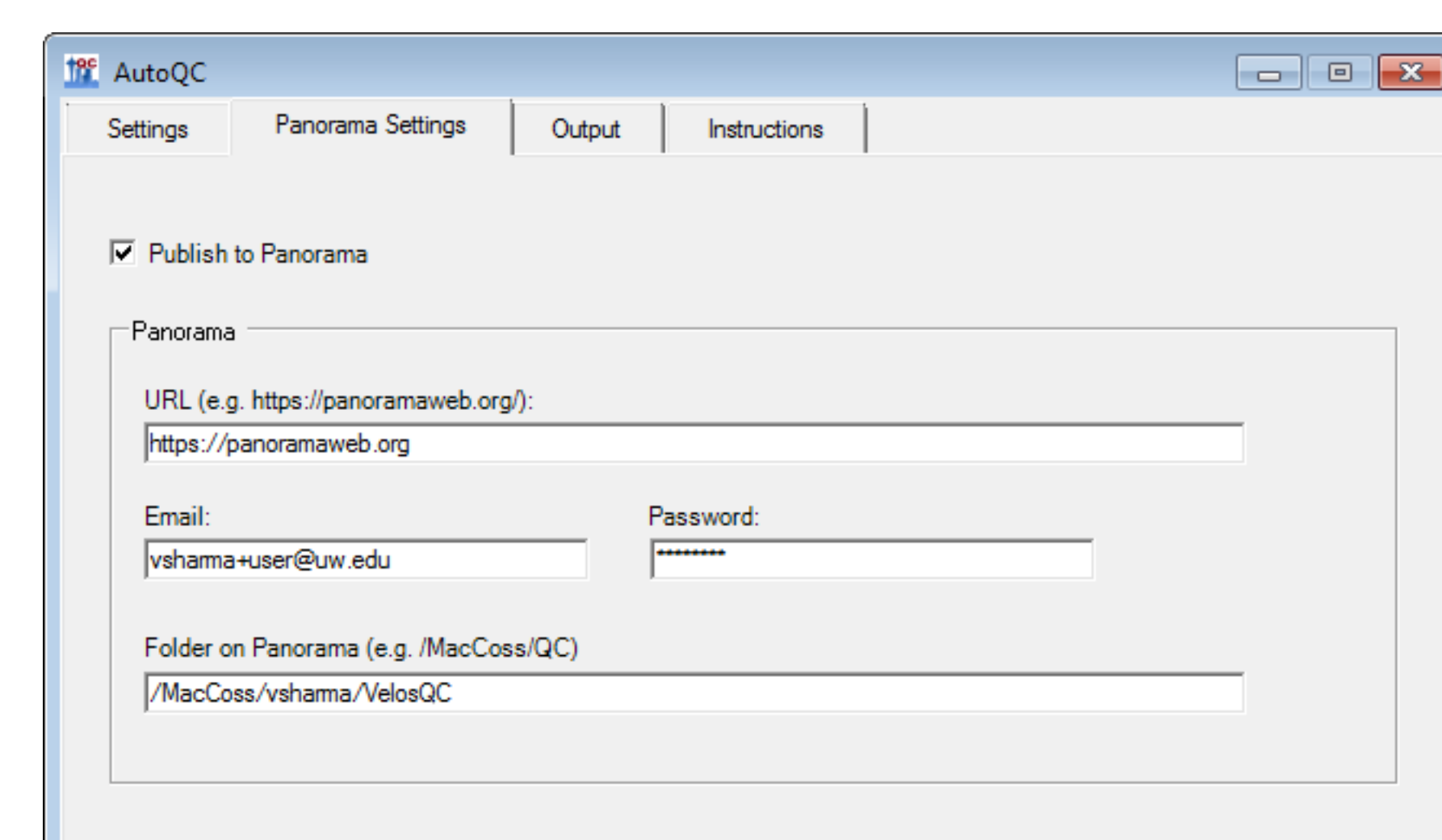


Figure 4: The user configures AutoQC with the location of the QC folder within Panorama and account credentials.

Acquire Data on Instrument

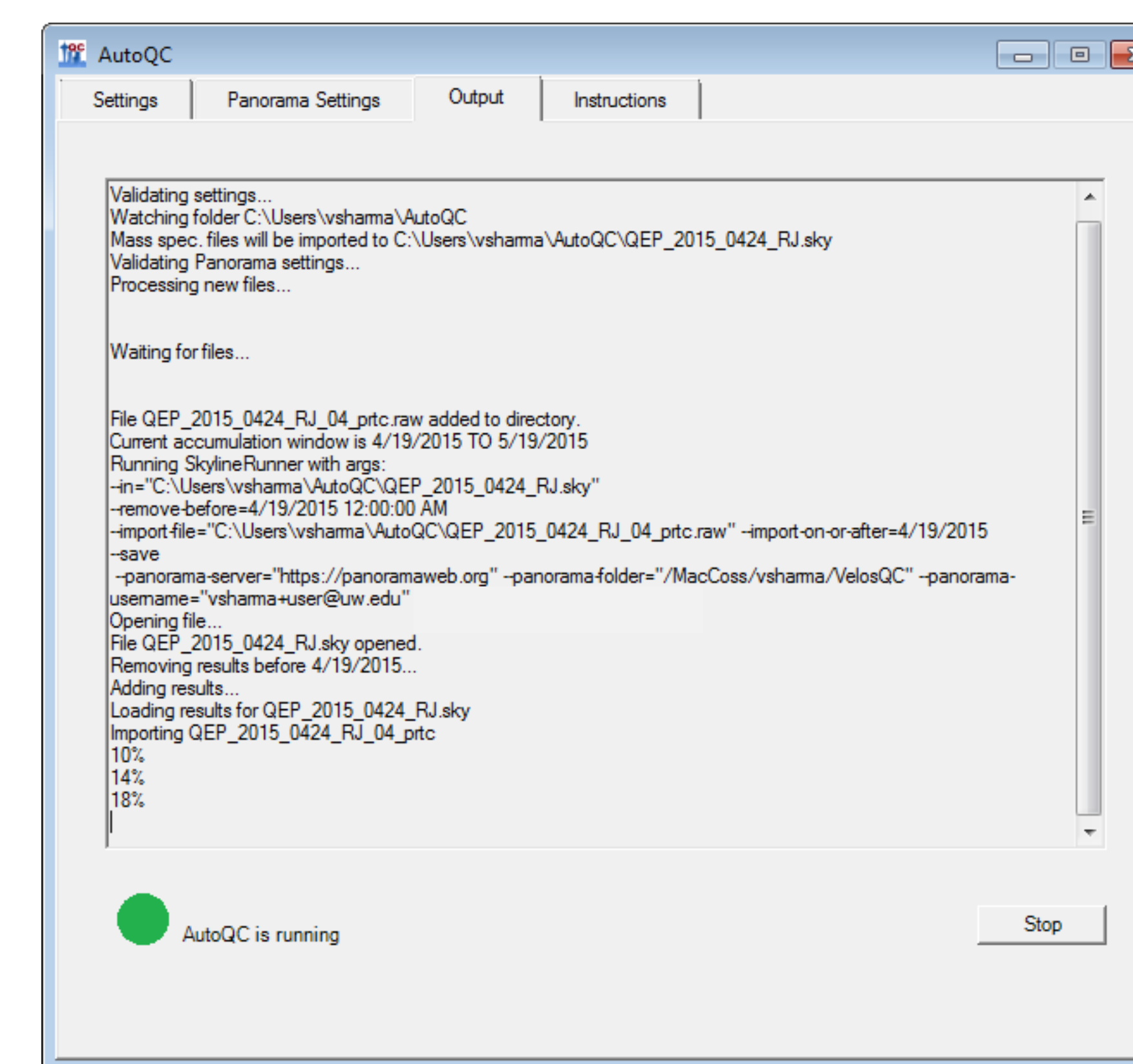


Figure 5: After data acquisition is complete, AutoQC detects the new file and launches SkylineRunner to process the data. It is added to the Skyline document and old data is archived based on the configuration. The document is then automatically uploaded into Panorama.

Choose Visualization Type

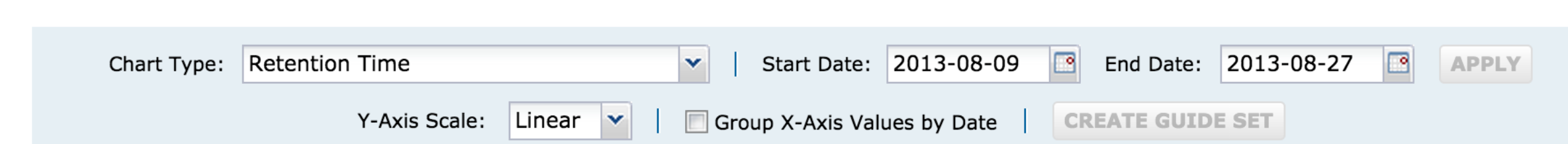


Figure 6: Panorama QC folders offer a variety of metrics and parameters for generating interactive Levey-Jennings plots, including those for retention time, peak area, peak width, and more.

Visualize Assay Performance

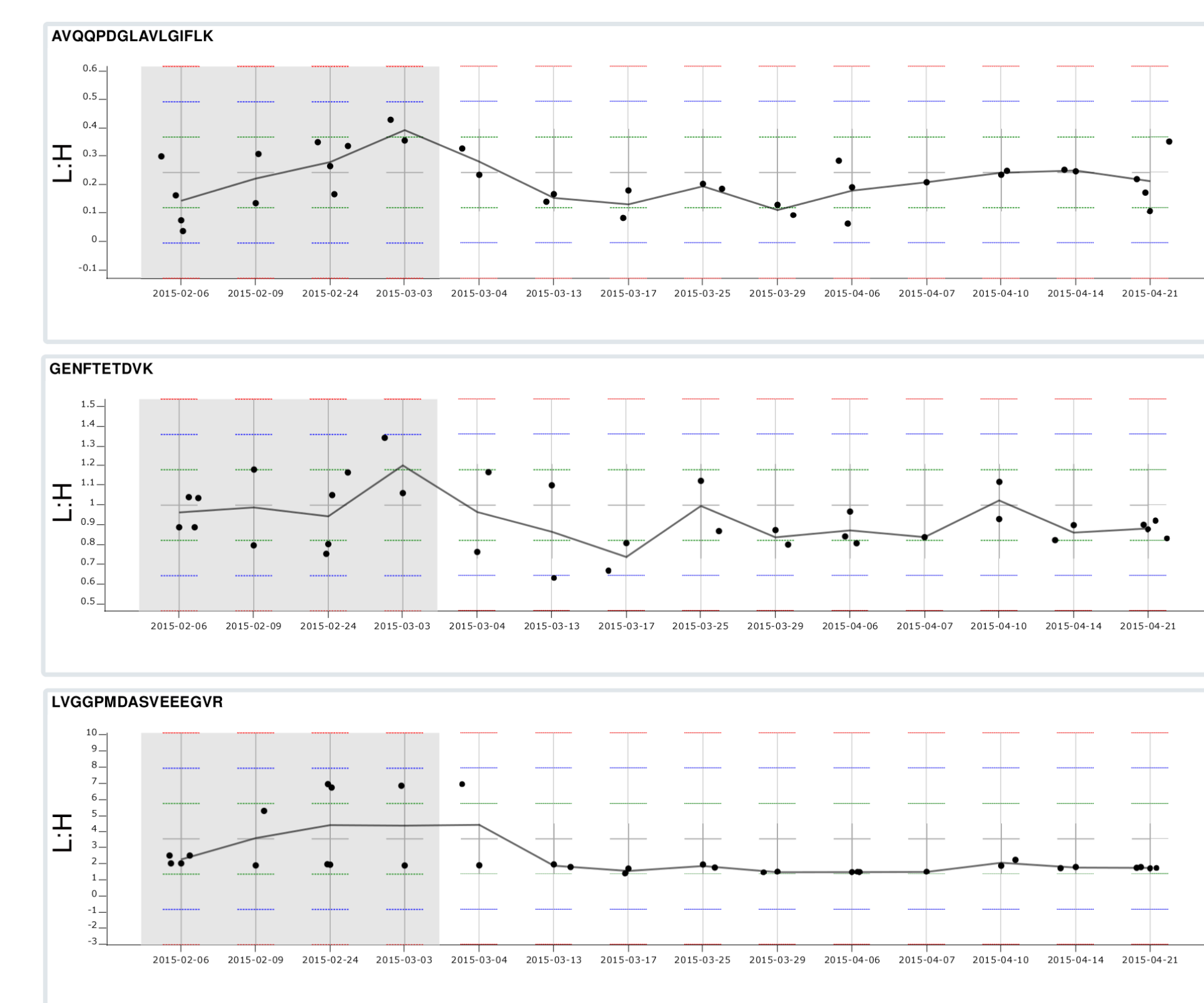


Figure 7: Three Levey-Jennings plots representing pooled CSF QC plate control used to determine processing conformity across multiple cohorts. The QC folder allows for easy visualization of the stability in the light-to-heavy ratio measured by these selected peptides lending confidence in the processing methods of the experimental samples. "Guide Set" (shaded grey) defines the expected value with the mean (grey line) and standard deviations (dashed green, blue, and red lines at +/- 1, 2, and 3 STDDEV) displayed to identify when runs fall out of the acceptance range.

Add Annotations to Track Changes

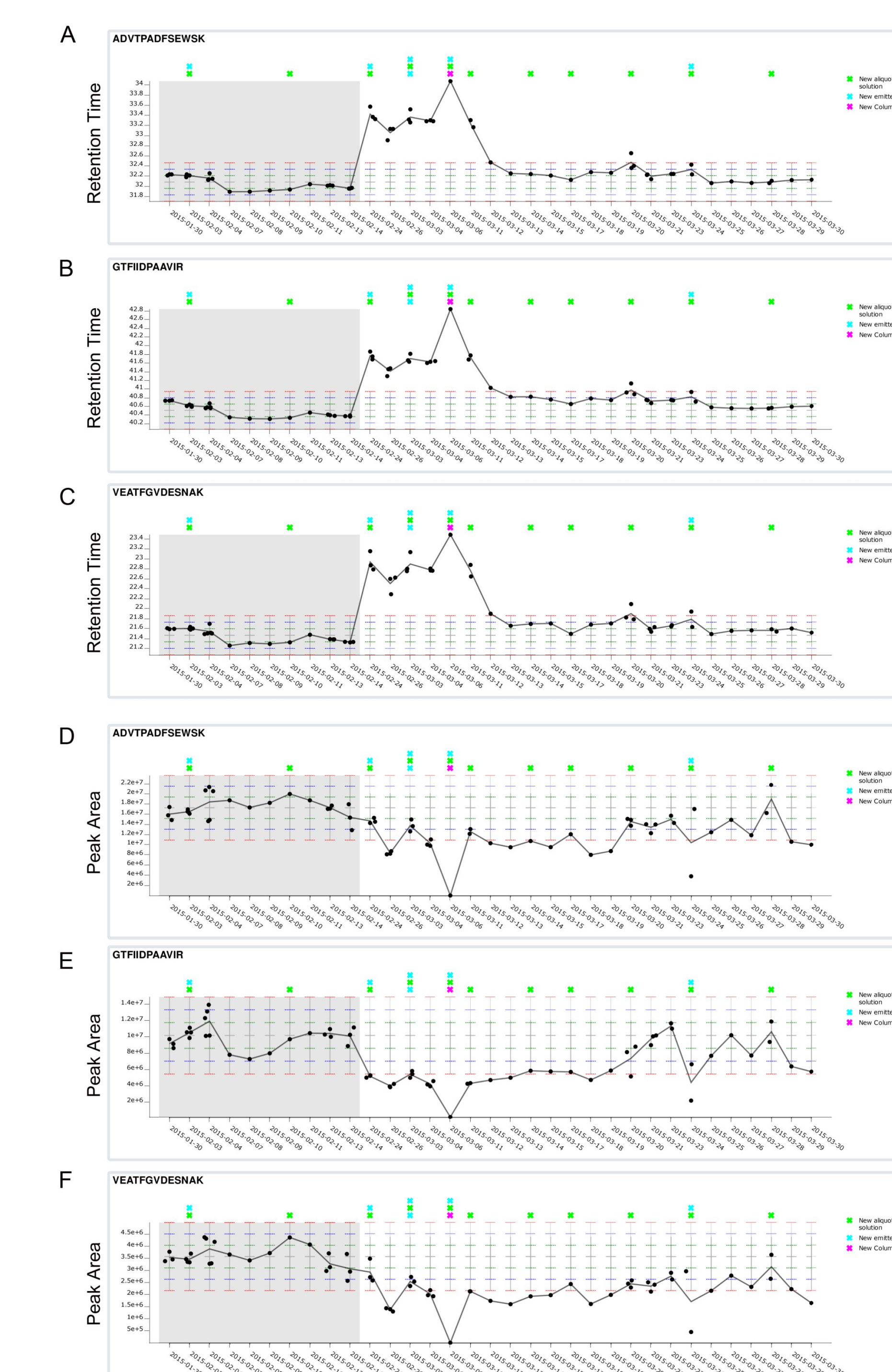


Figure 8: Six Levey-Jennings plots detailing changes in both retention time (A-C) and peak area (D-F). Three peptides were chosen to track QC performance. "Annotations," shown as symbols at the top of each plot, note changes in instrument conditions that can be tracked as they relate to changes in acquired data. Hovering over points shows additional detail.

Conclusions

As of May 2015, more than 100 labs are already using Panorama on a server hosted by the University of Washington. Additionally, major pharmaceutical companies and other organizations have deployed their own installations of Panorama. With the release of LabKey Server version 15.1 in March 2015, Panorama already supports quality control folders, and the upcoming 15.2 release (July 2015) adds new capabilities. Multiple instrument configurations may be tracked using separate QC folders, allowing labs to monitor all of their equipment in a centralized location. Presenting the Levey-Jennings plots in an interactive, secure, web-based interface, gives all authorized users immediate access to both historic and just-acquired assays.

References

- (1)MacLean B, MacCoss MJ, et al. *Bioinformatics*. 2010/02; 10.1093/bioinformatics/btq054.
- (2)Sharma V, MacLean B, et al. *J. Proteome Res*. 2014/08; 10.1021/pr5006636.
- (3)Bereman MS, MacCoss MJ, et al. *J Am Soc Mass Spectrom*. 2014/02; 10.1007/s13361-013-0824-5.

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