**Introduction**

We discuss the development of a new Python plug-in in the context of the multi-messenger with gravitational waves. When searching for host galaxies of gravitational-wave sources, the completeness of the galaxy catalog is a significant parameter to be considered [1]. Our plug-in estimates the completeness in the sky localization of a gravitational-wave source computing the intersection with high Galactic dust extinction regions as selected by users.

**Completeness of a catalog**

Following the method described in Dalya et al. [2], we calculate the completeness of a galaxy catalog.

**The plug-in algorithm**

To calculate the galaxy completeness for a gravitational-wave sky localization, we adapt the method described in the previous section. We select the galaxies between \( R_1 = d - 3\sigma_g \) and \( R_2 = d + 3\sigma_g \) (with \( d \) mean distance of the event and \( \sigma_g \) standard deviation), contained in a credible volume corresponding to the 90%. We also calculate the intersection area between the 90% credible area and high Galactic dust extinction regions as selected by users.

**Interaction with Aladin Desktop**

The plug-in is able to communicate with Aladin via the SAMP protocol. Tkinter Python module is used to create the pop-up window which displays the completeness plot with additional information in a dedicated legend.

**Conclusions**

We developed a new plug-in, in the context of the Virtual Observatory standards and tools, to define the completeness of a catalog in the credible volume of the event under examination. The plug-in is named Catalog Completeness in GW Sky Localizations. Thanks to the SAMP-VO protocol and the Tkinter package, our Python plug-in is able to communicate with the Aladin software. We visualize the gravitational-wave sky localization in the Aladin Desktop and a new dedicated window shows the plot of the completeness. The complete algorithm is reported in a public GitHub repository (https://github.com/elisacart/Catalog-Completeness-in-SkyLocalizations.git) which indicates all of the Python modules necessary for this analysis.

**References**