Virtual Observatory powered research in astrophysics

I. Chilingarian (1,2)

(1) CDS Observatoire astronomique de Strasbourg, France (2) Sternberg Astronomical Institute, Russia (chil@sai.msu.ru)

Abstract

Nowadays, following years of technological development, Virtual Observatory (VO) standards, resources, and services became powerful enough to help astronomers making real science on everyday basis. An astronomer is now able to combine "online" VO-enabled parts with "offline" research stages including dedicated data processing and analysis, observations, numerical simulations. This helps to overcome one of the major issues that most present-day VO studies do not go further than data mining. I will present VO-powered research projects related to extragalactic astrophysics combining VO and non-VO blocks resulted in peer-reviewed publications.

1. Discovery of compact elliptical galaxies

We have used a VO-fed workflow to automatically analyse a large amount of HST data and discovered a population of compact elliptical (M32-like) galaxies in nearby clusters [1]. Some of these galaxies were later observed with the 6-m telescope to confirm their membership in the clusters, some others were confirmed by analysing archival spectra also available in the VO. We have performed dedicated numerical simulations to model their origin by the tidal stripping, demonstrating the importance of this galaxy evolution mechanism.

2. Spectrophotometric properties of nearby galaxies

We have cross-identified three large sources of photometric data: GALEX GR4 (UV), SDSS DR7 (optical), UKIDSS DR7 (NIR) and compiled a homogeneous FUV-to-NIR catalogue of spectral energy distributions of nearby galaxies ($0.03 < z < 0.6$) converting the fluxes into the restframe [2]. We have extracted the data for the spectroscopically confirmed galaxies and fitted their SDSS DR7 spectra to obtain stellar population parameters, velocity dispersion and residual emission line fluxes of some 450000 galaxies.

3. The GalMer database

The GalMer database is a part of the Horizon project, providing access to a library of TreeSPH simulations of galaxy interactions [3]. We have developed a set of value-added tools related for data visualization and post-processing with available VO-interfaces, including the spectrophotometric modelling of galaxy properties, making GalMer the most advanced resource providing online access to the results of numerical simulations. These tools allow direct comparison of simulations with imaging and spectroscopic observations.

Summary

Presentation of these three examples aim at stimulating usual astronomers to carry out VO-enabled research on everyday basis. Although minor infrastructural difficulties still exist, VO-enabled research beyond data mining is already possible. We foresee a growing amount of VO-powered studies to arrive in near future.

References

[1] Chilingarian, I. et al.: A population of compact elliptical galaxies detected with the Virtual Observatory, Science, Vol. 326, pp. 1379-1382, 2009.

[2] Chilingarian, I.; Melchior, A.-L.; Zolotukhin, I.: Analytical approximations of k-corrections in optical and near-infrared bands, MNRAS in press, 2010, arXiv:1002.2360

[3] Chilingarian, I. et al.: The GalMer database: Galaxy Mergers in the Virtual Observatory, A&A in press, 2010, arXiv:1003.2343