GALMER : GALaxy MERgers in the Virtual Observatory

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Observatoire de Paris centre de recherche et enseignement en astronomie et astrophysique relevant du Ministère de l'Enseignement supérieur et de la Recherche.

Observers are more and more familiar with getting their data from the Virtual Observatory (VO), for example obtaining images and spectra of galaxies from the Web, instead of telescopes. For the first time, it is now possible to get simulated images and spectra from interacting galaxies, from the "Theoretical Virtual Observatory" too, in a way most convenient to compare with the observations. Astronomers from Paris Observatory have built a library of thousands of galaxy merger simulations, and made it available to users through tools compatible with the VO standards adapted specially for this theoretical database. The web site is http://galmer.obspm.fr.

To investigate the physics of galaxy formation through hierarchical merging, it is necessary to simulate galaxy interactions varying a large number of parameters : morphological types, mass ratios, orbital configurations, etc. On one side, these simulations have to be run in a cosmological context, able to provide a large number of galaxy pairs. On the other side, the resolution has to be high enough at galaxy scales, to provide realistic physics. The GalMer database is a library of thousands of simulations of galaxy mergers at moderate spatial resolution. It satisfies precisely this compromise between the diversity of initial conditions and the details of underlying physics.

The simulations are as realistic as possible. They include all state of the art physics known : gravitational N-body interactions between all particles (gas clouds, stars and dark matter), gas dissipation and hydrodynamics, formation of stars from the gas according to the observed Schmidt-Kennicutt law, feedback associated to starburst, provided by stellar winds and supernovae explosions, etc..

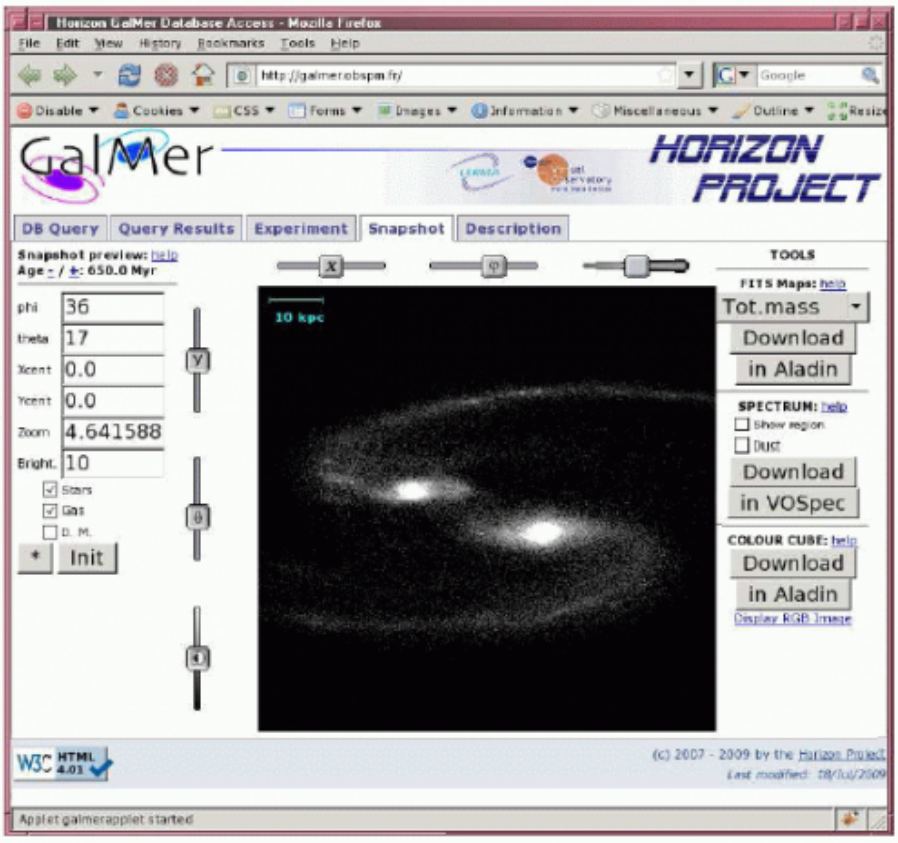

Figure 1 : Exemple de résultats obtenus interactivement à partir de l'interface Web de GalMer : une époque de la

simulation est présentée, après sélection des conditions initiales des galaxies en interaction, et leur orbite. L'image peut être analysée par plusieurs outils : rotations géométriques, rendu de la photométrie, ou des spectres dans une région choisie, etc ...

The results from the simulations can be analysed as for observations, and with even more details. For each selected projection, on-the-fly programs compute the projected image, with colour maps according to the age of the stars along the line of sight. The simulation knows the average birth time of any stellar particle, and computes the corresponding colour from the stellar population synthesis model PEGASE. A dust screen can be applied, corresponding to the gas column density along the line of sight, and according to the metal abundance computed from the stellar yield at each time-step of the simulation. Dust emission is also computed in the infrared, through a very simple and approximate radiative transfer.

All data can be accessed from the database, including all coordinates, velocities and properties of simulated particles in FITS binary tables. The main advantages of the database are VO access interfaces and value-added services which allow users to compare the results of the simulations directly to observations. GalMer can be used as a virtual telescope producing broadband images, 1D spectra, 3D spectral datacubes, and even producing the star formation rate, and history, along the galaxy interactions. Examples of the scientific usage of the database are given in the reference below. They include (1) studies of the star formation efficiency in interactions ; (2) creation of old counter-rotating components ; (3) reshaping metallicity profiles in elliptical galaxies ; (4) orbital to internal angular momentum transfer ; (5) reproducing observed colour bimodality of galaxies.

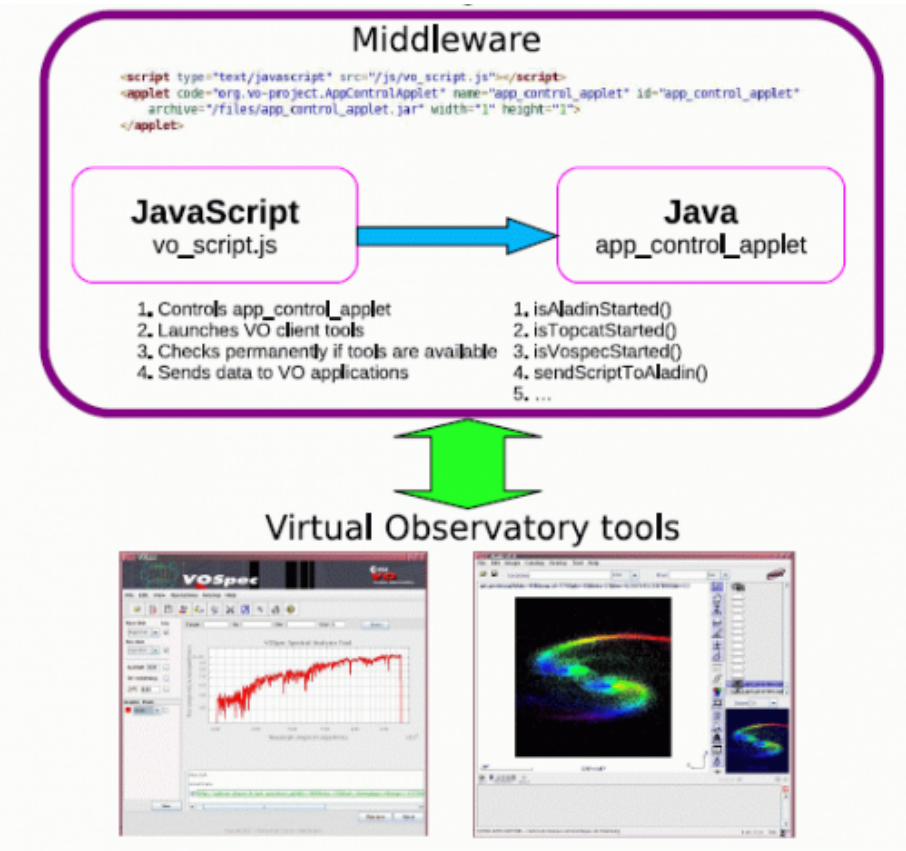

Figure 2 : L'interface entre la base de données GalMer et les outils de l'OV est fournie par un intergiciel, illustré ici, permettant d'obtenir un spectre dans VOSPEC, et une carte dans Aladin.

See the web site http://galmer.obspm.fr. The PI of the GalMer project is Paola Di Matteo. To contact the Galmer team, mail to <!â€" var part1 = "galmer.team" ; var part2 = "obspm.fr" ; var part3 = "GalMer team" ; document.write('Reference

I. V. Chilingarian, P. Di Matteo, F. Combes, A.-L. Melchior, B. Semelin The GalMer database: galaxy mergers in the Virtual Observatory accepted in Astronomy & Astrophysics, Mars 2010 ->ma' + 'ilto:' + part1 + '@' + part2 + '" class='spip_out'>' + part3 +'</' +'a' +'>') ; // -

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