FAST MOVING FRONTS - 2009

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Gustavo Bruzual & Stéphane Charlot talks with *ScienceWatch.com* and answers a few questions about this month's Fast Moving Front in the field of Space Science. The author has also sent along images of their work.

Article: Stellar population synthesis at the resolution of 2003

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SW: Why do you think your paper is highly cited?

Our paper provides interested users with a tool to interpret the spectral energy distributions of stellar populations in galaxies, from the Milky Way all the way to the most distant galaxies discovered in the universe.

The evolution in time of the light emitted by stars in a galaxy or a star cluster is a valuable clue to understanding the basic properties of stellar populations, which in turn inform us about the history of galaxy assembly. Age, chemical composition, and mass in stars are among the quantities that can be readily inferred from comparisons of our models with galaxy observations.

The paper appeared at the moment when observations from the Sloan Digital Sky Survey (SDSS) were becoming available in large quantities. The spectral resolution of the SDSS spectra matched quite well that provided by our models, and the models became almost "de facto," a convenient and ready-to-use tool to interpret these data.

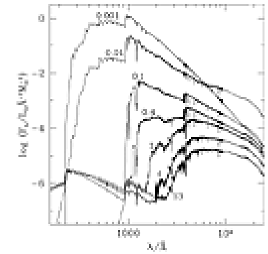
Additionally, we provided the users with a series of computational tools, which made applications of the models easy and convenient. Finally, the wide spectral coverage of these models makes them a useful tool to interpret data collected at all major ground-based and space-based ultraviolet, optical, and infrared telescopes.

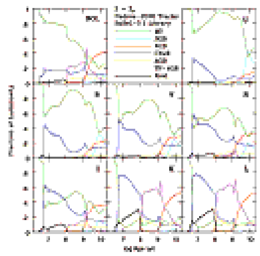
SW: Does it describe a new discovery, methodology, or synthesis of

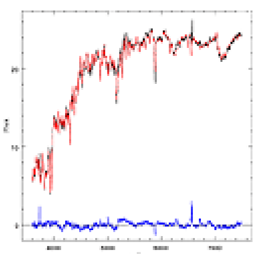
knowledge?

The paper assembles a large amount of astrophysical information available in the literature and on the Internet and makes specific predictions about the behavior in time of most of the observational properties of stellar populations in galaxies—independently of the effects of interstellar gas and dust.

By design, in fact, spectral evolution models constitute a synthesis of our knowledge of how stars evolve and shine, from which we can compute the amount of light emitted at any time and at any wavelength by an evolving stellar population. In a way, our models also defined a new methodology, which has become "a standard" in the field of spectral studies of galaxies.







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SW: Would you summarize the significance of your paper in layman's terms?

Our work allows observational astronomers to establish with relative certainty the age of a galaxy and the chemical composition and the total mass of stars shining in it. As we observe more and more distant galaxies, we also look further back in time because light travels at a constant speed.

Hence, the stars we see in distant galaxies are typically younger than those in the nearby universe, and the light they emit is bluer and more intense. Interpreting observations of distant galaxies requires a careful modeling of these effects. This is precisely what we provide in our paper.

SW: How did you become involved in this research and were any particular problems encountered along the way?

This research is the fruit of a long-term project we both got involved in at different epochs during our Ph.D. studies—GB about 10 years before SC. Perhaps the most major problem we kept encountering along the way has been the lack of reliable prescriptions to describe the light emitted by stars in some complicated phases of stellar evolution.

This can weaken considerably the applicability of the models in specific cases where the missing ingredients play a dominant role. Major progress in our research therefore relies on the progress accomplished in related fields of astrophysics, such as stellar evolution theory and stellar atmospheres.

SW: Where do you see your research leading in the future?

This kind of research will undoubtedly lead to a better understanding of the universe. The rate of progress in our theoretical understanding of the physics of stellar evolution and stellar atmospheres makes us foresee that, in the near future, the use of spectral synthesis models in studies of galaxy evolution will become more sophisticated.

The answer to problems like how galaxies are built up, how their mass is assembled, how copiously they form stars, and how their gas becomes enriched in different chemical elements, which at present are only hinted at, will be part of textbook astronomy.

SW: Do you foresee any social or political implications for your research?

From the social point of view, research in extragalactic astronomy, and astronomy in general, has contributed to our understanding of the universe and has increased the cultural heritage of mankind to levels unthinkable only a few years ago.

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