

DIVISION IV STARS
ÉTOILES

IAU Division IV organizes astronomers studying the characteristics, interior and atmospheric structure, and evolution of stars of all masses, ages, and chemical compositions.

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DIVISION IV COMMISSIONS

Commission 26	Double and Multiple Stars
Commission 29	Stellar Spectra
Commission 35	Stellar Constitution
Commission 36	Theory of Stellar Atmospheres
Commission 45	Stellar Classification

DIVISION IV WORKING GROUPS

Division IV WG	Massive Stars
Division IV WG	Abundances in Red Giants

INTER-DIVISION WORKING GROUPS

Division IV-V WG	Active B stars
Division IV-V WG	Ap and Related Stars
Division IV-V-IX WG	Standard Stars

TRIENNIAL REPORT 2006 - 2009

1. Introduction

Stars are the main visible constituents of the galaxies, and their properties are basic to our knowledge of the Universe.

- A precise determination of the structure of the interior of the stars, and of the physical phenomena at work, is necessary to predict their evolution as a function of their masses and their chemical composition. From these predictions, the ages of globular clusters are determined, directly linking to the age of the Universe and discriminating among different populations of the distant galaxies.

- The distance scale of the Universe is based on semi-primary distance indicators as Cepheids and type-Ia supernovae , X-ray binaries and binary milliseconds pulsars, which

are late stages of stellar evolution. Detailed modelling is necessary to understand the routes to their properties.

- Stellar abundances are a fundamental parameter used, for example, to check the primordial nucleosynthesis, the ages of the stars (from radioactive elements), the composition of supernovae ejecta, the star formation rates and even the initial mass function. A precise computation of these abundances in our Galaxy or in the Local Group galaxies requires very precise models of stellar atmospheres and the use of the best physics, e.g., NLTE line formation, 3D hydrodynamical model atmospheres. At the present time the uncertainties due to the interpretation of the data often exceed the uncertainties due to the measurement errors.

A role of our Division is also to promote progress in establishing the fundamental data necessary to provide the required ground truth, covering many aspects of atomic and molecular physics. All branches of astronomy benefit from progress in the understanding of stellar physics.

2. Developments within the past triennium

The scientific activity in the large field covered by Division IV has been very intense during the last triennium. It led to the publication of a very large number of papers which makes an exhaustive report impossible to produce. Here below are only some examples of recent progress:

- New wavelength regions, e.g., in the infrared, are now open to investigation with very powerful spectrographs based on mature detector technology. Large IR surveys provide extensive public data sets (UKIDSS, Spitzer Legacy Programs) and the Gould Belt Legacy survey will provide very soon samples of young stellar objects in the clouds down to the planetary mass regime, allowing time scales for different evolutionary phases and processes of clustered versus non clustered star formation be tested.

- Stellar classification once again finds itself at the forefront of stellar discovery and astrophysics, with the discovery of two new classes of cool stars (*L* and *T*) and the probable imminent discovery of yet another class (*Y*) of even cooler brown dwarfs.

- Recent solar observations have shown connections between the interior dynamics, surface magnetism and coronal phenomena, although it is still unclear where and how magnetic fields are generated in the Sun. Recent optical and X-ray observations of different stars with significant convective zones beneath their surfaces, reveal star spots and other surface atmospheric structures similar to solar magnetic ones. In many cases the long term evolution of these features is similar to the solar cycle. Advances in the Doppler imaging technique has allowed to obtain maps of star spot distributions and the first accurate measurements of stellar differential rotation. Moreover, the satellite *CoRoT* has detected solar-type oscillations in solar-type stars at unprecedented levels of precision.

- *CoRoT* now enables the study of photometric and spectroscopic variability of pre-main sequence stars with a rich variety of phenomena, e.g., pulsation, hot and cold spots, high modes of vibration, stellar multiplicity.

- Details of the structures of the stars are also obtained with interferometers. Stellar winds can be ‘visualized’. Recently the use of ESO’s Very Large Telescope Interferometer and its razor sharp eyes has helped to discover a reservoir of dust trapped into a disc that surrounds an elderly star. More extremely iron-poor stars have been discovered: three stars are now known with $[\text{Fe}/\text{H}] < -4.8$. The most iron-poor star known today

is HE 1327–2326 with $[\text{Fe}/\text{H}] = -5.4$. However, all these stars are very carbon rich. Are these very peculiar stars the oldest ones in the Galaxy?

3. Activity of Division IV Commissions and Working Groups

Division IV includes five Commissions and two Working Groups (see the header). Moreover, three Working Groups are shared with Division V (Variable Stars). All the Commissions and Working Groups have been very active during the last triennium, and all desire and deserve to continue their activity during the next one.

The Division IV / Commission 45 Working Group on *Standard Stars* has become, following a request by its membership, an Inter-Division IV-V-IX Working Group.

Several IAU symposia have been (or will be) coordinated by Division IV between September 2006 and August 2009.

In 2007:

- IAU S250 on *Massive Stars as Cosmic Engines*, December 2007, Kauai, HI, USA.

In 2008:

- IAU S258 on *The Age of Stars*, October 2008, Baltimore, MD, USA.

- IAU S252 on *The Art of Modelling Stars in the 21st Century*, April 2008, Nanjing, China.

In 2009:

- IAU S265 on *Chemical Abundances in the Universe – connecting first stars to planets*, August 2009, Rio de Janeiro, Brazil.

- IAU S268 on *Light elements in the Universe*, November 2009, Geneva, Switzerland.

Moreover, several other Symposia have been supported by our Commissions or Working Groups.

The following reports from the commissions and the working groups of the Division, document the highly dynamic field of stellar astrophysics.

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Monique Spite
president of the Division