

## **DIVISION II**

## **SUN AND HELIOSPHERE**

### *SOLEIL ET HELIOSPHERE*

Division II of the IAU provides a forum for astronomers and astrophysicists studying a wide range of phenomena related to the structure, radiation and activity of the Sun, and its interaction with the Earth and the rest of the solar system. Division II encompasses three Commissions, 10, 12 and 49, and four Working Groups.

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#### **DIVISION II COMMISSIONS**

**Commission 10**

**Solar Activity**

**Commission 12**

**Solar Radiation and Structure**

**Commission 49**

**Interplanetary Plasma and Heliosphere**

#### **DIVISION II WORKING GROUPS**

**Division II WG**

**Solar Eclipses**

**Division II WG**

**Solar and Interplanetary Nomenclature**

**Division II WG**

**International Solar Data Access**

**Division II WG**

**International Collaboration on Space Weather**

#### **TRIENNIAL REPORT 2006-2009**

### **1. Introduction**

Solar physics is a distinct subdiscipline with strong overlaps with both astronomy and space physics. Compared with other branches of astronomy and astrophysics, there is an enormous amount of detailed data on the Sun and on various aspects of solar activity. Since the beginning of the space age, instruments on spacecraft have provided more and more detailed data with higher and higher resolution. The two spacecraft of NASA's *STEREO* mission, and the Japanese-led multi-national *Hinode* spacecraft were launched during the past triennium, and are providing yet a further advance in resolution of solar phenomena. During this period solar activity has been near minimum, and there is an expectation that these missions will provide important new insights into solar flares as the Sun becomes more active (see the report from Commission 10 for further details).

One opinion of the role of solar physics in the IAU was put by the prominent solar radiophysicist, Paul Wild, who died on May 10, 2008. With more than a touch of irony, in his opening address at the IAU General Assembly in Sydney in 1973, Wild said (Wild

1973): “I have the feeling that to most astronomers the Sun is rather a nuisance. The reasons are quite complex. In the first place the Sun at once halves the astronomer’s observing time from 24 to 12 hours, and then during most of the rest of the time it continues its perversity by illuminating the Moon. Furthermore I have met numerous astronomers who regard solar astronomy to be now, as always before, in a permanent state of decline – rather like Viennese music or English cricket. Nevertheless those who study the Sun and its planetary system occasionally make significant contributions. There were, for instance, Galileo and Newton who gave us mechanics and gravitation; Fraunhofer who gave us atomic spectra; Eddington and Bethe who pointed the way to nuclear energy; and Alfvén who gave us magneto-hydrodynamics. Perhaps the point to be recognized is that the Sun has more immediately to offer to physics rather than astronomy.”

The role of solar physics in initiating new fields of research of relevance to both physics and astronomy has continued since this was written. Wild’s own research was one of the stimulants for the new field of plasma astrophysics, including collisionless shock waves, plasma emission processes and particle acceleration. Other areas of wider interest to physics and astronomy to which solar physics has made notable recent contributions include neutrino oscillations, astrophysical dynamos, and high-energy astrophysics.

## 2. Structure of the Division

Division II includes three Commissions, 10, 12 and 49, and four Working Groups. The current Commission presidents, elected at the Prague General Assembly, are James Klimchuk, Commission 10, Valentin Martínez Pillet, Commission 12, and Jean-Louis Bougeret, Commission 49. Also at the IAU XXVI General Assembly, in Prague, 2006, Lidia van Driel-Gesztelyi was elected the Division’s first secretary.

Commission 10 *Solar Activity*, focuses on transient aspects of the Sun, including flares, prominence eruptions, coronal mass ejections (CMEs), particle acceleration, magnetic reconnection and topology, coronal loop heating, and shocks in the corona. Commission 12 *Solar Radiation and Structure*, emphasizes steady-state aspects of the Sun, including long-term irradiance, helioseismology, magnetic field generation, active regions, photosphere, and chromosphere. Commission 49 *Interplanetary Plasma and Heliosphere*, studies the solar wind, shocks and particle acceleration, both transient and steady-state, e.g., corotating, structures within the heliosphere, and the termination shock and boundary of the heliosphere. There can be considerable overlap among the Commissions, such as in the areas of magnetic activity, solar evolution, particle acceleration, and space weather.

The four working groups involve the topics of solar eclipses, solar and interplanetary nomenclature, access to solar data including virtual observatories, and space weather.

The organizing committee of Division II includes the president, vice-president, secretary and immediate past president of the Division, together with the presidents and vice-presidents of the three Commissions. The position of Divisional secretary had been discussed and agreed in principle at the Sydney General Assembly, but it was only at the Prague General Assembly that it was decided to elect a secretary from among the vice-presidents of the Commissions.

On the 50th anniversary of the *International Geophysical Year*, the IAU endorsed 2007 as the *International Heliophysical Year* (IHY). ‘Heliophysical’ is a broadening of the concept ‘geophysical’, extending the connections from the Earth to the Sun and interplanetary space. IHY is taking advantage of the many near and deep-space missions/spacecraft launched over the past decade or so. IHY activities extend over the period 2007–2009, and are summarized on the website at URL <[hy2007.org](http://hy2007.org)>.

IAU participation in the IHY has been coordinated through the Division, with the IHY subgroup chaired by Nat Gopalswamy, with David Webb the IAU representative for the IHY. IAU Symposium No. 257 on *Universal Heliophysical Processes* (September 2008, Greece) is a specific example of IAU involvement in IHY activities.

### 3. Working Groups

The four current Working Groups of the Division are *Solar Eclipses*, *Solar and Interplanetary Nomenclature*, *International Solar Data Access*, and *International Collaboration on Space Weather*.

#### 3.1. *Solar Eclipses* (Jay M. Pasachoff)

The Working Group on *Solar Eclipses* is chaired by Jay M. Pasachoff (USA) and includes Iraida S. Kim (Russia), Hiroki Kurokawa (Japan), Jagdev Singh (India), Vojtech Rusin (Slovakia), Atila Ozguc (Turkey), Yihua Yan (China), Fred Espenak (USA), Jay Anderson (Canada, consultant on meteorology), Glenn Schneider (USA), and Michael Gill (UK, maintainer of Solar Eclipse Mailing List).

The WG has a web sites <[www.eclipses.info](http://www.eclipses.info)> and <[www.totalsolareclipse.net](http://www.totalsolareclipse.net)>. The WG has as its task the coordination of solar eclipse efforts, particularly making liaisons with customs and other officials of countries through which the path of totality passes and providing educational information about the safe observation of eclipses for the wide areas of the Earth in which total or partial eclipses are visible. The work is coordinated with that of the Program Group on Public Information at the Times of Eclipses of IAU Commission 46 on *Education and Development* (<[www.eclipses.info](http://www.eclipses.info)>). Two members, Espenak and Anderson, produce the widely used NASA Technical Publications with eclipse paths and detailed information, available as hard copies or online, linked through [www.eclipses.info](http://www.eclipses.info) or via the NASA Eclipse Web Site at <[eclipse.gsfc.nasa.gov/](http://eclipse.gsfc.nasa.gov/)>. The bulletins are available directly at URL <[eclipse.gsfc.nasa.gov/SEpubs/bulletin.html](http://eclipse.gsfc.nasa.gov/SEpubs/bulletin.html)>.

A notable past success was the distribution of material for tens of thousands of eye-protection filters after online consultation. A review article on eclipses will be published in *Nature* during 2009 as part of the *International Year of Astronomy*.

During the past triennium, following the Africa/Greece/Turkey/Asia eclipse (29 March 2006), total eclipses had a hiatus until the eclipses of 1 August 2008 and 22 July 2009. The 2008 total eclipse started in northern Canada and Greenland, crossed the extreme north (within  $7^\circ$  of latitude from the North pole), and descended through central Russia (including 2 minutes 20 seconds at the Siberian city of Novosibirsk), western Mongolia, and China. The 2009 total eclipse will start in India and cross Bangladesh before it enters China. It will cross Hangzhou and Shanghai while proceeding eastward, where it will pass just south of the main Japanese islands, crossing some small Japanese islands, before it reaches its maximum duration in the Pacific. As the longest eclipse in the saros, it passes 5 minutes 50 seconds on the centerline near Shanghai and reaches 6 minutes 39 seconds in the Pacific. The date of the 2009 eclipse clashed with the originally proposed start date of the IAU XXVII General Assembly in Rio de Janeiro, which is now scheduled to start less than two weeks after the eclipse.

The annular eclipse of 22 September 2006 was visible from Guyana, Suriname, French Guiana, adjacent Brazil, and the Atlantic Ocean, with partial phases visible from eastern South America, western and southern Africa, and part of Antarctica. Eclipse-knowledgeable professionals and amateurs gathered especially in Kourou, French Guiana. The

annular eclipse of 7 February 2008 was visible from Antarctica, with one French amateur astronomer viewing it from the top of Antarctica's tallest mountain and with partial phases visible from eastern Australia and New Zealand. The 26 January 2009 annular eclipse will be visible from Indonesia, especially western Java and eastern Sumatra, with partial phases visible from southern Africa, southern India, southeast Asia, and western Australia. The annular eclipse of 20 May 2012 begins in southeastern China, touches the southeast coast of Japan, crosses the Pacific, and ends in the southwestern United States, from northern California through parts of Utah, Arizona, and New Mexico, and ending in northwestern Texas. Of course, partial phases will be widely visible to the sides of these paths of annularity.

Partial solar eclipses included 19 March 2007, visible widely over Asia east of India, as far east as western Japan and western Alaska, and as far south as all of Korea; and 11 September 2007, visible in South America except for its northern part. There will be no other partial eclipses through 2010.

The following triennium will include the total eclipse of 11 July 2010 visible from some French South Pacific islands and Chile's Easter Island, and ending over southern Chile and Argentina. It will also include the 15 January 2010 annular eclipse, visible from Africa, the southern tip of India, northern Sri Lanka, Myanmar, and China, with partial phases visible from eastern Europe through Asia except for Japan and past mid-Java. The following total eclipse will be on 13 November 2012, which will begin and cross land only in northern Australia, including the Cape York peninsula, cross the ocean north of New Zealand, and continue over the southern Pacific, ending in the ocean substantially west of Chile.

### 3.2. *Solar and Interplanetary Nomenclature (Edward W. Cliver)*

The Working Group on *Solar and Interplanetary Nomenclature* is chaired by Edward W. Cliver (USA) and includes Jean-Louis Bougeret (France), Hilary Cane (Australia), Takeo Kosugi (Japan; deceased, 26 November 2006), Sara Martin (USA), Reiner Schwenn (Germany), and Lidia van-Driel-Gesztelyi (France, UK, Hungary).

With the help of the broader community, the WG identifies terms used in solar and heliospheric physics that are thought to be in need of clarification, and then commissions topical experts to write essays reviewing the origins of terms and their current usage or misuse. The first six essays were published in *Eos*, the weekly publication of the American Geophysical Union, under 'The Last Word' heading. The most recent essay in the series, and the only one published from September 2006 - June 2008, appeared in *Solar Physics*, called, *The misnomer of 'post-flare loops'* (Švestka 2007). At present no additional articles are in the queue.

### 3.3. *International Solar Data Access (Robert D. Bentley)*

The Working Group *International Solar Data Access* is chaired by Robert D. Bentley (UK). Originally formed as a group intended only to cover the solar part of Division II, the WG has been extended to include heliophysics data sets needed to support Space Weather and related studies. Many of the members of the WG have discussed the idea of building a virtual observatory (VO) in heliophysics. In order to address science problems that span the disciplinary boundaries this would provide enhanced access to solar and heliospheric data, and to magnetospheric and ionospheric data for planets with magnetic fields and/or atmospheres. In June 2007, several members of the WG met at the *Virtual Observatories in Geosciences (VOiG)* Conference held in Denver, CO, USA; the VOiG Conference was an activity held within the context of the Electronic Geophysical Year (eGY). Also in June 2007 Bentley presented a paper at the

IHY meeting in Turin entitled ‘Building a Virtual Observatory in Heliophysics’ that discusses many of the issues related to metadata that need to be resolved if you are to conduct automated searches across the domains. The WG has a website at the URL: <[www.mssl.ucl.ac.uk/grid/iau/index.html](http://www.mssl.ucl.ac.uk/grid/iau/index.html)>.

#### 3.4. *International Collaboration on Space Weather (David F. Webb)*

The Working Group for *International Collaboration on Space Weather* is chaired by David Webb (USA). The WG has as its main goal to help coordinate the many activities related to space weather at an international level. Its website is at the URL: [http://www.iac.es/proyecto/iau\\_divii/IAU-DivII/main/spaceweather.php](http://www.iac.es/proyecto/iau_divii/IAU-DivII/main/spaceweather.php). The site currently includes the international activities of the *International Heliospheric Year* (IHY), the *International Living with a Star* (ILWS) program, the *Climate and Weather of the Sun-Earth System* (CAWSES) WG on *Sources of Geomagnetic Activity*, and *Space Weather* studies in China.

The *International Heliospheric Year* is an international program of scientific collaboration that during the time period 2007–2009, centered on 2008, the 50th anniversary of the *International Geophysical Year*. Nat Gopalswamy (USA) is the chair of the IHY subgroup within Division II. The IHY was considered to be of sufficient importance to the IAU to have its own IAU scientific representative, currently David F. Webb. The physical realm of the IHY encompasses all of the solar system out to the interstellar medium, representing a direct connection between in-situ and remote observations. The IHY working group helped identify national leaders for the IHY program. The IHY organization has an International Advisory Committee headed by Roger M. Bonnet (France) and an International Steering Committee headed by Joseph M. Davila (USA). Coordinators were appointed for eight regions of the world and ~ 60 countries have functioning national committees. Complete information on the IHY can be found at the main IHY URL: <<http://ihy2007.org>>. Four key activities are planned under the IHY program: science activities, the UN Basic Space Sciences (UNBSS) initiative, IGY Gold, and public outreach activities.

The CAWSES Working Group on *Sources of Geomagnetic Activity*, also chaired by Nat Gopalswamy (USA), has as its objectives to understand how solar events, such as CMEs and high speed streams, impact geospace by investigating the underlying science and developing prediction models and tools. Finally, the Working Group on Space Weather Studies in China is chaired by Jingxiu Wang (China) and is involved with many new initiatives on space weather.

## 4. New website

During the last triennium a new Division II web site was established, and is maintained at URL: <[www.iac.es/proyecto/iau\\_divii/IAU-DivII/main/index.php](http://www.iac.es/proyecto/iau_divii/IAU-DivII/main/index.php)>. The web site provides a description of the Division objectives, lists the members of the Organizing Committee, informs of the latest Division-wide news and upcoming events and provides links to the three Commissions and four Working Groups (as well as to the IAU main web page). Publicly distributable documentation related to the Division is made available through the website, including IAU Newsletter or Symposia selections when available. The web site also hosts a private section (requiring authentication) that allows the members of the OC of the Division (and Commissions when implemented) to retrieve submitted Symposium, JD, etc., proposals during the evaluation phase. Currently, following the IAU making available (mid 2008) updated member lists, Division-wide and Commission-wide email listings are being implemented.

## 5. IAU meetings

The Division has played a leading role in the following IAU meetings, that have been held since the last triennial report Webb *et al.* (2006):

IAU S233 on *Solar Activity and its Magnetic Origin* was held in Cairo, Egypt, March 31-April 3, 2006 (Bothmer & Hady). The symposium was timed to follow the total solar eclipse of March 29, 2006.

At the General Assembly in Prague in 2006, Division II was involved in three Joint Discussions and one Special Session:

- JD1 on *Cosmic Particle Acceleration - from Solar System to AGNs* (Karlický & Brown 2007).
- JD3 on *Solar Active Regions and 3D Magnetic Structure* (Choudhary & Sobotka 2007).
- JD8 on *Solar and Stellar Activity Cycles* (Kosovichev & Strassmeier 2007).
- SpS5 on *Astronomy for the Developing World*, subsession on the IHY.

Symposia since the IAU involving Division II were:

- IAU S247 on *Waves & Oscillations in the Solar Atmosphere: Heating and Magneto-Seismology* was held in Porlamar, Isla de Margarita, Venezuela, 17-22 September 2007 (Erdélyi & Mendoza-Briceño 2007).
- IAU S257 on *Universal Heliophysical Processes* was held in Ionnina, Greece, 15-19 September 2008. The proceedings are to be edited by Dave Webb and Nat Gopalswamy.

One further symposium is to be held soon after the deadline for the present report:

- IAU S259 on *Cosmic Magnetic Fields – from Planets, to Stars and Galaxies* in Puerto Santiago, Tenerife Spain, 3-7 November 2008. Contact: Klaus G. Strassmeier.

Donald B. Melrose  
*president of the Division*

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