Office for Outer Space Affairs
United Nations Office at Vienna

UN Office for Outer Space Affairs

UN/NASA Workshop on the International Heliophysical Year 2007 and Basic Space Science

27 November – 1 December 2006
Indian Institute of Astrophysics
Bangalore, India

International Heliophysical Year 2007 (IHY)

- 50th anniversary of IGY 1957
- 50th session of UNCOPUOS
- 40th anniversary of Outer Space Treaty
- 50th anniversary of Sputnik 1

- Putting the 'I' in IHY by coordinating with institutions in all 192 UN Member States
  (178 UNDP, 185 PM)

- Regional and international workshops on IHY jointly organized by
  UNOOSA and IHY Secretariat (2005-2009)

- International IHY website www.ihy2007.org
- UNOOSA IHY website
  www.unoosa.org/oosa/en/SAP/bss/ihy2007/index.html

IHY: UNCOPUOS and UNGA

UNCOPUOS three-year Work Plan 2006-2008

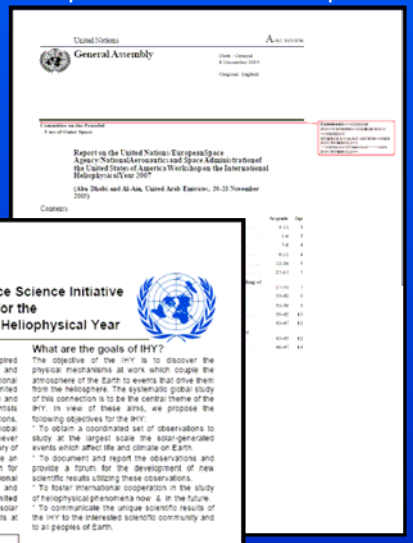
**The United Nations General Assembly,
in its resolution 60/99 of 2005**

**"Also notes with satisfaction
the contribution being made by the
Scientific and Technical Subcommittee and
the efforts of Member States and
the Office for Outer Space Affairs to
promote and support the activities being organized within
the framework of the
International Heliophysical Year 2007"**

IHY Outreach

- Workshop Reports (UN docs)
- Flyer
- Poster
- Brochure
- 50-page Booklet

Reports on IHY Workshops



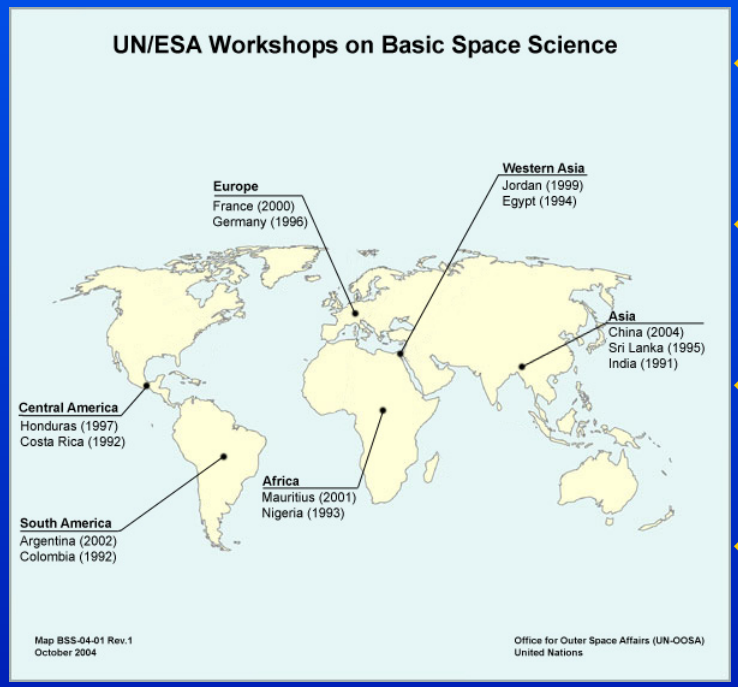
IHY Flyer

IHY Brochure (6 languages)

IHY Follow-up Projects

- Studying global phenomena on the largest possible scale with simultaneous observations from low-cost ground-based world-wide arrays of instruments and space-borne data (GPS)

UN/ESA Workshops on Basic Space Science (1991-2004)



- **Regional:**
  India, Costa Rica, Colombia, Nigeria, Egypt
- **Inauguration of optical telescopes:**
  Sri Lanka, Honduras, Jordan
- **International:**
  Germany, France, Mauritius, Argentina
- **Review of all workshops:**
  P.R. China


Mauritius 2001


Argentina 2002

BSS TRIPOD: Telescope, Observing, Teaching

- **Government of Japan:**
  - **Japanese Cultural Grant Aid**
    45cm reflecting telescope
  - CCD & computer equipment
  - Building/ dome/ maintenance provided by local institution
  - Sri Lanka 1996, Paraguay 2000, The Philippines 2001, Chile 2003, Nigeria 2004
  - Bolivia, Pakistan, Ethiopia on-going

Sri Lanka 1996

- **American Association of Variable Star Observers (AAVSO):**
  - **Hands-on Astrophysics**
  - **Setting Up a Variable Star Observing Programme**

- **Astrophysics for University Physics Courses**

Telescope ⇒ Observing ⇒ Teaching ⇒ Data Analysis ⇒ Data Transfer ⇒ Telescope Networking

First UN/NASA Workshop on IHY in November 2005 "*succeeded…beyond expectations!*"

- **UN, ESA, NASA, UAE Government sponsored,** attendance by His Highness Sheikh Al-Nahayan Minister of Education and the Chancellor of the UAE University
- **Instrument Donors Attending:** USA, Canada, UK, Switzerland, Japan, Brazil, Armenia
- **Potential Hosts Attending:** Georgia, India, Pakistan, Indonesia, Malaysia, Iraq, Iran, Sudan, Saudi Arabia, Algeria, Egypt, Libya, Cape Verde, Jordan, Ivory Coast, Cameroon, Nigeria, Eritrea, South Africa, …

Second UN/NASA Workshop on IHY
IIA, November 2006, Bangalore, India

Third UN/NASA Workshop on IHY
NAOJ, June 2007, Tokyo, Japan

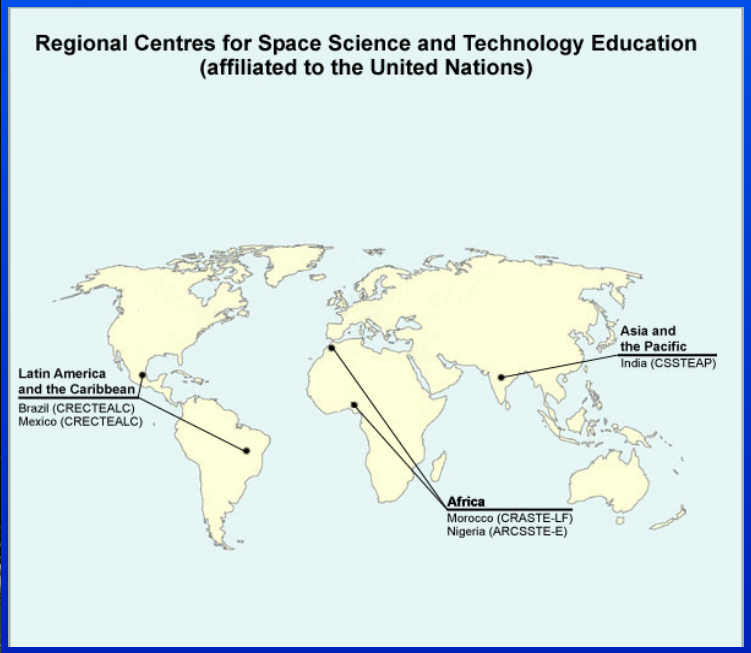
IHY/UNBSSI Distributed Instrument Programme

1. **Atmospheric Weather Educational System for Observation and Modeling of Effects** (USA)
2. **International Heliophysical Year magnetometer observatories** (Canada)
3. **Magnetic Data Acquisition System project** (Japan)
4. **Compound Astronomical Low-cost Low-frequency Instrument for Spectroscopy and Transportable Observatory** (Switzerland)
5. **Low-frequency radio antenna arrays** (USA)
6. **Global Positioning System in Africa** (France)
7. **Remote Equatorial Nighttime Observatory for Ionospheric Regions** (USA)
8. **South Atlantic Magnetic Anomaly very low frequency array** (Brazil)
9. **Scintillation Network Decision Aid** (USA)
10. **New type of particle detectors for space weather forecasting network** (Armenia)
11. **Muon network** (Japan)

IHY TRIPOD: Instrument Array, Data, Teaching

- Since 2005, deploying small inexpensive instruments such as magnetometers, radio antennas, GPS RECEIVERS, all-sky cameras, etc. around the world to make global measurements of ionospheric, magnetospheric, and heliospheric phenomena
- Partnership between instrument providers and instrument host nations
- Lead scientist/engineer provides instrumentation
  Host institution provides manpower, facilities, and operational support
- Data taking, sharing, analysis, publication
- Using data in teaching space science at university level

Regional Centres for Space Science and Technology Education affiliated to the United Nations



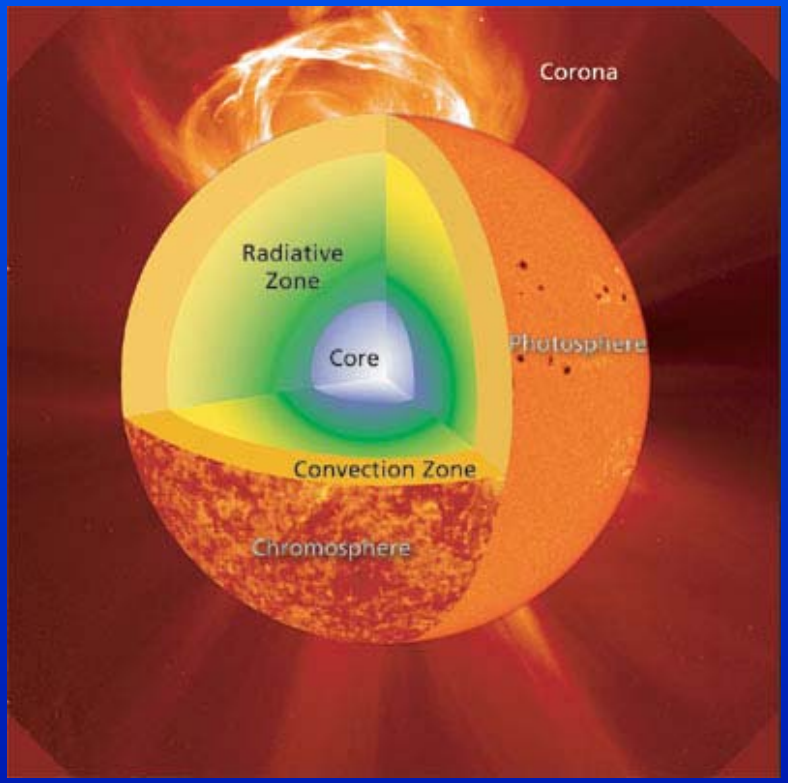
- The Regional Centres for Space Science and Technology Education were created under the auspices of the United Nations through its Office for Outer Space Affairs (UNOOSA)
- Goal: to develop, through in-depth education, an indigenous capability for research and applications in the core disciplines of:
  - Remote Sensing & GIS,
  - Satellite Communications,
  - Satellite Meteorology and Global Climate,
  - Space and Atmospheric Sciences as well as data management.

- Regional Centres located in:
  - African region: CRASTE-LF (Morocco), CSSTE-E (Nigeria)
  - Asia and the Pacific region: CSSTEAP (India)
  - Latin America and the Caribbean: CRECTEALC (Brazil and Mexico)

THANK YOU!

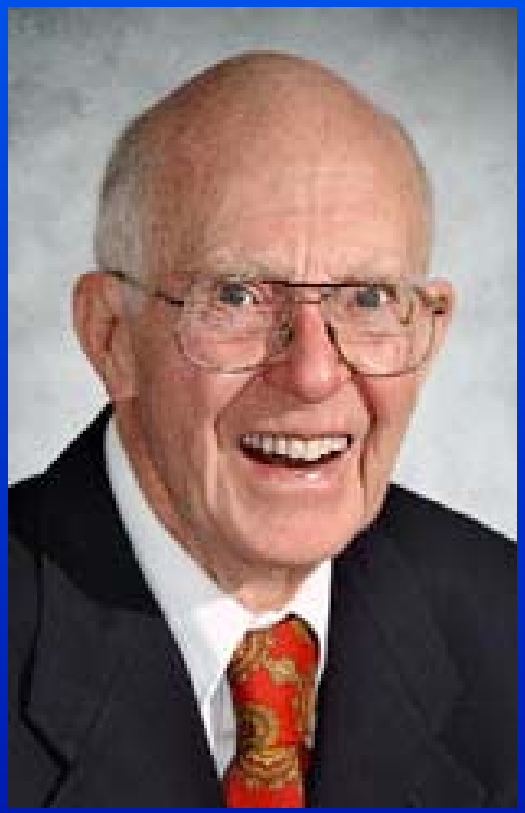
Office for Outer Space Affairs
United Nations Office at Vienna
Website: www.unoosa.org
E-mail (OOSA): oosa@unvienna.org
Fax (OOSA): (+43-1) 26060-5830

The Structure of the Sun



- The Interior
  - Core
  - Radiative zone
  - Convection zone
- The Surface and Atmosphere
  - Photosphere
  - Chromosphere
  - Corona

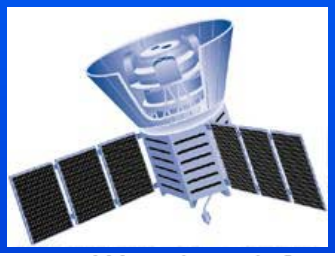
Solar Neutrinos

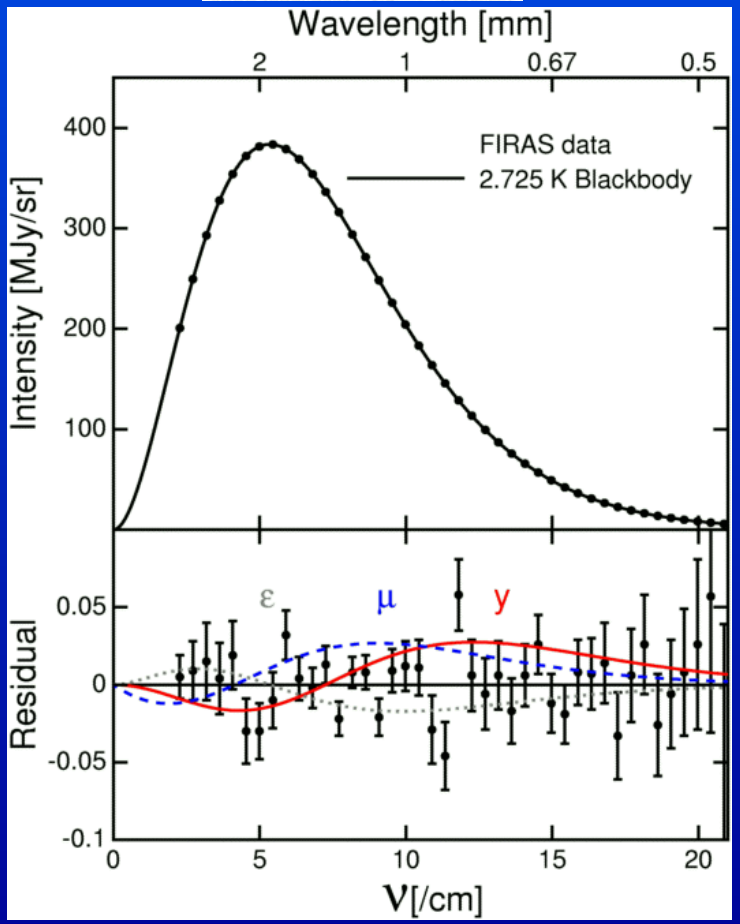


Ray Davis,
Nobel Prize winner, 2002

- In 2002 Ray Davis shared the Nobel Prize for Physics with two other scientists.
- The award was for his pioneering work on solar neutrinos and especially for revealing the “Mystery of the Missing Neutrinos”

Cosmic Background Explorer (COBE)

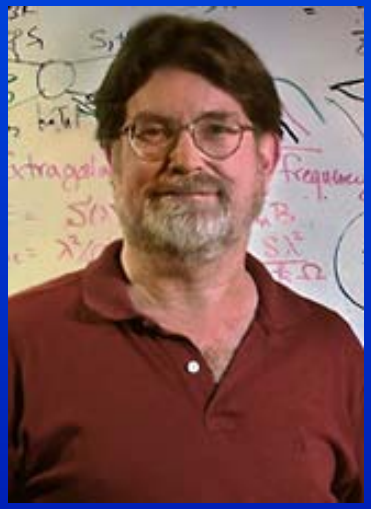




- COBE Far-Infrared Absolute Spectrometer (FIRAS) instrument.
  - Measured temperature of the cosmic microwave background (CMB): 2.726 +/- 0.010 K over the wavelength range from 0.5 to 5 mm.
  - Deviates from pure blackbody spectrum by less than 0.01%.
  - Small deviation places strict limits on energy release after Universe was 1 year old! (z~3x106).
  - Supreme confirmation of Big Bang theory for creation of the universe which requires relic radiation signature to be a black body.

Nobel Prize in Physics 2006

"for their discovery of the blackbody form and anisotropy of the cosmic microwave background radiation"



John C. Mather
USA
NASA Goddard Space Flight Center
Greenbelt, MD, USA

George F. Smoot
USA
University of California
Berkeley, CA, USA

Non-extensive Statistical Mechanics

Generalizing Boltzmann-Gibbs statistical mechanics

B.G. Statistics - A reminder.

- Entropy: $S = -k\sum_i \rho_i \ln \rho_i$
- Constraints: $\begin{cases} 1 = \sum_i \rho_i \\ U = \sum_i \rho_i \epsilon_i \end{cases}$

- Maximize the objective: $J = -k\sum_i \rho_i \ln \rho_i + \sum_i \rho_i + \beta \sum_i \rho_i \epsilon_i \qquad \frac{\partial J}{\partial \rho_j} = 0$
- Yields distribution: $\rho_i = e^{-\beta \epsilon_i} / Z \qquad \text{where } Z = \sum_i e^{-\beta \epsilon_i}$

Postulate: [C. Tsallis J. Stat. Phys. 52 p479 (1988)]

Generalized entropy:

$$S_q = k\frac{1-\sum_i \rho_i^q}{q-1} \qquad q \in \Re$$

where q characterizes the extensivity of the statistics.

Note: For q=1 regular B.G. Statistics is recovered:

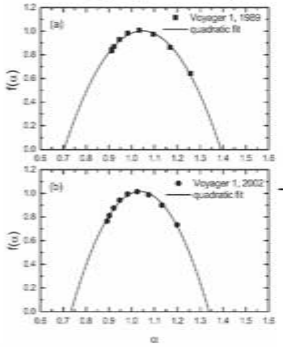
$$S_{q\to 1} \to -k\sum_i \rho_i \ln \rho_i$$

Solar Wind: Magnetic Field Strength

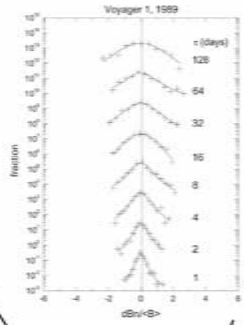
SOLAR WIND: Magnetic Field Strength

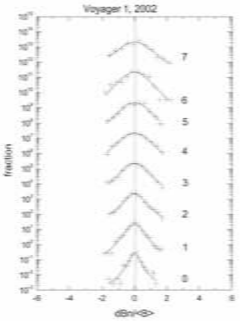
L.F. Burlaga and A. F.-Vinas (2005) / NASA Goddard Space Flight Center

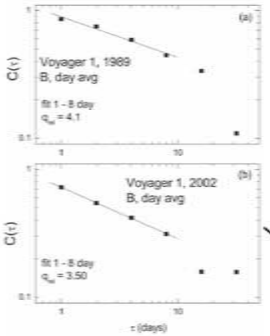
[Data: Voyager 1 spacecraft (1989 and 2002); 40 and 85 AU; daily averages]



$q_{sen} = -0.6 \pm 0.2$







$q_{rel} = 3.8 \pm 0.3$

$q_{stat} = 1.75 \pm 0.06$

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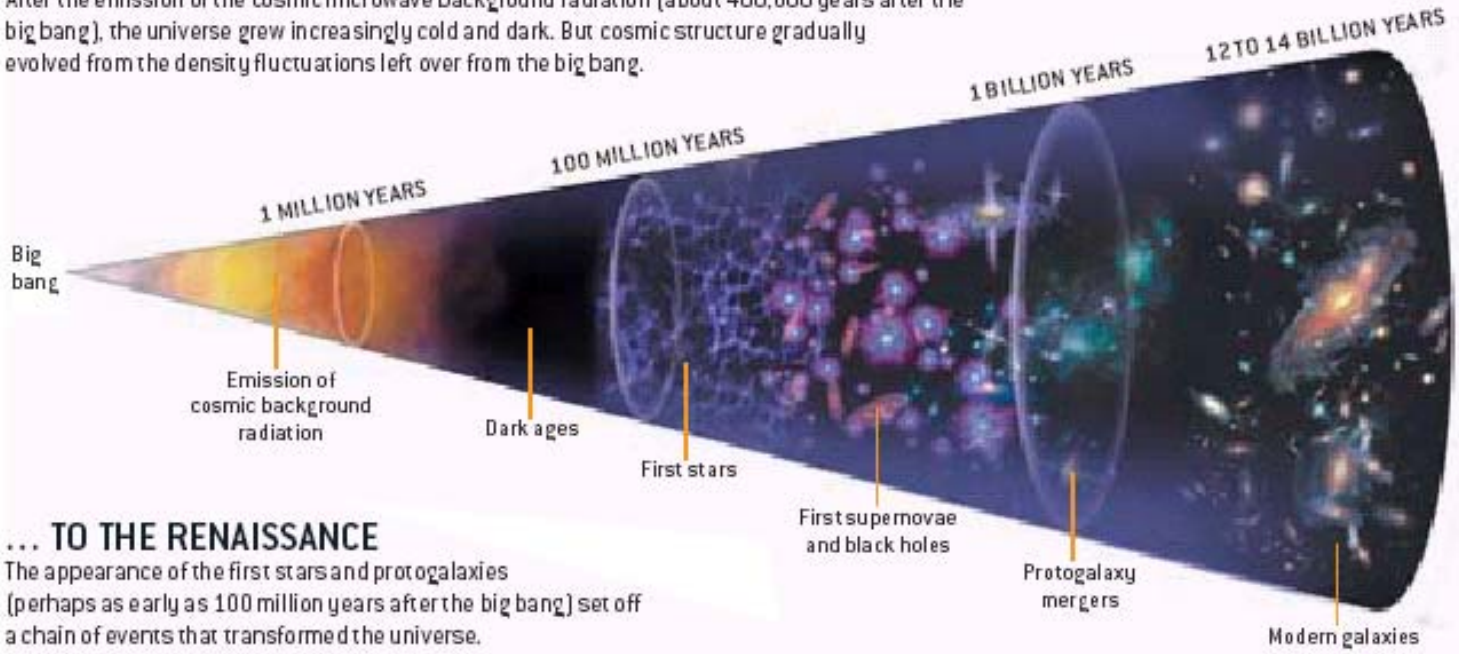
IHY: GPS Applications in Low-cost, Ground-based, World-wide Instrument Arrays

1. **Global Positioning System in Africa** (France)
   Increase number of real-time dual-frequency GPS stations for ionospheric studies
2. **RENOIR: Remote Equatorial Nighttime Observatory for Ionospheric Regions** (U Illinois, USA)
   Study equatorial/low-latitude ionosphere/thermosphere system
3. **SCINDA: Scintillation Network Decision Aid** (Hanscom AFRL, USA)
   Prediction of communications degradation due to ionospheric scintillation
4. **SEVAN: Space Environment Viewing and Analysis Network** (Alikhanian PI, Armenia)
   Neutron-muon detecting system for cosmic ray secondary fluxes
5. **CIDR: Coherent Ionospheric Doppler Radar** (U Texas, USA)
   Measure line-of-sight relative electron content using radio beacons
6. **Rutherford Appleton Laboratory Low-Cost Ionosonde** (RAL, UK)

COSMIC TIME LINE

FROM THE DARK AGES . . .

After the emission of the cosmic microwave background radiation (about 400,000 years after the big bang), the universe grew increasingly cold and dark. But cosmic structure gradually evolved from the density fluctuations left over from the big bang.



. . . TO THE RENAISSANCE

The appearance of the first stars and protogalaxies (perhaps as early as 100 million years after the big bang) set off a chain of events that transformed the universe.