

## Curriculum Vitae of Jean-Loup Bertaux (January 2016)

**BERTAUX Jean-Loup** Christian. Born January 8, 1942, Toulouse (Haute-Garonne), France.

**Present position:** Directeur de recherche emeritus, since September 1<sup>st</sup>, 2008

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**Citizenship:** French

### Education

- PhD, Geophysics, University of Paris, France, 1974
- Licence of Physics, University of Paris, France, 1965
- Graduated from Ecole Polytechnique, France, 1961-1963

### Recent Professional Experience

- Visiting Researcher, Boston University 2008-present
- Directeur de Recherche Emérite au Service d'Aéronomie du CNRS ( September 1<sup>st</sup>, 2007), then at LATMOS, after the fusion of Service d'Aéronomie with another laboratory.
- Directeur de Recherche (Classe Exceptionnelle Exceptionnelle 2<sup>nd</sup> grade at CNRS, the highest possible grade at CNRS) at Service d'Aéronomie du CNRS 2000-31 August 2007.
- Management of space experiments as Principal Investigator (PI): SPICAM on Mars Express (PI ship transferred to Franck Montmessin), SPICAV on Venus Express, SWAN on SOHO (now co-PI with Eric Quémerais being PI)
  - Co-Investigator on Ultra Violet Spectrometer (UVS) Voyager 1 and 2, OSIRIS (camera) and Alice (UV spectrometer) on Rosetta ESA mission to a comet.
- On the ESA ENVISAT mission, I was at the origin of the GOMOS investigation (Global Ozone Monitoring by Occultation of stars), which aim is to monitor the vertical distribution of Ozone in the stratosphere all around the world, and to detect its long term variations, together with other minor stratospheric constituents (NO<sub>2</sub>,NO<sub>3</sub>,H<sub>2</sub>O, aerosols).

### Fellowships, Honors, and Awards

**2014** Corresponding Member of the Académie de l'Air et de l'Espace.

**2011** Chevalier de la Légion d'Honneur (Décret du 13 Juillet 2011), given by Jacques Blamont, from French Académie des Sciences and US Academy of Sciences.

**2010** Recipient of Christiaan Huygens Medal from European Geophysical Union

**1993** Full member of the International Academy of Astronautics

**1988** Corresponding member of the International Academy of Astronautics

**1983** Médaille d'argent du CNES (for my work on Voyager mission)

**1982** Prix Deslandres de l'Académie des Sciences (for my work on planetary exospheres and interstellar medium)

**1978** Prix Louis Jacot

**1976** Chevalier de l'Ordre du Mérite

**1972** Médaille de bronze du CNRS (for the discovery of Interstellar Wind and Hydrogen envelopes around comets).

### **Selected Peer Reviewed Publications and Other Major Publications**

At the time of writing (January 2016), according to the ADS system, I had recorded a total of 955 scientific publications or presentations with a recorded abstract, including 421 publications accepted in journals with referees, such as: Nature, Science, Astrophysical Journal, Astronomy and Astrophysics, Journal of Geophysical Research, Icarus, Planetary and Space Sciences, Astrophysical Journal, Planetary and Space Sciences.

According to the ADS system, I have been an author or co-author of 57 papers that have been quoted at least 57 times (Hirsch index =57). My publications recorded a total of 12691 citations.

I wrote a book about comet Halley and its return in 1986 and relevant space missions, De l'autre côté du soleil, (Albin Michel, 1986)

### **Selected recent Scientific achievements and relevant publications:**

#### **Planet Mars:**

- discovery of aurorae on Mars.
- first observation of UV nightglow on Mars: the Nitric Oxide emission
- first observation of O<sub>2</sub> recombination nightglow on Mars
- first evidence of super saturation of H<sub>2</sub>O on Mars
- the annual cycle of the exosphere (with John Clarke)

#### **Planet Venus:**

- acquisition of the only vertical profile of SO<sub>2</sub> in situ (Vega-1 and 2)
- detection of a high altitude layer of sulfur dioxide (SO<sub>2</sub>)
- long term variations of sulfur dioxide (SO<sub>2</sub>) at cloud top: volcanoes or atmospheric changes?
- discovery of a warm layer of air in the night of Venus
- first detection of ozone
- first observation of UV dayglow from Venus
- the slowing down of the zonal super rotation by interaction with topography.

**Planet Earth:**

- monitoring of ozone, NO<sub>2</sub>, NO<sub>3</sub>, H<sub>2</sub>O in the stratosphere from 2002 to 2012

**Comets:**

- discovery of the huge hydrogen envelope around comet Bennett in 1969  
- theoretical prediction of OH prompt emission.

**Heliospheric physics, Astrophysics and exo-planets:**

- detection of the deflection of the hydrogen flow at the heliopause interface.  
- first detection of galactic Lyman alpha emission  
- first detections of Earth's size exoplanets around M dwarf, and exoplanets in the Habitable zone  
- implementation of a web-based service to correct astronomical spectra from telluric absorption: TAPAS.

**Some relevant papers are listed below:****Mars:**

**Bertaux, Jean-Loup;** Leblanc, François; Witasse, Olivier; Quemerais, Eric; Lilensten, Jean; Stern, S. A.; Sandel, B.; Korablev, Oleg Discovery of an aurora on Mars, 2005 Nature.435..790B

**Bertaux, J-L.,** Leblanc F., Perrier S., Quemerais E., Korablev O., Dimarellis E., Reberac A., Forget F., Simon P-C., Stern S-A., Sandel B. and the SPICAM team , 2005, Nightglow in the Upper Atmosphere of Mars and Implications for Atmospheric Transport, Science, 307, 566-569.

**Bertaux, J. L.,** B. Gondet, F. Lefèvre , J. P. Bibring, and F. Montmessin (2012), First detection of O<sub>2</sub> 1.27 μm nightglow emission at Mars with OMEGA/MEX and comparison with general circulation model predictions, J. Geophys. Res., 117, E00J04, doi:10.1029/2011JE003890

L. Maltagliati, F. Montmessin, A. Fedorova, O. Korablev, F. Forget, and **J.-L. Bertaux,** Evidence of Water Vapor in Excess of Saturation in the Atmosphere of Mars, Science, 333, no. 6051, 1868-1871, 2011, DOI: 10.1126/science.1207957

**Venus:**

**Bertaux, Jean-Loup;** Widemann, Thomas; Hauchecorne, Alain; Moroz, V. I.; Ekonomov, A.P., VEGA 1 and VEGA 2 entry probes: An investigation of local UV absorption (220-400 nm) in the atmosphere of Venus (SO<sub>2</sub>, aerosols, cloud structure) Journal of Geophysical Research, Volume 101, Issue E5, p. 12709-12746 (1996)

Zhang, X., M.-C. Liang, F. Montmessin, **J.-L. Bertaux,** C. Parkinson and Y. L. Yung, Photolysis of sulphuric acid as the source of sulphur oxides in the mesosphere of Venus, Nature Geoscience, 3(12), 834 - 837, 2010, doi:10.1038/ngeo989

Marcq, Emmanuel, **Jean-Loup Bertaux,** Franck Montmessin and Denis Belyaev, Variations of sulphur dioxide at the cloud top of Venus's dynamic atmosphere

Nature Geoscience January 6, pp.25-28, (2013)

**Bertaux, J.-L.**, A.-C. Vandaele, O. Korablev, E. Villard, A. Fedorova, D. Fussen, E. Quémerais, D. Belyaev, A. Mahieux, F. Montmessin, C. Muller, E. Neefs, D. Nevejans, V. Wilquet, J. P. Dubois, A. Hauchecorne, A. Stepanov, I. Vinogradov, A. Rodin & the SPICAV/SOIR team, A warm layer in Venus' cryosphere and high-altitude measurements of HF, HCl, H<sub>2</sub>O and HDO, *Nature*, 450, 646-649, 2007. DOI:10.1038/nature05974

Montmessin, F., **J.-L. Bertaux**, F. Lefèvre, E. Marcq, D. Belyaev, J.-C. Gérard, O. Korablev, A. Fedorova, V. Sarago, A. C. Vandaele, A layer of ozone detected in the nightside upper atmosphere of Venus, *Icarus*, 216(1), 82-85, 2011, doi:10.1016/j.icarus.2011.08.010

Jean-Yves Chaufray, **Jean-Loup Bertaux**, Francois Leblanc, First observation of the Venus UV dayglow at limb from SPICAV/VEX, *Geophysical Research Letters*, vol.39, pp.20201, (2012), 10.1029/2012GL053626

**Bertaux, Jean-Loup**, Khatunstsev, I.V. , Hauchecorne, Alain, Markiewicz W.J., Marcq E., Lebonnois, S., Patsaeva, M., Turin, A., Fedorova, A., Observed Influence of Venus topography on the zonal wind and albedo at cloud top level: the role of stationary gravity waves, submitted 2015, *J Geophys.Rev.*, in revision (2016).

#### **Comets :**

**J.L. Bertaux**, J.E. Blamont - Observation de l'émission de l'hydrogène atomique de la comète Bennett. *C.R. A.S.*, 270, 1581-1584 (1970)

**Bertaux, J. L.**, The UV bright SPOT of water vapor in comets, *Astronomy & Astrophysics Letters*, Volume 160 L. 7B (1986)

Kissel, J.; Sagdeev, R. Z.; **Bertaux, J. L.**; Angarov, V. N.; Audouze, J.; Blamont, J. E.; Buchler, K.; Evlanov, E. N.; Fechtig, H.; Fomenkova, M. N.; and 13 coauthors Composition of comet Halley dust particles from VEGA observations, *Nature*, 321, 280 (1986)

Sagdeev, R. Z.; Szabo, F.; Avanesov, G. A.; Cruvellier, P.; Szabo, L.; Szego, K.; Abergel, A.; Balazs, A.; Barinov, I. V.; **Bertaux, J.-L.**; and 28 coauthors, Television observations of comet Halley from VEGA spacecraft, *Nature*, 321, 262 (1986)

**Bertaux, J.L.**, Estimate of the erosion rate from H<sub>2</sub>O mass-loss measurements from SWAN/SOHO in previous perihelions of comet 67P/Churyumov-Gerasimenko and connection with observed rotation rate variations, *Astronomy & Astrophysics*, Volume 583, id.A38, 10 pp. (2015)

#### **Exoplanets:**

Bonfils, X.; Delfosse, X.; Udry, S.; Forveille, T.; Mayor, M.; Perrier, C.; Bouchy, F.; Gillon, M.; Lovis, C.; Pepe, F.; Queloz, D., Santos, N.C., Segresan, D, **Bertaux, J.L.**,

The HARPS search for southern extra-solar planets. XXXI. The M-dwarf sample (2013), *Astronomy and Astrophysics*, 549, p.109

Udry, S.; Bonfils, X.; Delfosse, X.; Forveille, T.; Mayor, M.; Perrier, C.; Bouchy, F.; Lovis, C.; Pepe, F.; Queloz, D.; **Bertaux, J.-L.**, The HARPS search for southern extra-solar planets. XI. Super-Earths (5 and 8  $M_{\oplus}$ ) in a 3-planet system, (2007) , *Astronomy and Astrophysics*, 469, L43-L47

### **Heliospheric physics and Astrophysics:**

**J.L. Bertaux**, J.E. Blamont - Evidence for a Possible Source of Extra-terrestrial Lyman-alpha : the Interstellar Wind. *Astron. Astrophys.*, 11, 200-217 (1971)

Lallement R., Quémerais E., **Bertaux J.L.**, Ferron S., Koutroumpa D. and Pellinen R., 2005, Deflection of the Interstellar neutral Hydrogen Flow across the Heliospheric Interface, *Science*, 307, 1447-1449.

Lallement, Rosine; Quémerais, Eric; **Bertaux, Jean-Loup** Sandel, Bill R.; Izmodenov, Vlad, (2011) Voyager Measurements of Hydrogen Lyman- $\alpha$  Diffuse Emission from the Milky Way, *Science*, 334, p.1665

Quémerais, E., Lallement, R., **Bertaux, J.-L.**, Sandel, B. R., Izmodenov, V., Malama, Y., Ultraviolet Glow from the Hydrogen Wall, *The Astrophysical Journal*, 711, 2, 1257-1262, 2010, doi: 10.1088/0004-637X/711/2/1257.

**Bertaux, J. L.**; Lallement, R.; Ferron, S.; Boonne, C.; Bodichon, R., TAPAS, a web-based service of atmospheric transmission computation for astronomy, *Astronomy & Astrophysics*, Volume 564, id.A46, 12 pp. (2014)

### **Professional Activities and Service**

. PI of H and He photometer on board soviet spacecraft Prognoz 5 and Prognoz 6 in 1975-1976 (with V.G. Kurt).

. PI of ISAV spectrometer on Venus descent probes Vega-1 and Vega-2 in 1985 (with V.I. Moroz)

. PI of Hydrogen and Deuterium experiment ALAE on board shuttle missions Spacelab 1 (1983) and ATMOS-1 (1992)

• PI of SPICAV/SOIR instrument on board ESA Venus Express 2001-2016

• PI of SPICAM instrument on board ESA Mars Express 1998-2010  
now Deputy-PI with Franck Montmessin as PI. 2010-present

• PI and then Deputy PI of SWAN instrument on SOHO 1990-present

• Promoter of GOMOS on ENVISAT, and now member of the GOMOS Quality Working Group in charge of algorithm developments and improvements

• Co-I on two experiments of Rosetta : The OSIRIS camera and the ALICE UV

spectrometer.

- Co-Investigator on Ultra Violet Spectrometer (UVS) Voyager 1 and 2 :1973-present
- Reviewer for Advances in Space Research, Icarus, A and A, Astrophysical Journal, Journal of Geophysical Research, Nature, Science and Planetary and Space Science , Atmospheric and Chemistry sciences 1972- present

**Professional Affiliations:**

Member of the American Geophysical Union

Solar System Working Group of Agence Spatiale Européenne (1977-1979)

**Short overview of my works:**

I have worked in various fields. Five main topics may be identified:

- the Earth's atmosphere (stratosphere, mesosphere, thermosphere and the hydrogen exosphere)
- the cometary environment (nucleus, dust, gas and the huge hydrogen envelope)
- the planetary atmospheres : Mars, Venus, Jupiter, Saturn, Titan, Uranus, Neptune and Triton
- the interstellar medium in the vicinity of the solar system, its interaction with the heliosphere, the interplanetary gas (Hydrogen and helium), originating from the flow of interstellar gas in the solar system that we called the Interstellar Wind.
- the solar wind and its variation as a function of heliographic latitude.

At the present time (January 2013) I have the responsibility as Principal Investigator or deputy -PI of three space experiments:

1. On board the SOHO mission, I was of SWAN experiment (Solar Wind Anisotropies), which measures the latitudinal variation of the solar wind, and found the Lyman alpha signature of the existence of the heliopause and the effect of the interstellar magnetic field on the flow. I passed to Eric Quémerais the PIship while remaining as Deputy PI.
2. On board the Mars Express ESA mission, I was PI of the SPICAM experiment, which has characterized the atmosphere of Mars with various modes of observation (mainly solar and stellar occultation technique). I passed to Franck Montmessin the PI ship while remaining as Deputy PI.
3. On board the Venus Express ESA mission, I am PI of the SPICAV experiment, which is characterizing the atmosphere of Venus with various modes of observation, including a new IR Hi-res solar spectrometer (SOIR) to detect HDO.
4. On the ESA ENVISAT mission, I was at the origin of the GOMOS investigation (Global Ozone Monitoring by Occultation of stars). Since it is funded by ESA, it has no PI, but everybody recognizes my important role for its existence and success.
5. I am co-Investigator on the ALICE UV spectrometer and OSIRIS camera on board the ESA Mission Rosetta, rendez-vous with comet Churyumov Gerasimenko 67P.

I have participated, or I am participating to at least one space mission to all 9 planets, including New Horizons to Pluto.

### **Full Citation for EGU medal Christian Huygens in 2010.**

Jean-Loup Bertaux is Directeur de Recherche emeritus from CNRS, in the LATMOS Laboratory from Université de Versailles Saint-Quentin, and Associate Professor at Boston University. His whole career was spent at Service d' Aéronomie du CNRS, where he developed a number of space instruments dedicated to the study of planetary atmospheres (including the Earth), the solar wind, the interstellar/ interplanetary medium. He is the co-discoverer, with Jacques Blamont, of the huge hydrogen envelopes of comets, and of the interstellar wind, this flow of interstellar hydrogen and helium which flows permanently through the solar system. He has been the PI (Principal Investigator) of many space instruments on soviet and ESA mission: Spacelab-1, Atlas-1, SOHO, Mars Express and is presently PI on Venus Express. He fostered the method of star occultation for probing vertical profiles of atmospheric constituents, which is presently operating simultaneously on Mars, Venus, and the Earth, with GOMOS on ENVISAT for the long term monitoring of ozone. He participated, or is participating to at least one space mission to all 9 planets. He participated to the team of Michel Mayor, who implemented at ESO La Silla observatory the HARPS spectrometer, successful discoverer of many exo-planets. He is the author or co-author of more than 250 scientific publications, and a book about the 1986 space exploration of Halley's comet : *De l'autre côté du soleil* (Albin Michel).