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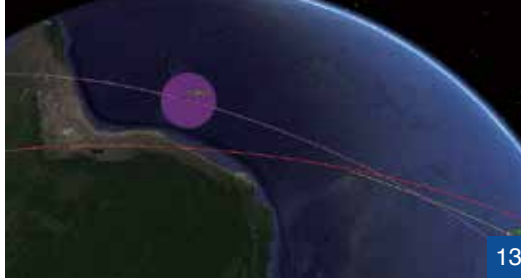
# AEROSPACE CHINA

中国航天英文版



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# Collaboration Between the Centre Spatial de Liège and China

Pierre Rochus  
University of Liège

Created in 1962, the Centre Spatial de Liège (CSL) (IAL Space at that time) is an applied research center owned by University of Liège, focused on design, integration and calibration of space observation instruments, including environmental test facilities and high level laboratories. CSL operates a highly specialized environmental test center to support ESA programs as well as the space industry and regional companies. Through several state of the art facilities standing in an ultra-clean environment, CSL provides a customized service to expose instruments, systems and even satellites to extreme conditions encountered in deep space with a unique expertise in optics and thermal regulation, including cryogenics. CSL participated in a great number of renowned ESA, NASA, CNES space missions such as SOHO-EIT, XMM, COROT, HERSCHEL, PLANCK, IMAGE, JUNO. CSL employs about 100 highly skilled employees at its Liège Science Park location. Some of the CSL science areas of expertise are: optical design and metrology, non-destructive testing, surface micro-texturing, sensors and components working under extreme environment conditions, lasers, cryogenics, thermal and mechanical design, signal processing etc.

International collaboration has always been of prime importance for CSL, from the beginning with their first space projects in the sixties: around 20 sounding rockets launched from Kiruna (Sweden, situated in the province of Lapland), the Stellar UV Radiation Experiment aboard TD-1A launched by a Thor-Del-

ta N from the Vandenberg Air Force Base on April 11, 1974, and the Faint Object Camera for the Hubble Space Telescope (NASA). International collaboration is quite natural in space science as you put together the needed competencies and capacities from different groups, for a common scientific objective. International cooperation in space enables the achievement of ambitious science goals in understanding the Universe, while allowing transfer of technology, impacting on science education and on the economy.

There are several ways to initiate international cooperation; it can be by direct contact as we did for KUAFU, China Academy of Space Technology (CAST), Weihai University and Northwestern Polytechnical University (NPU), motivated by the specific expertises gained by each of the partners. The second way is to be involved through one of the official space agencies (ESA in our case), as we did for the SMILE mission. These collaborations between universities and research institutes, most of the time, extend to the space industry which are working for the institutes.

The intention of CSL to start collaboration with China is not new at all. Concerning the development of scientific payloads, being involved in SOHO and in the IMAGE missions, Professor Pierre Rochus from CSL was regularly invited as an expert from 2004 until 2010, to working meetings in China to prepare the scientific solar mission called KUAFU, a “LI + Polar” triple star project, composed of three spacecraft.



Figure 1 International Symposium on KuaFu Project

In 2006, CSL signed a protocol agreement with the Center for Space Science and Applied Research, China (CSSAR) for the joint optical design and the calibration of the prototype plasmaspheric EUV camera for the Chinese Lunar Project Chang'e 2.

On July 22, 2006, Dr. WU Ji, Director of CSSAR and Pierre Rochus, Scientific Director of CSL signed a protocol for the joint optical design and the calibration of the prototype plasmaspheric EUV camera for the Chinese Lunar Project Chang'e 2 including required HMW.

Since 2016, CSL participated in the joint ESA – CAS mission (S2) to investigate the dynamic response of the Earth's

magnetosphere to the solar wind impact on a global basis. CSL contributes to the UV Imager for the whole northern auroral oval with high temporal and spatial resolution (under fully sunlit conditions) by:

- Performing the full calibration of the instrument in the UV;
- Manufacturing a very specific (155 - 175 nm) multilayer coating with very high rejection in the visible range.

The Principal Investigators are Graziella Branduardi-Raymont from Mullard Space Science Laboratory, University College London, UK, and WANG Chi from the State Key Laboratory of Space Weather, NSSC, CAS.



Figure 2 Protocol signing between CSSAR and CSL



Figure 3 Collaboration between CAST and CSL

Since 2013, CSL has been in contact with CAST and Beijing Institute of Space Mechanics and Electricity (BISME) for the developments of space technologies.

More recently, our new Rector Pierre Wolper (nominated in October 2018) signed, as the Dean of the Applied Science Faculty, an agreement for the participation in the Belt and Road Aerospace Innovation Alliance (BRAIA) in Spring 2017. The BRAIA initiated by NPU, China, is an international aerospace organization composed of universities, research institutes, and academic organizations in the field of astronautics. The alliance was officially established in April 2017. The alliance's mission is to create a platform for international exchange and cooperation in the aerospace field. It aims at promoting a profound cooperation among the members in scientific research, talent cultivation and for the combination of production, teaching, and research.

The aerospace department of the University of Liège called LTAS is collaborating with NPU (Aerospace FEM simulations and topological optimization) since 1984 by exchanging professors and students. Professor ZHANG Weihong, Vice President

of NPU completed his Ph.D and worked in Liège during 1985 - 1996, many others followed afterwards. This collaboration is still going on very well. The University of Liège and NPU being both members of BRAIA, decided to collaborate with NPU on the following topics:

- LTAS will pursue its collaborations with NPU;
- CSL will start collaboration with NPU on the development of common nanosatellites; CSL, specialized in space instrumentation development and qualification, will collaborate with the National United Engineering Laboratory of Microsatellite Technology and Application from NPU (NELM). CSL will provide the payload (in Earth observation) and NELM will provide the spacecraft.

All these intended international collaborations were confirmed and reinforced by three specific events which all occurred in November 2018:

- APSCO 9th International Symposium on "Developing Next-Generation Aerospace Innovative Talents through

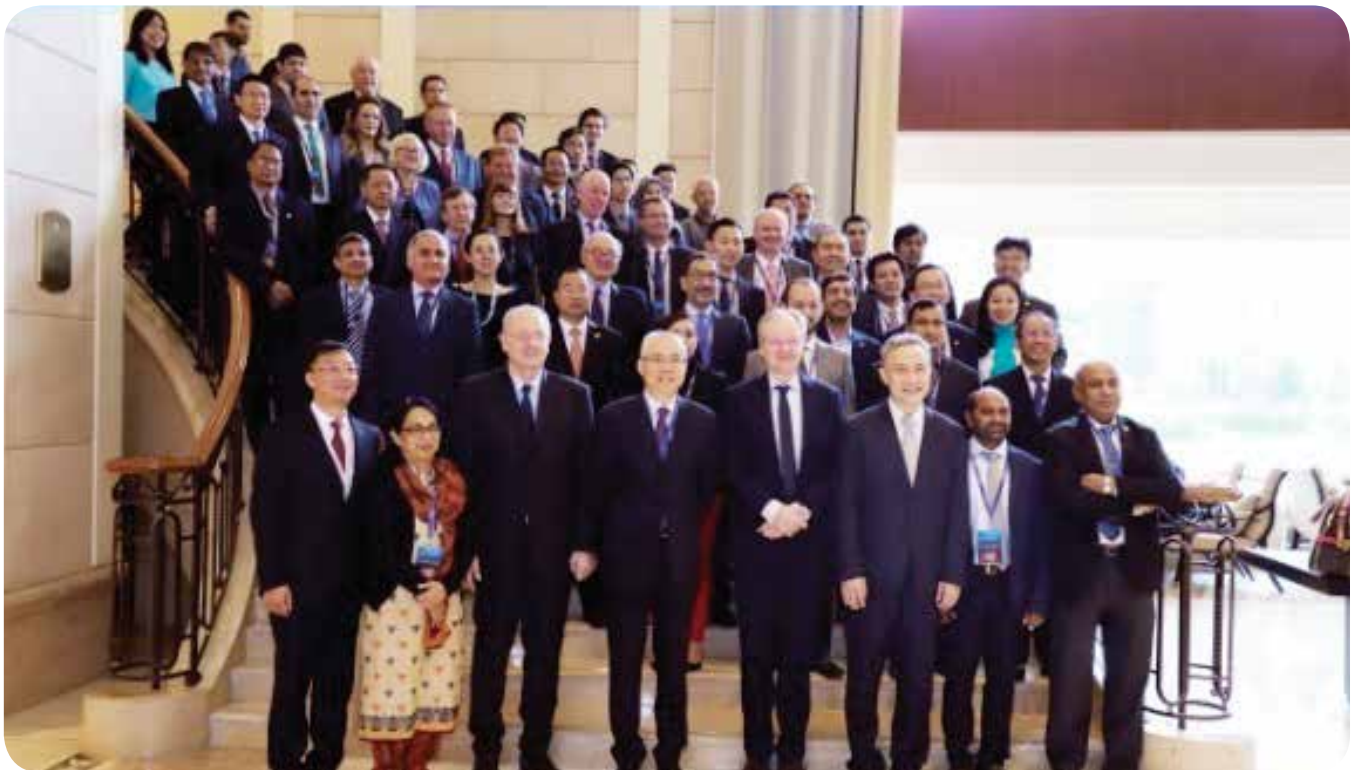


Figure 4 APSCO 9th International Symposium



Figure 5 First China microsatellite symposium held in Xi'an

Space Cooperation" in Beijing;

- First China Microsatellite Symposium November 18 - 20, 2018 at NPU, Xi'an
- The Photo Exhibition and Reception for Achievements of China-Belgium Science and Technology Cooperation at the Chinese Embassy in Brussels, Belgium, November 26, 2018.

Professor Pierre participated at the International CubeSat

Contest where students from middle schools and universities throughout the world could participate, as well as researchers from research institutes or enterprises, and individuals or groups interested in CubeSat and astronautics. The contest was hosted by the BRAIA at the NPU. It was co-hosted by the International Astronautical Federation for which Pierre Rochus is chairman of the Space University Administrative Committee. The other co-hosts were the Chinese Society of Astronautics and Chinese



Figure 6 On November 26, the Chinese Embassy to Belgium held the photo exhibition, displayed the achievements of the two countries' cooperation in science and technology in the 40 years of China's reform and opening up. Chinese Ambassador to Belgium CAO zhangming and Chinese Vice Minister of Science and Techuology ZHANG Jianguo addressed the photo exhibition.

Institute of Command and Control IEEE Xi'an Section. The theme of this contest was "CubeSat, the platform of an innovative space mission." Sir Martin Sweeting, Founder & Chairman of Surrey Space Centre gave an introductory talk on Small Satellites Changing the Economics of Space. Following the amazing progress in miniaturizing essential components of spacecraft, the last decade has witnessed an important development in nano- and micro-satellites. Beyond the mere technological experiment, these small satellites are now considered as important complements of much larger and more sophisticated probes to do scientific research.

In this context, CSL is conducting a feasibility study on a UV photometer on-board a 3U CubeSat. The scientific purpose of this payload will be to collect the time series of photometric measurements of bright massive stars. These massive stars are very hot and luminous objects emitting copious amounts of UV radiation. The properties of these stars during their life and their death in gigantic supernova explosions make them key players in the evolution of the Universe.

The UV photometer will be used for imaging photometric observations of massive stars in the spectral range 250 and 350 nm. The strength of space photometry is the absence of signal perturbation by the Earth's atmosphere and the continuity of the time-series. Precisely measuring photometric variations allows studying radial and non-radial pulsations of stars. This discipline, called asteroseismology, is currently the most powerful technique for probing the physical conditions of the interiors of stars. An important problem in asteroseismology of massive stars is the mode identification. Simultaneous observations in the near UV (250 - 350 nm) and in the visible (600 nm) provide the best combination for precise and accurate mode identification based on amplitude ratios in massive stars. The latter pass-band is precisely the one of some satellites in the BRITE constellation. Combining the observations of our instrument with those of BRITE will result in unprecedented results for pulsating massive stars. The baseline for the UV photometer is a Ritchey-Chretien telescope composed of two reflective hyperbolic mirrors that focalize the light coming from space onto a focal plane protected by an optical filter. For the platform, CSL is willing to collaborate with the NELM, which has the expertise and the tools to develop and qualify nanosats. The project also foresees a 6 U CubeSat provided by NELM, for further developments of EO telescopes from CSL. A very close collaboration will be needed since in the case of nanosat, the integration needs a precise definition of the interfaces. This project will also involve

the students from both universities. This collaboration will also be open to university members of BRAIA and of SUAC.

#### Author Biography:



Pierre Rochus is senior consultant, honorary professor at the University of Liège and past scientific director of Centre Spatial de Liège (CSL), invited professor at KUL; he is the Chairman of the Scientific Council of the Royal Observatory of Belgium and member of ESA Space

Weather Steering Board.

Professor Pierre Rochus started his research in Theoretical Nuclear Physics from 1974 to 1981, at the University of Liège. From 1981 to 1988, he was responsible for (among other activities) the Design and Development of 3 different lubrication units for the CFM 56-2, -3, and -5 turbo-engines and responsible for the Design and Development of Ariane-5 valves. In parallel, from 1988 till 2008, he was part time professor at HEC Liège. From 1988 until now, he served at the CSL where he finally became the Deputy General Manager (since 2004) and ordinary professor at the Aerospace Department, LTAS, ULg and Invited Professor at KUL (Leuven). His main activities are in space instrumentation: development and qualification of 17 space instruments, in particular PI on EUI/Solar Orbiter, Co-I on HI/ Solar Orbiter, WSPR/SPP, ICON. He is author and co-author of over 150 scientific publications.