

The “Station de Planétologie des Pyrénées” (S2P), a collaborative science program in the course of a long history at Pic du Midi observatory.

F. Colas (1), A. Klotz (2), F. Vachier (1), M. Birlan (1), B. Sicardy (3), J. Lecacheux (3), M. Antuna (6), R. Behrend (4), C. Birnbaum (6), G. Blanchard (6), C. Buil (4,5), J. Caquel (6), M. Castets (5), C. Cavadore (4), B. Christophe (6), F. Cochard (4), J.L. Dauvergne (6), F. Deladerriere (6), M. Delcroix (6), V. Denoux (4), J.B. DeVanssay (6), P. Devechere (6), P. Dupouy (5), E. Frappa (6), S. Fauvaud (5), B. Gaillard (6), F. Jabet (6), M. Lavayssiere (6), T. Legault (6), A. Leroy (5), A. Maury (6), M. Meunier (6), C. Pellier (6), C. Rinner (4), E. Rolland (6), O. Stenuit (6), I. Testar (6), P. Thierry (4), O. Thizy (4), B. Tregon (5), F. Vaissiere (4), S. Vauclair (6), C. Viladrich (6), C. Angeli (6), J.E. Arlot (1), M. Assafin (28), D. Bancelin (1), D. Baratoux (29), N. Barrado-Izagirre (8), M.A. Barucci (3), L. Beauvalet (9), P. Bendjoya (13), J. Berthier (1), N. Biver (3), D. Bockelee-Morvan (3), D. Berard (3), S. Bouley (10), S. Bouquillon (9), P. Bourget (11), F. Bragas-Ribas (7), J. Camargo (7), B. Carry (1), S. Chevrel (2), M. Chevreton (3), P. Colom (3), J. Crovisier (3), J. Demars (1), R. Despiou (2), P. Descamps (1), N. Dolez (2), A. Doressoundiram (3), P. Drossart (3), A. Egal (1), T. Encrenaz (3), S. Erard (3), R. Ferlet (12), A. Fienga (14), M. Fulchignoni (3), J. Gaudemar (27), P. Gutierrez (20), O. Hainaut (11), D. Hestroffer (1), R. Hueso (8), S. Jancart (6), I. Jegouzo (27), E. Jehin (14), L. Jorda (17), A. Kryszczyńska (16), T. Kwiatkowski (16), P. Lamy (17), V. Lainey (1), P. Laques (2), M. Laas-Bourez (13), J.F. Leborgne (2), A. Lecavelier Des Etangs (12), E. Lellouch (3), A.C. Levasseur-Regourd (17), J.M. Gómez (8), L. Maquet (1), F. Marchis (18), E. Meza (3), T. Michalowski (15), O. Mousis (16), G. Quitte (2), D.A. Nedelcu (20), J.L. Ortiz (20), G.S. Orton (21), M. Pajuelo (1), S. Pau (3), G. Perrin (3), P. Pinet (2), M. Popescu (19), P. Pravec (23), S. Renner (1), F. Rigaud (27), J. Rogers (6), F. Roques (3), D. Rouan (3), P. Rousselot (23), A. Sanchez-Lavega (8), A. Santerne (24), E. Saquet (1), P. Scheirich (22), F. Sevre (12), F. Taris (9), D. Tiphène (3), G. Vauclair (2), W. Thuillot (1), J.M. Trigo-Rodríguez (25), O. Vaduvescu (26), J. Vaubaillon (1), C.H. Veiga (7), J.L. Vidal (6), A. Vidal-Madjar (12), A. Vienne (1), P. Tanga (13), R. Vieira-Martins (7), T. Widemann (3).
(1) IMCCE, Observatoire de Paris, France, (2) IRAP, Toulouse, France, (3) LESIA, Observatoire de Paris, (4) Aude Association, Paris, France, (5) T60 Pic du Midi Association, Toulouse, France, (6) TIM Association, Paris, France, (7) Observatorio Nacional, Rio de Janeiro, Brasil, (8) Unidad Asociada Grupo Ciencias Planetarias, UPV/EHU, Bilbao, Spain, (9) SYRTE, Observatoire de Paris, France, (10) GEOPS, Université Paris Sud, Orsay, France, (11) European Southern Observatory, Garching, Germany, (12) Institut d'Astrophysique de Paris, France, (13) Observatoire de la Côte D'Azur, Nice, France, (14) Institut d'Astrophysique et de Géophysique, Liège, Belgium, (15) Astronomical Observatory Institute, A. Mickiewicz University, Poznan, Poland, (16) Laboratoire d'Astrophysique de Marseille, France, (17) UPMC, LATMOS, Paris, France, (18) SETI Institute, Mountain View, USA, (19) Astronomical Institute of the Romanian Academy, Bucharest, Romania, (20) Instituto de Astrofísica de Andalucía, Granada, Spain, (21) Jet Propulsion Laboratory, Pasadena, USA, (22) Astronomical Institute, Ondrejov, Czech Republic, (23) UTINAM, Université de Franche-Comté, Besançon, France, (24) Centro de Astrofísica da Universidade do Porto, Portugal, (25) Institute of Space Sciences (CSIC-IEEC), Barcelona, Spain, (26) Isaac Newton Group, Santa Cruz de la Palma, Spain. (27) GEPI, Observatoire de Garis, France. (28) Observatorio do Valongo, UFRJ, Rio de Janeiro, Brazil, (29) JET, Toulouse, France.

Abstract

Founded in 1873 [4] (Davoust, 2014) by two amateurs (general Nansouty and engineer Vaussehat), the Pic du Midi observatory has been the result of collaboration between amateurs and professionals. The solar coronagraph works thanks to an association [9] (Vaissière, 2015) and private funds. We can also mention the fantastic history of the 60 cm telescope which has recently celebrated its 100th anniversary. This instrument, a gift of Marcel Gentili in 1945 is now fully managed by an association [3] (Castets, 2015). Due to recent budget cuts, the Bernard Lyot 2-m telescope involves several amateur observers [7] (Mathias, 2015). In the context of the 50th anniversary of the 1 m telescope, we will

come back on the successful scientific collaborations of this operation and the future that opens with new information technology.

1. Planetology at Pic du Midi

1.1 The early times

Although meteorology was the main purpose of the early development of the observatory, astronomers quickly realized the stability of the atmosphere and the possibility of making good planetary works. It really began in 1860 with the expedition of the photographer and climber F. Maxwell-Lyte [8] (Sanchez 2014) during the solar eclipse of July 18th. These images noticed by the press helped to launch

the foundation of the observatory in 1873. Pic du Midi history is marked by numerous private contributions like the continual supply of the Ramond Society [1] (Beigbeder, 2015), accompanying the Observatory since its foundation!

1.2 The modern times

It is difficult to summarize all the works carried out in planetary science at the Pic du Midi, but we must mention the tremendous work done by Bernard Lyot with the development of the solar coronagraph and outstanding planetary images which established the reputation of the Observatory. We can also highlight the cooperation between amateur and astronomer for the discovery and the confirmation of the super rotation of Venus's atmosphere [2] (Boyer, 1961). It also includes the discovery of Saturn satellite Helene [6] (Lecacheux, 1980) and the first ground-based observation of Venus surface [5] (Lecacheux, 1993).

2. Planetology Station (S2P)

2.1 One meter telescope

The telescope was built in the 60's in the wake of Apollo missions. Afterwards, it became almost exclusively devoted to planetary science mainly to study planetary surfaces. Now it continues to observe planets in parallel to space probes, but its main area of research has refocused on asteroids and comets. Its purpose is to carry on long-term studies of most families of small bodies.

2.2 Interplanetary dust

For fifteen years we have extended our research to the field of meteors and more generally of interplanetary matter. We installed at Pic du Midi CABERNET and FRIPON cameras for meteor observations and we regularly observed lunar impacts. Following the observations of the impact of comet SL9 on Jupiter, we are making a survey of asteroidal impacts on giant planets to constrain the density of interplanetary dust.

3. Conclusion

Since the beginning, the "S2P" asked and encouraged amateur astronomers to contribute to solar system research. As an example, the first permanent CCD detector used at 1-m telescope was developed by an

amateur team from Toulouse. In the past, the price of sensors was the limiting factor. Now, it is the cost of manpower, therefore, we encourage amateur astronomers to contact the first author to participate to observations. The telescope is now equipped with high-level detectors (CCD for long exposures and CMOS for short exposures) We will soon install a low-resolution spectrometer for the characterization of the chemical composition of small bodies. The 1-m telescope has also completed a renovation, but it remains old and will never be completely automated, so we always need observers!

Acknowledgements

We want to thank Observatoire Midi Pyrénées for managing the observatory, in particular the 1 m telescope. We also acknowledge the contribution of all the technical team at the summit who often work under difficult conditions. We also thank Paris Observatory, especially IMCCE and LESIA, who always supported the S2P. Finally, a very special thanks to all the amateurs who have spent time and money to make the operations so efficient.

References

- [1] Beigbeder, F.: Société Ramond (<http://www.ramond-societe.com/home.html>), Bagnères de Bigorre, France.
- [2] Boyer, C., Camichel, H.: Observations photographiques de la planète Vénus ,Annales d'Astrophysique, 1961.
- [3] Castets, M.: Association T60, Pic du Midi, Toulouse,, <http://www.astrosurf.com/t60/>, France
- [4] Davoust, E.: Pic du Midi : Cent ans de vie et de science en haute montagne, MSM, 2014.
- [5] Lecacheux, J., Drossart, P., Laques, P., Deladerriere, F., Colas, F.: Detection of the surface of Venus at 1.0 micrometer from ground-based observations PSP, 1993.
- [6] Lecacheux, J., Laques, P.; Vapillon, L., Auge, A., Despiau R.: A new satellite of Saturn DioneB, Icarus, 1980
- [7] Mathias, P.: OA, Télescope Bernard Lyot, Tarbes, France <http://www.tbl.obs-mip.fr/observation/oatbl>
- [8] Sanchez, J.C.: Le Pic du Midi de Bigorre et son observatoire, Cairn éditions, 2014
- [9] Vaissière, F.: Les Observateurs Associés, Bagnères de Bigorre: <http://www.climso.fr/en/>, France.