Conference report

About the Moon Farside 2019 IAA Symposium

*held on March 27, 2019, at the IAA in Paris*

By Claudio Maccone,
IAA Director for Scientific Space Exploration
and Chair, IAA Committee on SETI

1. Introduction

In 2018 China landed robotic spacecrafts on the Farside of the Moon: something that no other country ever did. This new course of astronautics implies radio-pollution on the Farside: the dream of doing noise-free radio astronomy from the Farside is endangered forever unless some kind of international agreement is reached among all space-faring nations before even more radio pollution is brought there by private space missions. A loosing battle already? Maybe.

But Astronomers and Scientists cannot be fooled by the Rich and Clever just because Astronomers and Scientists are “so poor”. The international scientific community must act before it gets too late, just as for global warming and increasing pollution on Earth.

A contribution was given by the IAA during the Paris Spring Meetings of 2019 when the “Moon Farside 2019” IAA Symposium was held in Paris on March 27, organized by myself (Program attached herewith).

**And our intention is to run one more similar IAA Symposium, open to anyone interested (free entrance), entitled “Moon Farside Negotiations”, in Washington DC on Saturday, October 19, prior to the opening of the 2019 IAC and at the same 2019 IAC venue: politics of science at the highest international level.**

Even the United Nations COPUOS in Vienna are now keeping an eye on all this.

2. The IAA Symposium on “Moon Farside 2019” held on March 27, 2019, at the IAA in Paris.

The Program of the IAA Symposium held on March 27, 2019 at the IAA in Paris appears in the next page. The date of Wednesday, March 27, had been selected by the Symposium Organizer, Dr. Claudio Maccone, so as to let the Symposium to be attended by as many Delegates as possible who were in Paris to attend the Paris Spring Meetings during the week of March 25 through 29, 2019.

Among the Participants were:

1) The Chinese Delegation of about 20 members led by Dr. Wu Weiren, Chief Designer of China’s Lunar Exploration Missions. He spoke Chinese, ad his young co-workers immediately translated his sentences into English. The relevant slides were all in English.

2) A Russian Delegation made up by some three members who happened to be in Paris to attend the Paris Spring Meetings was present.

3) A few American IAA Academicians, among them Dr. Ralph McNutt, were present also, but, unfortunately, neither an official United States Delegation nor a NASA Delegation attended the Symposium. This seems to reflect the “undecided” attitude widespread in the United States about “what to do with the Moon Farside”: whether to legally protect it somehow, or just abandon it to the appetites of private entrepreneurs, in the best Far West tradition.
Moon Farside 2019

IAA Symposium
Wednesday, March 27th, 2019, 09h00 – 13h00
At IAA, 6 rue Galilee, PARIS. Metro: Boissière

Final PROGRAM

8:30 – 9:00 Registration of Participants

9:00 – 9:10 Welcome to Participants, Jean-Michel Contant, IAA Secretary General  IAA Paper #

9:10 – 9:20 Welcome Address, Jan Woerner, ESA Director General  IAA-MF19-02

9:20 – 9:50 Twenty Years of IAA Studies to Protect the Moon Farside Radio-Noise-Free Environment
Claudio Maccone, IAA Director for Scientific Space Exploration  IAA-MF19-03

9:50 – 10:20 China’s Queqiao and Chang’e 4 space missions to the Moon Farside
Wu Weiren, Chief Designer of China’s Lunar Exploration Missions  IAA-MF19-04

10:20 – 10:40 The Breakthrough Listen Search for Extraterrestrial Technologies
Andrew Siemion, Director, Breakthrough Listen, University of California at Berkeley  IAA-MF19-05

10:40 – 11:00 Coffee Break

11:00 – 11:20 Open Debate among the Participants about the Presentations held in the morning.
All Participants  IAA-MF19-06

11:20 – 11:40 Moon Village Association (MVA) Activity
Giuseppe Reibaldi, President, Moon Village Association  IAA-MF19-07

11:40 – 12:00 Lunar Farside: from Recent to Upcoming Probes and Activities
Bernard Foing, Executive Director, International Lunar Exploration Working Group  IAA-MF19-08

12:00 – 12:20 Moon Farside 2019 DECLARATION
Claudio Maccone and All Participants  IAA-MF19-09

12:20 GROUP PHOTOGRAPH OF PARTICIPANTS TAKEN
Summary of the Talks given at the Symposium.

Contrary to the Symposium Final Program appearing in the previous page, no Registration of the Participants took place: interested persons who had been previously informed just walked into the room and attended the Symposium, sometimes asking short questions at the end of each speaker’s talk. The whole Symposium was chaired by Dr. Claudio Maccone throughout the whole morning.

CONTANT. The IAA Secretary General, Dr. Jean-Michel Contant, firstly welcomed the Participants.

WOERNER. After Contant, the Director General of ESA, Prof. Jan Woerner, made a very good Welcome Address. Woerner, in particular, pointed out that, in order to explore the Farside robotically and remotely from the Earth, a Relay Satellite like the Chinese “Queqiao” **MUST** be previously put into orbit around the Lagrangian Point L2 of the Earth-Moon system, that hovers about 65,000 km above the Farside along the Earth-Moon axis. There is no other technological way to keep the radio link between the Earth and the Moon Farside as the laws of Celestial Mechanics (or if you prefer, Astrodynamics) must be fulfilled at all times. The following Figure 1 shows this **unavoidable situation** (image taken from the Wikipedia site https://en.wikipedia.org/wiki/Chang%27e_4).

![Figure 1](https://en.wikipedia.org/wiki/Chang%27e_4)

Figure 1. The crucial Lagrangian point L2, about 60,000 km above the Farside. The two great mathematicians Leonhard Euler (1707-1783) and Joseph-Louis Lagrange (1735-1813), made their mathematical research work around 1780, obviously without any suspicion of future spaceflight applications. Then, their mathematics was forgotten by everyone until 1906, when experts in celestial mechanics came to realize that the Trojan asteroids along the Jupiter orbit around the Sun Jupiter were just rocks trapped by gravity around the Lagrangian points L4 and L5 of the Sun-Jupiter system. After 1945 the era of spaceflight began, and orbital experts came to realize that this “gravitational miracle” called “Lagrangian Points” exist at many other locations in space. In particular along the Earth-Moon axis at about 65,000 km over the Moon Farside is the Lagrangian point L2 of the Earth-Moon gravitational system. Please find more about this wonderful mathematical story at the website https://en.wikipedia.org/wiki/Lagrangian_point and related websites. In the spring of 2018, China set up the first ever Relay Satellite called Queqiao just there. Thanks to Queqiao, beginning on January 3rd, 2019, China was able to land on the Farside the various spacecrafts of the Chang’e 4 space mission(s), as better described in the following Figure 2.
Going now back to the IAA Symposium held on March 27, 2019, in his speech, Prof. Jan Woerner declared that, rather than building a new Relay satellite to be placed at the Lagrangian point L2 above the Moon Farside, **ESA should better NEGOTIATE with the Chinese** to let Queqiao be used by ESA also. This would save a lot of time and money to ESA, and would also improve “politically” the relationship between Europe and China. Unfortunately the USA were absent from this discussion.

Finally, Woerner added that “NO POLLUTION” should be made on the Moon and the Farside in particular. But this seems to be more a pious wish than a “real-politiks” statement.

One point should be added: ESA (i.e. Woerner) could release an “invitation to tender” to the European space companies that would enable them to conduct Phase A, Phase B and possibly even Phase C/D for a space mission intended to land an optical telescope and a radio telescope at the Farside Centre, that is the most shielded region of the Moon from man-made radiation coming from Earth. Crater Daedalus would be an ideal place for that, as we now come to consider.

MACCONE.

After Woerner, the next speaker was the Symposium organizer, Dr. Claudio Maccone, IAA Director for Scientific Space Exploration and chair of the IAA Committee on SETI (Search for Extra-Terrestrial Intelligence). He firstly pointed out that the IAA had been conducting studies about the Moon Farside unique radio-noise-free environment as early as the 1990s. The French radio astronomer Jean Heidmann [https://fr.wikipedia.org/wiki/Jean_Heidmann](https://fr.wikipedia.org/wiki/Jean_Heidmann) had started such studies, and Maccone took over after Heidmann’s death in 2000.

To make a long story short, on June 10, 2010, this author made a presentation in front of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) in Vienna. His presentation was of course archived.
That presentation’s goal was to ask the United Nations to *legally protect* a circular piece of land on the Moon Farside centered around the Antipode (the point opposite to the Earth at the Farside center). The word “protect” means here to reserve that “Protected Antipode Circle (PAC)” for use by scientists only, especially radio astronomers, forbidding any other non-scientific activity by realtors, industry, tourists and the military. A neat description of this project was recently re-published in Maccone, 2019, ref. [5] and will not be repeated here. However, our readers are strongly advised to read that paper carefully, just to know the reasons why they and the International Astronomical Union (IAU) in particular, should support this author’s project before it gets too late. Thanks.

One might naïvely expect that, after such an official presentation at the United nations, something should have happened towards the Moon Farside’s protection, either at the political level or the scientific level, or at both. But you are to be disappointed: nothing happened at all for the next five years after 2010. Why?

Because no national “big” space agency, nor any private entrepreneur, had the technological capability of sending a spacecraft to the Moon Farside before until about 2015, actually until 2018, as it did happen. The International Astronomical Union should have been the #1 promoter of the Farside Protection but that large international institution didn’t care either, or was just unaware even of the urgency of this issue: they love too much topics like “dark matter”, or what will happen when the Andromeda Galaxy collides with the Milky Way in just about 3 billion years, and similar “learned topics”. So, the IAU astronomers didn’t “get down” to legal-scientific topics like the Moon Farside Protection.

The situation started to change only in the summer of 2015, when the new Director General of ESA, Prof. Jan Woerner, began his term. Woerner declares himself to be a civil engineer, very much interested in building a Moon Village possibly on the Farside, though the Moon Village location was not specified yet.

Next, a host of eager “Moon bases constructors” established the Moon Village Association (November 2017).

But nobody cared to ask to reserve the central part of the Farside, specifically crater Daedalus, for usage by radio astronomers only. This author’s voice was a voice in the desert, once again.
The need to keep the Farside of the Moon free from human-made RFI (Radio Frequency Interference) has long been discussed by the international scientific community. In particular, in 2005 this author reported to the IAA (International Academy of Astronautics) the results of an IAA “Cosmic Study” that had been started back in 1994 by the late French radio astronomer Jean Heidmann (1923-2000) and had been completed by this author after Heidmann’s death (see, for instance, Maccone, 2003 and 2005).

The center of the Farside, specifically crater Daedalus, is ideal to set up a future radio telescope (or a phased array) to detect radio waves of all kinds that it is impossible to detect on Earth because of the ever-growing RFI.

Nobody, however, seems to have established a precise border for the circular region around the Antipode of the Earth (i.e. zero latitude and 180 deg longitude both East and West) that should be protected from wild human exploitation when several nations will have reached the capability of easy travel to the Moon.

We now describe the PAC, the Protected Antipode Circle. This is a large circular piece of land about 1820 km in diameter, centered around the Antipode of the Earth on the Farside. The same Circle is also defined by spanning an angle of 30 degrees at the Moon center along the Earth-Moon axis in all directions reaching the Farside, and so also in longitude and in latitude. In other words still, the PAC spans a total angle of 60 deg at the cone vertex right at the center of the Moon. There are three sound scientific reasons for defining PAC this way:

1) PAC is the only area of the Farside that will never be reached by the radiation emitted by future human space bases located at both the L4 and L5 Lagrangian points of the Earth-Moon system (the geometric proof of this fact is trivial);

2) PAC is the most shielded area of the Farside, with an expected attenuation of man-made RFI ranging from 15 to 100 dB or higher;

3) PAC does not overlap with other areas of interest to human activity except for a minor common area with the Aitken Basin, the southern depression supposed to have been created 3.8 billion years ago during the “big wham” between the Earth and the Moon and supposed to possibly contain some frozen water.

Figure 3 shows a photo of the Farside of the Moon, the two parallels at plus and minus 30 degrees drawn by solid red lines, and PAC, the Protected Antipode Circle, shown as the red, solid circle centered at the Antipode and tangent to the above two parallels at plus and minus 30 deg. In view of these unique features, we propose PAC to be officially recognized by the United Nations as an INTERNATIONALLY and LEGALLY PROTECTED AREA, where no radio contamination by humans will possibly take place now and in the future, for the benefit of scientists of all Humankind.
Figure 5. PAC, the Protected Antipode Circle, is the circular piece of land (1820 km in diameter along the Moon surface) that we propose to be reserved for scientific purposes only on the Farside of the Moon. At the center of PAC is the Antipode of the Earth (on the equator and at 180 degrees in longitude) and, near to the Antipode, is crater Daedalus, an 80 km crater proposed by the author in 2005 as the best location for the future Lunar Farside Radio Telescope. Inside Daedalus, the expected attenuation of the man-made RFI (Radio Frequency Interference) coming from the Earth is in the order of 100 dB or higher.

In order to detect radio signals of all kinds, as radio astronomers do, it is mandatory to firstly reject all man-made RFI (Radio Frequency Interference). But RFI is produced in ever increasing amounts by the technological growth of civilization on Earth, and has now reached the point where large bands of the spectrum are blinded by legal or illegal transmitters of all kinds.

Since the 1980s, the late French radio astronomer Jean Heidmann (1923-2000) pointed out that Radio astronomy from the surface of the Earth is doomed to die in a few decades if uncontrolled growth of RFI continues. Heidmann also made it clear, however, that advances in modern space technology could bring Radio astronomy to a new life, was Radio astronomy done from the Farside of the Moon, obviously shielded by the Moon spherical body from all RFI produced on Earth. Since the mid 1980s Heidmann was already referring to the ITU (International Telecommunications Union) documents in this regard, for example, the document ITU-R RA.479-5 of 1974 and updated in 1979. The meaning of Article S22 if this ITU document is shown hereafter in Figure 6.
Figure 6. The area of the Farside covered by the ITU 1974 Article S22 is nearly the whole of the Farside, and so it is a much larger than the PAC proposed by this author at the United Nations COPUOS on June 10, 2010, for legal protection against electromagnetic emissions of all kinds. Yet nobody cared in the years before 2015 because nobody cared about sending spacecrafts to the Moon Farside. This picture changed suddenly in 2015 when the new Director General of ESA, Jan Woerner, started advocating the creation of a Moon Village, though where it should be built is unclear up to now (September 2019). Even more, the picture changed in 2018, when China sent a few spacecraft to explore the Farside and a Relay satellite (Queqiao) at the Lagrangian point L2, about 65,000 km above the Moon and along on the Earth-Moon axis, necessary to keep the radio link between the Earth and the spacecrafts exploring the Farside.

WU WEIREN AND THE CHINESE DELEGATION.

After Maccone, the Chinese Delegation (about 20 persons) kept the floor, led by Dr. Wu Weiren, who spoke Chinese only. His young co-workers immediately translated his speech into English. Weiren described in much detail what is summarized in this Report in Figures 1 and 2, and will not be repeated here.

SIEMION and the SETI utilization of the Farside in the future, if legally PROTECTED.

Dr. Andrew Siemion, website https://en.wikipedia.org/wiki/Andrew_Siemion, Director of the Berkeley SETI Program, spoke next. He pointed out the SETI utilization of the Farside in the future, if legally PROTECTED.
After the coffee-break, the Chinese Delegation left the room, and only two more Speakers gave talks at the Symposium.

**REIBALDI**

Giuseppe Reibaldi is the President of the Moon Village Association (MVA), as per the website https://moonvillageassociation.org/team/mva-board-of-directors/giuseppe-reibaldi/

He made a presentation about the Moon Village Association activity, but not about the need to reserve a part of the Farside for an Astronomical Observatory.

**FOING**

Bernard Foing is a French scientist at the European Space Agency (ESA), Executive Director of the International Lunar Exploration Working Group (ILEWG) and was Principal Project Scientist for SMART-1, the first European mission to the Moon. Website https://en.wikipedia.org/wiki/Bernard_Foing

He made a presentation about the activity of the International Lunar Exploration Working Group (ILEWG), but not about the need to reserve a part of the Farside for an Astronomical Observatory.

After that, having the Chinese Delegation left at the time of the Coffe-Break already, it was felt that no picture could be taken because of the Chinese absence, and Maccone declared the Symposium ended.

This report was written in Turin (Torino), Italy, on September 9, 2019.

Claudio Maccone