

ON A POSSIBLE FUTURE NATIONAL RADIO ASTRONOMY FACILITY

June 2015

In the general context of the creation of a Space Centre in Hoa Lac, near Ha Noi, the Department of Astrophysics (DAP) of the Viet Nam National Satellite Centre (VNSC) was asked to study possible radio telescope installations that Viet Nam might wish to acquire in the near future. An interim draft report was presented to the VNSC Directorate on May 7th and positively received. We recall briefly below the main points that were raised. On reception of the interim report, the VNSC Directorate asked the DAP to prepare a detailed report covering the period 2017 to 2020, which is the subject of the present text.

1. Brief reminder of the main issues raised in the interim report

A responsible approach implies the preliminary growth of the community of potential users, which must be the priority in the first three years or so. The support received during this period will be determinant in defining the next step. In particular, the Vietnamese research community needs adequate support to have access to frontline international facilities. The aim is to federate and train the user community and to foster its growth and ability to perform excellent research that can strengthen the position of the country on the international scene and accelerate the development and progress of high tech industry and R&D.

Astrophysics is today the most dynamic branch of natural sciences, gathering scientists from many other fields at the frontline of fundamental research. Convincing arguments must be given to science policy deciders and dynamic outreach initiatives must attract the interest of the public. A clear separation between the latter, resting in priority on TV programmes of quality, planetariums, science exhibitions and events, small optical telescopes, etc..., and frontline research, which is the object of the present report, must be clearly drawn. From the experience of successful Asian astrophysics communities (China, Japan, Korea and Taiwan) centralization of resources and coordination is a condition of success. It implies a spirit of partnership, with the association of universities with the project, and a spirit of service in an environment that brings together science and technology.

The regional context is an essential parameter and advice and support must be sought from foreign scientists having experience as well as informed and educated views on the issues of relevance. The astrophysics communities in the region have explicitly expressed their support for the progress of astrophysics in Vietnam and offered their help to plead the case with our authorities. An international advisory committee should be set up to help, support and monitor progress.

2. The four-year plan (2017-2020)

In the wake of the interim report and of the comments it triggered from the VNSC Directorate, we list below the main points that have been retained for the period 2017-2020. They include support to DAP for training abroad (mostly in Asia), including schools, conferences and short visits to astrophysics research teams; support for VNSC to foster new talents in modern electronics, with emphasis on millimetre wavelengths; support to two or three foreign astrophysicists to travel to Ha Noi once a year and take part in the meeting of the advisory committee; support to fund and coordinate a network of half a dozen or so small radio telescopes used to train students all over the country.

2.1 DAP training

In the period being considered, we would expect each team member to take part in an average of two to three schools and/or conferences per year. Counting 1'300 USD per event, this totals a yearly amount of ~20'000 USD. However, we shall continue, as in the past, to benefit from financial support from foreign conference and school organizers as well as from NAFOSTED, which will cover typically half of the total sum. We therefore retain a yearly sum of 10'000 USD for this entry. In addition, as is presently the case, some team members will spend short periods of time abroad in order to work together with their foreign collaborators. The current agreement between the French CNRS and VAST should cover part of such stays when in Paris. Similar arrangements will help covering other stays abroad. On average, we estimate a yearly total of 10'000 USD that remain to be covered by the present project.

The presence of Viet Nam on the international scene, in particular through its participation in the International Astronomical Union (IAU), is an essential element of success. However, as the latter is covered by the Vietnamese Astronomy Society, we do not include the yearly IAU fee in the present project: it should belong to another entry of the science budget of Viet Nam.

Moreover, we expect the DAP staff to steadily increase buy one member each year. However, the cost incurred by such increase are not, and should not be, included in the present project.

2.2 Millimeter wave technology

We have discussed with Vu Viet Phuong the possibility to support a small project aiming at the construction of a 100 or so GHz receiver. The main idea behind such a project would be to develop in VNSC skills in modern millimeter wave electronics. While the manpower manning such a project would not belong to our department, we would give it full scientific support and consider therefore that it should be included in the present project. We estimate a yearly sum of xx USD covering both manpower and material resources required for the project to be successfully operated.

2.3 Advisory Committee

We attach much importance to the constitution of a small Advisory Committee that would help us progress in our development. We think typically to two to three Vietnamese members and as

many foreign members. The yearly meeting of the Committee would be scheduled in such a way as to take maximal advantage of the presence in Viet Nam, or nearby, of some of the foreign members. We believe that a total yearly amount of 5'000 USD should be sufficient to cover the expenses incurred by the Committee.

2.4 A SRT network

We recall that the idea is to equip a few universities and/or institutes across the country with small 2.6 m diameter radio telescopes tuned on the 21 cm hydrogen line and to organize communication and exchange of experience between them. To be successful, such a project must be manned by motivated and competent scientists and engineers. In the present Vietnamese situation, we expect to find such people in the radio and communication departments. While the radio telescopes would remain the property of VNSC, their maintenance and operation would be fully delegated to them. Preliminary contacts have shown that we can easily find half-a-dozen of such partners across the country. This project would give a major boost to the interest for radio astronomy and more generally astrophysics in Viet Nam. The cost implied covers the acquisition of the telescopes and a small running budget for the animation of the network (with a yearly meeting somewhere in the country). The former amounts to ~7'000 USD per telescope, namely 42'000 USD in total. As different parts need to be purchased in the United States from different manufacturers, we contacted the company from which we acquired our own radio telescope, who agreed to do the work for us and ship the whole set of instruments in a single package, which would greatly ease the logistics and the custom formalities. We allocated an amount of ~3'000 USD for this work, totalling 45'000 USD for the material costs. The running budget necessary to keep the network alive should not exceed 2'000 USD as we expect each member to contribute his part.

2.5 Using existing communication antennas

Experience exists in the world of radio astronomers having used large communication antennas for radio astronomy research at decimetre wavelengths. We are presently in contact with someone having such experience in Japan to learn what kind of work can be done. From a preliminary exploration of existing Vietnamese communication antennas not being too heavily used and possibly offering idle observation time, we spotted large (up to 12 m diameter) Vinasat antennas in the South (Binh Duong) being kept as spares in case of failure of the main antennas. We are pursuing this exploration and study how to take advantage of their existence. For the time being, we do not allocate any specific sum, possible expenditures would be included under 2.2.

3. Conclusion

The amount of resources requested for the implementation of the present project are summarized in the table below. It sums up to a yearly amount of (27+xx)'000 USD and a total of (153+4xx)'000 USD over the four years. In principle, all items could start being operational in 2016 and an early implementation of the project would be very valuable and a strong element of success.

<i>Item</i>	<i>Yearly amount (USD)</i>	<i>Capital investment</i>
<i>Schools and conferences</i>	<i>10'000</i>	<i>-</i>
<i>Short stays abroad</i>	<i>10'000</i>	<i>-</i>
<i>Millimeter wave technology</i>	<i>xx'000</i>	<i>-</i>
<i>Advisory committee</i>	<i>5'000</i>	<i>-</i>
<i>SRT network</i>	<i>2'000</i>	<i>-</i>
<i>SRT instruments</i>	<i>-</i>	<i>45'000</i>
<i>Total over four years</i>	<i>(108+4xx)'000</i>	<i>45'000</i>

If properly implemented, the above recommendations will help preparing the ground for planning the construction of a national radio telescope. As we see it today, the best candidate instrument would be a 20 m diameter antenna installed in Hoa Lac or in the immediate neighbourhood and equipped with receivers reaching down to centimetre wave length making possible its inclusion in a very long base line international network. By then, the community of potential users should have grown to fifty or so and it would then be possible to put together a small team having the responsibility of the design, construction, exploitation and maintenance of the national facility. By then, the National Space Centre should have taken shape and provide an ideal framework to centralize coordination and resources. By then, several members of the Vietnamese astrophysics community would have acquired experience with the operation and exploitation of similar instruments in East and South-east Asian countries. By then, finally, the community would have gained experience and coherence, would have acquired new skills in microwave technology and would have established itself more firmly on the international scene.

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