

Protocol of
“Herouni Mirror Telescope’s Advisory Group” meeting

Participants: as mentioned (list below)

Date: **09 Dec 2020**

Meeting place: Zoom platform

Discussion format: report / Q&A

Discussed questions:

1. **Introduction by Arevik Sargsyan about test No2**
2. **Results of the test:** Suren Eyrarmjyan shows the system and describes the results
3. **Q&A and Comments by the AG**
4. **Next steps and other to-dos**
5. **Sum-up by Arevik Sargsyan**

Participants:

	Name	Institute	Expertise
1.	Uwe Bach	MPIFR, DE	Effelsberg VLBI friend and EVN TOG chair
2.	Kees van't Klooster	ESA/ESTEC- retired	Radio telescopes and antennas
3.	Leonid Gurvits	JIVE, NL	JIVE representative, space science and radio astronomy
4.	Harro Verkouter	JIVE, NL	VLBI digital instrumentation and data engineering
5.	John Sarkissian	CASS (Parkes Observatory), AU	Radio telescope operation and development
6.	Arevik Sargsyan	HUSC, AM	Antenna engineering
7.	Suren Eyrarmjyan	HUSC, AM	Antenna engineering
8.	Karine Darbinyan	JAF, HUSC, AM	Responsible for the project, operational management

1. Introduction by Arevik Sargsyan about test No2

Intro: It is well known that the current situation in Armenia is not stable [after the war during Sep-Nov 2020], but the JAF already met with the newly appointed Minister of Economy [Mr. Vahan Kerobyan] and got his preliminary support for the HUSC project and on establishing the new entity.

On test No2: as agreed by the AG, we decided to try to point out some radio-sources. As one axis of the ROT is melted/broken, we tried to move antenna's pendulum, change the position of the declination by hand, but it was a sad mistake - North-South axis can be rotated, but it can't rotate the pendulum on declination way, on West-East. We found it there, while starting to move the antenna.

(Video of the test is turned on)

As you can see, here we try to find the real position. Because of the Cardan system, we have two coordinates: one - the declination, South-North, and the West-East. During measurements we turned the antenna to 0 degrees of East-West, which means that the pendulum is on the meridian, but we had the angle between zenith and pendulum axis = 1.5 degrees and we can't move that now. Our team and the professional team with alpinist equipment climbed up and tried to move the motor. The climbing way to the pendulum is via the east leg. On the east leg we have a little bridge for making any performances. Equipment was placed here, on that bridge. Once climbed, the team opened the motor, the one of the South-North axis, and changed the position of the pendulum directly to the meridian point. Suren Eyranyan recorded by the spectrum analyzer directly from the bridge, with a start at around 14:00.

Sources have been chosen thanks to John Sarkissian's help, who preliminary provided Arevik Sargsyan with a list of sources which are available on our declination and which might be interesting on 4.5 GHz. Using time calculators, we have chosen a number of potential sources. Here Suren and we are deciding the time when sky will pass through our pattern. And finally I show [by the application] that we have just passed Cygnus constellation from the Zenith, we tried to fix Cygnus A and Cygnus X and maybe the North America Nebula.

(presentation of the table of the chosen sources)

We were ready to record, but it was not possible to do with the ones in colored lines. Line4 is the hazard in Hercules constellation, Line5 - Cygnus A and Line8 - Cygnus X, Line10 - Nebula, as well as because of the time (it became dark) it was not possible to record BL Lacertae, Line6. We were obliged to finish at 17:30.

The latitude of ROT-54/2.6 was +40.350805, +40:21, the current position was +38.85, +38:51.

2. Results of the test: Suren Eyranyan shows the software and describes the results

Last time the logging was with a narrow-band signal. Per your suggestion and recommendation, this time we have decided to log around 300 MHz band with, with center frequency 3.5 MHz. We were logging power-spectrum density, to be able to see the power in 1 Hz band along with 300 MHz entire band. It is visible in the waterfall diagram that we registered a few changes. We have done several types of processing's on 3D frequency intensity.

The logging started at 13:30 and locked at 17:20. We are not sure we got the right results and we

need your comments on it. On the place we didn't log the self-noise of the receiver, so why I repeated the experiment later at the laboratory environment, where I closed the RF-inputs in the receiver, with the much load, 500 on, and logged data for 2 hours (just enough to compare with another measurement that we have done). These results are pretty much flatter, mean value of this curve, spikes and changes are more or less flat - previously we had changes in wider range, relatively wider as values still are very small for single hertz band.

We would like to discuss with you to find out if there are results and we have noises from the space or it is just records of the receiver's self-noises. There are 3 time zones where we expect to see some signals. The similar spikes are recorded for different time zones. The interesting thing is that all these spikes are very close to each other. If we put some standard level, the average duration of the spike and its pick are around 1-1.5 minutes. It is the only common thing we see in picks.

3. Q&A and Comments by the AG

- **Uwe Bach:** 1.5 minutes it's 15 arc seconds per second, so it will be something like 22 arc minutes one and a half-minute, 3 times 7 arc minute beam. Pattern of the antenna is wider.
- **Uwe Bach:** What was interesting to me is that you said that around 16:30 it was the Cygnus region and we had for half an hour which is a long bump. Actually the Cygnus region is also the galactic background. It could be really off-set just from the Cygnus region passing by. This is a really long thread.
- **John Sarkissian:** Zoom the picks starting from 16:07 till 16:27, because we might see the rise starting there. **Suren Eyrarmjyan:** This was also a question for us - why is there a power-down here and we have a relatively huge dump here, after which we again start seeing the rising. This is numb for us, we can't understand for sure what is the reason for the thing that happens here.
- **John Sarkissian:** From 16:00 to 16:14 looks very regular to me. What is the RFI environment there? **Arevik Sargsyan:** Good. **Suren Eyrarmjyan:** There is no signal around, it's quite RF-clean territory.
- **Kees Van't Klooster:** The RFI use per definition is low, because of the pattern property of this antenna, it's screened by the metallic.
- **John Sarkissian:** And can we repeat it? **Arevik Sargsyan:** Yes. **Harro Verkouter:** On the next day the same pattern should be shifted by 4 minutes and repeated.
- **Harro Verkouter:** How easy is it to make a test like this? Is it quick to arrange? **Suren Eyrarmjyan:** Yes, it is. And currently I'm working on modernisation of the software (to do the powering band measurement or to start to log just the power and not the spectrum to do the logging). Now I'm doing some experiments here, but have a need to get an agreement from the Government, which is not so difficult.
- **John Sarkissian:** How stable is the position? Does it need to be assigned the position? You want to minimise the minimum of variables of change in the observation and shift the position? **Arevik Sargsyan:** No shifting, now we know the position exactly, the pendulum is stable enough. Next tests might be done keeping in mind that nothing changed in the axis position.
- **Kees Van't Klooster:** Is it very different from Zenith? **Arevik Sargsyan:** Yes, one and a half degrees to the South, with zero on Azimuth.

4. Next steps and other to-dos

Suren Eyrarnjyan: Whether it's right to have measurements for smaller period of time, like for several of hours, my assumption is maybe it will be better to measure during 24 hours or even during a couple of days, then we will be able to see any similarities, and that might give us more precise understanding whether it is a random noise that we recorded or that we expected. **Uwe Bach:** You have an interesting recording around Cygnus, and I think it would be enough to record during 2 different days during one and a half hour passing through Cygnus region, with 8 minutes shift, and if you can compare this, you don't need to spend 5 hours at the telescope. **Leonid Gurvits:** Yes, repeatability day after day is very important. **Arevik Sargsyan:** It is impossible to have a 2-days comparison, because it was done on 3rd December and it is not so good weather now. **Leonid Gurvits:** That's ok, it's not necessary to adjust at base. If you do it at the same sidereal time, just overlap a one-day record, say - 2 hours, then at the same sidereal time do it later. **Arevik Sargsyan:** We will organize it in a few days, ok.

Suren Eyrarnjyan: I try to find a better, calibrated receiver whose measured results will be undoubtable for us, with a low sensitivity. The values of the sources presented in the shown table are very low, that's why I'm not sure whether we saw those signals. If it was the Milky Way, then maybe yes. But the levels mentioned at the table are too small and, as Arevik Sargsyan mentioned, if we calculate the power in these results in volts and change it to Jansky, it'll become something like megaJansky's - too much. This is why we have to understand if we may find a more intensive source with higher levels, try to log it's signal, then we will be closer to a successful measurement. **Uwe Bach:** I wouldn't change too much now for the next measurement, better to use the same set-up. If you have a chance to repeat next week, which makes it 10-12 later, record at 15:00-16:30, you should see the same behavior again. If not, it was probably the weather, or the receiver, or other uninteresting source.

John Sarkissian: Can you do more statistical analysis? You have a 2-hour lamp measurement, make a stat analysis from that and compare it with the same stat analysis of the receiver sector to see if they are stat-ly different. That will already show you if the telescope is doing something. **Uwe Bach:** You can look at RMS and the amount of fluctuations. If the weather is quite stable at 5Gh, you shouldn't see too much variation because of the capacity changes or something.

Suren Eyrarnjyan: The saw changes inside the spectrum. **John Sarkissian:** At the next measurement, if you want to make sure, you might be able to point a web-cam upstairs at the telescope, cover the cloud-coverage and see if it correlates with that. **Suren Eyrarnjyan:** At least, we can visually control that.

Kees Van't Klooster: Can you check the input impedance of the patch antenna? Because microstrip patch antennas are sometimes famous for the very narrow band input impedance.

5. Sum-up by Arevik Sargsyan

- We should repeat the same observation for some 2 more hours passing again Cygnus
- and compare the results of those curves with the new ones and see if there is any time-shift at some angle.