NORDIC OPTICAL TELESCOPE

MEMO

Sta Cruz de La Palma, November 17, 2006

From : Thomas Augusteijn
Subject : How much service observing we can do?

---

1 Introduction

In the last Council meeting it was requested that we look at realistic options for increasing the use of service observing as suggested by the evaluation panel.

From an operational point of view the main question in that respect is the amount of astronomy effort that is available to do service observing. For this purpose I have made an overall estimate of the amount of time needed for the different tasks to determine the amount of nights that we can do service observing with the current supplement of staff astronomers and students.

The calculations described below are presented in such a way that it should be relatively easy to estimate the effect of, e.g., increasing the number of students or the fraction of time they spend on duties, or increase the typical length (i.e., limit the number) of observing runs, etc., on the amount of service observing.

The SOFIN nights done in service mode by Dr. Ilya Ilyin are not considered here.

2 Considerations

The main aim of this exercise is to make a rough, but reasonable estimate of the maximum amount of service observing we might do without very significantly effecting operations due to lack of maintenance etc. Specifically, I want to make a truly fair estimate, and push things to the maximum without making any unreasonable assumptions. In the end the estimate should be defendable and we should also be able to actually implement the estimated amount of service observing if it is decided to do so.

For the service observing I specifically look at the staff effort needed to be at the telescope and execute the service observing. This assumes that there is relatively little additional effort needed to obtain and process the information from the PIs of the proposals, plus

collecting and distributing the data and details of the observations to the PIs, which would not be needed for a regular observing or technical night. Specifically, the idea is that this is provided via the 'Service Observing System' through the OBs and Observing Scripts which would need significant improvement if the amount of (queue) service observing is increased significantly, especially on the side of automatic validity and feasibility checks such that the only task is truly executing the observations.

As the precise amount of software development effort needed depends on the total amount of service observing and the way this is implemented (e.g., an expansion of the fast-track program, or full-blown queue-mode service observing of regular proposals) this is not specifically included in the considerations here. It should also be realized that at least for extensive queue-mode service observing in a (more or less) optimal way you need to overfill the queue by a large amount (3 is a commonly accepted number) to be sure that you do not run out of targets in any specific seeing, Moon, weather or RA range.

The values for the different parameters given below, especially those related to the amount of effort available and required, have been discussed in detail with the staff and present a general consensus. Specifically, we do not expect any of these numbers to be far removed from the true values and the result should be fairly accurate.

3 Definitions/input

- FTE (Full Time Equivalent): One year corresponds to 220 working days, i.e., the number of week days in a year minus the public holidays (∼12 a year), minus regular holidays (∼30 a year depending on age).

  $$FTE = 220 \text{ days}$$

- Compensation time: The NOT does not pay overtime or night time work, but people are compensated in time. Simply speaking, staying overnight at the observatory is compensated with one day off. This is to compensate for the typical longer working hours and for having to stay overnight. Effectively this means a night at the telescope corresponds to 12 working hours with 4 hours of compensation.

- Astronomy support night: In this case, the support astronomer will spend the night on the mountain, where s/he typically is at the telescope until midnight and is on-call the rest of the night. In principle, a day including a night on the mountain is counted as 2 working days to account for the extended work hours and the need to stay over-night on the mountain and be on-call. On the other hand, some time during these days are left for other tasks and we estimate the equivalent effort for 1 support night to 15 hr = 1.875 working days.

  $$A_{sup} = 1.875 \text{ days}$$

  The detailed estimate is as follows:

```
travel                          3 hours
setup/mounting/morning tasks    2 hours
introduction                    6 hours (2 afternoon, 4 at night)
compensation                    4 hours

total                          15 hours
```

The amount of astronomy support nights depend on the number of observing runs, or equivalent the total number of available nights divided by the average length of observing runs. As shown in the latest reports to the STC the average length of observing runs is 3 nights.

$$L_{obs} = 3 \text{ night/run}$$

- Technical or Service night: In this case, the support astronomer will spend the whole night at the telescope and the few hours in the day time are needed to prepare for the night. Here staying a day including a night on the mountain is counted as 18 hr = 2.25 working days, which in this case are fully spend on astronomical support.

  $$A_{tech/ser} = 2.25 \text{ days}$$

  The detailed estimate is as follows:

```
travel                          3 hours
setup/mounting/preparation      2 hours
observing                       7 hours (corrected for weather)
flat fielding and such          2 hours
compensation                    4 hours

total                          18 hours
```

  There are a significant number of technical nights (needed) each year to do tests (part 'planned' as part of calibration plans, part new things/problems as they arise). On average we have about 50 technical nights a year.

  $$N_{tech} = 50 \text{ nights}$$

- Astronomy staff: They have 50% of their time for research and 50% of their time they should spend on duty tasks. We estimate that at least 50% of their duty time (i.e., 25% of the total time) is needed for regular 'maintenance' tasks (tests, calibration plans, technical assessments of proposals, answering queries, etc), which leaves at most 25% of their time for regular support nights and to do service observing.

  $$\alpha_{staff} = 0.25$$

There are current 4 staff astronomers at the NOT.

$$N_{staff} = 4$$

- Student staff: They should spend 25% of their time on duty tasks. Here I will assume that they will spend all that time on support nights and service observing, i.e., no other duty related tasks.

  $$\alpha_{stud} = 0.25$$

  We currently have typically 4 astronomy students at the NOT.

  $$N_{stud} = 4$$

- Student training: For this a student will have to spend a few nights at the telescope with one of the staff astronomers or an experienced student at the telescope. As a minimum a service observers will have to learn spectroscopy and imaging with either ALFOSC or NOTCam, and the use of FIES and StanCam. They also would have to be trained in using the telescope and doing the service observing (i.e. using the system to select and execute observations). In principle all these things can be trained more or less together but a proper indepth knowledge is needed before anybody can be expected to do service observing at a proper level and we estimate that 5 full nights of technical or service observing is needed to be properly trained. In general, students stay one full year at the NOT, so this number is nights per student per year.

  $$N_{train} = 5 \text{ nights/student}$$

4 Calculation

The total amount of effort available for service and technical nights is related to the number of available staff and students and the fraction of their time they spend on this. From the above considerations the currently available effort is

Available effort from staff	$N_{staff} \times \alpha_{staff} \times FTE = 4 \times 0.25 \times 220 = 220$
Available effort from students	$N_{stud} \times \alpha_{stud} \times FTE = 4 \times 0.25 \times 220 = 220$
Effort needed for technical nights	$N_{tech} \times A_{tech/ser} = 55 \times 2.25 = 113$
Effort needed for training nights	$N_{stud} \times N_{train} \times A_{tech/ser} = 4 \times 5 \times 2.25 = 45$

The resulting available effort for support and service is

$$(N_{staff} \times \alpha_{staff} + N_{stud} \times \alpha_{stud}) \times FTE - (N_{tech} + N_{stud} \times N_{train}) \times A_{tech/ser} =$$

$$= 220 + 220 - 112.5 - 45 = E_{avail} = 283$$

Assuming a given number of technical nights (with the corresponding requirements in effort) the remaining nights can either be service nights or regular observing run nights. The total effort in either doing a service night or a astronomical support night is:

Service nights $N_{ser} \times 2.25$

Astronomical support nights $[(365 - N_{tech} - N_{ser})/L_{obs}] \times 1.875$

Equating the total available effort to the required effort for service and support nights it follows directly how many service nights we can support per year.

$$N_{ser} \times 2.25 + [(365 - N_{tech} - N_{ser})/L_{obs}] \times 1.875 = E_{avail} \Leftrightarrow$$

$$N_{ser} \times 2.25 + [(365 - 50 - N_{ser})/3] \times 1.875 = 282.5 \Leftrightarrow$$

$$(2.25 - 1.875/3) \times N_{ser} = 282.5 - 315 \times 1.875/3 \Leftrightarrow$$

$$N_{ser} = (282.5 - 196.875)/(2.25 - 0.625) = 53$$

The remaining number of regular observing nights is $N_{reg} = (365 - N_{tech} - N_{ser}) = 262$

The corresponding number of observing runs is $R_{obs} = N_{reg}/L_{obs} = 87$

Over the last 2 years we have done an average of 25 nights of service observing, so this number can be double. Note that 75% of all nights available after subtraction of technical nights are Nordic. Currently this is $N_{Nordic} = 0.75 \times (365 - N_{tech}) = 233$ nights per year. Given the above $100 \times N_{ser}/N_{Nordic} = 100 \times 53/233 = 23\%$ of these nights could be done in service mode.

This does not include the SOFIN nights done in service mode by Dr. Ilya Ilyin. Over the last 2 years he has done an average of 33 nights. Assuming this level would be maintained, a total of ∼85 nights a year, i.e., ∼35% of all Nordic time, could be done in service mode.

5 General formula

The above specific calculation has been made for the current situation but it has been set-up in such a way that a general formula can be derive which defines the number of service nights that can be supported as a function of all the different parameters involved. With the formula given below it is possible to explore the effect of different options to increase the amount of service observing. Of course, this does not say anything about the feasibility of such an option (e.g., you might increase the amount of duty for new students, but then the question is if you can still attract sufficient students).

It is easiest to break-down the calculation in two parts. In the first part we detail the available effort

$$(N_{staff} \times \alpha_{staff} + N_{stud} \times \alpha_{stud}) \times FTE - (N_{tech} + N_{stud} \times N_{train}) \times A_{tech/ser} = E_{avail}$$

and in the second part the required effort to do service and astronomical support nights

$$N_{ser} \times A_{tech/ser} + [(365 - N_{tech} - N_{ser})/L_{obs}] \times A_{sup}$$

where

N_{staff}	=	Number of astronomy staff	=	4
N_{stud}	=	Number of astronomy students	=	4
FTE	=	Full Time Equivalent (days)	=	220
α_{staff}	=	Fraction of total time for a member of the astronomy staff available for night time duty	=	0.25
α_{stud}	=	Fraction of total time for an astronomy student available for night time duty	=	0.25
$A_{tech/ser}$	=	Effort to do a night of technical or service observing (days)	=	2.25
A_{sup}	=	Equivalent effort to do a astronomical support night (days)	=	1.875
L_{obs}	=	The average length of an observing run (nights)	=	3
N_{tech}	=	Number of technical nights per year	=	50
N_{train}	=	Number of nights needed to train a student	=	5
N_{ser}	=	Number of service nights per year	=	TBD

Equating the available and required effort it follows that

$$N_{ser} \times A_{tech/ser} + [(365 - N_{tech} - N_{ser})/L_{obs}] \times A_{sup} = E_{avail} \Leftrightarrow$$

$$(A_{tech/ser} - A_{sup}/L_{obs}) \times N_{ser} = E_{avail} - A_{sup} \times (365 - N_{tech})/L_{obs} \Leftrightarrow$$

$$N_{ser} = [E_{avail} - A_{sup} \times (365 - N_{tech})/L_{obs}]/(A_{tech/ser} - A_{sup}/L_{obs})$$

6 Examples

- Increasing the average length of observing runs, with a corresponding decrease in the number of number of runs by a factor 2, i.e., from 3 nights per observing run to 6 nights per run: $L_{obs} = 6$

  Result $N_{ser} = 95$

- Increase the amount of duty for students to 50% which is all spend on night time duty: $\alpha_{stud} = 0.5 \Rightarrow E_{avail} = 502.5$

  Result $N_{ser} = 188$

- Decrease the number of technical nights. Note that there is always a need for technical nights to do tests (part 'planned' as part of calibration plans, part new things/problems as they arise). There is the possibility to combine the technical nights with the service nights where either tests or service observations are done in a flexible way. However, this will complicate things for the scheduling and distribution of time, where it should be noted that the technical nights are taken from the total number of nights before the time is separate for Nordic, Spanish and ITP proposals. To be able to do this in a transparent way will require a significant amount of software development. Here I will assume that we only need 30 technical nights a year: $N_{tech} = 30 \Rightarrow E_{avail} = 327.5$

  Result $N_{ser} = 73$