Minutes of the February 8 2012 meeting about the outcome of the 3rd run of NIKA at Pico Veleta

S. Leclercq

Participants:
Néel: AB, AM, CH, NB, AC, MC
IPAG: FXD, NP
LPSC: JMP, LP, FK
AIG Cardiff: PhM, EP
IRAM Gre: KS, SL, RZ, MR, JP, RN, AN
IRAM Gra: NB, AS, SN, CK

Minutes

The text in bold characters highlights the main items of the discussions.
The text in red bold characters highlights an important problem to be understood and solved.

KS: **We need a clear report of the run for the council**: we have to justify the use of telescope time. In the past it was not too difficult because it was 1st runs and improvements were significant. But 3-4 runs start to be a non-negligible number; the council asks for results compatible with science grade instrument allowing availability to the community in a near term future.

AM: **Description of the Oct 2011 run**
See presentation slides on: http://www.iram.fr/~leclercq/NIKA/NikaPage.html
Some elements were discussed during the presentation:

- According to its spectral analysis: the **dichroic could be used as a band-pass filter** for the 1mm band.
- **Noise level** of **1mm** array = noise level of **2mm** array, the **difference** in sensitivity is **only due to the cutoff at 1/3rd of the foreseen band-pass** of the 1mm channel due to the use of a wrong filter.
- It is not easy to cover the entire 1mm atmospheric window (~ 100 GHz bandwidth) because of impedance matching problem, but work is in progress.
- **Cause of glitches unknown**: can't be cosmics because the rate should have been at maximum 3x what we see in lab, and it shouldn't have been variable as we witnessed. These glitches can't be microphones either because of the decay time is incompatible with this hypothesis.
- **Beam broadening**: If the dichroic would have been curved this could maybe explain such an effect on the channel on the reflective path, but this is the 2mm channel and the beam broadening is more important on the 1mm channel. Many think this could be an optics problem, but SL mentioned that the **strength of the effect is incompatible with optics properties, as shown by Zemax simulations** where a ~15% effect could be explained that way, not a >100% effect. Furthermore, even with the hypothesis that this beam

variation is an effect of the distortion; RZ added that **in the center of the array the distortion is negligible, so the beam should be correct, but it is ~2 times broadened compared to the value it should have *and* compared to the values it had during run 2** which used the same optical setup. So there's something more than just an optical effect.

- Besides this effect is not seen on run 2 data whereas optics was the same. So there's **still no convincing explanation for this effect**.

FXD: **Data processing status**
See presentation slides on: http://www.iram.fr/~leclercq/NIKA/NikaPage.html
Some elements were discussed during the presentation:

- **Plateau**: AB has a **hypothesis** (**non linearity** of the acquisition chain + **crosstalk**) and plan **to test it in lab** (see effect on empty slots on the array where there's no detector, and also play with the amplifiers power).
- **Crosstalk**: from pixel to pixel near in frequency and near in position; KS to **NP: write a memo** with **number** of pixels cross-talking (~10%) and the procedure to **flag** them. Note: the crosstalk structure and population depend on the sky noise level.
- Beam distortion: eccentricity seems reproducible. **Distortion / broadening could be tested in lab**. Need ~15 days to put experiment in place.
- Relative (pixel to pixel) photometry (conversion of measured signal to Jansky): relative photometry = pixel to pixel. RZ stressed the fact that the **variation** across the FOV and between the 2 methods (**RF vs PF**) is very **problematic**. **FXD: 7% dispersion of relative photometry in 10 hours** (flux of Neptune calibrated with Mars).
- When **RZ** uses Flat Field on Mars to measure Uranus and Neptune, he **sees up to 300% variation**, depending on weather conditions.
- Absolute photometry: need more work. So far Xavier (and others) use the taumeter; FXD and PhM will redo the plots with opacity deduced from measures.
- Sky and electronic noise: spectral decorrelation (1 mm vs 2mm) works less good than special decorrelation. The reason is that the spectral decorrelation does not remove the **electronic common mode**, whereas the spatial decorrelation does it.
- Sensitivity: the numbers are based on "on sky time" (remove overheads…)

Discussion

- Problem of time sample variation: **RZ found up to 20% variation on the acquisition times for both 1mm and 2mm data, plus a different apparent synchronization of the 1mm array** (1mm data need to be corrected so that subscans forth and back are correctly aligned). Elvin send time stamps every second, but variations are not correlated in 1 sec. AB says it might be explained by something from the acquisition electronic.
- RF_dIdQ vs PF_dIdQ: it is known that **RF** is **not good with big derivative** (e.g. strong sources), but **PF should be** almost **perfect**. ➔ **We need a proof** that PF is really reliably proportional to the incoming signal, with simulated data, and lab data. Problem: it will take time to do this (~ 6 months); currently we are just at the beginning of learning how KIDs work with a tone modulation.

- **Mid-term** goal: there's a clear **need to improve the software**. This will take several months, but now we have run data that can be used to test the software.
- The 2 main **problems** from the run that absolutely need **to be addressed**:
    1. **Electronic cross-talk**
    2. **Focal plane distortion (unexpected central beams broadening)**
- **Detector cross-talk: work in progress** to minimize it by through improved design. ➔ Don't put too much effort in correcting the current cross-talk with software.
- **Plateau: need experiment in lab** to characterize it and find the best set of parameters **such that this effect disappears** while the response and sensitivity stay high (ex: changing gain, and so on).
- Distortion: grid distortion compatible with Zemax simulation (while beam broadening much bigger than predicted in Zemax). The future final optics of the prototype (to be implemented next run) will have much lower grid distortion.
- **Pointing and focus**: as warned by IRAM since the beginning (2007) high precision pointing (subsequently angular resolution and photometry accuracy) can be obtained only using the standard procedure put in place after many years of experience with the 30m telescope. That is to say: **use 1 pixel, with wobbler and excellent synchronization** to perform pointing and focus (cross-shaped scan). This is much faster and, more importantly, **independent from** any a priori knowledge of the **array geometry**. Then only when this is known we can characterize the array geometry (beam maps, etc.). As RZ explained several times this is the only way to get rid efficiently of numerous systematic and statistic uncertainties hidden at many places in the system. This was true with horned detectors, and as expected from IRAM and shown by the numerous problems seen in the data of all the past runs of all the prototypes tested (GISMO & NIKA), it stays true also for filled arrays. Main problem to solve with wobbler: synchronization.
- **Next run: early June** (exact date to be defined). **IRAM needs** from NIKA team a short **document with justifications and goal for this run** (4^{th} run is not a small number anymore, IRAM need to justify telescope use to the council)
- Future: in 2-3 months we have to be ready with a clearer organization structure for the big instrument (NIKA instrument, 6.5' FOV). E.g. MOU, reports planning, financial spending, etc.