Impact of Operations on Analysis

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WEH/BEC/MAT/AN 030913

- **Clock Jumps**
  - The Mark IV correlator does not handle arbitrary offsets
  - If sub-second portion (available from gps-fmout or fmout-gps) of the clock offset exceeds about ±30 milliseconds it must be reset.
  - If the integer second portion (available normally from "sy=run setcl &") of the clock offset exceeds about ±5 seconds it must be reset.
  - Correct as soon as possible
  - Smaller offsets should not be removed.
- **Extra Cable delay**
  - If you leave the cable extender for the cable measurement in the line by accident, don't take it out once the experiment has started unless you believe there is something wrong with the device.
  - Likewise do not make the cable measurement during the experiment. If you forget to make it beforehand, please wait until the end.
  - Phase meter must be in the middle half of the range
- **Sensitivity Effects**
  - $s \propto \frac{1}{SNR} \propto \sqrt{\frac{SEFD_1 SEFD_2}{T_{\text{int}}}} \Big/ S_c$
    - s is the precision of the observation (sigma) or how good a measurement we are making (the smaller the better)
    - $SEFD_1$ is SEFD at antenna 1 (the smaller the better)
    - $SEFD_2$ is SEFD at antenna 2 (the smaller the better)
    - SNR is the signal-to-noise ratio, or how much stronger the signal is than the noise (the larger the better)
    - T_{int} is the integration (recording time) of observation (the larger the better)
    - S_c is the correlated source flux (the larger the better)
  - The geodetic precision is roughly proportional to the average observation sigma. For example if one station's receiver is warm, that station's SEFD might typically go up by a factor of three. Then the average sigma would go up a factor of $\sqrt{3}$ or about 1.7, a station position estimate that would have been precise to about 5 mm would instead be precise to about 8.5 mm.
  - Warm receiver with SEFD 3 times normal is the same as observing 1/3 of the time
  - Target (minimum) SNR values are typically 20 at X-band, there are no fringes of SNR falls below about 7. With an SEFD 3 times normal, the target SNR becomes 11, not fatal and many observations exceed the target.
  - A warm receiver at one station usually won't destroy an experiment as is, but it may prevent fringes to a high SEFD station if it was scheduled with a lower SNR

target. For example baselines to O'Higgins are typically scheduled with a target of 15. If Hobart warms-up the SNR is reduced below 9 and the Hobart-O'Higgins baseline will be marginal at best.

- Other effects that increase SEFD
  - Pointing off by one half of a full-width-half-maximum (FWHM) drops the response of the antenna by a factor of two and so doubles the SEFD and the sigma is increased by $\sqrt{2}$
  - If the focus is off, the same rule applies, if the response is down half, the SEFD is doubled and the sigma is reduced $\sqrt{2}$
  - Power image rejection:
    - Front-end, doubles the noise level in all channels, so reduces sigma by $\sqrt{2}$ (also does bad things to phase-cal: adds spurious signals)
    - VC/BBC, doubles the noise level in that channel, so reduces the sigma by about a small amount, but is bad otherwise
- Missing channels
  - Each lost channel reduces data yield by about 7%
  - In addition it can compromise the delay resolution function, please see the accompanying write-up by Axel Nothnagel
- Phase-cal
  - Should be about 1% in power
  - Too strong reduces sensitivity and produces spurious signals
  - Phase-cal too weak spurious signals can be a problem