

Observatory Solar status update

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Band 7 was offered from Cycle-7



- First offered in Cycle 7
- No mixer detuning
- IF power above specification range
- Required modification of IFP attenuator optimisation algorithm to deal reliably with the abnormal power
- Linearity correction needed in data analysis
- Require Band 7 phase stability (hard in daytime)
- 3 projects requested Band 7 in Cycle 7, 2 out of the 3 were fully observed and passed QA0 (the third was not observed due to the lack of suitable targets)

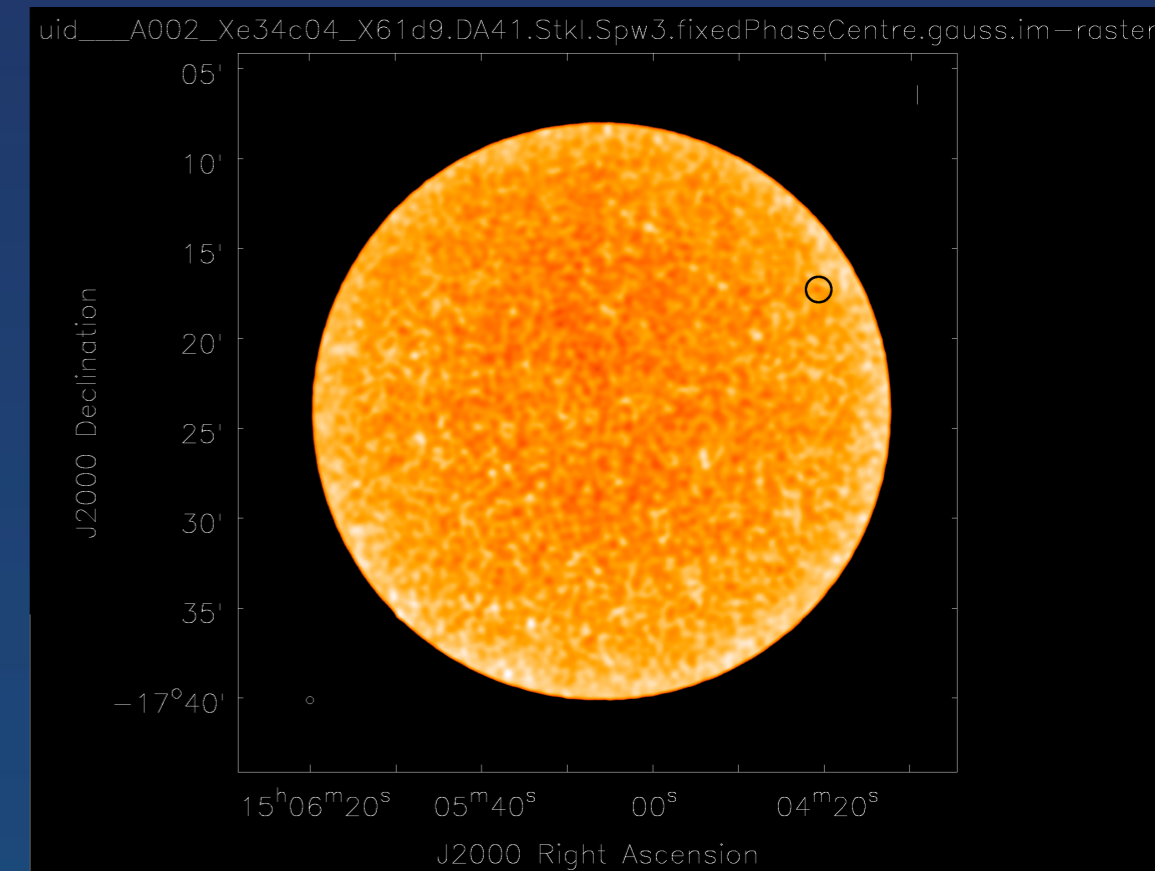


Band 5 offered for Cycle-8



- Band 5 Solar functionality has been successfully implemented and commissioned
- Mixer detuning mode for B5 receivers is a little more complex than B3/6 to get reliable results:
 - (1) Set $V_{SIS} = 2.5\text{mV}$
 - (2) Optimize LO power to get $I_{SIS} = 125\mu\text{A}$ (higher than normal)
 - (3) Set $V_{SIS} = 3.3\text{mV}$ detuned bias
 - For B5 LO power needs to be non-standard, and can't be optimised with detuned bias setting as I_{SIS} is very weakly LO power dependent there
- In future a more general/flexible detuning implementation, allowing per-receiver settings would be better
- Solar CSV team recommended tuning:
 - LO1=198 GHz => LSB: 190-194, USB: 202-206 GHz
 - Note: previous suggestion of LO1=194GHz may have given better WVR correction (183GHz line in absorption); maybe still interesting to use for testing?

- ESO is working with the EU antenna ACU vendor (Microgate) on fast scanning support
- Currently working well, to be formally delivered later this year
- Can track up to full drive acceleration limits, which is 3 times higher than PM antennas
- Can work with frequencies up to at least 3Hz, c.f. 1.6Hz for PM antennas
- For solar full disk maps, increased acceleration limit allows either $\sqrt{3}$ **shorter map durations or higher elevation limit** (83 deg for current default parameters, c.f. ~ 65 deg for PM antennas).
- For smaller regional maps could use higher frequencies
- Operational advantage of higher wind speed limit



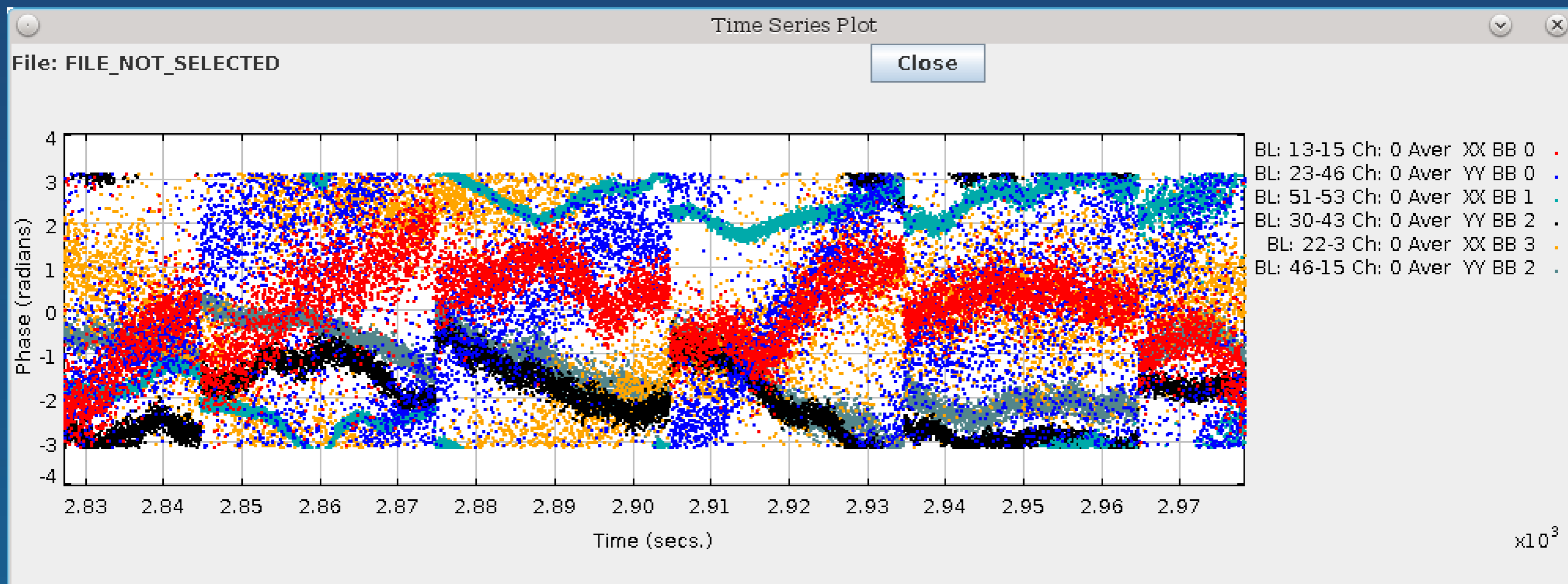


JPL Horizons ephemeris format change



- Around 2020-01-21 JPL made changes to Horizons ephemeris format
- Reported in PRTSPR-47717
- Impacted several independent ephemeris parsers in ALMA!
- Ivica Skokic quickly updated the Solar Ephemeris Genreator (26 Jan)
- Control software and OT updated for Cycle-8, backports to Cycle-7 available but adoption still under discussion (SCCB-1048)
- Currently need to modify ephemerides to old format for production OT and online environment

- During high cadence study test observation, phase steps were noticed
- An ephemeris for the barycentre was being observed
- Steps occur every 30 seconds at Delay Event boundaries
- Logs showed the delay/phase centre location was stuck during each Delay Event
- Very clear pathology aided diagnosis





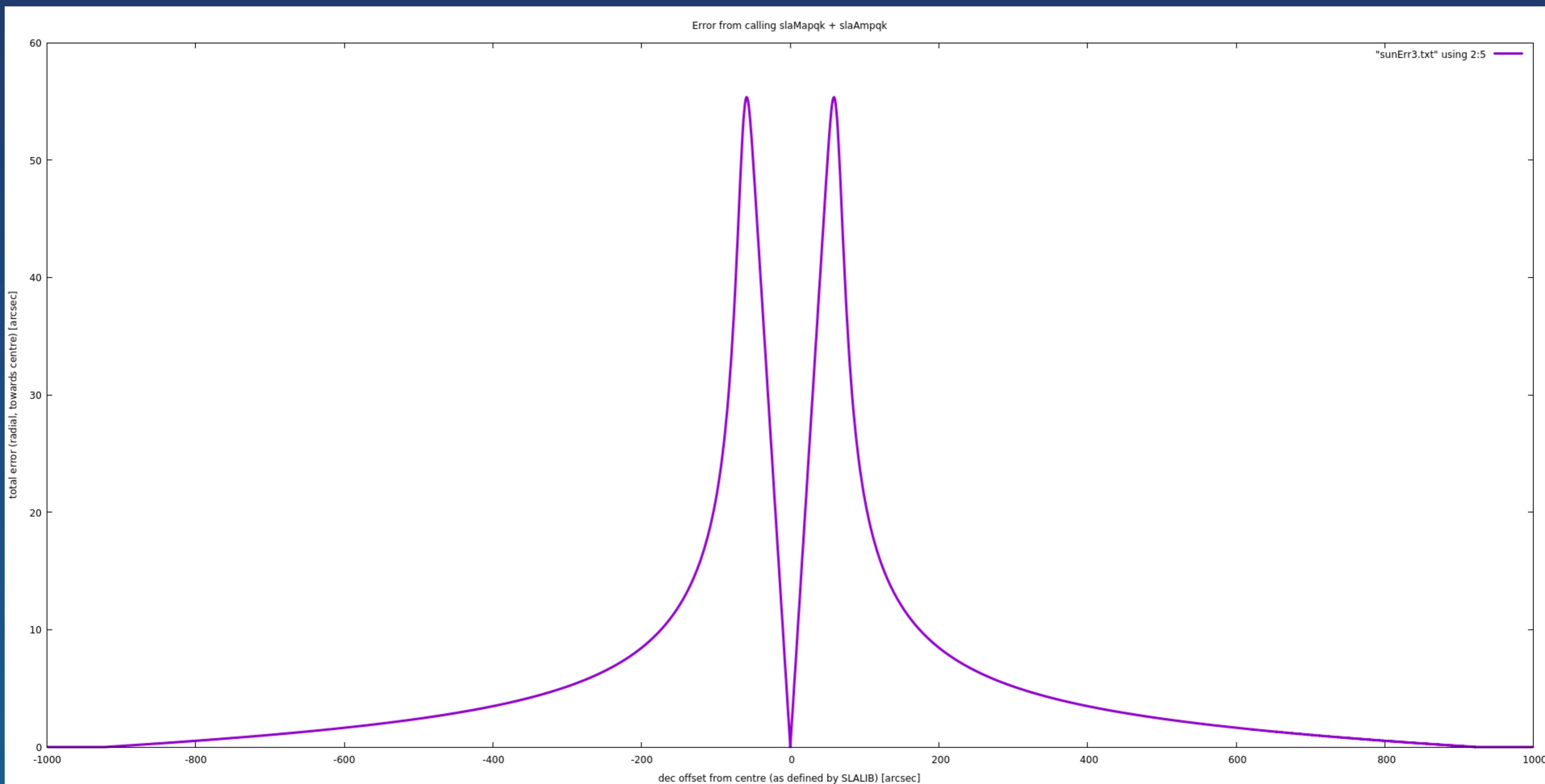
ICT-16261 cause and fixes



- Initially feared a problem disabling GR light bending correction in CALC (a previous classic issue; now disabled for Ephemeris objects)
- Turned out to be *another* GR light bending correction
- DelayServer converts RA,Dec to Az,El to apply horizon offsets, then back to RA,Dec
- Uses routines in standard SLALIB package to do this
- These apply a GR bending correction for the Sun (only)
- Seems to misbehave computationally when tracking extremely close to the exact barycentre, leading to the position freezing
- Unfortunately also a more general problem: Forward and inverse conversions behave differently within the disk of the Sun, leading to systematic astrometric error even when not at the barycentre
- For Cycle-8: skip transforms when horizon offset is zero; disable horizon offsets in the DelayServer when observing the Sun (antenna pointing is independent)

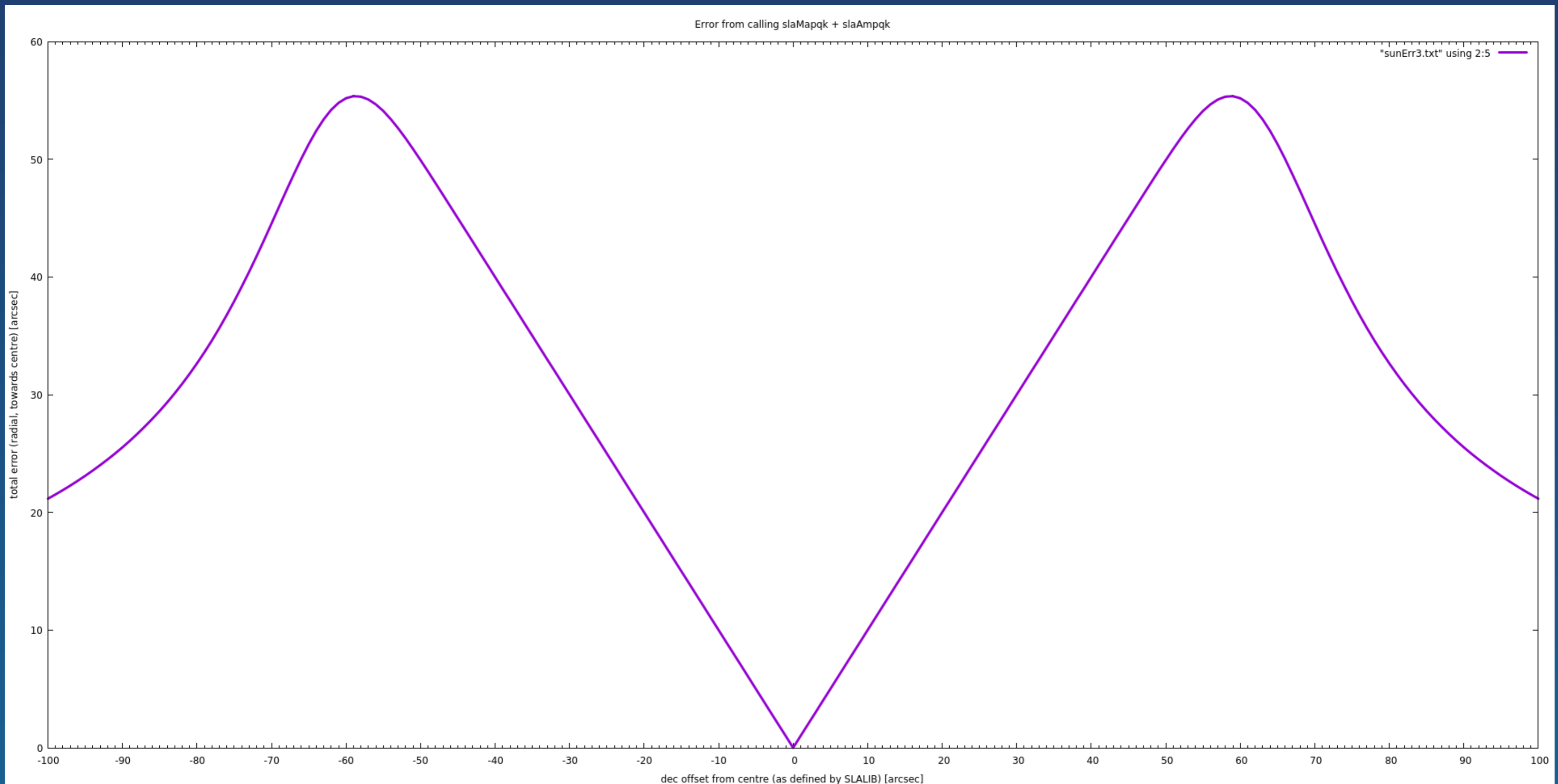


Astrometric error due to ICT-16261



Astrometric error due to ICT-16261

- Within 40'' of centre the assumed barycentre position is returned exactly, so radial error is equal to the input radial distance
- Phase steps are due to this, as assumed barycentre only updated once per delay event, so returned position is static within each 30s event

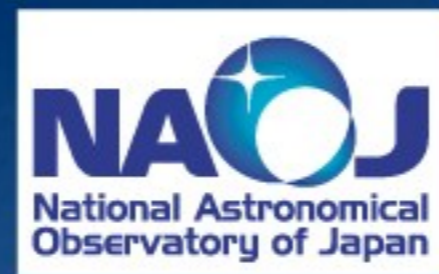




EOC Solar priorities (discussion?)



- Currently stated ObsMode2020 priorities:
 - Polarisation (=wide-field circular?)
 - Spectral line (if FDM = overhaul correlator calibration handling)
- Perhaps consider regional TP mapping instead of one as easier?
- High cadence depending on study outcome? Technically working
- On software side, some significant clean-ups (in SSR and CONTROL) would be worth considering at some point if priorities for new Solar features and from other EOC areas allow; we are building up layered workarounds and have outdated code in use from initial commissioning
- Validation of ICT-16261 fixes e.g. Solar astrometry testing?
- Maybe OTFI interesting to consider for Solar observing?



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