AGN Summary Report on Cadences v2.0 and v2.1

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Motivation: The SCOC is looking for **feedback from the SCs** (yes, **you**! see **bold** text below) as it considers several remaining cadence topics/questions in detail over the next *many* weeks/several months as follows.

1. **Filter Distribution**
    - **a.** Should the survey cadence skew towards bluer filter observations (compared to current baseline)?
    - **b.** Should the same filter balance be applied to WFD vs other regions (Galactic, NES, SCP)?
    - **c.** What exposure time (1x30 or 1x50s) should u-band observations adopt?
    - **d.** Should the survey adopt fixed or variable exposure times in each filter (e.g., variable or fixed depth)?
    - **e.** Should the survey adopt a different exposure than 2x15s (or possibly 1x30s) for non-u-band filters? (see the shave filters v2.1 simulations)
2. **Nightly Visits pairs and triplets**
    - **a.** Should we add a third visit anywhere/everywhere in the sky (e.g. Gal vs EG or by Ecliptic Latitude)?
    - **b.** Should there be a third visit all the time, or on only some observations?
    - **c.** If there is going to be a third visit on a night, what is the spacing between the 2nd and third visit?
    - **d.** If there is no third visit, what is the time separation between visit pairs (33 minutes versus 2-7 hours)?
3. **Footprint**
    - **a.** What should the exact Declination and dust extinction limits for the WFD region be?
        - [v2.0 adopts -70 < dec < ~+3 to +15 and E(B-V)<0.2 mag]
    - **b.** Should we add the Virgo cluster to WFD?
        - [very small addition for relatively high impact]
    - **c.** What should the definition of the Galactic Bulge/Plane regions be?
    - **d.** Fractionally how much time is spent observing WFD, Galactic Plane, North Ecliptic Spur, South Celestial Pole, pencil beam surveys?
        - [the latter is punted to Q5 and Q8 below]
4. **Rolling Cadence**
    - **a.** Should a rolling cadence be adopted in the WFD?
    - **b.** Should a rolling cadence be adopted in the special regions of the WFD (NES, GP, SCP) and also in the minisurveys?
    - **c.** Which scheme for rolling should be adopted? (number of bands, other spatial region splits)
    - **d.** How aggressive should the rolling be in the WFD or non-WFD footprint?
    - **e.** When should rolling start (end of year 1 or at 1.5 years)?
5. **DDF Strategy**
    - **a.** How much survey time should be spent on the DDFs?
        - Should all DDFs be observed for the entire 10 years?

   b. Do some DDF fields get more observations in certain years and fewer/none in others (rolling DDF strategy)? If so, which ones and how many years do those fields get observed?
   c. What uncertainties remain to finalize the Euclid South DDF as the 5th field (what else do we need to know about observing and co-observing needs)? Should the Euclid South DDF be observed differently to other DDFs?
6. **Early Science**
   a. Should the LSST cadence start from year 1, or should some other cadence be executed for part of year 1?
      -
   b. To what extent should incremental template generation be prioritized in Year 1?
   c. What community feedback do we need to help decide the early science strategy?
7. **Time allocation for ToO**
   a. How many ToOs per year should be observed?
   b. How should time be allocated for ToOs with respect to the LIGO-Virgo runs?
   c. How should ToO observations be coordinated with other groups?
   d. Should ToO observations be discovery-night only or follow up on days scales?
8. **Micro-surveys**
   a. How should micro-surveys be prioritized?
   b. Should any microsurveys occur in Year 1? If so, which ones?
   c. What should happen to the even smaller sub-percent micro-surveys ('nano'-surveys) proposed?

CARINA:
   a. If approved, how much time should be allocated for the micro survey?
   b. Should one week in a year be spent observing the Carina cluster (carina_* run)?
   c. Should this micro-survey be executed every year or only some years?

ROMAN:
   a. Should there be a micro-survey of a Roman microlensing bulge field?
   b. If yes, how much time should be allocated?

LV GALAXIES:
   a. Should there be deeper g-band imaging of 10 local volume galaxies?
   b. If yes, how much time should be allocated?
   c. Should all 10 local volume galaxies receive additional g-band observations?

SMC Microlensing
   a. Should there be high cadence visits in the SMC for microlensing?
   b. If yes, how many pointings should be awarded (1 or 2)?

NORTHERN STRIP
   a. Should there be a northern stripe observed with a limited number of visits in ugrizy from the upper limit of the survey footprint to Dec=+30?
   b. If so, how much time should be allocated to the survey?

SHORT EXPOSURES:
   a. Should there be a single short (5s) exposure survey of the sky in ugrizy in year 1 for static sky calibration?
   b. Should there be four short exposures of the sky in ugrizy at a range of times for transient detection and static sky calibration
   c. If so, how much time should be allocated

NEO Twilight:
   a. Should there be a low solar elongation Solar System NEO twilight survey?
   b. If so, how often should this micro-survey be executed?

Lynne Jones has generated a series of notebooks based on the available metrics and the v2.0/2.1 opsims, several geared toward each SC, to help investigate the above questions. See in particular:

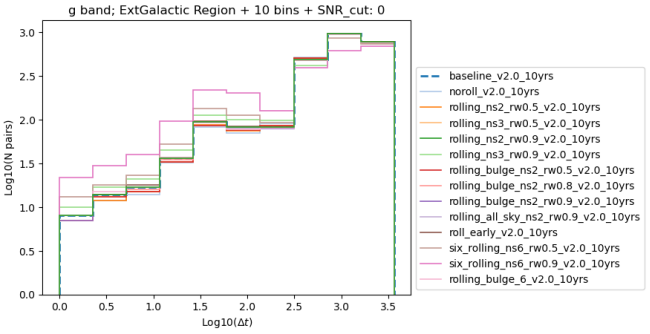
fbs_2.0/SummaryInfo_v2.1.ipynb
fbs_2.0/Demo_AGNmetrics.ipynb

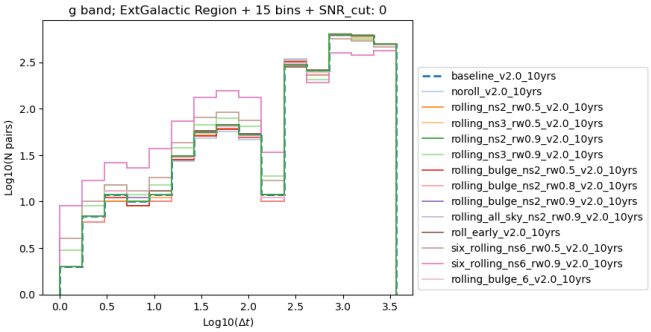
Peter Yoachim generated this summary document as well.

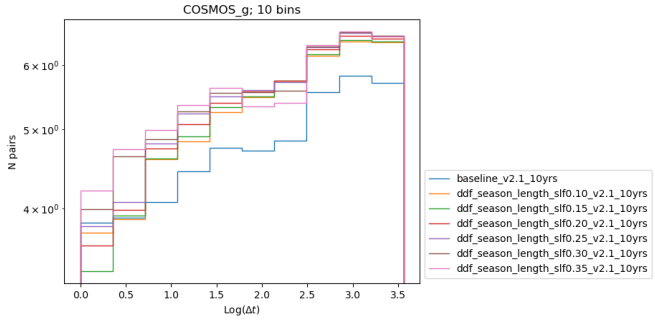
For reference, the metrics that we used to evaluate relevant AGN science cases are:

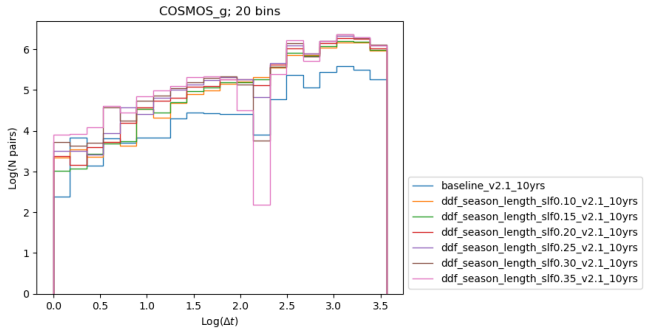
NQSO	metric to calculate the number of QSO expected per sq degree (sensitive to total filter depths)
AGN SFUncert	metric to calculate the expected errors on the SF. a binning of 10 was adopted, spanning 1 day to 10 yr timescales. This is deemed insufficient to capture season length variations. => 20 bins will do better (see below)
AGN TimeLags	metric to calculate how well sampled various time lags will be (default 100 days)

AGN SF metric binning:





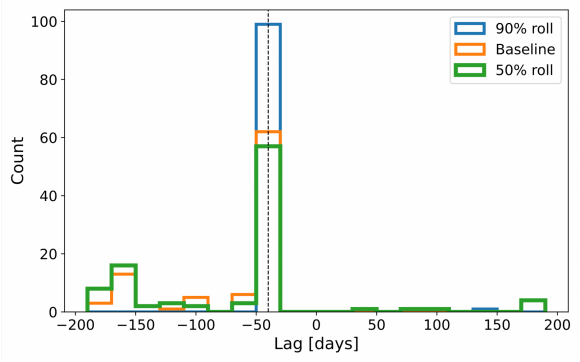


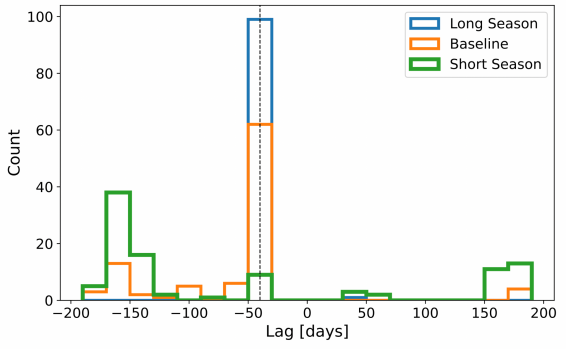


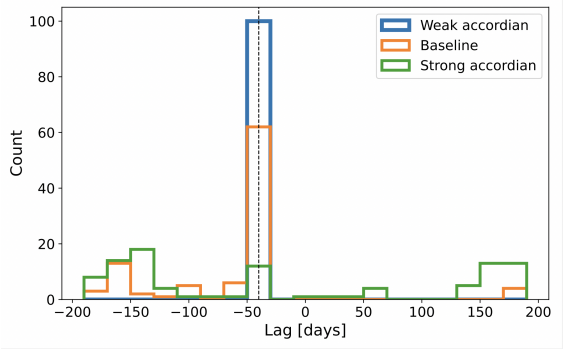
DISK/CONTINUUM LAGS: *Amy Secunda looked at JAVELIN lag distributions for 100 mock 10-yr light curves with input lags between u and y of -40 days (a reasonable average value, although AGNSC would really want to probe a broader range of ~few to few 100 days), applying a few select opsim families to compare across extremes:*

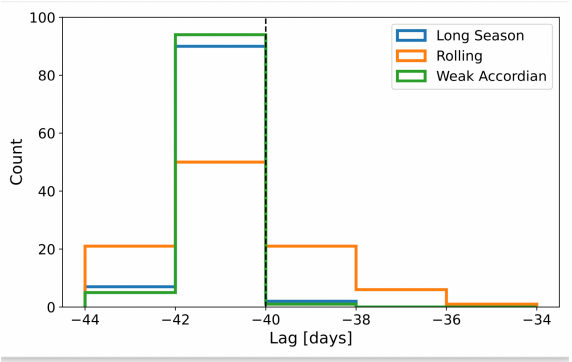
Baseline: baseline_v2.1_10yrs.db
Short Season: ddf_season_length_slf0.35_v2.1_10yrs.db
Long Season: ddf_season_length_slf0.10_v2.1_10yrs.db
90% Rolling: rolling_all_sky_ns2_rw0.9_v2.0_10yrs.db
50% Rolling: rolling_ns2_rw0.5_v2.0_10yrs.db
Weak Accordian: ddf_accourd_sf0.10_lsf0.1_lsr0.5_v2.1_10yrs.db
Strong Accordian: ddf_accourd_sf0.30_lsf0.4_lsr0.1_v2.1_10yrs.db

Regarding mock light curves with different length lags, sometimes lags >100 days actually do better than the 40 day lag examples, even with shorter season lengths. Haven't determined exactly why that is yet. Using our model for the long lag we think we've detected for Fairall 9, we predict the long lag timescale most commonly ranges from ~10-1000 days at z<2, and that ~40-50 days is a very typical long lag timescale around z=0.5, which is why I've been using that as an example. At any rate, hopefully I'll have a finished draft of this paper soon, which includes more information on our long lag models and a wider parameter study of quasar properties and redshifts, and can send it to you.









CIV lags *=> full range 50-650 days (substantial fraction b/t 90-300 days). Missed by short seasons.*

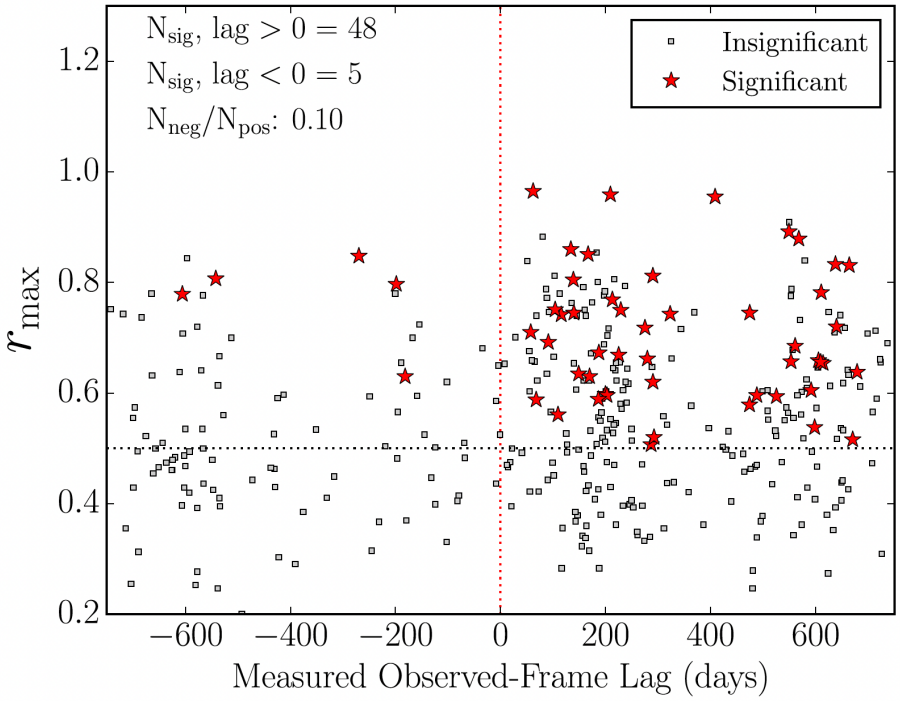


Figure 6. The measured time lag vs. r_{max} for all quasars in our sample. Those measurements that do not meet the criteria for significant lags are shown as gray points; those that meet all of the significance criteria are represented by red stars. The vertical dotted red line indicates a lag of zero, to guide the eye, and the horizontal dotted black line indicates the threshold of $r_{max} = 0.5$ used to select our significant lag sample.

MgII lags *=> vast majority b/t 100-300 days. Largely missed by short seasons.*

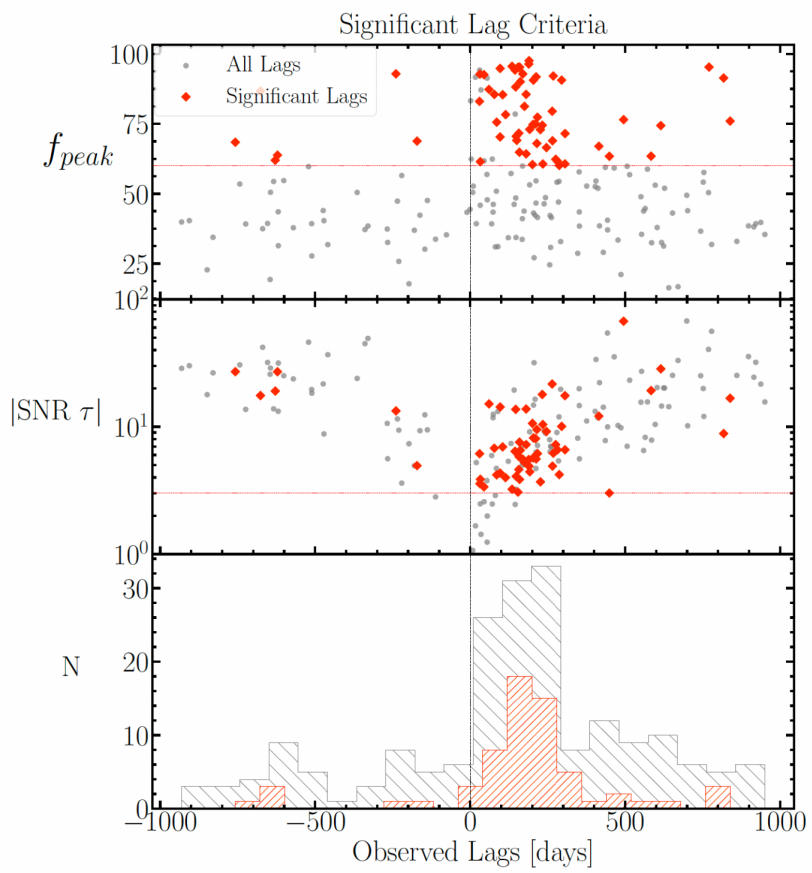
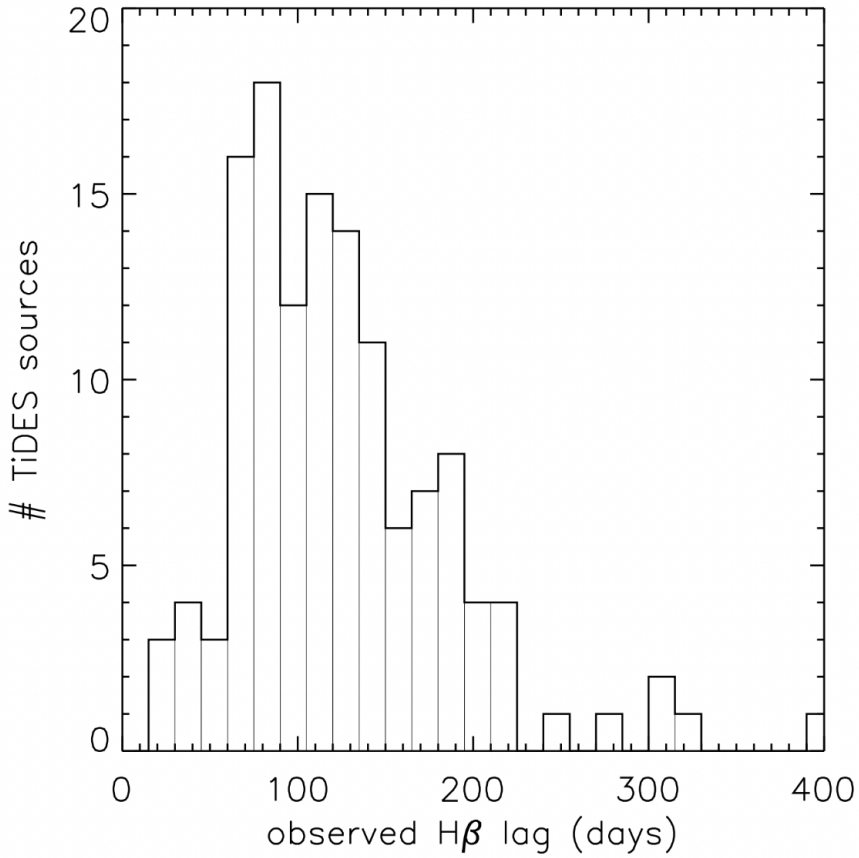


Figure 5. The lag significance criteria for the `JAVELIN`-measured lags. **Top:** The fraction of the lag posterior within the primary peak, f_{peak}. **Middle:** The absolute value of the lag SNR. **Bottom:** The histogram of measured lags for the full sample of 193 AGN (gray) and the sample of significant lags (red). The sample includes 57 significant and positive lags that meet both the f_{peak} and |SNR| criteria (red lines in the top 2 panels, defined in Section 4.2), with an average false-positive rate of 11%.

Hbeta lags *=> lag distribution for TIDES targets with z<0.9 in DDFs => b/t ~60-200 days, peaking at 90-100 days. Largely missing with short seasons.*



Questions for AGNSC:

- ***Which opsims are preferred or to be avoided, and why (quantitatively)?***
- ***Where would the AGNSC draw the line at acceptable/unacceptable deviations from the current baseline (5%? 10%? 20%?)?***
- ***What metrics take priority when conflicts exist?*** AGN SFUncert
- ***Besides these, are there any other implemented metrics that the SCOC should be looking to gauge impact on AGN science? [list below]***

Other?	Blazars

The results were interpreted by AGNSC members as follows:

- Filter Distribution: **largely neutral**, aside from mild disfavor of longer u-band exposures
- Good seeing (added to filter dist): **very mild favored**, but SF highlights strong trade-offs between bands.

- Nightly pairs/triplets: **overall very strongly disfavored by SF,** but very mildly favored by time lag.
- Footprint: **disfavor GP and NES increase opsims**
- Rolling Cadence: SF metrics largely neutral, perhaps mildly **favoring NS2 cases** with 50%, 80% and to lesser extent 90% rolling fractions.
- DDFs: =>at least 5% allocation **favored**. 50% rolling weight **favored**, while large gaps (80-90% rolling weight?) **disfavored**. **Long seasons strongly favored.** Important that at least some DDFs sample a broader range of parameter space than WFD, with better statistics.

good, neutral, bad	baseline	Filter Distribution	Nightly pairs vs. triplets	Footprint	Rolling Cadence	DDFs	Good Seeing
NQSOs	V2.0 Neutral for most members of family, but CAUTION for baseline_retrofoot, retro_baseline	V2.1 shave most neutral, with slight better performance at shave35_40, MILD CAUTION for sgave_20 and 22 v2.1.	V2.0 neutral for all presto families and long gapsl, but CAUTION for presto_gap1.5-4.0 and presto_gap1.5-4.0_mix	Neutral for vary_nes and vary_gp v2.0 CAUTION: plane_priority0.2-1.2 _pbf and pbt v2.1 are of similar mild underperformance Very good in plane_priority_0.1 pbt and pbf	Neutral v2.0	Neutral for all members in v2.0 and v2,1	Neutral for all memebers of this family v2.1
AGN SFUncert	Baseline_v2.1 caution, only improvement in i and r band, baseline_v2.0 neutral, basline_retrofootv_2.0 is better than basline v2.0; retro_baseline_v2.0 is the best but bad in u band	Shave_20 to shave 28 Shave_30 slightly below neutral; shave_30 to shave_40	Presto_gap, presto_gap_mix; presto_half_gap and presto_half_gap_mix families are slighlyt improved; long_gap family is below neutral; the worst are long_gaps_nightsoff0 _delayed_1 and long_gaps_np_nights off0_delayed_1	Plane_priority and pencil families are bad in u, y, z bands; almost neutral in g band and good in i and r bands In summary caution	Neutral for whole family, but slight underperfomrance at rolling_ns3_rw0.9, white stripe at rolling_buldge_ns2_rw0.9	Ddf_frac, ddf_double, ddf_quad; ddf-bright; Ddf-accordion almost neutral as it has slight underperformance in g and u band; but the best accordions are ddf_accord_sf0_0.5_, ddf_accord_sf0_0.3_5;ddf_accord_sf0_0.4_0.3; ddf_old of similar quality; and ddf_early_deep	Each member of the family has underperofmance in different filters , unstable for the metric
AGNTimeLags (level 1 Lynne notebook): time lags in range 100-400 ld	**v2.0 slightly better than v2.1, but not huge effect on time lag measurement. both ok**	**long_u1, long_u2 shave_XX<32, shave_XX>l32**	presto_gapXX, presto_gapXX_mix, presto_half families, and long_gaps family	Caution:Plane_ priority family outside DDFs However plane_priorty family with XX<35 in galactic plane could be fine for time lag measurement of quasars behind galactic plane. These quasars are also important for AGN science.	rolling, r, _six_rolling	ddf family ddf accordion CAUTION: ddf_quad_subfilter, ddf_bright	good_seeing_family
AGNTimeLags (level 2 analysis: Accretion Disk time lags ≤10ld)	Baseline_families in DDF	Shave_family in DDF	Long_gaps in DDF	Plane_priority in DDF Footprint in DDF	rolling_ns, _six_rolling in DDF	ddf_ family , specially ddf_accordion CAUTION: ddf_quad_subfilter!!!	Good_seeing in DDFF