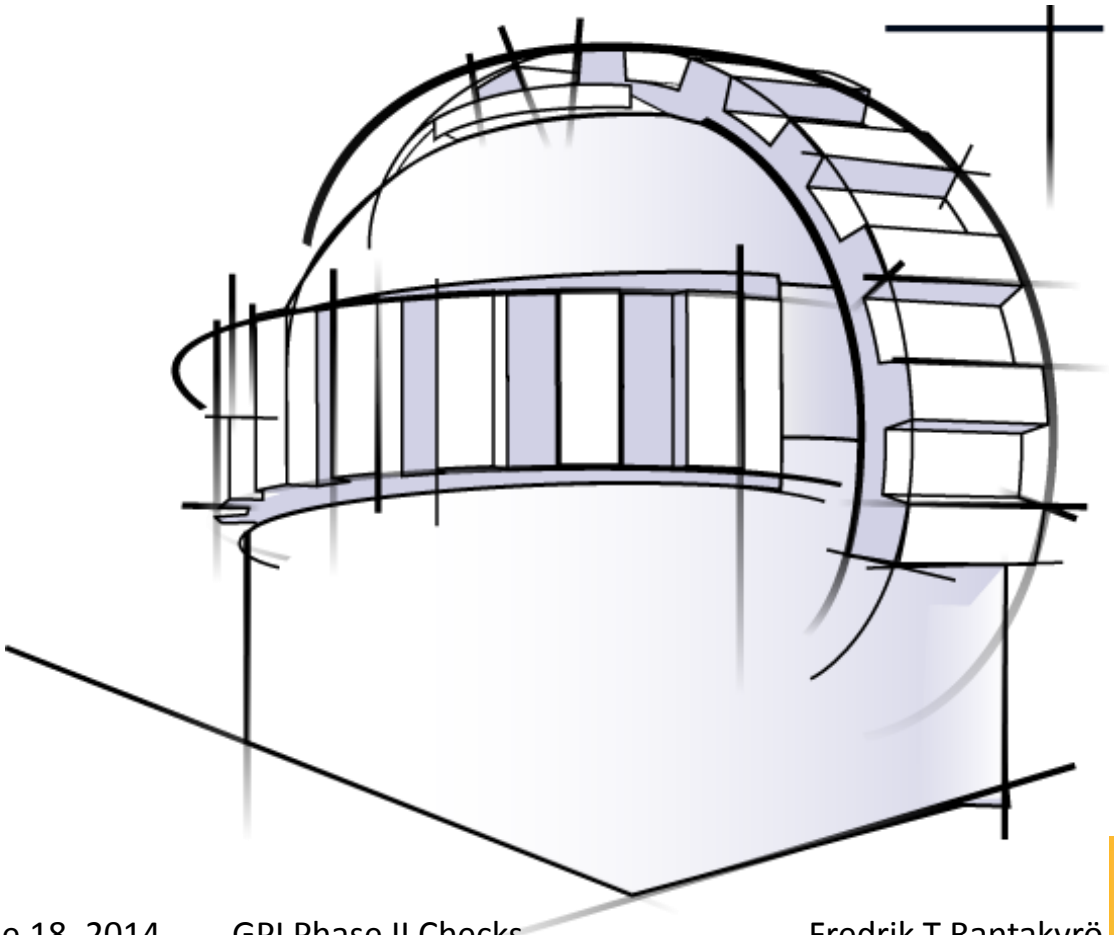
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GPI Phase II Checks



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The goal of this presentation is to be able to do the proper GPI Phase II issues checks.

With the updates to the PIT and OT since March this has been streamlined significantly, leaving only minor checks to be done by the P2 checker.



It should be noted that GPI is offered in 14B in Shared Risk. Most if not all Performance numbers are expected to change for 15B and it is planned to continue to streamline/simplify OT/PIT even more.

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Phase II Checking

The Phase II check point of view GPI consists of 4 components as these are driving the Phase II checking.

1. OIWFS (The Adaptive Optics, AOWFS), a high order, fast (1KHz) AO system that corrects for the atmospheric turbulence. Sets the limit on allowed brightness in I-band.

2. LOWFS (The CAL unit), low order, slow AO (0.1Hz) system that is designed to keep the object on the mask. Sets the limit on allowed brightness in H-band.

3. The IFS, Hawaii 2 NRG chip, field of view 2.7”x2.7”, minimum exposure time 1.49s, maximum exposure time 999s. Sets the limit on allowed brightness in the science band and the maximum field of view.

4. Coronographic Mask or Direct. Sets the limit on Inner Working distance and brightness.

Main webpage**: http://www.gemini.edu/sciops/instruments/gpi/instrument-performance**

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OIWFS and LOWFS Limits

http://www.gemini.edu/sciops/instruments/gpi/instrument-performance?q=node/12166

GPI limiting magnitudes are determined by several components, the OI WFS (I-band), the LOWFS (H-band), and the IFS (selected science filter).

In addition the observing conditions add another layer of limits. Thus the brightest of the science object is limited in **I**-band from the AOWFS, in **H**-band from the LOWFS (not a constraint in DIRECT mode as then no coronographic mask is used and no LOWFS is possible).

	Maximum brightness [mag]	**Minimum brightness [mag]**
I-band (AOWFS)	1	9.0
H-band (LOWFS)*	1	9.0

*Only valid in **Coronographic** mode, in the **Direct** mode there is no LOWFS and thus no constraint imposed by the LOWFS.

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OIWFS and LOWFS Weather Limits

http://www.gemini.edu/sciops/instruments/gpi/instrument-performance?q=node/12166

The given magnitude limits for the AOWFS and the LOWFS (if used) should be modified in the following way for worse than IQ70 CC50 conditions:

Observing conditions	**Decrease of faintness limit [in magnitudes]****
IQ70 CC70	1.5
IQ85 CC50	1.5
IQ85 CC70	3

**Note that the decrease in magnitudes is ONLY applied to the faint end, it does not mean that brighter than normal targets can be observed. This is to make operations safe and avoiding locking on noise in the control loops.

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IFS Limiting Magnitudes

http://www.gemini.edu/sciops/instruments/gpi/instrument-performance?q=node/12166

The selected observing mode is strongly affecting the brightness of the target that can be observed with the IFS without saturating in the selected science wavelength by the IFS.

The principal four modes (each that can be done in all the filters Y, J, H, K1 and K2) are Coronographic Spectroscopy (the "-coro" modes), Coronographic polarization (the "-coron-pol" modes), Direct (the "-direct") observations with either spectroscopy or polarization. Note that this limit is applicable to the relevant science wavelength.

Note that it is possible to observe brighter than the limit w.r.t IFS as it means that the detector will saturate, if this is acceptable for the PI then this is OK. At this moment we don't have clear guidelines on how far out the saturation will go as this requires a lot of on-sky testing that we haven't yet have time to perform.

Observing Mode	Maximum brightness [mag]
[Y...K2]-coro	1
[Y...K2]-coron-pol	3
[Y...K2]-direct	8
[Y...K2]-direct-pol	11

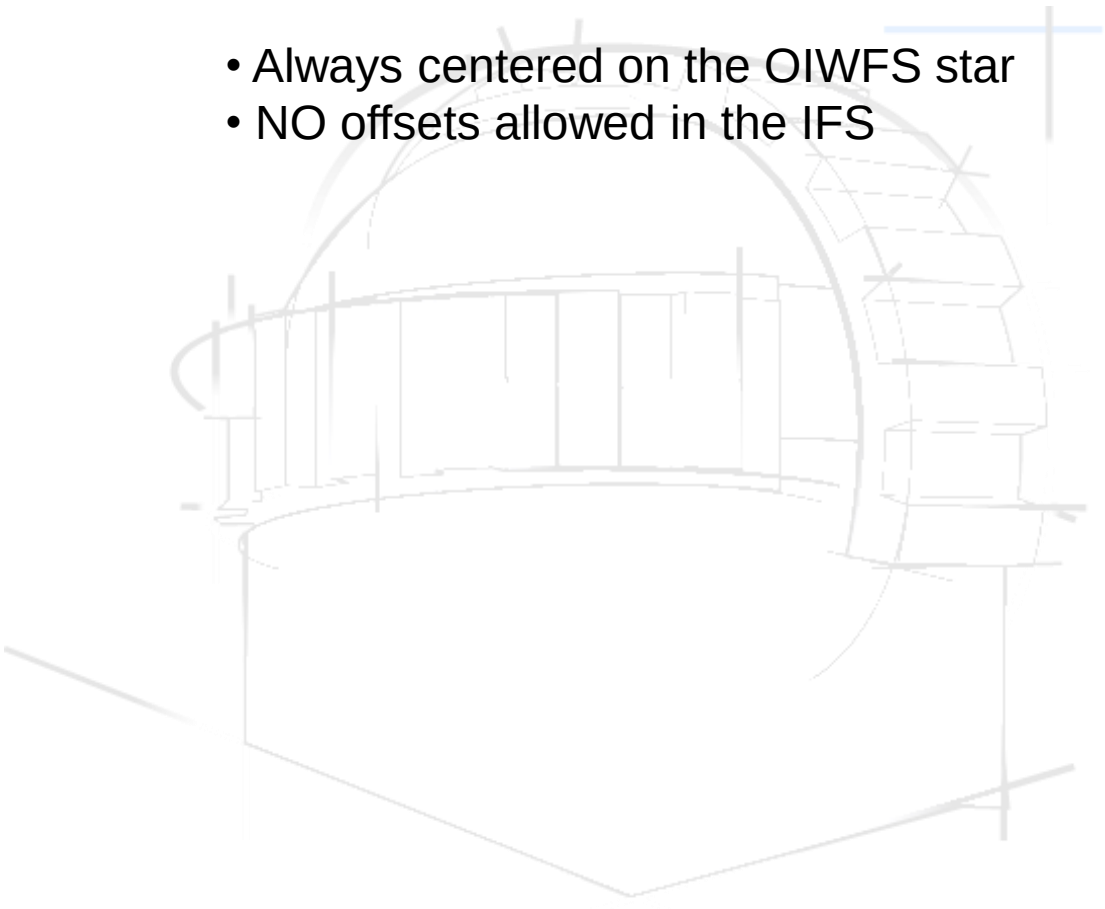
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IFS Limiting Field of View

The GPI IFS has a field of View of 2.7”x2.7”

- Always centered on the OIWFS star
- NO offsets allowed in the IFS



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Coronographic Mask/Mode

http://www.gemini.edu/node/11550

The tables below list the properties of the standard GPI coronagraphic configurations. GPI will automatically select appropriate apodizer, focal plane masks, and Lyot stops for each wavelength.

Configuration	Filter	**Wavelength range (1/2 power bandpass, microns)**	Spectral resolution (per 2 pixels)	**Coronagraph focal plane mask diameter (mas)**
Y-coron/coron-pol	Y	**0.95 - 1.14**	34-36	**156**
J-coron/coron-pol	J	**1.12 - 1.35**	35-39	**184**
H-coron/coron-pol	H	**1.50 - 1.80**	44-49	**246**
K1-coron/coron-pol	K1	**1.9 - 2.19**	62-70	**306**
K2-coron/coron-pol	K2	**2.13 - 2.4**	75-83	**306**

Thus the choosen mode will set three important parameters for feasibility:

1. Inner Working Distance
2. Spectral Resolution
3. Wavelength range

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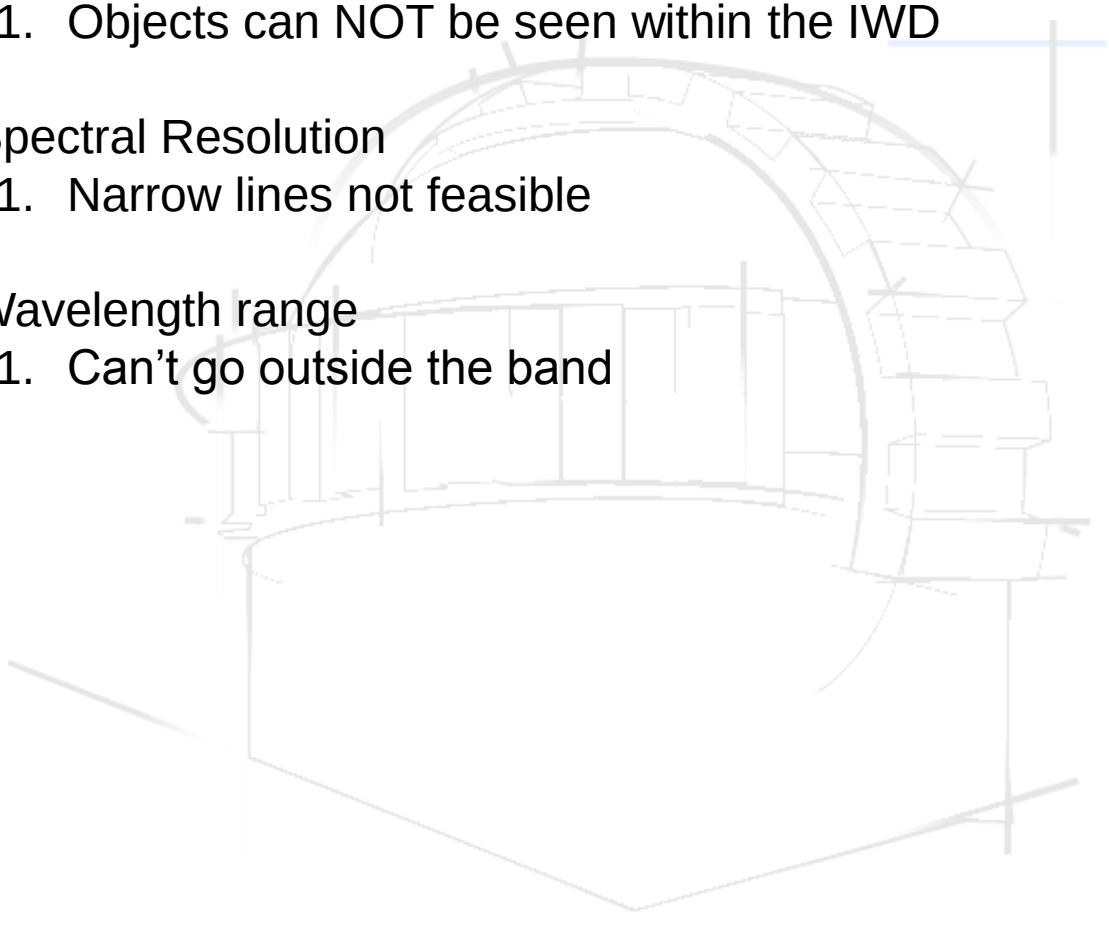
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Coronographic Mask/Mode

1. Inner Working Distance
    1. Objects can NOT be seen within the IWD

2. Spectral Resolution
    1. Narrow lines not feasible

3. Wavelength range
    1. Can’t go outside the band



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Performance

http://www.gemini.edu/sciops/instruments/gpi/instrument-performance?q=node/11552

GPI Performance has one fundamental parameter, which is the measured Contrast.

Nominally this is simple but varies with:

- I-band magnitude → Limits OIWFS
- IQ (nominal performance for IQ70, NO guarantee on performance in IQ85)
- Airmass → Nominal performance ZD=<40, allowed <=50
- Size of the object Extended objects <<2”
- Peak contrast reached ~0.3-0.4” from the object

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Performance Assessment Checks

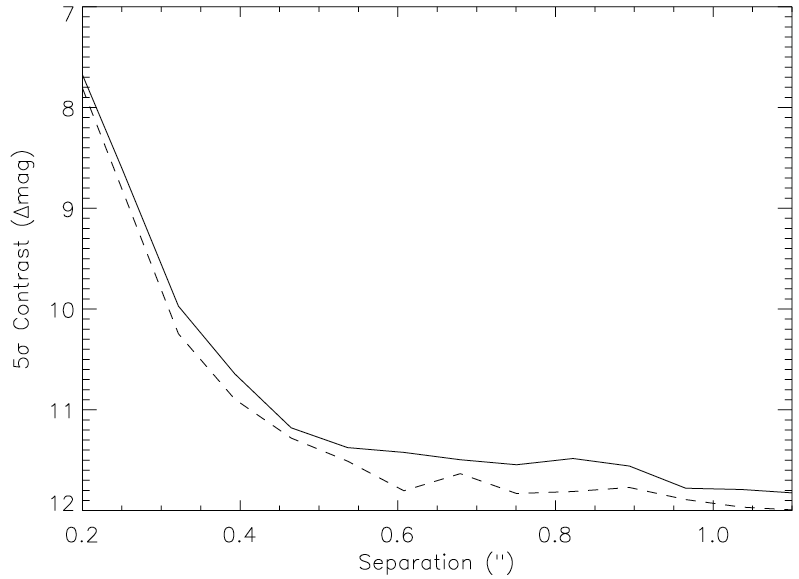
- IQ
  - PI loosens the constraints but still uses Contrast for IQ70
- Airmass
  - PIT has “built-in” constraints but it means that Dec ~< +15 and Dec >~ 75
  - For the semester the target must be above the ZD~45 for at least 2h to be suitable.
- Size of the object
  - Contrast less for extended object, WIP on details

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Performance Assessment Checks II

- Peak contrast reached ~0.3-0.4” from the object
  - Contrast drops sharply within this distance
  - DIRECT mode is still WIP on contrast but expect at a minimum one order (2.5 mag) worse contrast.
  - Postprocessing works great, but not more than ~3 magnitudes



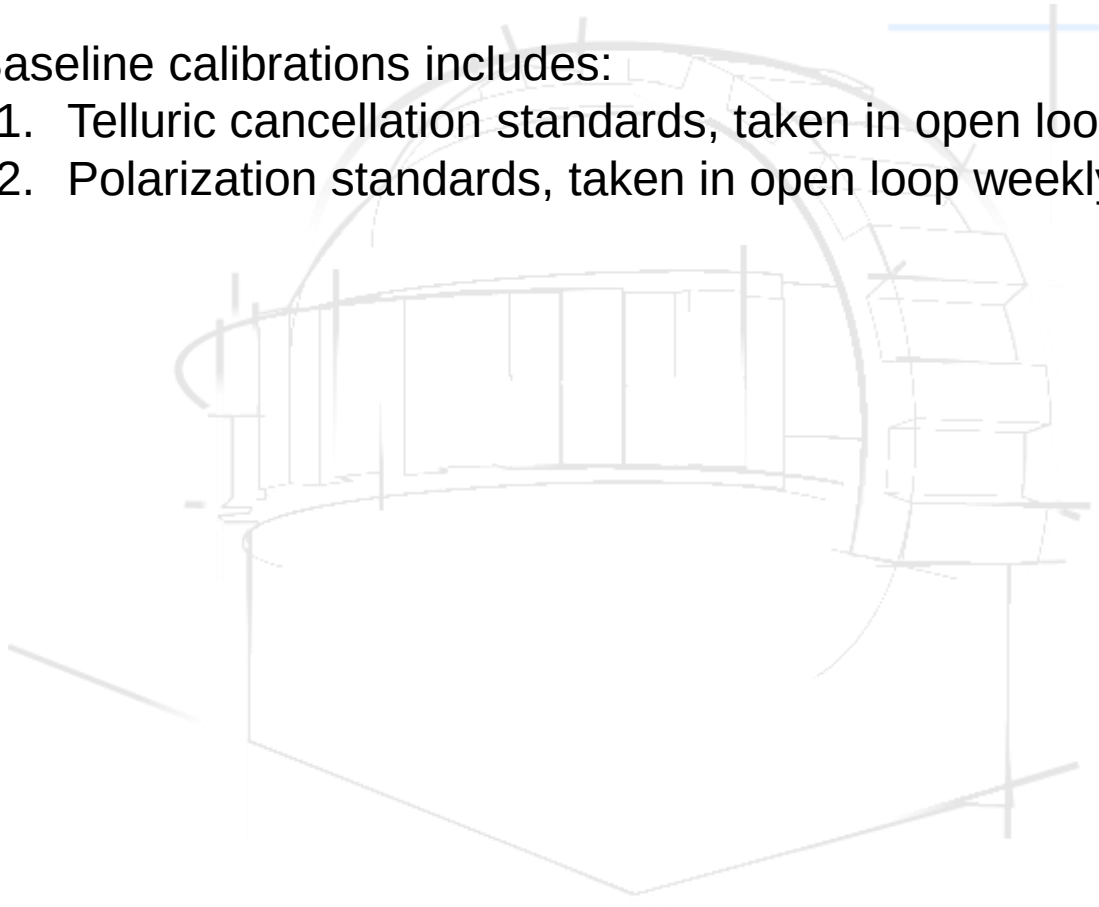
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Various Items

1. Acquisition **must** be done for each requested mode (15m)

1. Baseline calibrations includes:
    1. Telluric cancellation standards, taken in open loop weekly.
    2. Polarization standards, taken in open loop weekly.



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Skeletons: Polarization

The OT now has the skeleton building logic implemented for GPI. This means that when the skeletons are applied the following observations are created:

1. An observation folder is created with the Name of the target and the observing mode.
2. In the folder two observations are created:
    1. In the polarization mode it creates:
        1. One *acquisition observation*: **NO** changes need to be done as this is only for internal calibrations. There is an observation but this is a dummy observe that we expect to deprecate in the next release, thus **NO** images are taken.
        2. One *science observation*: The PI need only change the *exposure time* and the number of *coadds*, possibly adding more iteration loops to reach the requested total time. The science observation consists of several iterations that each loops through the standard half-wave plate angles.
            1. In the case of *K1* and *K2* the skeleton logic automatically adds *SKY* sequences at the end of the *science observation*.

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Skeletons: Spectroscopy

The OT now has the skeleton building logic implemented for GPI. This means that when the skeletons are applied the following observations are created:

1. An observation folder is created with the Name of the target and the observing mode.
2. In the folder two or three observations are created:
    1. In the spectral mode it creates:
        1. One *acquisition observation*: **NO** changes need to be done as this is only for internal calibrations. There is an observation but this is a dummy observe that we expect to deprecate in the next release, thus **NO** images are taken.
        2. One *science observation*: The PI need only change the *exposure time* and the number of *coadds*, possibly adding more iteration loops to reach the requested total time.
            1. In the case of *K1* and *K2* the skeleton logic automatically adds *SKY* sequences at the end of the science sequence.
        3. One *arc observation*: This is for spectral extraction purposes, this should **NOT** be changed. The arc is at the science wavelength for *Y*, *J*, and *H* bands, but for *K1* and *K2* the arc is taken in *H* (arcs in *K1* and *K2* take too long).

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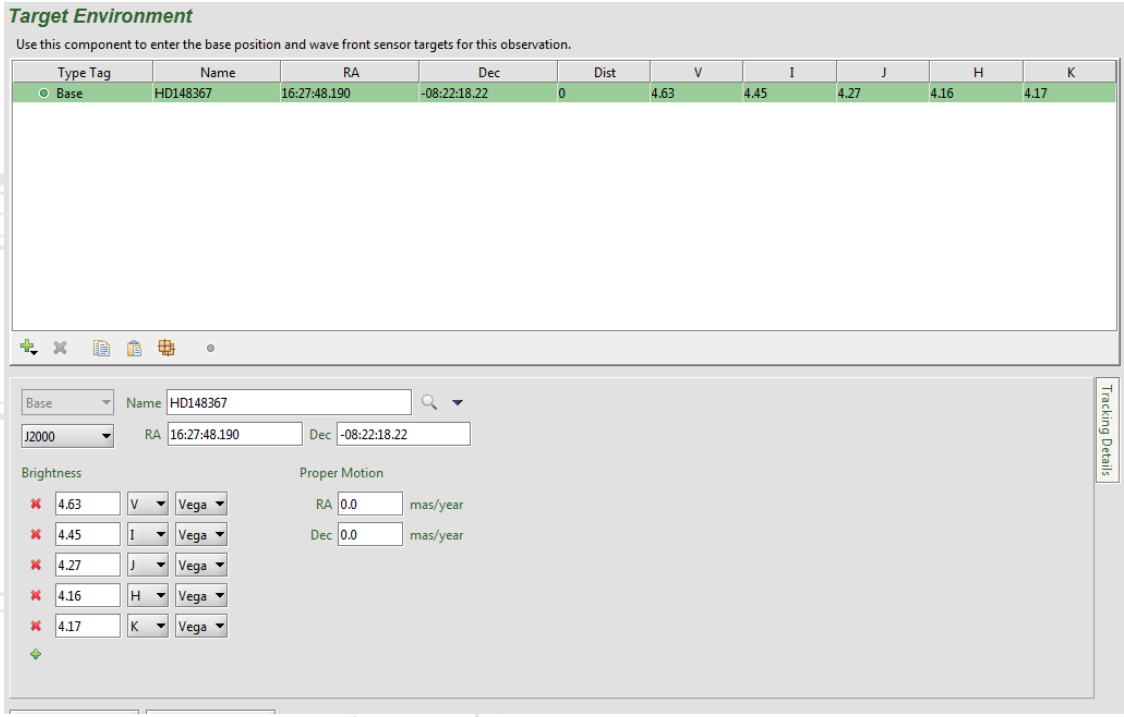
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Phase II Checking: Target

OT has a lot of built-in checks on magnitudes and modes. But sometimes issues slips through.

Check that:

- I, Y, J, H, and K must have defined magnitudes
- Proper motions are critical, the OIWFS has a field of view of ~1” and thus wrong proper motions slows down acquisition, most stars that GPI can observe have pRA>0 and pDec>0
- For the same reason accurate source coordinates are important, use the search when possible.



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Phase II Checking: Acquisition

1. Make sure that the PI hasn't edited the *acquisition sequence*. It **MUST** be *Observing Class Acquisition Calibration* and contain 3 observes.

It should be stressed that this is **ONLY** for internal calibrations and NO science images are taken.

Phase II Checking: Arc

1. Make sure that the PI hasn't edited the *arc sequence*. It should be an arc in the science waveband (except for *K1* and *K2* where it is in *H*). Exposure times are 30s and 2 coadds with one observe. The observing mode should be identical to the *science sequence*.

This arc is to improve the spectral extraction of the IFS data.

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Phase II Checking: Science

With the skeletons implemented only minor checking is needed:

1. Exposure times * coadds should approximately be 60 seconds. There are cases where the PI can go longer if willing to saturate and/or a faint target (fainter than 8th).
2. Total *science sequence* should **not** be longer than 1h as an internal calibration (aka *Acquisition*) is needed every hour.
3. In the case of *polarization* the PI should copy and add iteration sequences so that the desired time is reached. The PI should not have increased the observes to larger than one.
4. In the case of *spectroscopy* the PI can just increase the observes to reach the desired time.
5. *SKY sequences*: The skeleton creates *sky sequences* at the end of the *science sequence* in *K1* and *K2*, it may be possible that some PI wants to have them interleaved, which is OK. As a general rule *sky sequences* should be one-fifth of the science.

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Phase II Checking: Timeline

1. The timeline is now accurate. Check that the total planned time isn't larger than the allocated time.

Phase II Checking: Notes

1. Make sure that the PI have clear "Yellow Notes" if the observation is in any way non-standard.

Phase II Checking: Calibrations

1. All calibrations are taken through the calibration program. This means that there should be no flats, arcs, calibrators or darks defined by the PI.
2. Any extra telluric or PSF calibrators should be *Observation Class: Nighttime Program calibrations*, as these calibrations are taken weekly.

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Open Issue

1. We are still working on the ideal exposure times vs magnitude of the target. As a general rule use:

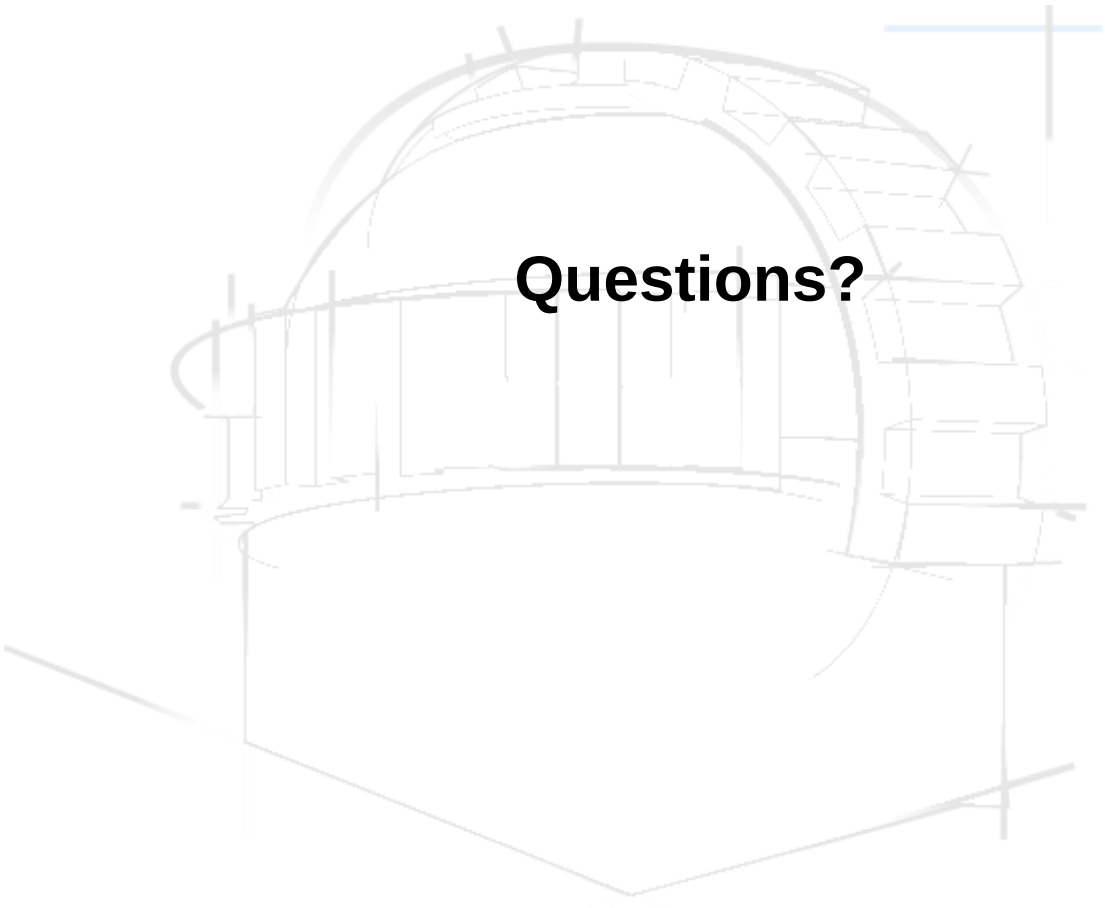
Magnitude (in science band)	Exposure Time
8	60s
7	30s
6	15s
5	6s
3	1.5s

Divide exposure times by 3 for polarization.

We will update with more definite numbers as soon as possible

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Questions?

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