Questions to the PACE RFI; Reference Number: NNG15PACERFI; Date: May 08, 2015			
Page	Reference/Section	Question	NASA Response
Page 2	Mission Schedule	Considering the significant time span from the present to the release of the Draft RFO in September 2016, we recommend the PACE program office plan to conduct a spacecraft study.	The PACE project office will consider conducting a study.
Pages 3 and 8	OMU dimensions	The OMU's size is 0.8 x 0.8 x 0.6 meters. Which face of the OMU is the mounting face and which face is nadir? In addition, there is a 1.0 x 0.5 meter radiator, which needs an unobstructed view to space. What is the relationship of the radiator to the OMU? Is it mounted to the OMU and if so, in what manner and orientation? Alternatively, does the spacecraft manufacturer mount the radiator to provide an unobstructed cold view with heat pipes conducting heat from the OMU to the radiator? Is there a Polarimeter STEP file available? If not, can NASA provide a sketch of the Polarimeter concept?	Several providers are being considered for the polarimeter, so detailed information on this instrument is not available at this time.
Page 3	Instrument Mounting	The paragraph states that both instruments shall be mounted on kinematic mounts to minimize loads on the instrument structure. The mounting description for the OCI describes a four-point mount. Which statement is correct?	The OCI STEP file is correct.
Page 4	Communications	Is 300 Mbps the information rate or the bit rate after FEC is applied? If it represents bit rate after FEC, what FEC is assumed/required?	The 300 Mbps is the effective data rate and should be derated for header information and errors.
Page 4	Orbit Parameters	The requirements state a sun synchronous polar orbit with an equatorial crossing between 11:00AM and 1:00PM. Having both morning and afternoon nodes complicates the design. We recommend choice of either one or the other equatorial crossing for this RFI.	For the purpose of this RFI, assume a single 12:30 pm orbit crossing +/- 10 minutes
Page 4	Pointing knowledge/pointing control	We assume the pointing knowledge and control requirements are at the spacecraft bus to instrument interface. Please confirm this assumption. Are there any co-alignment requirements between OCI and the Polarimeter?	Yes, the pointing knowledge and control requirements are at the spacecraft bus to OCI instrument interface. There are no co-alignment requirements between the OCI and polarimeter.
Page 4	Requirements table Jitter value of 3 arcsec/.16 sec	Both the OCI and the Polarimeter contain moving parts that could be a jitter source for the other instrument. Should the bus developer assume each instrument provides its own isolation system to avoid disturbing the other instrument? Who is responsible for the system end-to-end jitter performance? Is there a frequency component to the Jitter specification?	The jitter requirements will be at the interface between the spacecraft bus and instruments. The spacecraft bus will need to meet them, and the instrument will need to be able to tolerate it. The frequency component is the pointing stability requirement.
Page 4	Communications	Are there rate requirements for S-Band command and telemetry links? Are there any encryption requirements on these links?	The S-band downlink data rate is 32kbps. The uplink (commanding) is required to be encrypted. Command authentication is also required

Questions to the PACE RFI; Reference Number: NNG15PACERFI; Date: May 08, 2015			
Page	Reference/Section	Question	NASA Response
Page 5	Safety and Mission Assurance	Are Single Point Failures (SPFs) affecting mission performance other than de-orbit permissible?	Single point failures are permissible for science operations functions, but are not permissible for deorbit.
Page 5	Safety and Mission Assurance	The text requires single fault tolerance for de-orbit. In accordance with NASA-STD-8719.14A, Requirement 4.6-4, "Reliability of post mission disposal operations in Earth orbit: NASA space programs and projects shall ensure that all post mission disposal operations to meet Requirements 4.6-1, 4.6-2, and/or 4.6-3 are designed for a probability of success as follows: a. Be no less than 0.90 at EOM. b. For controlled reentry, the probability of success at the time of reentry burn must be sufficiently high so as not to cause a violation of Requirement 4.7-1 pertaining to limiting the risk of human casualty." Are designs meeting criteria b. which may be less expensive acceptable?	Assume that both a) and b) need to be met.
Page 6	Ocean Color Instrument (OCI) figure	Are any spacecraft maneuvers required to perform the Daily Solar Cal., Nadir shown in the figure? The figure shows the OCI switched to 0 degrees tilt after the Daily Solar Cal. Should this be +20 degrees? Page 5, spacecraft maneuvers, describes a monthly solar calibration maneuver. How is this different from the Daily Solar Cal?	Yes, the tilt should be +20 degrees. The daily solar calibration target is visible to the sun when the spacecraft passes over the pole (either north or south depending on the direction of the spacecraft orbit). The monthly solar calibration target is normally shaded from the sun to protect it from degradation. It can only see sun if the spacecraft is in the proper orientation. The monthly solar calibration should not drive power or thermal requirements.
Page 6, 7, 9 and 11	Instrument data rates	The RFI describes data rates as orbit averages, but the mission description states the instruments only deliver data during the sunlit portion of the orbit. Are the data rates averages over the sunlit portion only?	The data rate averages are over the whole orbit. The data can be metered out by the instrument to produce a steady data rate or be transmitted as it is produced depending on spacecraft preference.
Various	Mass and Power Values	The RFI states some mass and power numbers as containing 30% contingency and others as not to exceed numbers. What is the difference? Should the contractor assume that all values given for the instruments are not to exceed values and include appropriate contingencies?	Yes, for the purposes of this RFI, the mass and power numbers should be treated as not to exceed numbers.
Various	Sunlit portion	Is there a definition of the sunlit portion of the orbit? For instance, is there a specific solar zenith angle, or is it only when the observed Earth surface is illuminated?	The sunlit portion of the orbit is up to solar zenith angles of 75 degrees.

Questions to the PACE RFI; Reference Number: NNG15PACERFI; Date: May 08, 2015			
Page	Reference/Section	Question	NASA Response
General	Various	Can GSFC provide an annotated graphic of the instruments, with callouts/identification of key components of the instrument and in particular the radiators? This would greatly aid contractor understanding.	An annotated graphic of one concept for the OCI instrument is included below. Several providers are being considered for the polarimeter, so detailed information on this instrument is not available at this time.
Page 7	Polarimeter	Is the 51 x 51 degree clear field of view for the Polarimeter a half angle or full angle measurement? Is the FOV rectangular or cylindrical?	This is a full angle, rectangular field of view.
Page 12 Page 7	Section 4.7.1 Section 4.1.2	These paragraphs state; "The OCI instrument has two field of view requirements, the optical field of view that is +/- 58 degrees across track and +/-20 degrees along track." *and* "The Polarimeter requires a 51 x 51 degree clear field of view to take data." Are these constraints just optical FOV requirements or do they include keep-out FOV constraints to accommodate other requirements such as glint and stray light? If there are other optical constraints, please identify them.	These are fields of regard that include the keep out zones for glint and stray light.
Page 8	4.2.1 Mechanisms – OCI	Does the OCI include any momentum compensation? If so, what are the OCI's momentum characteristics during instrument shut down or safe mode transition?	No, the OCI does not include momentum compensation. When the instrument is shut down, it will coast to a stop. This is also true of safe mode. It is expected that the spacecraft will provide the momentum compensations and would be told when to apply the compensation (from the instrument).
Page 8	3.1 Mechanisms – Polarimeter	Is the 0.2 Nms uncompensated momentum of the Polarimeter a steady state value or is it sinusoidal? In what direction is the uncompensated momentum? If it is sinusoidal, what is the frequency?	This is a steady state value. The momentum vector is in the direction of the polarimeter FOV.
Page 8	Alignment Requirements	The RFI requires the instrument interfaces not shift on-orbit by more than 15 arc-seconds total including jitter. Is this measured at the interfaces of the OCI or OMU to the spacecraft individually, or between the spacecraft interface of the OCI and the spacecraft interface of the OMU, or with reference to some other datum, such as the base of a star tracker mount?	It is measured at the interface between the spacecraft bus and the OCI and between the spacecraft bus and the polarimeter.
Page 8	Alignment Requirements	The RFI requires alignment to the spacecraft of both the OCI and Polarimeter within +/- 0.5 degrees. Please define "aligned to the spacecraft." Is this an absolute alignment to defined spacecraft axes or on-orbit axes, or is this measurement accuracy? Is this intended to align the cross track scan axes of the instrument to the in-track/velocity vector?	This is meant to generally align the cross track scan axes of the instrument to the in-track velocity vector. This requirement is meant to be accomplished with general 'best practice' tolerances. No shimming is desired and it is not intended to drive spacecraft cost.

Questions to the PACE RFI; Reference Number: NNG15PACERFI; Date: May 08, 2015			
Page	Reference/Section	Question	NASA Response
Page 8 and 12	OCI Packaging and Thermal	The text describes the interface as both a hexapod and a four-point mount. Please clarify.	The OCI has a four-point interface to the spacecraft (with 8 legs).
Page 8	Thermal	The text states the Polarimeter requires an obstructed view to space. Are intrusions into the radiator FOV permitted (as with the OCI radiator) and if so what are the back-loading limits or what are the required sink temperatures?	Any backloading to the instrument radiators shall be less than 1.0 Watt
Page 8	OCI Thermal	The instrument has a 0.32 m^2 thermal radiator that needs an unobstructed view to cold space in order to cool the instrument properly Can the radiator sink temperature requirement be provided for both instrument radiators?	The Instrument Radiators shall reject heat to a -173 K equivalent sink temperature.
Page 8, 9 & 12	Sections 4.5.1, 4.4.1 and 4.7.1	Section 4.5.1 states the OCI has 4 electronics boxes (ICDU, HSEU, SDEU, and MEU). However, sections 4.4.1 and 4.7.1 state the OCI has two components, instrument and electronics box. Please clarify.	OCI has 4 electronics boxes (ICDU, HSEU, SDEU, and MEU). In section 3.6., the instrument was divided into two components: the "instrument" component of OCI listed refers to the optical-mechanical unit, and the "electronics box" component of OCI refers to the electronics module, including the 4 electronics boxes. Note: The ICDU may be moved to the spacecraft.
Page 8 and Page 12	Sections 4.4.2 and 4.7.2	This RFI states, "The Polarimeter optical mechanical unit (OMU) will be thermally isolated from the spacecraft via MLI. The OMU has a 1.0 x 0.5 m radiator that needs an obstructed view to cold space to cool the instrument properly. The OMU temperature ranges (at mounting interfaces) are as follows: operational -10 to +40 degrees C, survival -20 to +30 degrees C, and start-up -20 °C to +30 degrees C" *and* "The OMU baseplate (CFRP honeycomb panel) serves as the main interface with spacecraft. It is an aluminum main structure that is isostatically mounted on baseplate with three flexible titanium bipods. The OMU is thermally decoupled from the platform by means of thermal washers." 1) Since MLI will provide radiative isolation between the OMU and the spacecraft bus. Are there any conductive isolation requirements between the OMU and the bus? 2) Who is responsible for providing the titanium bipods for the OMU mounting? 3) Are the bipods included in the Polarimeter mass estimates? 4) Do the mounting interface temperature requirements for the OMU apply to the bus/titanium bipod interface, or to the OMU CFRP panel?	1) The conductive interface between the OMU and spacecraft shall be less than 0.1 W/C. 2) The instrument will be responsible for providing the titanium bipods for the OMU mounting. 3) Yes, the polarimeter bipods are included in the polarimeter mass estimates. 4) The mounting interface temperature requirements for the OMU apply to the bus/bipod interface

Questions to the PACE RFI; Reference Number: NNG15PACERFI; Date: May 08, 2015			
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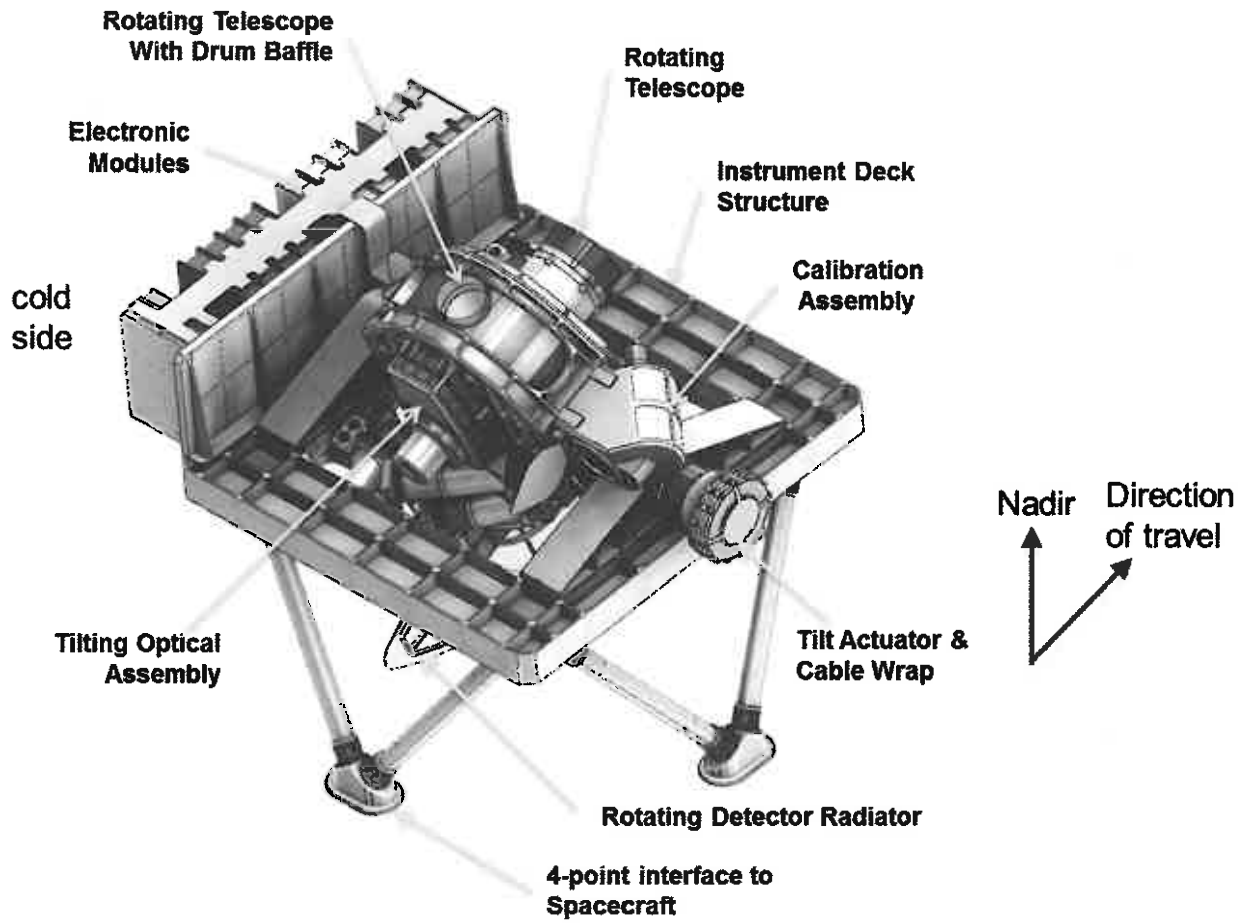
Page 9, 10 & 12	Sections 4.4.2, 4.5.2 and 4.7.2	Sections 4.7.2 and 4.4.2 state the Polarimeter has 1 electronics box, which mounts to the spacecraft. However, section 4.5.2 states the Polarimeter has two electronics boxes. Please clarify.	The polarimeter only has one electronics box. The Filter Wheel Control Unit is part of the OMU.
Page 9 & 11	OCI Section 4.5.1 Polarimeter Section 4.5.2	Is the 28-34 volt range only for the instrument operational modes? Is a wider voltage range acceptable for survival or safe-hold modes? Can the instruments operate over a wider voltage range (on the low side)? e.g. 28 +/- 6V	Yes, a wider voltage range is acceptable for safehold mode.
Page 9 & 11	Section 4.5	The RFI requires downlink of all housekeeping and science telemetry to the Near Earth Network (NEN) within 3 hours of collection with a 95% probability of transmission exclusive of NEN reliability, but inclusive of MOC reliability. What is included in the 95%? Is this RF link availability due to atmospheric conditions or a MOC availability requirement, or are elements of spacecraft reliability included? Given there are no redundancy requirements for the MOC, please clarify this requirement.	The 95% relates to spacecraft availability (not availability of the end-to-end system).
Page 9	OCI interface	Please describe the content and accuracy of the data passed to the OCI on the GPS data line	GPS will provide orbit position and time.
Various	General	Are there any ancillary data requirements such as the spacecraft data that is required to be stored with mission data for science data processing? If so, at what rate must we provide the data? In addition, are there any timing accuracy requirements, such as time stamping of instrument or spacecraft ancillary data that exceeds the 2 msec GPS timing requirement?	Yes, all spacecraft housekeeping data should be stored with the science data. The 2 msec GPS timing requirement should be used for all data. The spacecraft will provide the GPS time to the instrument, and the instrument will stamp its own data.
Page 10 & 3	OCI payload power	There are minor differences in stated requirements for the OCI payload power. Page 10 states 308 Watts. Page 3 states 310 Watts. Which is correct?	The total power (with contingency) for OCI is 308 Watts.
Pages 16 and 17	Section 3 ROM Price & Section 8	Both sections request both a "ROM Price estimate by Government Fiscal Year" and a "Funding Profile." Is there a difference between these items?	The ROM in Section 3 should not include any of the options (i.e., Sections 8 and 9). The ROM price estimate in Section 8 is just for the direct broadcast option. The ROM price estimate in Section 9 is just for the MOC option.
Page 17	Section 6 last paragraph	"The IGSE will need 1 m^2 area during thermal vacuum testing." Is the 1 m^2 inside the Thermal vacuum chamber? If so, please provide a volume and orientation with respect to the instrument.	This requirement is no longer needed. NASA has decided that the IGSE is not needed at Observatory-level testing

Questions to the PACE RFI; Reference Number: NNG15PACERFI; Date: May 08, 2015			
Page	Reference/Section	Question	NASA Response
Page 17	Section 8	What is the frequency band of the optional direct broadcast link? Please provide ground terminal characteristics, coding, allowable BER, availability requirements, and any other link characteristics needed for contactors to size the on-board system.	The direct broadcast user-ground system characteristics are: • Ground Antenna Diameter: 7.62 ft • Antenna Efficiency: 0.55 • Ground Antenna Gain: 44.0 dB • Received Power: -95.6 dBm • System Noise Temp: 135K • System G/T: 22.7 sB/K • **Implementation Loss: -2.5 dB** • Received SNR - Eb/No: 7.4 dB • Required Eb/No for 1E-8 BER: 4.4. dB

Annotated Graphic of One Concept for the OCI Instrument