Performance Calculations for Low Observable Tracer (LOT)

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Active EO
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US Army Corps of Engineers
BUILDING STRONG®

Description Tracer fire at MCB Camp Pendleton DM-ST-89-00210.jpg
en.wikipedia.org

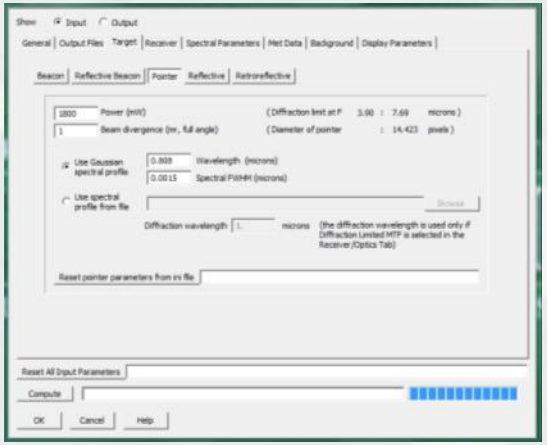
Tagging, Tracking & Locating (TTL) Performance Calculations

- There are limited predictive tools that enable the TTL user, product developer, or technology evaluator to assess the capabilities of emerging TTL technologies for operational use.
- Our approach compares new product developments in a quantifiable manner. It allows for the prediction of *system performance* of sensors and taggants in terms of detection range.
- It accounts for sensor parameters, taggant and background characteristics, solar illumination, and most weather conditions.
- Our system-level approach is to devise a method to quantify whether specific TTL materials, coupled with EO sensors, will indicate a tactical advantage prior to development, procurement, and fielding of those systems.

TTL Performance Calculations

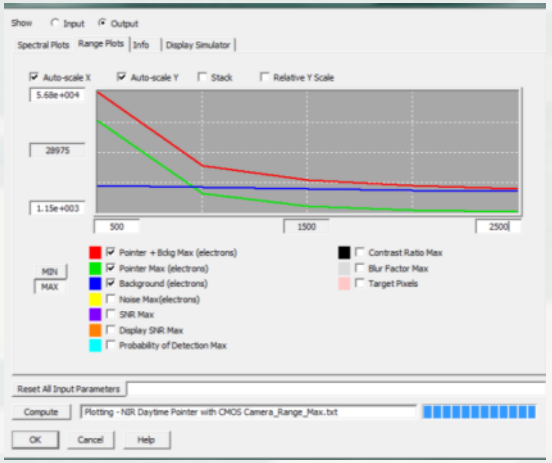
Accommodates specific imaging sensor parameters:

- Detector (Spectral quantum efficiency, Pixel size, Wavelength range, Pixel blur)
- Lens (F number, MTF, Spectral transmission)
- Illumination (Wavelength, Power, Divergence, Solar)

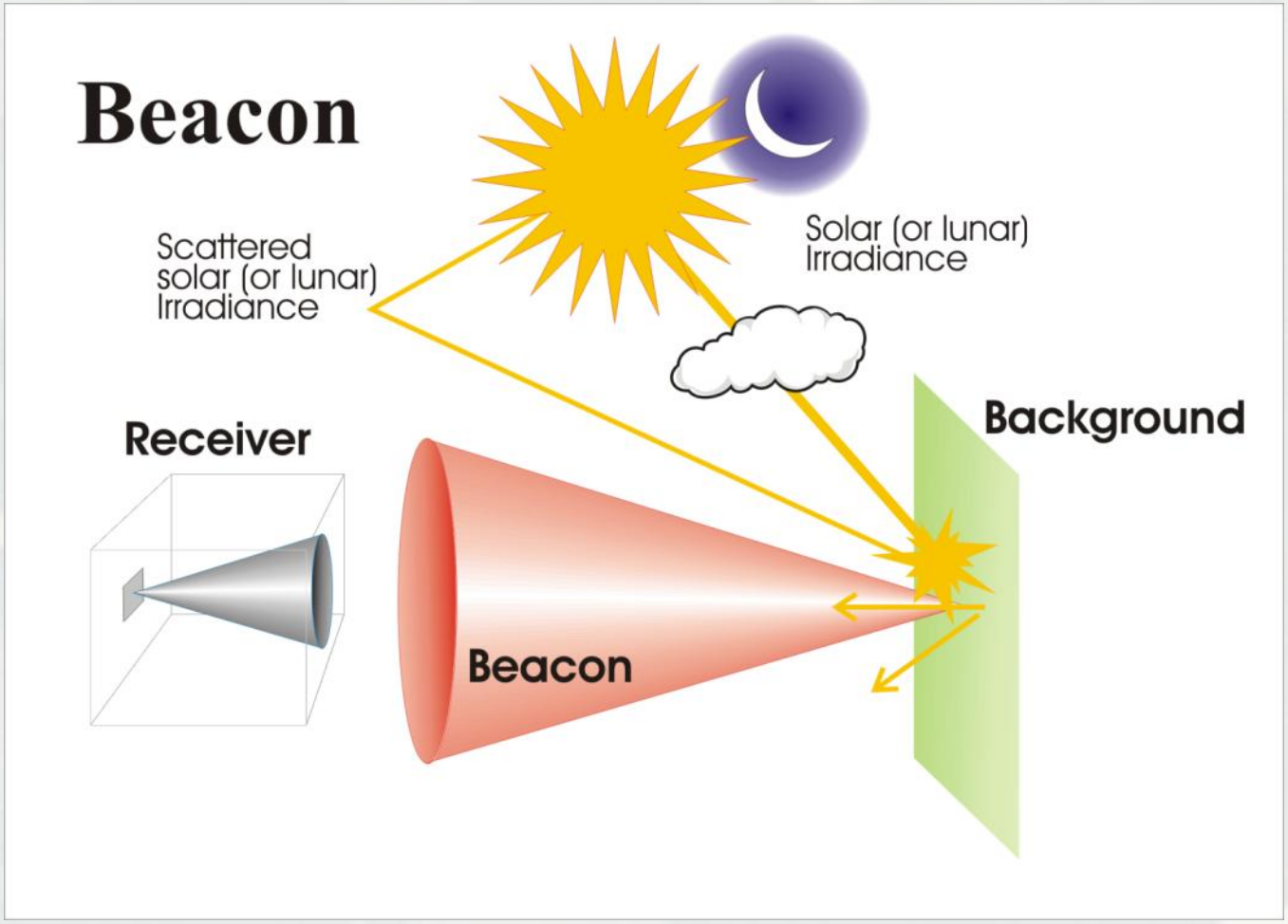


Calculates and displays performance metrics as a function of range for:

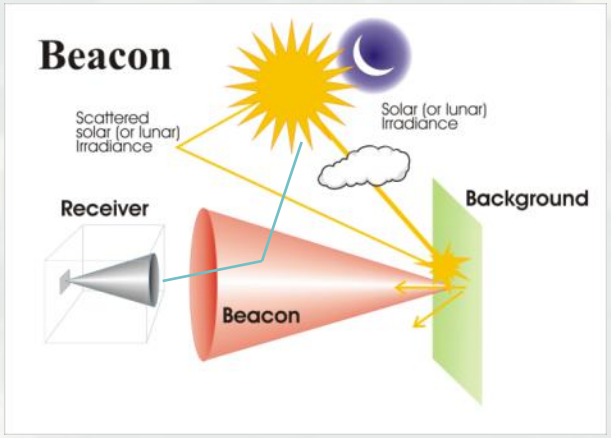
- Signal, Background and Noise
- Signal-to-Noise ratio (SNR)
- Probability of Detection (Pd) - Rosell Model
- Contrast Ratio

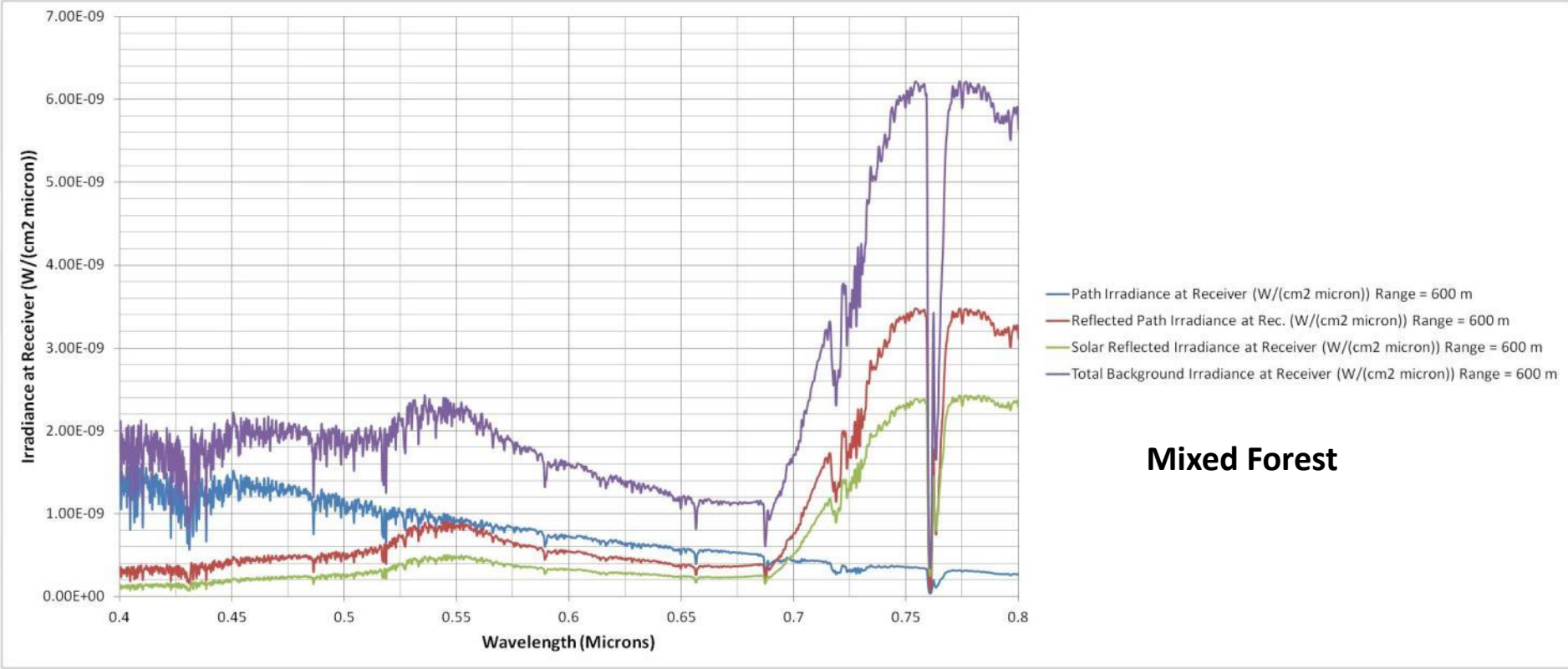


LOT Scenario



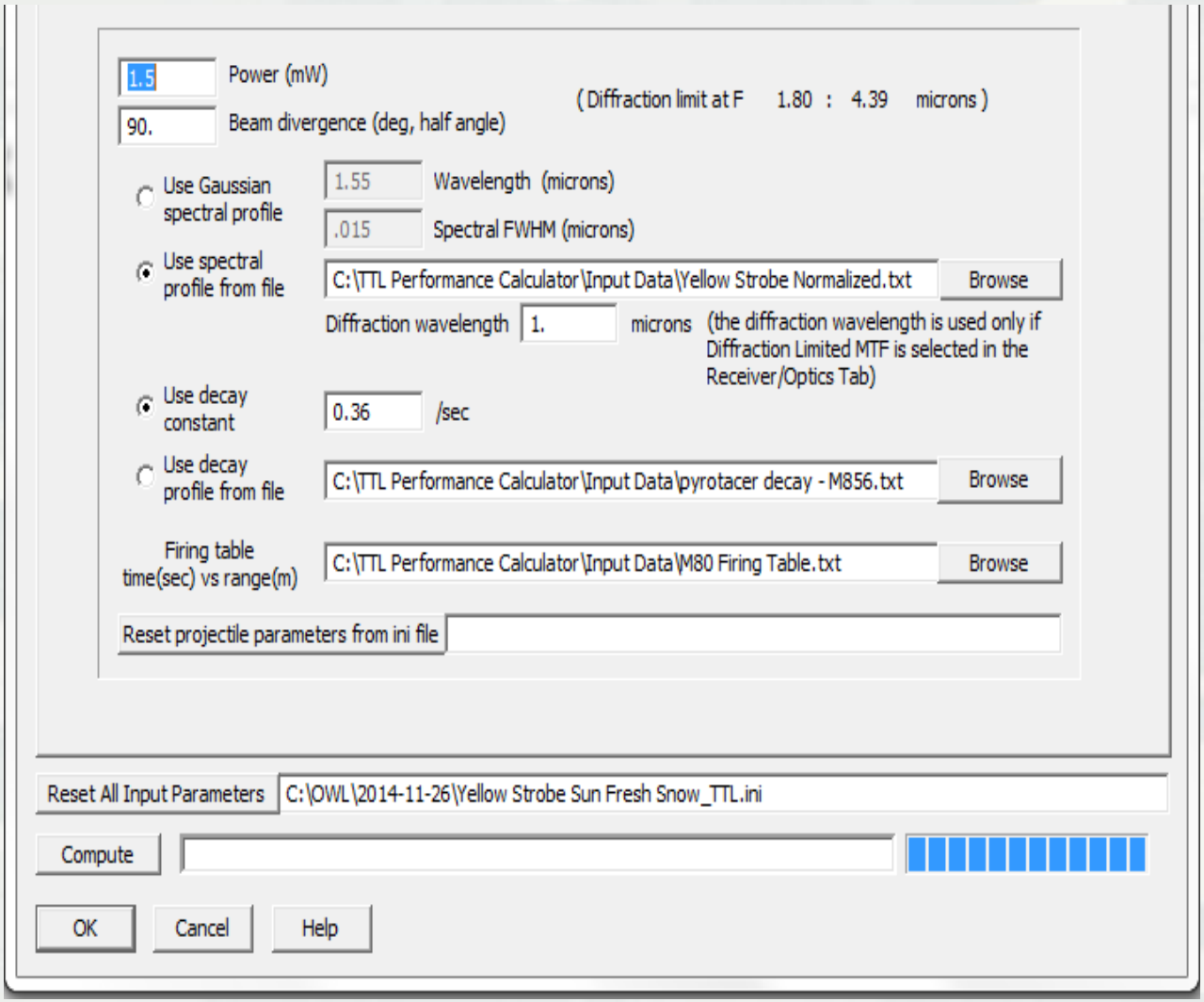
Background Irradiance at Receiver Aperture





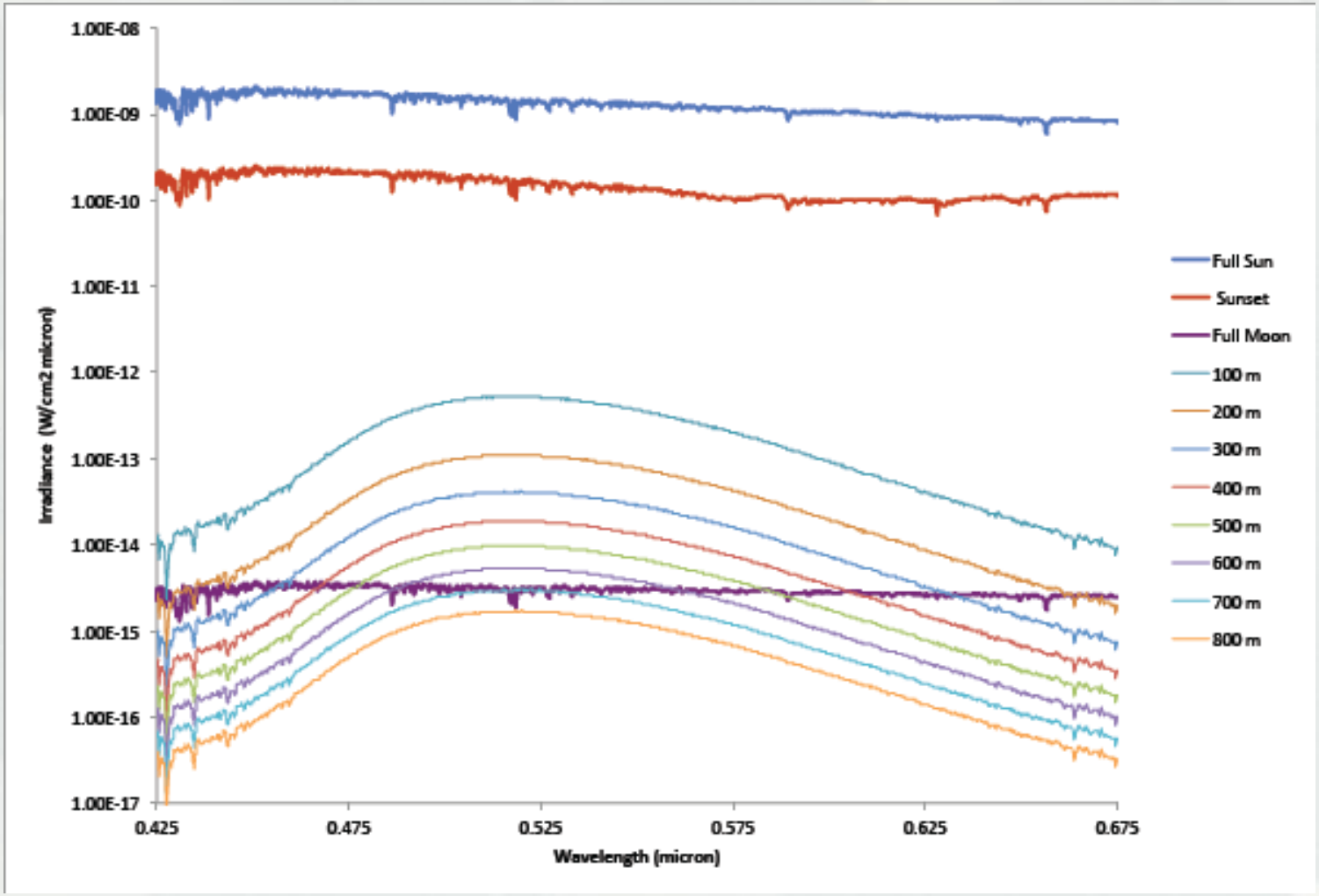
Mixed Forest

Important Parameters

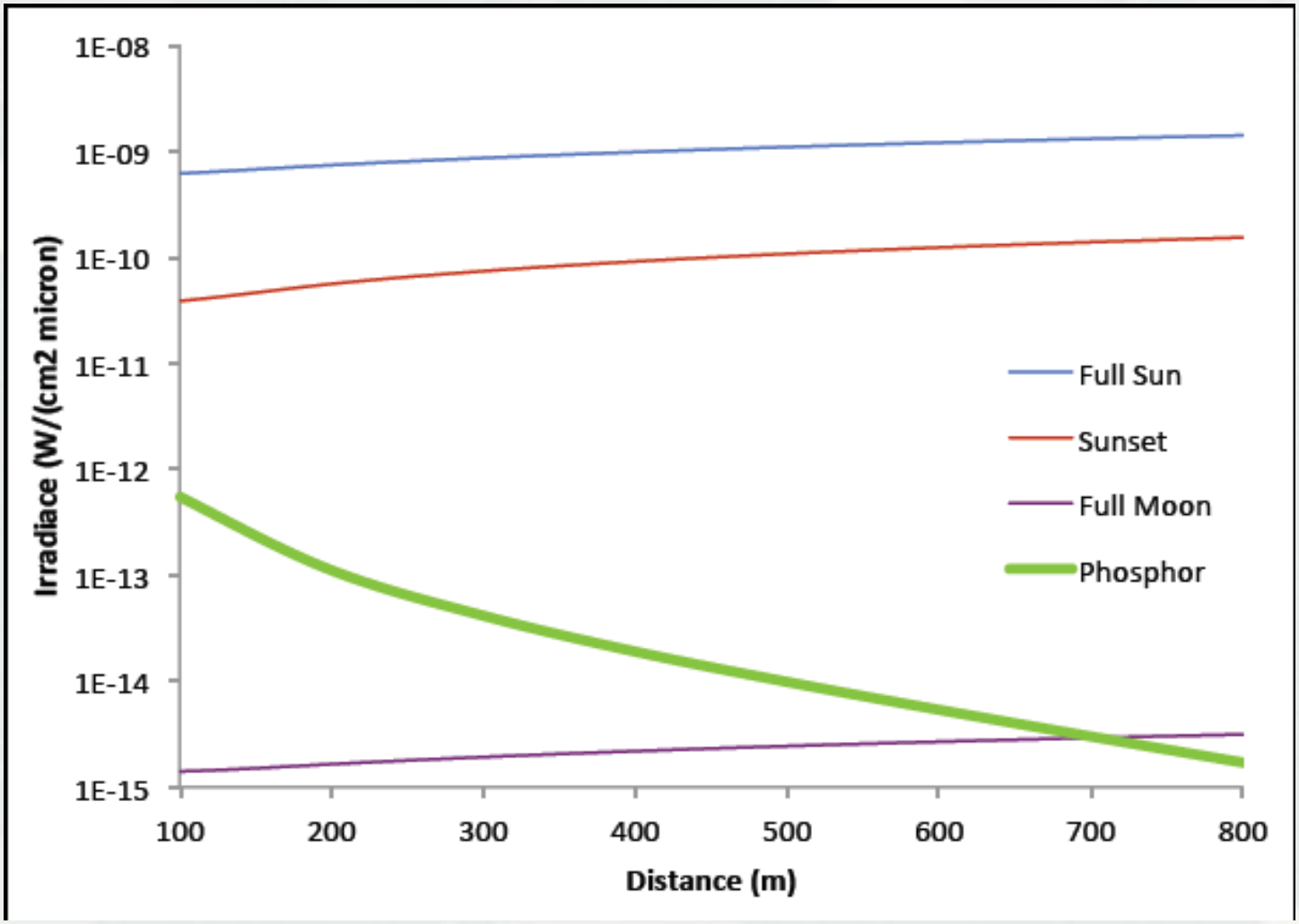


- Power
- Divergence
- Decay constant
- Spectra

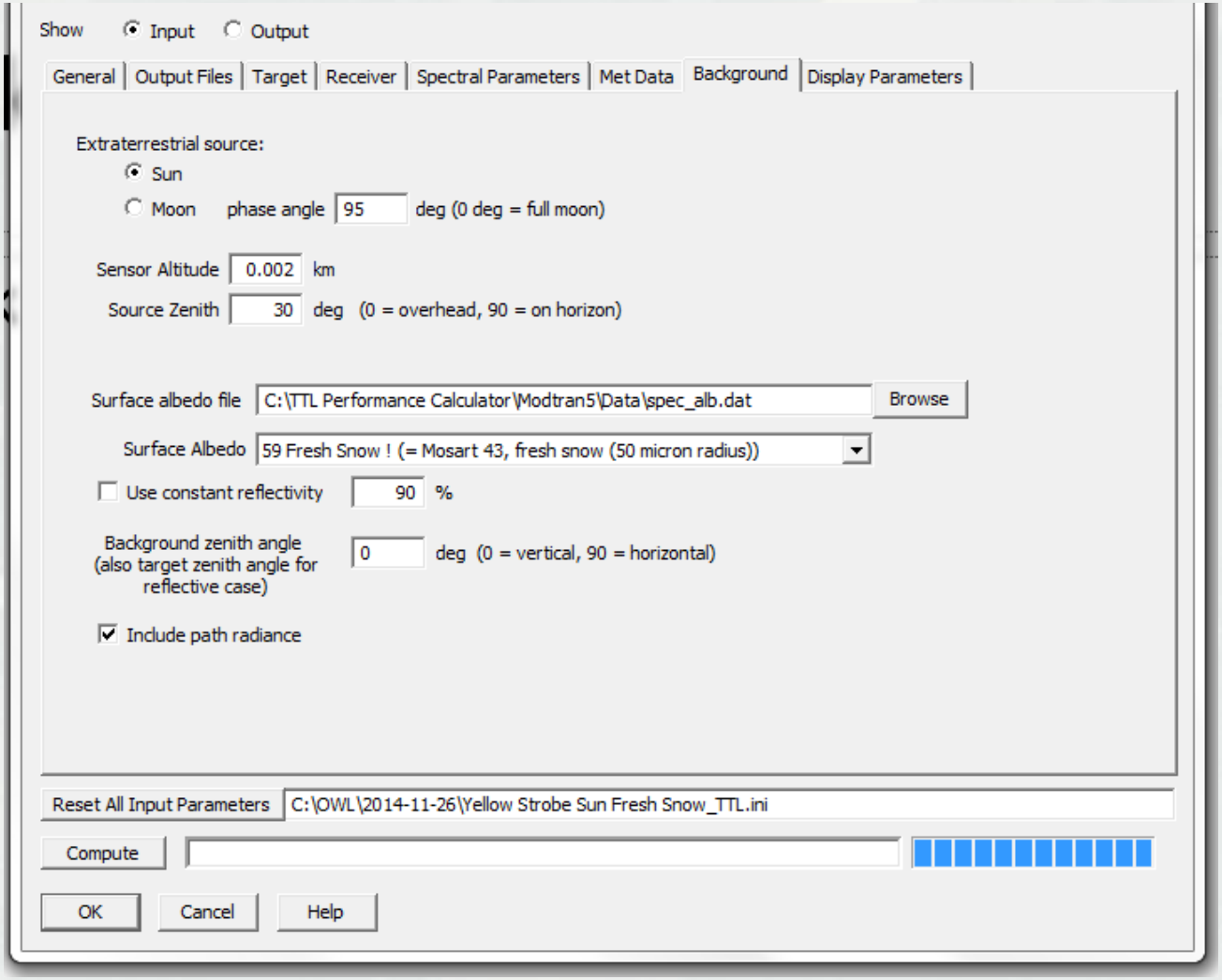
Phosphor- Forest Background



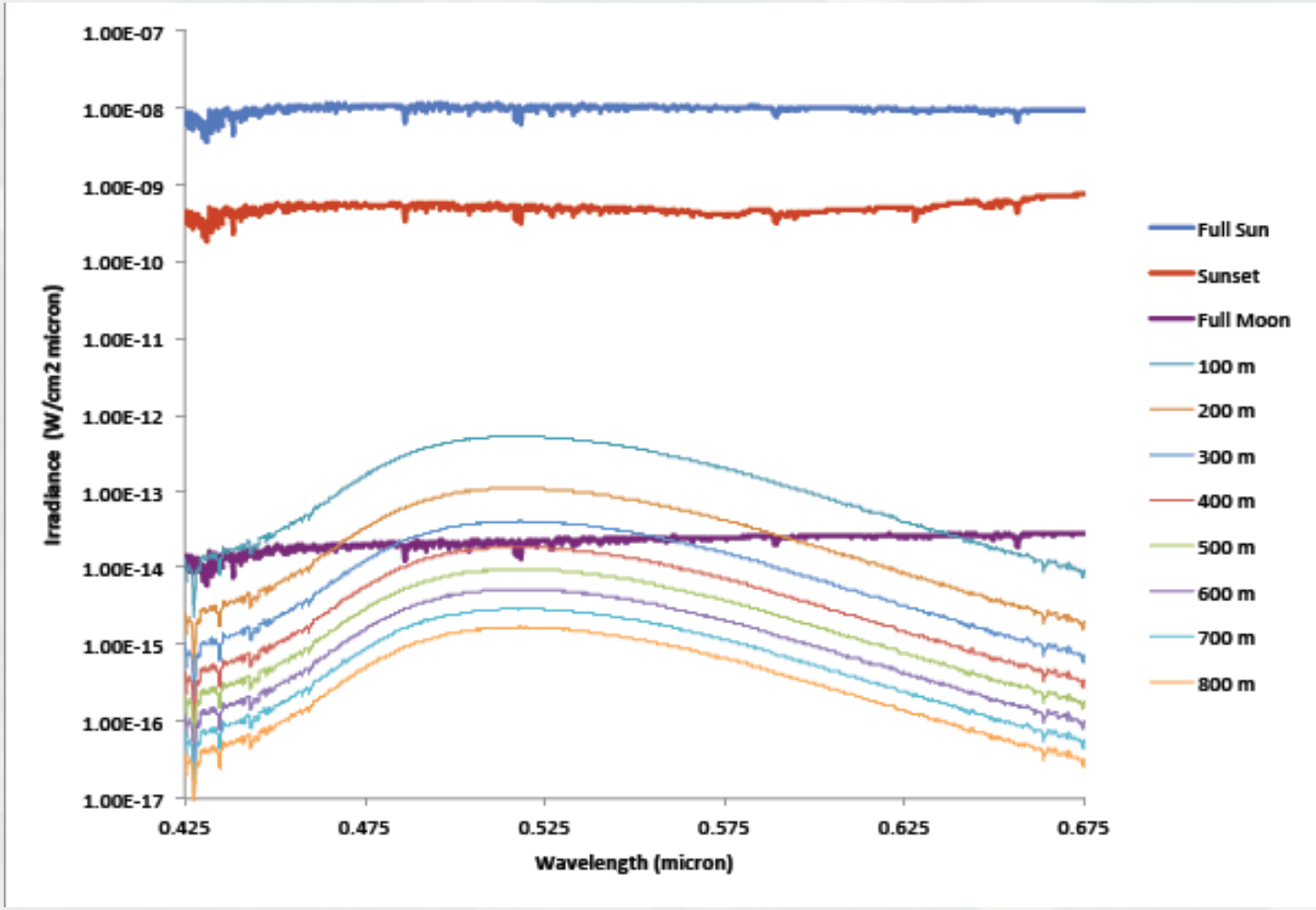
Phosphor- Forest Background



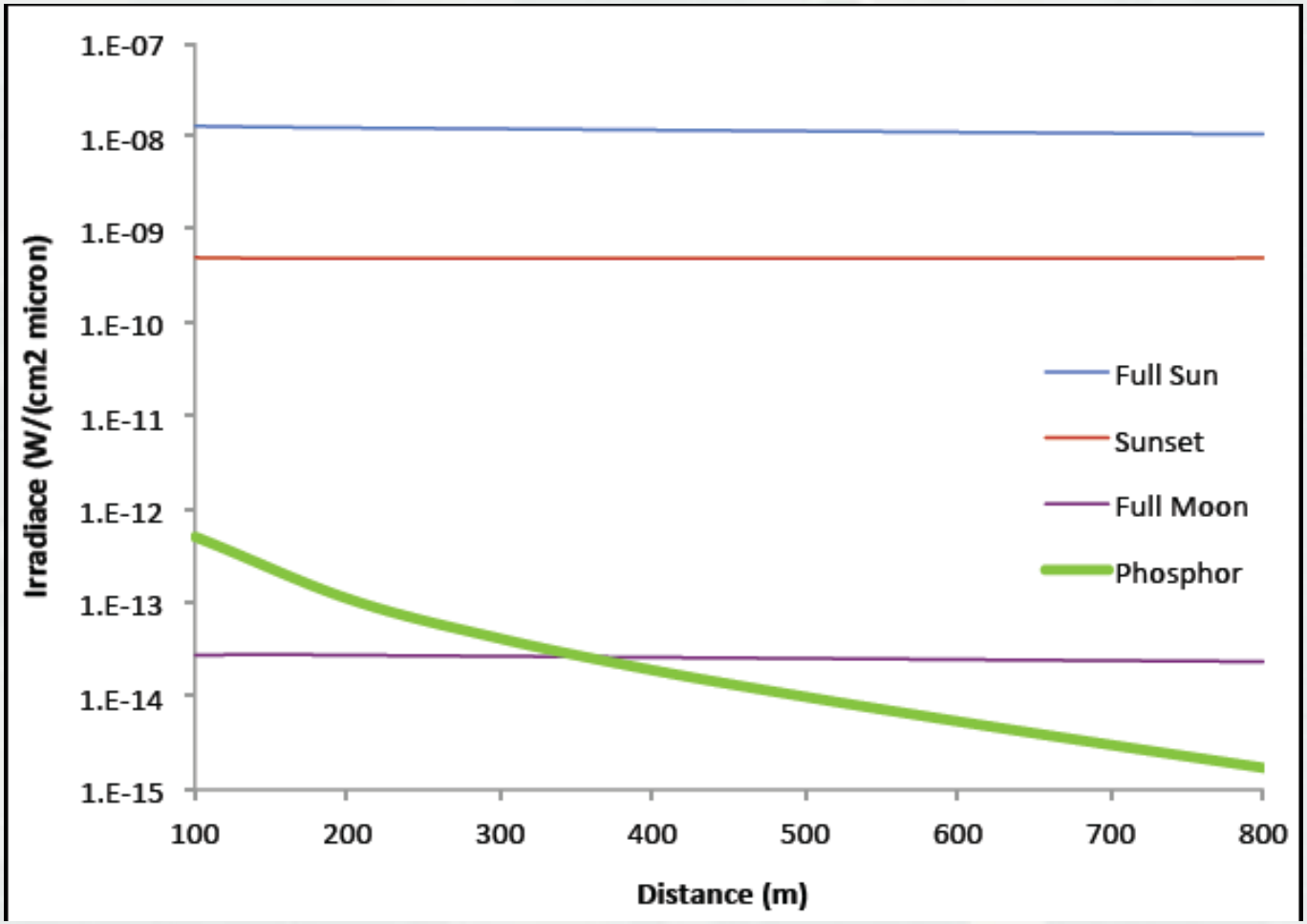
Background


Show
Input
Output
General
Output Files
Target
Receiver
Spectral Parameters
Met Data
Background
Display Parameters
Extraterrestrial source:
Sun
Moon
phase angle
95
deg (0 deg = full moon)
Sensor Altitude
0.002
km
Source Zenith
30
deg (0 = overhead, 90 = on horizon)
Surface albedo file
C:\TTL Performance Calculator\Modtran5\Data\spec_alb.dat
Browse
Surface Albedo
59 Fresh Snow ! (= Mosart 43, fresh snow (50 micron radius))
Use constant reflectivity
90
%
Background zenith angle
(also target zenith angle for
reflective case)
0
deg (0 = vertical, 90 = horizontal)
Include path radiance
Reset All Input Parameters
C:\OWL\2014-11-26\Yellow Strobe Sun Fresh Snow_TTL.ini
Compute
OK
Cancel
Help

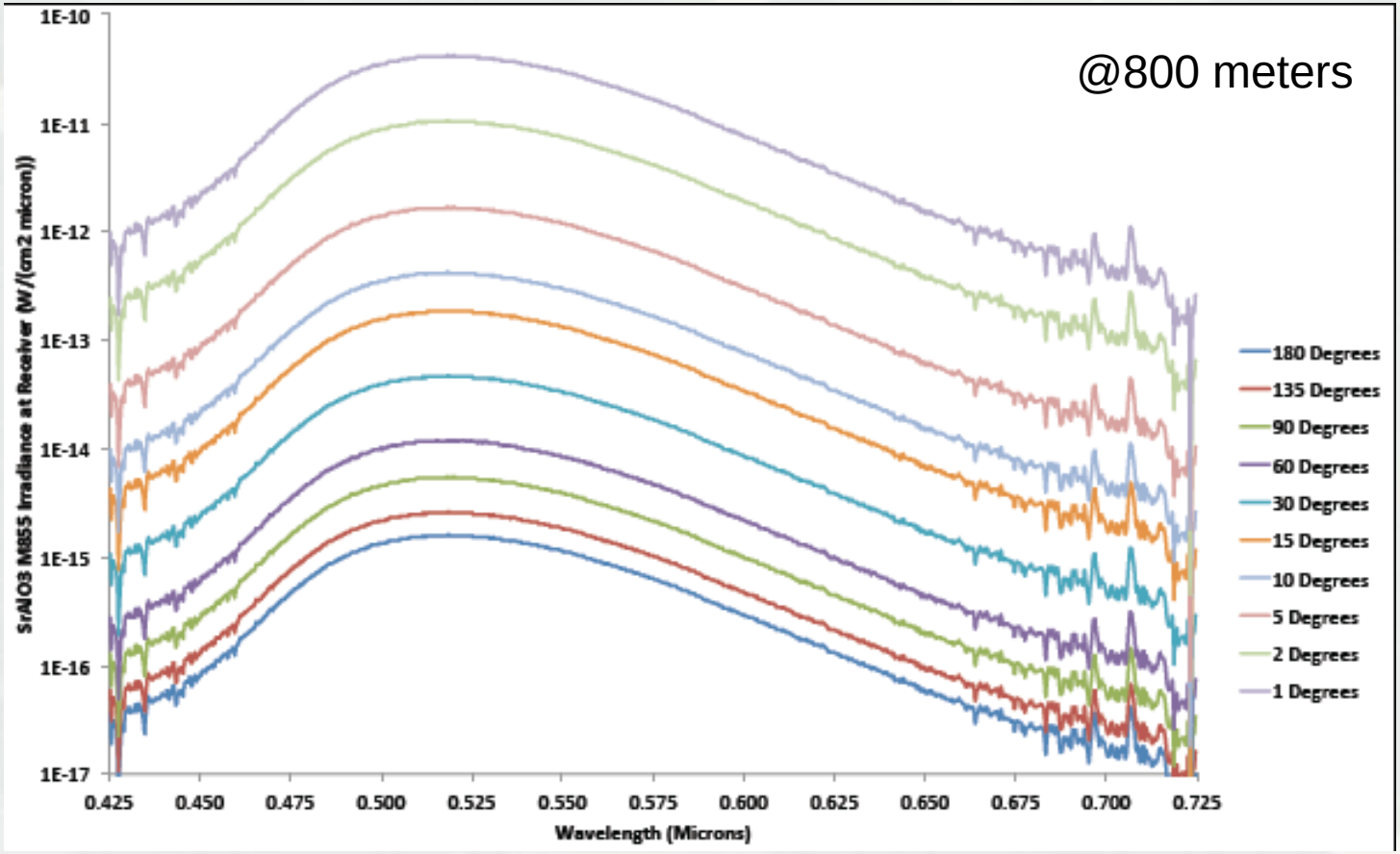
Phosphor- Snow Background



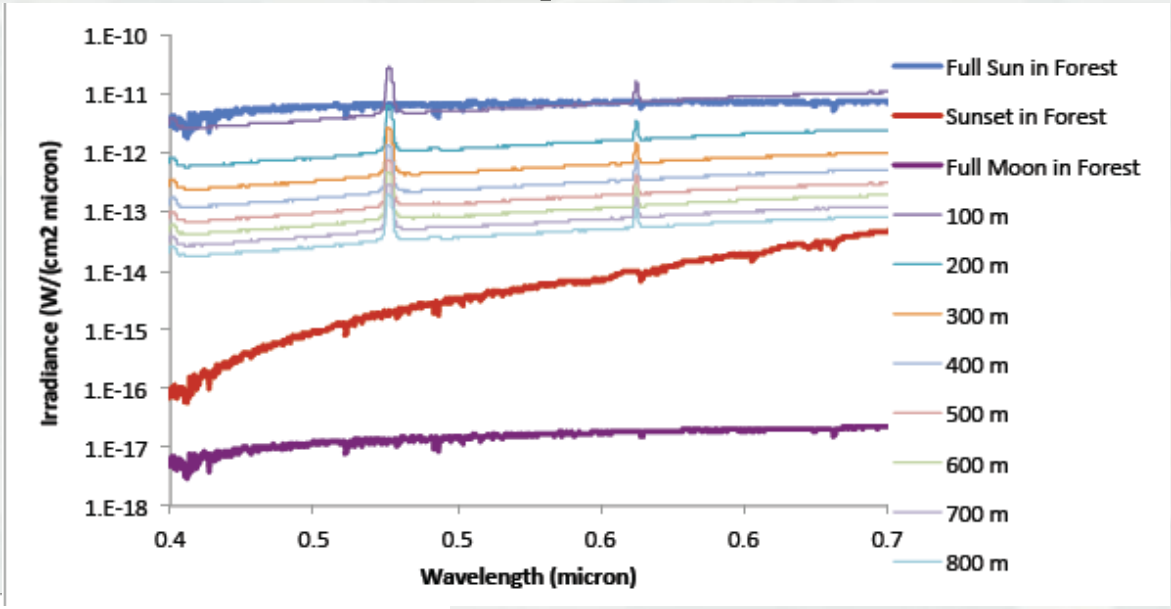
Phosphor- Snow Background

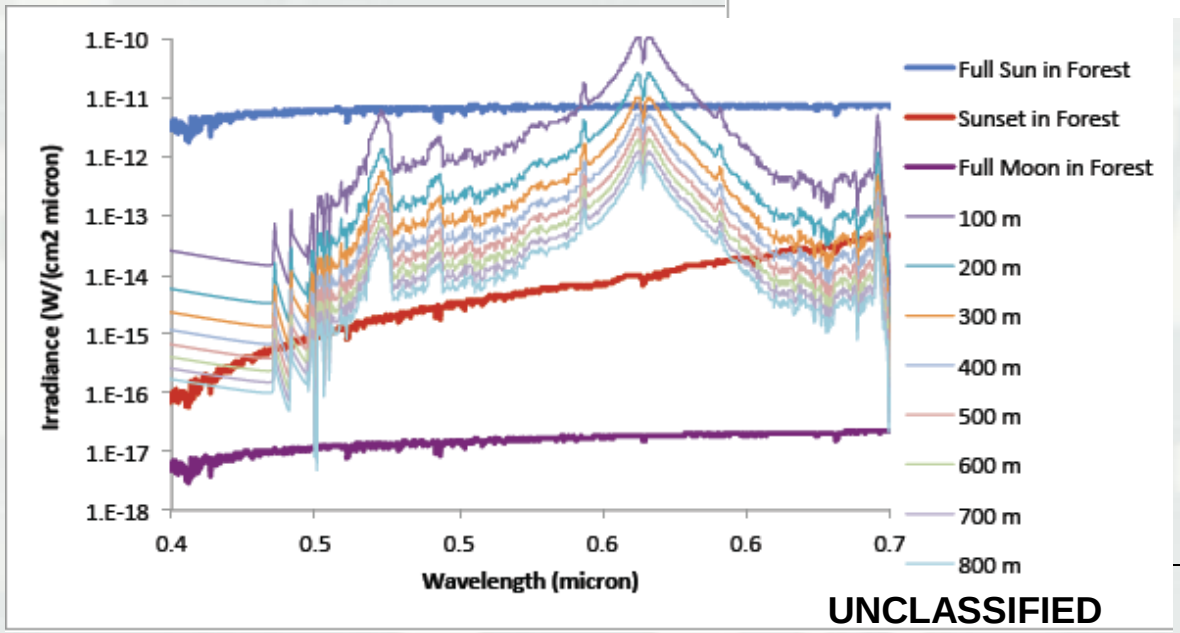


Angle Dependence

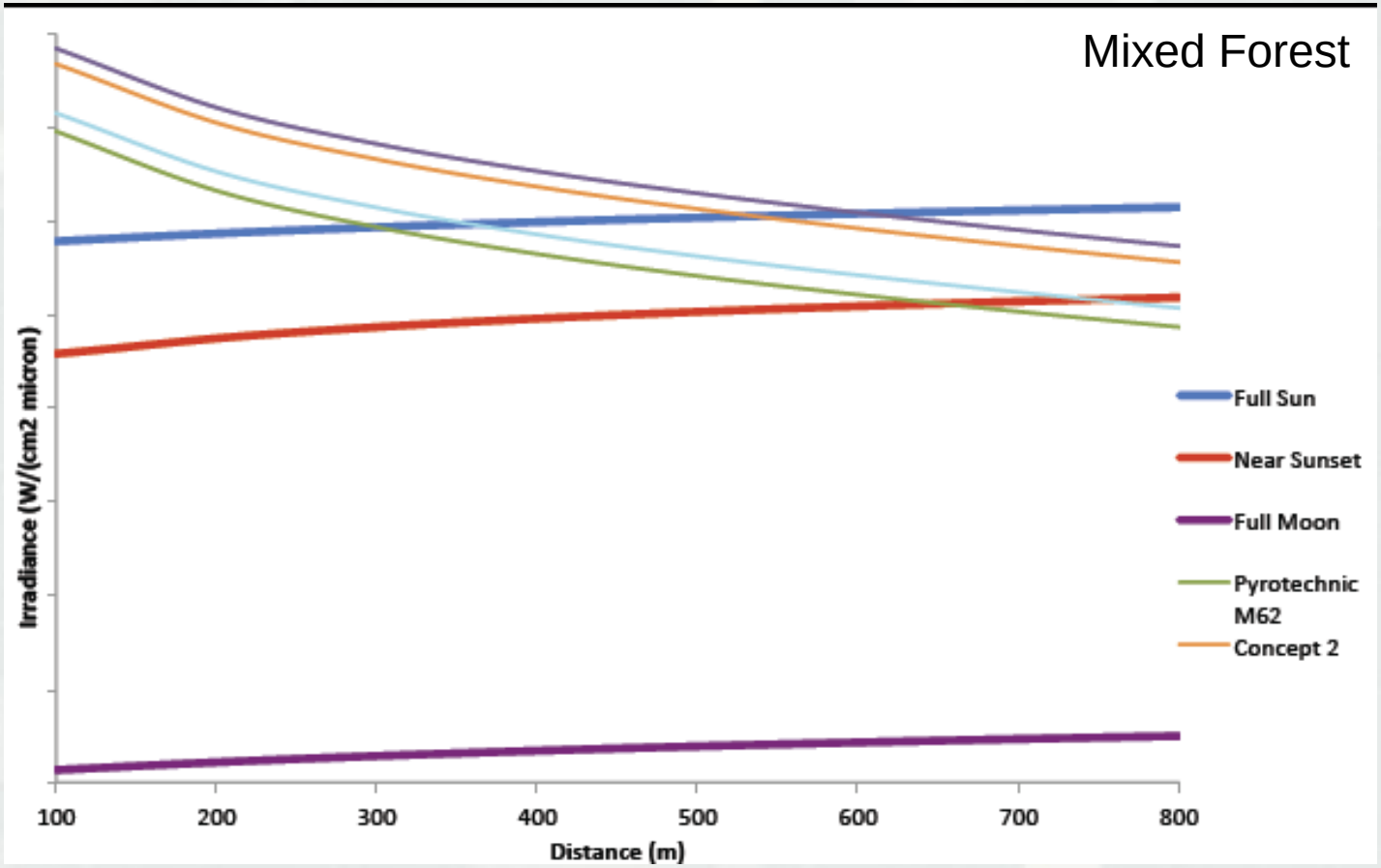


Various Concepts





Various Concepts vs M62



Conclusions

•Performance calculations were used to determine the distance that various tracer concepts can be seen with the naked eye.

• Performance calculations were done spectrally, to account for atmospheric transmission, fluorescent wavelengths, filter transmission, and background reflectivity.

• Calculations were performed under various solar and lunar conditions.

•Weather conditions (fog, clouds and rain) will also be studied.

• Upper boundary- 800 meter range desired in full sun with snow as the background.