Initial Commit Statement

# Functionality

* Object structure to support the custom writing of simulations of any QKD link
* Link loss model for a satellite to ground downlink including
  + Atmospheric loss, based on MODTRAN simulation data
  + Geometric loss
  + APT loss
  + Internal (efficiency) loss
* Simulation of satellite to ground QKD link through multiple different protocols
  + BB84
  + BB84 decoy
  + COW
  + DPS
  + E91
* Computation of background count rates due to light pollution at measured at HWU’s Errol site and other locations
* Computation of background count rates due to light from UK cities and simulated jamming terminals reflecting of satellite surface
* Files to support the simulation of many different orbits (including sun synchronous) and function to calculate the inclination and period of sun synchronous orbit of a given altitude.
* Approximation of the QBER and loss characteristics of several different HWU single photon detectors for varying repetition rate, including
  + Perkin Elmer
  + Excelitas
  + Laser Component
  + Hamamatsu
  + MPD
  + SNSPDs at 780 and 1550nm

# Objects

Subclasses are listed indented below their superclass. Abstract classes are *italicised.*

* PassSimulation
* *Link\_Model*
  + Satellite\_Link\_Model
  + Satellite\_Reflection\_Link\_Model
* *Located\_Object*
  + Background\_Source
    - Jamming\_Laser (also inherits from Telescope)
    - LPM\_City
  + Ground\_Station
    - Chilbolton\_OGS
    - Errol\_OGS
    - HWU\_OGS
    - York\_OGS
  + Satellite
* *DetectorFactory*
  + Excelitas\_Detector\_Factory
  + Generic\_Detector\_Factory
  + Hamamatsu\_Detector\_Factory
  + Laser\_Component\_Detector\_Factory
  + MPD\_Detector\_Factory
  + Perfect­\_Detector\_Factory
  + SNSPD\_1550\_Cryo\_Detector\_Factory
  + SNSPD\_1550\_Room\_Temp\_Detector\_Factory
  + SNSPD\_780\_Detector\_Factory
* *Detector*
  + BB84\_Detector
    - decoyBB84\_Detector
  + COW\_Detector
  + DPS\_Detector
  + E91\_Detector
* *Protocol*
  + BB84\_Protocol
  + decoyBB84\_Protocol
  + COW\_Protocol
  + DPS\_Protocol
  + E91\_Protocol
* *Source*
  + BB84\_Source
  + decoyBB84\_Source
  + COW\_Source
  + DPS\_Source
  + E91\_Source

# Resources

* Cities.mat a .mat file containing 14 UK cities implemented as background light sources
* Sun.mat a .mat file containing an implementation of the sun as a background light source
* Atmospheric\_Transmittance\_Legacy.mat a .mat file containing atmospheric transmittance data courtesy of Elizabeth Eso simulated in MODTRAN for different wavelengths for 90° elevation.
* Elevation\_Wavelength\_Atmospheric\_Transmittance.mat a .mat file containing atmospheric transmittance data courtesy of Elizabeth Eso simulated in MODTRAN for different wavelengths and elevations. This data is also included as spreadsheets in the same folder.
* ChilboltonWithHeadlights780nm.mat, ErrolWithMoon780nm.mat, ErrolWithMoon850nm.mat, HWU780nm.mat, HWU850nm.mat, York780nm.mat, York850nm.mat. .mat files containing background count rate data from site analyses of these locations.
* Multiple .script and .bak files allowing GMAT to be used to simulate various relevant orbits. In this context SS denotes sun synchronicity.
* Multiple .txt files containing longitude, latitude, altitude and time data for GMAT orbit simulations, used to interface data into satellite implementations. Again SS denotes sun synchronicity
* Multiple “Histogram.mat” files containing response histogram data for all detector types which can be used to compute QBER and losses due to detector timing jitter.