ctools - Action #3065

Add moon constraint to csviscube

11/14/2019 10:44 AM - Knödlseder Jürgen

Status:	Closed	**Start date:**	11/14/2019
Priority:	Normal	**Due date:**	
Assigned To:	Knödlseder Jürgen	**% Done:**	100%
Category:		**Estimated time:**	0.00 hour
Target version:	1.7.0		

Description

So far the csviscube only has a Sun constraint. A moon constraint should be added.

In the CTA scheduler, Pep Colomé mentioned that they take into account the sky brightness as a function of Moon altitude, Moon-target distance, and Moon phase.

So far there exists a moonzenith parameter that is however not yet used. It looks like a parameter that limits the sky brightness would be more appropriate. A moon model can for example be found in Britzger, D. (2009) (studies of the Influence of Moonlight on Observations with the MAGIC Telescope. Diploma thesis Universitat München. https://magicold.mpp.mpg.de/publications/theses/DBritzger.pdf). An alternative an simpler moon model can be found in attachment:1991PASP__103_1033K.pdf.

According to https://arxiv.org/pdf/1704.00906.pdf, MAGIC observations are typically done up to 12 times NSB_dark, where NSB_dark are the NSB conditions towards the Crab with no moon in the sky.

A much more simple scheme is used in attachment:SSTillumination.pdf. Here, the fractional lunar illumination (FLI) is used, which is fraction of the lunar disk that is illuminated at local civil midnight. In ESO standards, lunar dark time is when FLI < 0.4. Nevertheless, even if the moon illumination is small, a minimum distance to the moon should probably be respected (the MAGIC paper speaks about 20 deg). Hence it would make sense to add to more parameters to csviscube:
- moondist: the minimum distance from the moon
- flimax: the maximum allowed FLI

History

#1 - 11/14/2019 03:22 PM - Knödlseder Jürgen

- File viscube_south.png added

- File viscube_north.png added

- File viscube_south_womoon.png added

- File viscube_north_womoon.png added

- Status changed from New to Pull request

- Assigned To set to Knödlseder Jürgen

- Target version set to 1.7.0

- % Done changed from 0 to 100
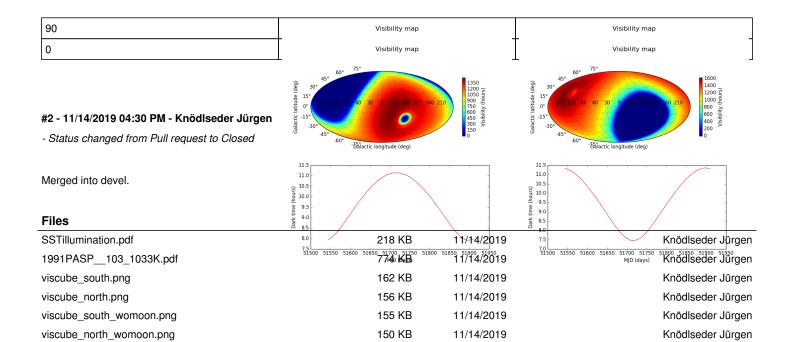
I implemented two Moon constraints:

- moonzenith, which is a minimum zenith angle required for the Moon, similar to the constrain of the Sun. If the Moon is higher in the sky than this zenith angle, the corresponding times are excluded
- maxfli, which is the maximum fraction of lunar illumination. If the fraction of lunar illumination is below this threshold, no Moon constraint is applied

I also added a binary extension table to the output FITS file that contains a number of parameters as function of time. Parameters include the Sun and Moon positions, the lunar elongation and fraction of illumination, and the dark time.

I also added a script show_viscube.py to display the visibility cube integrated over all zenith angles and the dark time as function of time. Below the results for the South site (geolon=79.4041, geolat=-24.6272) and the North site (geolon=17.8900, geolat=+28.7619) for sunzenith=105.0, moonzenith=90 and maxfli=0.4 (which are the default parameters) for one full year. In addition, results are also show for moonzenith=0 to illustrate the impact of the Moon constraint.

moonzenith	South	North

90	Visibility map	Visibility map
0	Visibility map	Visibility map

#2 - 11/14/2019 04:30 PM - Knödlseder Jürgen

- Status changed from Pull request to Closed

Merged into devel.

Files

SSTillumination.pdf	218 KB	11/14/2019	Knödlseder Jürgen
1991PASP__103_1033K.pdf	774 KB	11/14/2019	Knödlseder Jürgen
viscube_south.png	162 KB	11/14/2019	Knödlseder Jürgen
viscube_north.png	156 KB	11/14/2019	Knödlseder Jürgen
viscube_south_womoon.png	155 KB	11/14/2019	Knödlseder Jürgen
viscube_north_womoon.png	150 KB	11/14/2019	Knödlseder Jürgen