

## ctools - Support #2512

### ctools time (MET reference, and MJDREFF)

06/13/2018 01:13 PM - Sadeh Iftach

<b>Status:</b>	Closed	<b>Start date:</b>	06/13/2018
<b>Priority:</b>	Normal	<b>Due date:</b>	
<b>Assigned To:</b>	Knödseder Jürgen	<b>% Done:</b>	100%
<b>Category:</b>		<b>Estimated time:</b>	0.00 hour
<b>Target version:</b>			

#### Description

Hello,

I had a question about times in ctools.  
When I define an observation in python with:

```
tmin = (Time('2000-01-01T12:00:00', format='fits', scale='utc')).isot
tmax = (tmin + TimeDelta(40, format='sec')).isot
```

I would expect that the obs interval will be 0-40 sec.  
However, the output of ctobssim gives:

```
2018-06-13T10:02:32: +=====+
2018-06-13T10:02:32: | Parameters |
2018-06-13T10:02:32: +=====+
.....
2018-06-13T10:02:32: tmin .....: 2000-01-01T12:00:00.000
2018-06-13T10:02:32: tmax .....: 2000-01-01T12:00:40.000
.....
2018-06-13T10:02:32: +=====+
2018-06-13T10:02:32: | Simulate observation |
2018-06-13T10:02:32: +=====+
.....
2018-06-13T10:02:32: Time interval .....: 64.184 - 104.184 s
.....
```

This offset of 64.184 seconds seems to correspond to the choice of

MJDREFF=7.428703703703703x10-4

used e.g. by FERMI.

If this is not a bug, then the documentation in e.g., <http://cta.irap.omp.eu/ctools/users/tutorials/quickstart/simulating.html> is a bit misleading, as the true reference time is 2000-01-01T11:58:55.816.

This becomes even more confusing if one uses a temporal model, as in [http://gammalib.sourceforge.net/users/user\\_manual/modules/model.html#temporal-components](http://gammalib.sourceforge.net/users/user_manual/modules/model.html#temporal-components).

The examples encourages the user to use

```
MJDREFI = '51544'
MJDREFF = '0.5'
```

This choice is consistent with a reference time of 2000-01-01T12:00:00.  
However, in order to really match the time reference used by ctobssim, one needs to set

MJDREFF = '0.50074287037037037'

(add 64.184 sec) or alternatively, to use

```
tmin = (Time('2000-01-01T12:00:00', format='fits', scale='utc') - TimeDelta(64.184, format='sec')).isot
tmax = (tmin + TimeDelta(40, format='sec')).isot
MJDREFF = '0.5'
```

Then one gets

```
2018-06-13T10:09:47: +=====+
2018-06-13T10:09:47: | Parameters |
2018-06-13T10:09:47: +=====+
.....
2018-06-13T10:09:47: tmin .....: 2000-01-01T11:58:55.816
2018-06-13T10:09:47: tmax .....: 2000-01-01T11:59:35.816
.....
2018-06-13T10:09:47: +=====+
2018-06-13T10:09:47: | Simulate observation |
2018-06-13T10:09:47: +=====+
.....
2018-06-13T10:09:47: Time interval .....: 0 - 40 s
```

In this case, the base reference time defined in the temporal model (i.e., model\_temporal\_lightcurve.fits in the example) would indeed be zero seconds.

I'd appreciate some advice on whether this behaviour is a bug, or if I have made a mistake myself.

What is the true reference time in ctools?

What is the recommended way to define the time reference in a temporal model fits file?

As a side note, it would be very handy if an example model\_temporal\_lightcurve.fits file was included in the tutorialsop. Creating it from scratch for a first-time user was non trivial.

Thanks for the advice,  
lftach.

## History

### #1 - 06/13/2018 02:40 PM - Knödseder Jürgen

- Status changed from New to In Progress
- Assigned To set to Knödseder Jürgen
- % Done changed from 0 to 10

The difference comes from the fact that the time string is in the UTC time system, while the seconds reported by ctobssim is in the TT time system. The difference between both systems is 64.18 sec at the specified time. You may check this using the xTime tool, specifying UTC as input and TT as output:

[https://heasarc.gsfc.nasa.gov/cgi-bin/Tools/xTime/xTime.pl?time\\_in\\_i=2000-01-01T12%3A00%3A00.000&time\\_in\\_c=&time\\_in\\_d=&time\\_in\\_j=&time\\_in\\_m=&time\\_in\\_sf=&time\\_in\\_wf=&time\\_in\\_sl=&time\\_in\\_sni=&time\\_in\\_snu=&time\\_in\\_s=&time\\_in\\_h=&time\\_in\\_sz=&time\\_in\\_ss=&time\\_in\\_sn=&timesys\\_in=u&timesys\\_out=t&apply\\_clock\\_offset=yes](https://heasarc.gsfc.nasa.gov/cgi-bin/Tools/xTime/xTime.pl?time_in_i=2000-01-01T12%3A00%3A00.000&time_in_c=&time_in_d=&time_in_j=&time_in_m=&time_in_sf=&time_in_wf=&time_in_sl=&time_in_sni=&time_in_snu=&time_in_s=&time_in_h=&time_in_sz=&time_in_ss=&time_in_sn=&timesys_in=u&timesys_out=t&apply_clock_offset=yes)

The interpretation of the times in the light curve file depend on the keywords in the light curve file header. If TIMESYS='TT' then you need to specify also times in the TT time system in the table. If you want times in UTC you need to specify TIMESYS='UTC'.

Please let me know if this answers your questions. I recognize that these issues should be better explained on the documentation web pages.

## #2 - 06/13/2018 04:15 PM - Sadeh Iftach

Thanks, Jürgen.

For completeness, here's a self consistent configuration which works with the model\_temporal\_lightcurve.fits file.  
- parameters:

```
deltaT = TimeDelta(40, format='sec')
tmin = Time('2000-01-01T12:00:00', format='fits', scale='tt')
tmax = tmin + deltaT
tmin = str(tmin.utc) # == "2000-01-01T11:58:55.816(UTC)"
tmax = str(tmax.utc) # == "2000-01-01T11:59:35.816(UTC)"
MJDREFI = '51544'
MJDREFF = '0.5'
TIMESYS = 'TT'
TIMEREF = 'LOCAL'
TIMEUNIT = 's'
```

- output:

```
2018-06-13T13:39:17: +=====+
2018-06-13T13:39:17: | Parameters |
2018-06-13T13:39:17: +=====+
.....
2018-06-13T13:39:17: tmin .....: 2000-01-01T11:58:55.816(UTC)
2018-06-13T13:39:17: tmax .....: 2000-01-01T11:59:35.816(UTC)
.....
2018-06-13T13:39:17: +=====+
2018-06-13T13:39:17: | Simulate observation |
2018-06-13T13:39:17: +=====+
.....
2018-06-13T13:39:17: Time interval .....: 0 - 40 s
```

---

I'm still slightly confused about the input to ctobssim. If I try to explicitly do

```
tmin = Time('2000-01-01T12:00:00', format='fits', scale='tt')
tmax = tmin + deltaT
tmin = str(tmin.tt)
tmax = str(tmax.tt)
TIMESYS = 'UTC'
```

I get

```
2018-06-13T13:53:47: +=====+
2018-06-13T13:53:47: | Parameters |
2018-06-13T13:53:47: +=====+
.....
2018-06-13T13:53:47: tmin .....: 2000-01-01T12:00:00.000(TT)
2018-06-13T13:53:47: tmax .....: 2000-01-01T12:00:40.000(TT)
.....
2018-06-13T13:53:47: +=====+
2018-06-13T13:53:47: | Simulate observation |
2018-06-13T13:53:47: +=====+
.....
2018-06-13T13:53:47: Time interval .....: 64.184 - 104.184 s
```

and a consistent model\_temporal\_lightcurve.fits file.  
However, the quoted reference is now

```
2018-06-13T13:53:47: Time interval .....: 64.184 - 104.184 s
```

Looking at the docs at <http://cta.irap.omp.eu/ctools/users/tutorials/quickstart/simulating.html> , it says that one can set the reference system of

ctobssim by e.g. "MJD 58849.0 (TAI)".

I would therefore have expected that 2000-01-01T11:58:55.816(UTC) and 2000-01-01T12:00:00.000(TT) would be equivalent (and would both indicate the [0 - 40 s] interval). However, the string input to ctobssim seems to always be interpreted as UTC

**#3 - 06/13/2018 05:50 PM - Knödseder Jürgen**

Indeed, UTC and TT are different time scales, so "UTC in TT" does not really make sense, that's why it is not supported.

**#4 - 06/14/2018 09:20 AM - Sadeh Iftach**

- *Status changed from In Progress to Closed*

- *% Done changed from 10 to 100*

Thanks again for the quick replay!