

Additional instructions for programme 70-508

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Statement

In order to successfully perform these observations, one needs to use three tools at the same time:

- The asteph tool (providing ephemerides and rates)
- The hitandrun tool (keeping up the non-sidereal rate of the telescope with the non-sidereal rate of the asteroid)
- The OB script for the instrument (ALFOSC by default)

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- Working principle of hitandrun
- What to expect from asteph
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Asteph – new capabilities (1/4)

- Object types (-t)
 - asteroid (default)
 - comet
 - unconfirmed (ephemerides calculated in-house on the fly)
 - horizons

Asteph – new capabilities (2/4)

- Guiding rates (-r)
 - full (default)
 - half (used for weird cases like polarimetry of slow targets)
- Position angle modes (-m)
 - ima (default; for imaging)
 - fixed (current rotator position for fast imaging, not yet added)
 - para (parallactic angle; for slow spectroscopy)
 - along-slit (motion vector along slit; for fast spectroscopy)
 - optimal-ll (for extended guided fast spectroscopy, dimension 1)
 - optimal-lr (for extended guided fast spectroscopy, dimension 2)

Asteph – new capabilities (3/4)

- Guiding (-g)
 - on
 - blind
 - update
- Arbitrary time (-e) (if omitted, uses current time)
- Object name (-n) (Only mandatory flag; spelling convention varies for different types)

Asteph (4/4)

- Not all flag combinations are allowed.
- Full documentation at <https://www.not.iac.es/observing/too/P70/P70-508/HOWTO>

What does hitandrun do? (1/4)

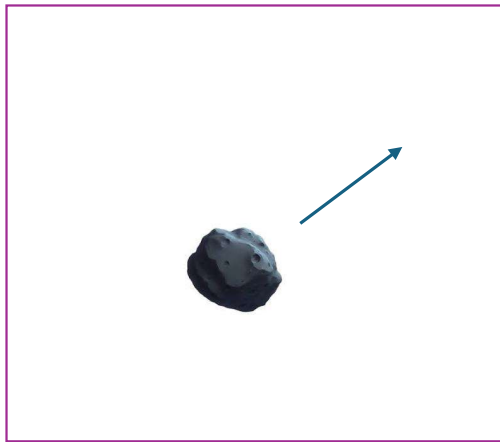
ALFOSC FOV,
sidereal tracking



- The telescope arrives to a future position of the asteroid and waits.

What does hitandrun do? (2/4)

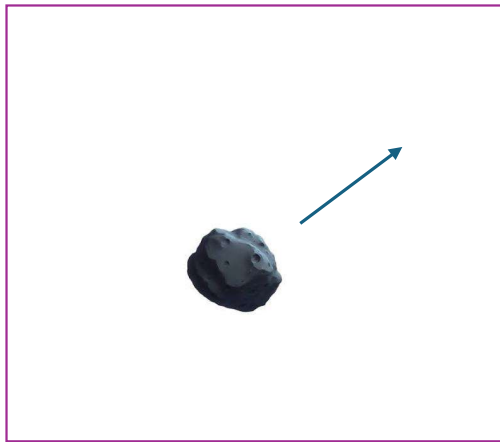
ALFOSC FOV,
sidereal tracking



- The asteroid arrives at the FOV of ALFOSC at a pre-calculated time.

What does hitandrun do? (3/4)

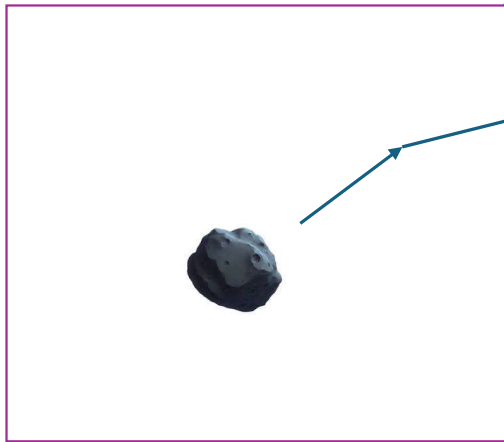
ALFOSC FOV, non-
sidereal tracking



- At the moment the asteroid is in the centre of FOV (according to provided ephemerides), the non-sidereal tracking is switched on.
- Now you can integrate

What does hitandrun do? (4/4)

ALFOSC FOV, updated
non-sidereal tracking



- The non-sidereal tracking rate of the telescope is updated accordingly with the changing rate of the asteroid.
- No need to interfere with integration!

Hitandrun syntax

```
hitandrun CAXA292 hitandrun.input '2024-Oct-02 20:24:00.000' 10 3600 ima
```

Name of target

Name of hitandrun ephemeris file (usually always the same)

Time step in the near future where the telescope will be pointing and start non-sidereal tracking. Unfortunately, the '.000' is necessary 😞

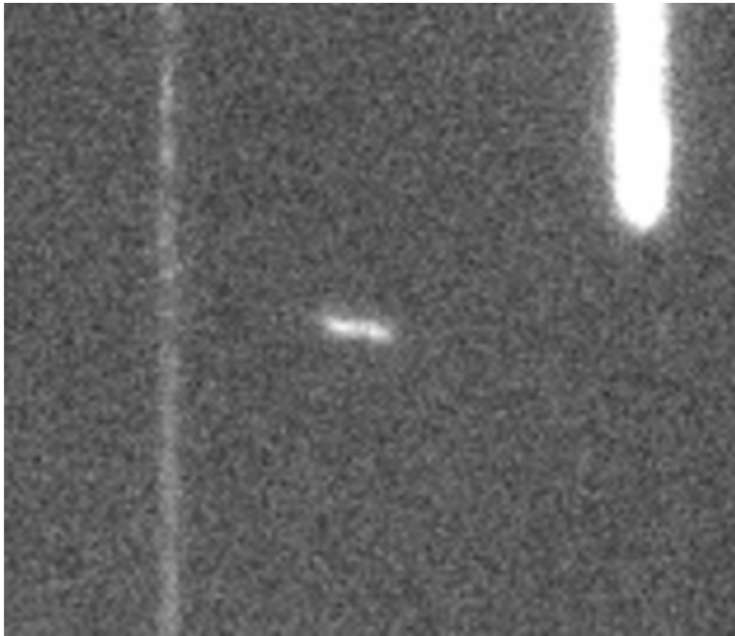
How often are rates updated (in s)? 1 is minimum, 10 seemed ok for ~2000"/hr

How many times are rates updated

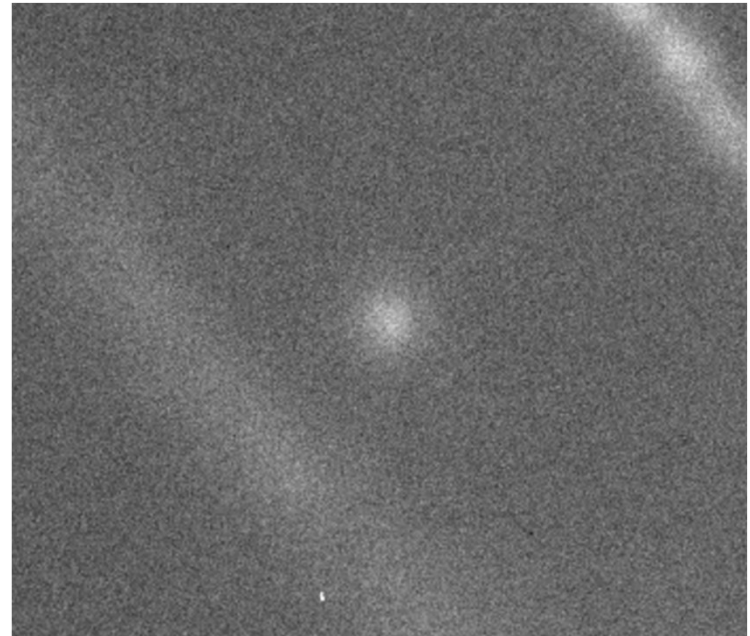
Field-rotator options: 'ima', 'fixed', 'para', or number for along-scan

Imaging results

Without hitandrun



With hitandrun



How the decision what to observe is made

- Brightness
 - $18 > V > 20$ -> photometry
 - $V < 18$ -> spectroscopy
- Velocity
 - $\text{Vel} < 200$ "/hr -> -g on (normal guiding with repositioning guide probe)
 - $\text{Vel} > 200$ "/hr -> -g update (new capability, three-sequencer-window juggling)

... so, for tcs.astepph, one would probably only need to use

- For the majority of targets

```
tcs.astepph -t unconfirmed -g update -n $NAME
```

```
tcs.astepph -t asteroid -g update -n $NAME
```

- For reasonably slow targets

```
tcs.astepph -t unconfirmed -g on -n $NAME
```

```
tcs.astepph -t asteroid -g on -n $NAME
```

- We are still thinking about field rotator angles (-p)

How to observe with '-g update' ? (1/6)

Seq 1:

```
tcs.astepph -t  
<unconfirmed|  
asteroid> -g update -n  
$NAME
```

-> produces file
hitandrun.input

Takes several minutes

Seq 2:

Seq 3:

How to observe with '-g update' ? (2/6)

Seq 1:

tcs.asteph
output done and
ok

Seq 2: OB

Run photometry
or spectroscopy
script

Until 'wait for
asteph' – leave
waiting

Seq 3:

How to observe with '-g update' ? (3/6)

Seq 1:

tcs.astepph
output done and
ok

Seq 2: OB

OB script is
waiting...

Seq 3:

Hitandrun will
first point to the
position in the
near future

How to observe with '-g update' ? (4/6)

Seq 1:

tcs.astepph
output done and
ok

Seq 2: OB

OB script is still
waiting...

Seq 3:

After arriving at
position, press
Enter when
guiding -> not
actually guiding,
but ensuring
correctness of
pointing

How to observe with '-g update' ? (5/6)

Seq 1:

tcs.asteph
output done and
ok

Seq 2: OB

OB script is still
waiting...

Seq 3:

Once time
matches
position,
constantly
updating blind
tracking begins

How to observe with '-g update' ? (6/6)

Seq 1:

tcs.astepph

Seq 2: OB

Now, press Enter
to continue OB
script and start
integration

Seq 3:

Hitandrun is
updating every n
seconds

Typical cases of failure

- 1. What if the object was unconfirmed at submission but became confirmed between submission and execution?
 - In this case `asteph` should give you a new asteroid designation on the command line. Rerun with `-t` asteroid and the new name.
- 2. What if `asteph` cannot calculate an orbit?
 - You can retry a couple of times, but if it doesn't work then there is nothing you can do about it, so just abort the observations.
- 3. What if things stop working at midnight UTC?
 - `Asteph` doesn't handle change of dates for `-g` update. Rerun `asteph` after change of date (in UTC).

Requested testing

- Testing a really unconfirmed object
- Testing spectroscopy – does hitandrun work accurately enough for asteroid to remain on the slit?
- Testing spectroscopy – which is the optimal slit: 1.8” or 2.5”?
- Testing spectroscopy – which position angle is optimal?
- Any bugs / usability suggestions are very welcome!