

→ RIDDLE #5

ESA's NEO Coordination Centre

Scanning the sky like a fly

The explosion of a 20 metre meteoroid over the city of Chelyabinsk happened just 7 years ago. Many buildings were damaged and more than 1500 people were hospitalised. And there was no pre-warning. In order to reduce the risk that we are taken by surprise by an asteroid that is impacting on Earth, ESA and NASA are regularly scanning the sky to detect these potentially hazardous objects early enough.

Now ESA wants to reinforce its efforts and develops a new telescope called the Flyeye Telescope. Why Flyeye? Because the incoming light is reflected from its 1.15 m main mirror to a beam splitter that distributes the field-of-view to 16 different cameras (see Fig. 1), just like the facets of an eye of a fly produce a compound image of its environment. With this novel approach, with one exposure an area in the sky measuring 6.7 deg by 6.7 deg can be imaged. Rather than scanning the full sky over two weeks, the Flyeye Telescope can scan the entire night sky in two nights. The final location of the first Flyeye Telescope will be Monte Mufara in Sicily (Italy) and a second telescope will go to Chile.

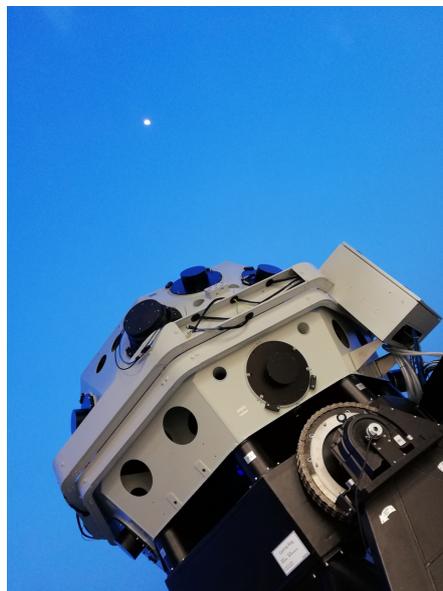
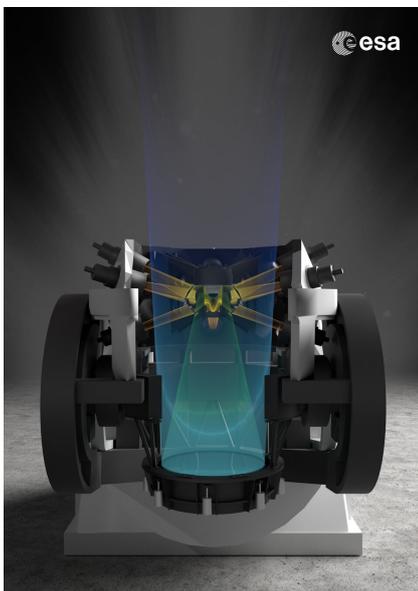


Figure 1: ESA's Flyeye telescope. On the left: light pathways through the telescope. On the right: the telescope watching the sky at its integration site, Turate (Italy)

In order to tell the telescope where to look at each moment of the night, an observation plan has to be established. To make life a bit easier, programmers usually divide the sky in fields (this is called tessellation of the sky) and write scripts that tell the telescope to move at time t to a field with the field-ID x . For the ESA telescope in Tenerife these fields are arranged in latitude bands. Of course as the latitude circles shrink towards the North pole, these fields start to overlap more and more, but not too much. For the Flyeye telescope we have one additional difficulty as the field-of-view of the telescope is rotated by 45 deg.

And here comes our next riddle:

Design a tessellation of the sky with squares measuring 6.7 deg by 6.7 deg and rotated by 45 deg such that the whole sky is covered, i.e. there must not be gaps between the squares. We are looking for the solution with the smallest number of squares but a complete coverage of the sky. Fig. 2 shows an attempt for a tessellation, but with quite some gaps towards the North pole (and similarly around the South pole). To clarify the rotation of the fields: the line from the North point of the field to its South point must always lie on a meridian. However, the fields that cover the North or South pole itself can have any orientation.

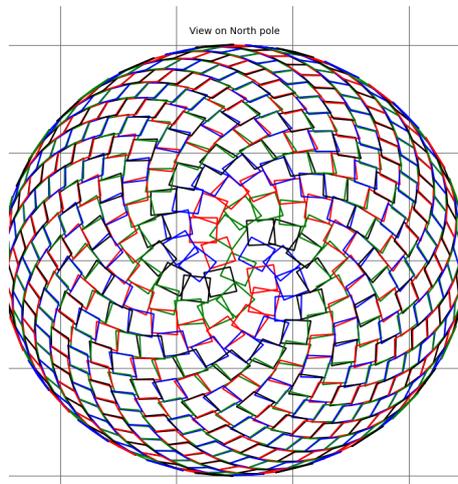


Figure 2: Attempt for a Flyeye tessellation of the sky with gaps around the North pole

Please, send your responses before the proposed deadline to the following e-mail: neocc@ssa.esa.int.

Use as subject of your e-mail: "Riddle #5 – solution".

Moreover, please let us know if you would prefer not to have your name included in the list of correct replies.

N.B.: in order to check if your responses satisfy the requirement that there are no gaps we ask you to send us a file with the coordinates of the centres of each field, either in right ascension and declination or in Cartesian coordinates assuming a radius of the sphere of 1 (i.e. the length of the vector to each centre shall be 1). Pictures of your solution will not be enough.

neo.ssa.esa.int

To subscribe to our newsletter, fill the form at <http://neo.ssa.esa.int/subscribe-to-services>

To unsubscribe or for any further information, please send an email to neocc@ssa.esa.int

