Archeops Optical Configuration for Trapani 1999 flight

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From various document (and contributions from Bertrand Gautier, Fred Gannaway, Peter Ade, Bruno Maffei, Ravinder Bhatia and Alain Benoit), here is a summary of the optical configuration of telescope+ photometer that is planned for Trapani Test flight in July 1999 (and Kiruna 2001).

The telescope, as shipped to Grenoble by Shaul Hanany, should have the following characteristics (version 7):
off-axis gregorian telescope with a parabolic primary and ellipsoid concave secondary, satisfying the Dragone condition.
Overall size: 1500 by 2420 by 1160 mm
Primary apparent diameter: 1500 mm (real projected diameter is 1780 on a tangent to the outside rim)
Off-axis angle is about 60 deg.
Primary focal length: 1112 (from primary mirror center to focus)

Secondary projected diameter is 800 mm (oversized with respect to the 23 degrees (30 dB limit) given by the horns which project to 650 on the secondary).
The Secondary conjugates the primary focus onto the focal surface (which is not a really a plane): distance as measured with the chief ray from secondary to the focal surface is 815 mm away, diatance from primary focus to secondary is 490.
The Primary center is imaged by the secondary at a distance of 440 from the focal surface. This point is aimed at by all the horns to minimise sidelobes.
The focal plane itself is a surface of a sphere with a radius of curvature of 1010 mm. it is concave toward the incoming beam (so the center of the sphere is toward the secondary).

The focal length of equivalent telescope is 800, so the f number is 800/1500= 0.5333. Hence the focal surface scale is 13.96 mm/ deg on the sky.

At Trapani, on the focal surface, the radius from the center bolometer axis to the ring bolometer axis is 28.6 (by construction); that's a separation of 2.048 degrees on the sky. The Kiruna hexagonal compact configuration will give 1.21 degrees between nearby bolometers.

The used distance between the back-to-back horn mouth to the focal phase center is taken as 12 mm (although it actually depends on the wavelength 5 at 2 mm and 18 at 1.2 mm)

Fig1: Trapani 1999 configuration: the arrow is scan drift direction

The bolometer base is shown (it is not the focal surface). One hexagon is the imprint of one bolometer (20 mm side). On the sky nearby bolometers are separated by 2.048 degrees.

The four nominal bolometers could be placed as:

143 Ghz in position 1 and 6

217 Ghz in position 4 and 5

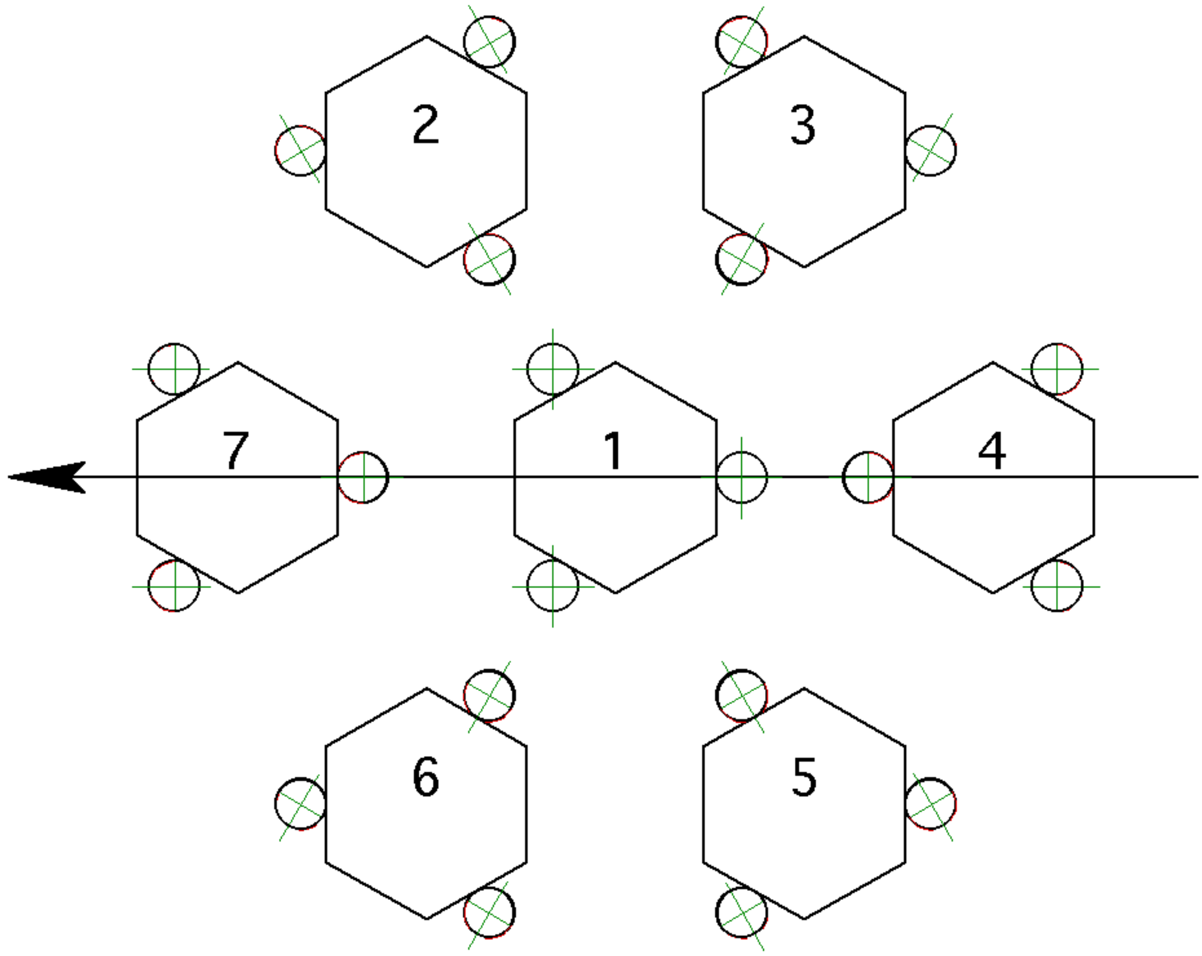

Fig. 2: Kiruna configuration: scan drift direction is horizontal

The bolometer base is shown (it is not the focal surface). One hexagon is the imprint of one bolometer (20 mm side, 1mm spacing). On the sky nearby bolometers are separated by 1.21 degree.

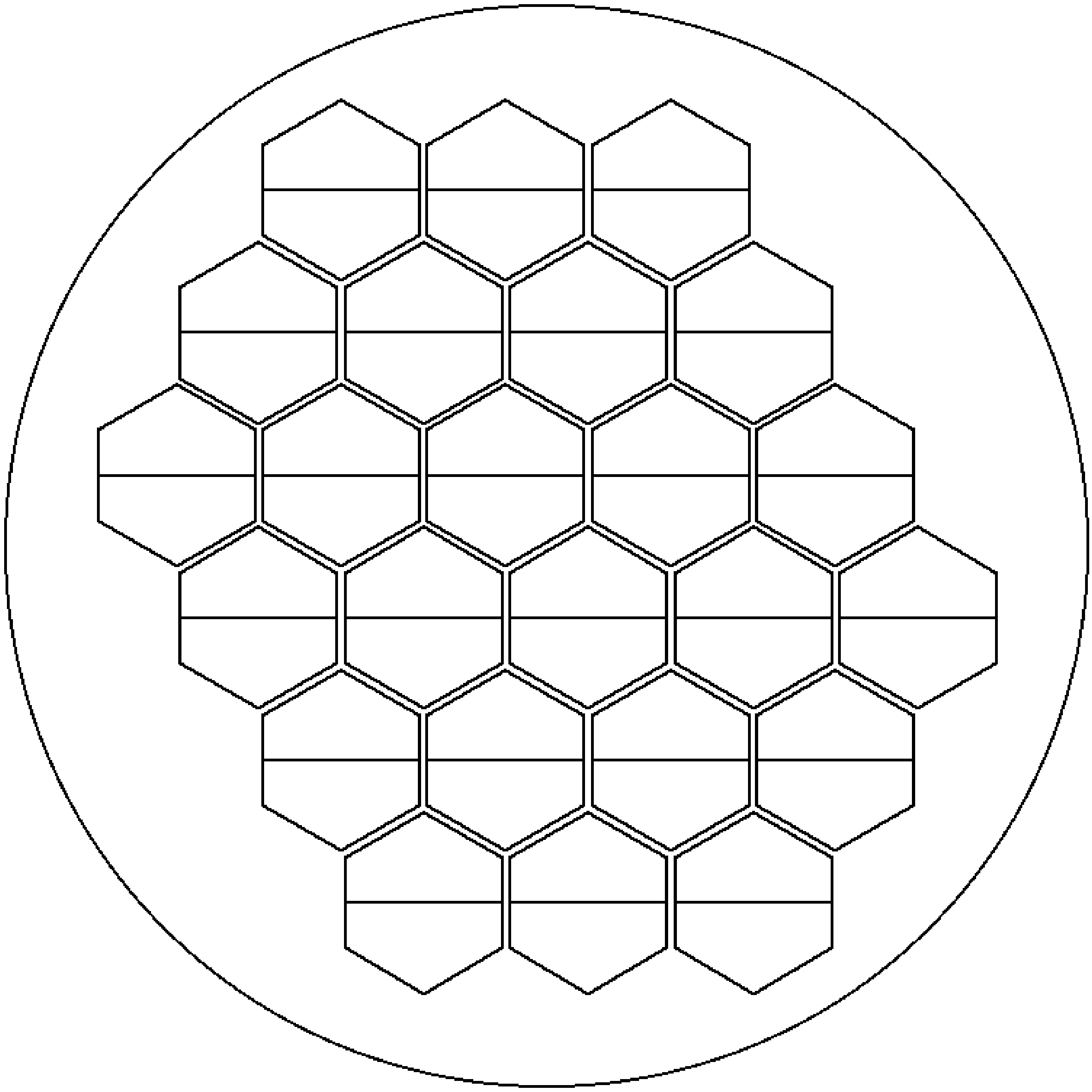

Fig. 3: Cold optics for Trapani flight: Sphere 1 is centered on the image of the primary mirror center through the secondary mirror. The back-to-back horns are aiming at that point. The focal phase center is on the Sphere 2. For the chief ray this is inside the horns at the nominal 12mm distance. (there is a slight displacement of 0.5 mm between sphere 1 and 2 for off-center bolometers)