The SPHERE – Atmospheric Cherenkov Light Imaging Detector

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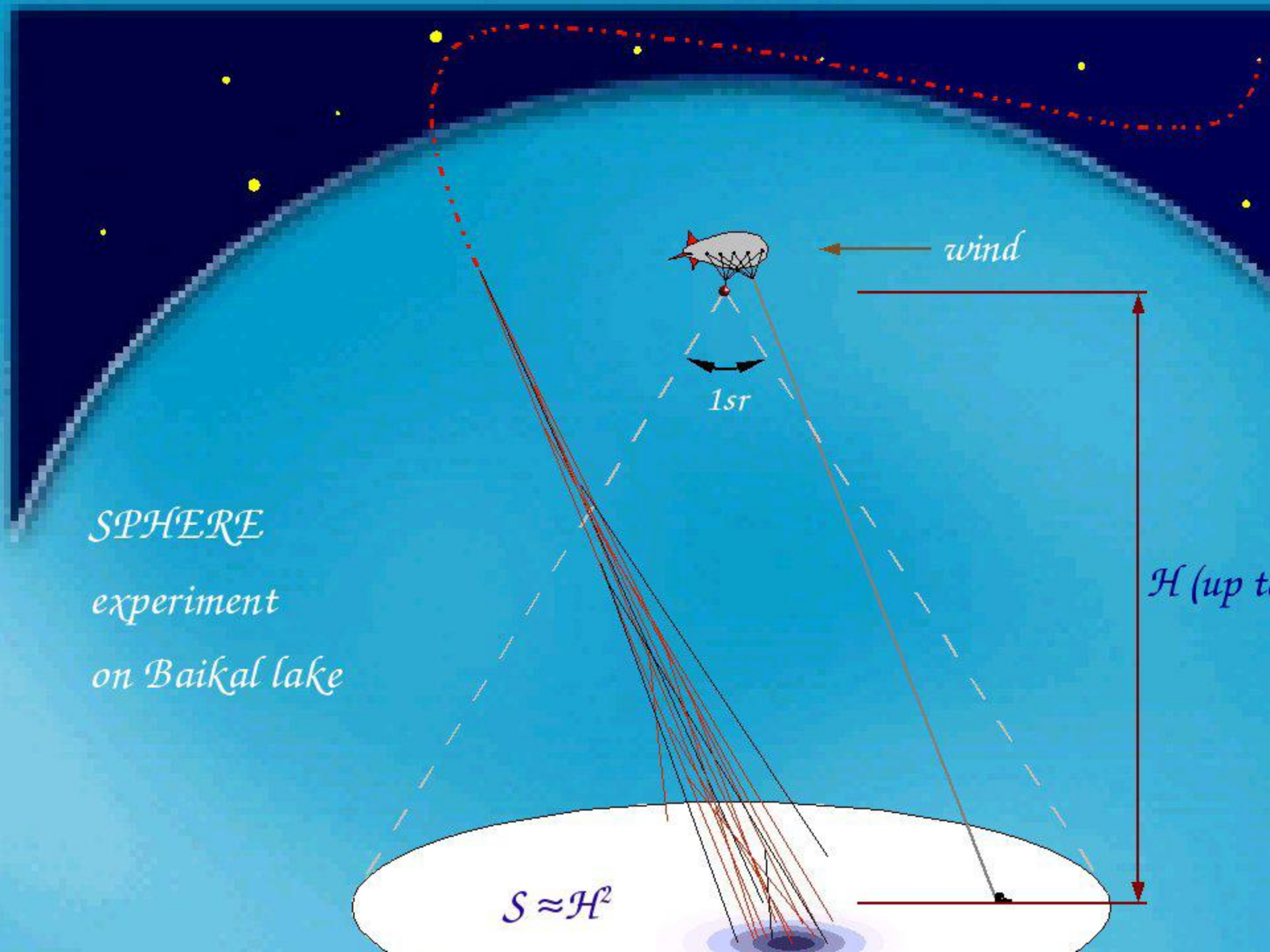
The aim of the experiment SPHERE

The study of the high energy cosmic rays with the method first proposed by A.E. Chudakov.

The Cherenkov light generated by the high energy cosmic rays in the atmosphere and reflected by the snowy surface is detected at moonless night by Cherenkov light imaging detector lifted by the tied balloon to the altitude ranging from several hundred meters up to several kilometers.

The detector system works like a camera and detects the images of Cherenkov light spots produced by Extensive Air Showers (EAS) on the snow covered ground surface.

At the altitudes 1-3 km the apparatus can register the EAS images corresponding to primary cosmic rays with energies 10-1000 PeV.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The first prototype SPHERE-1

In the first prototype of the detector – SPHERE-1 – the spherical mirror of the diameter 1.2 m and the set of 19 photomultipliers in the mosaic were used.

The present detector SPHERE-2

In the present detector – SPHERE-2 – seven segment spherical mirror with overall diameter 1500 mm and radius of curvature 940 mm is used.

The photomultiplier mosaic in the mirror focus consists of 109 PM tubes. To optimize the optical resolution and the optical acceptance the diaphragm of 930 mm in diameter is placed in front of the mirror. It was fixed to achieve the optical acceptance 52 angular degrees.

Since the detector operates in winter meteorological conditions and on the heights in the atmosphere the electronics must be able to withstand the temperatures as low as –40 degrees Celsius and the low power consumption electronic system is desirable to be used.

The experimental runs

The expeditions take place annually in winter time during moonless nights on the snowy surface of lake Baikal .

The testing runs

The testing expeditions took place in 2008 and 2009. The experimental equipment of SPHERE-2 detector was lifted up by the tied aerostat balloon to the height 700 m above the snowy surface of the lake.

The data taking runs

The regular data taking experiments with SPHERE-2 took place in 2010.

1) R.A. Antonov et al., Nuclear Physics B - Proceedings Supplements, 175-176, (2008) 194-197.

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