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Optical spectroscopy and radar analysis of transient luminous phenomena in the low atmosphere over Hessdalen valley NORWAY

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For over 100 years glowing light balls of different sizes and colours has been observed in the low atmosphere over a remote Norwegian valley called Hessdalen . The light balls behaviour is transient and unpredictable, but the predominant trajectory is horizontal. The valley is located in the middle of Norway where the climate is sub arctic in winter and humid during summertime. Hessdalen is famous for its mines with iron, zinc and copper ore. Big deposits of ore still reside inside the valley, and the mountains are penetrated by several Mineshafts, one of them as deep as 1000m.
In the period of 1981 to 1984 big outbreaks of luminous phenomena's was observed inside the valley, leading to a scientific investigation conducted by E. Strand. In 1998 The Østfold University college installed a automatic research station inside the valley and in 2000 the Italian institute for radio astronomy, IRA, installed UHF radar and electromagnetic receivers developed by S. Montebugnoli and J. Monari from the Medicina radio telescope. Every year since 2000, field campaigns has been carried out in the first weeks of September. In 2007 a big outbreak happened again where the author managed to get simultaneous optical observations, video footage, optical spectrum analysis and radar data of huge light balls moving horizontally around in the valley for four hours. No sound was heard and no magnetic AC signals were detected, while electric field registrations were inconclusive. This result urging the need for more sensitive receiving equipment, which was supplied by French researchers in 2010 under the supervision of T. Farges & E. Blanc from CEA.
Optical living time has been observed from milliseconds up to two hours, while radar detection has confirmed living times up to four hours while invisible in the optical range. The radar reflections indicate a huge reflecting area, pointing towards the presence of ionisation inside the luminous balls. The radar echoes seem not to decay when the phenomena's invisible state appears. The "bubbles" seems to come out of thin air, and the horizontal movement has similarities to standing waves. Analyses of the phenomena's optical spectrum indicate a high-energy state where the phenomena mostly are radiating in the UV range, with a spectrum shape similar to the Vega star. An ionized "bubble" radiating in the UV spectrum may explain the invisible state, but how this energy build up can take place is still to be found. In 2010 a fisheye, all-sky camera, was installed at the mountain Skarvan at 1000m altitude where the phenomena showed up under the horizon down in the valley, indicating that the place of birth is down in the valley/mines, this separating the Hessdalen phenomena from Sprites that are observed in the middle atmosphere.