Meteor Storm over Calar Alto!

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Emotions ran high on that cold mountain top in the Spanish Sierra Nevada. Yes, we did see that tremendously spectacular alpha Monocerotid meteor outburst. *But why o why did that field of thin cirrus had to pass over just during the 30 minutes that the outburst was in progress?!?* We didn't know weather to laugh or cry. But soon, excitement began to fill our minds. It *did* happen! We hadn't been fools after all! This was worth the $25 000 expedition and all painstaking preparations!

Prologue: meteor outbursts are not rare

Meteor outburst are not really rare. They are believed to happen at about the same rate as a moon eclipse: about twice a year on average. But many of them are missed because they are not easy to predict, are usually of short duration and usually happen outside the periods of main stream activity, which still see little observational coverage besides the efforts of some dedicated individuals.

Meteor outburst, defined as any meteor activity significantly above the normal annual activity of the stream in question, come in two different types as recently defined by Dr. Jenniskens of NASA/Ames Research Center: 'far comet type outbursts' and 'near comet type outbursts'. Near comet type outbursts are most commonly known to amateur astronomers. These happen because the parent comet, usually a short period comet, is near perihelion, and the Earth encounters the fresh dust near the cometary body. Famous events of this type are the recent series of Perseid outbursts and the renowned Leonid outbursts.

Far cometary type outbursts are less known to most amateurs. These happen without a warning: there is no parent comet nearby to warn astronomers that something might happen. Usually, the stream in question is associated with a long periodic comet. The most well known examples of this kind of outbursts are the Lyrid outbursts, the last of which was observed from the USA in 1982. The cause of this type of outbursts has long been a mystery. The late Dr. Kresák sought an explanation in the dense dust trails detected by the IRAS satelite in the trail of several comets. These trails, however, are much too small to explain the rate at which such events occur: chances of a direct encounter between the Earth and such a trail are almost negligible. And why then don't they occur each year for a given stream?

Recently, Dr. Jenniskens proposed that far cometary type meteor outbursts might find their origin in planetary perturbations on such trails. The planetary gravity influences act to modify the orbits of individual particles in the trail, which are consequently spread over a larger area, thus enlarging the probabilities of an occasional encounter with the Earth.

They can even be predicted... sometimes at least

Following the notion that planetary perturbations are involved, the next step is to assess under which conditions they lead to a meteor outburst. This is exactly what Dr. Jenniskens did for several streams. He predicted that the quite obscure alpha Monocerotid stream might give an outburst on November 22, 1995, which would be visible from Europe.

Many people in the field of meteor astronomy remained quite sceptic, but they were proven wrong: there *did* occur a spectacular outburst!

An α Monocerotid outburst is rare

The alpha Monocerotids are a rather obscure stream, and the meteor outbursts it produces are of a rather freaky type. The outbursts last very short (less than half an hour) and the activity profile is very steep, with peak Zenith Hourly Rates of 1000 or even higher. Thrice before had they been observed: in 1925, 1935 and 1985. This lead some scholars to propose a 10 year period, which would suggest that four events should have been missed between 1935 and 1985. Actually, Dr. Jenniskens believes that this is not the case and that 1925, 1935, 1985 and 1995 are the only years that planetary perturbations were favourable and the alpha Monocerotids showed an outburst. Therefore, an alpha Monocerotid outburst is rare: they happen only 3 to 4 times a century. Another remarkable feature is that the maximum Zenith Hourly Rates reach such a high level that the outbursts might actually classify as a small storm. And *these* are the outbursts which are realy rare!

Two outbursts within four days is even more rare

November 1995 was believed to become a remarkable month in the history of meteor astronomy: and indeed, it turned out to be. Two meteor out-

bursts within four days is unique in history. On November 18, the Leonids returned with rates about four times as high as usual. Four nights later, the alpha Monocerotids poured from the sky. And in both cases, Europe was the right place to be.

So why not organize an expedition?

In anticipation of both the Leonid and Monocerotid events, the Dutch Meteor Society organized an observational expedition to Southeastern Spain, which usualy has climatologically circumstances much more favourable than those of the Netherlands with it's notoriously bad weather in November. We established three temporary stations at the small villages of Zaffaraya, Alcudia de Guadix and Almedinnila in a geometric pattern favourable for multistation photography and video-observations. Spanish observers of SOMYCE, supplied with photographic equipment by DMS, established a fourth station at Chirivel. All of these stations operated fully automatic multi-camera mounts equiped with high quality 35 mm Canon camera's, synchronious rotating shutters and covering the whole sky above ~15 degrees. The first three stations also operated image intensified video equipment. On the invitation of Dr. Uli Thiele, a fifth station -a joint venture between DMS and NASA- was established at the famous Calar Alto Observatory during the night of the alpha Monocerotid outburst.
Since such a large scale observational campaign in a foreign country is well above the financial carrying capacity of the standard Dutch meteor amateur, we succesfully tried to get sponsorship for the expedition. Eventually, the whole expedition was carried out at the cost of Dfl. 35 000, about $25 000. On November 14, 22 observers left Shiphol Airport for a nine day campaign, while a truck loaden with equipment already was heading for Spain.

The dramatic events at Calar Alto Observatory

I was at Calar Alto, a major professional German-Spanish Observatory located at a 2100m high mountaintop in the Spanish Sierra Nevada, during that dramatic night of November 22. Together with Dr. Peter Jenniskens of NASA/Ames Research Center, who predicted the outburst, and Charlene Hasselbach from California, we ran the temporary fifth station in the photographic network. Observing with a limiting magnitude near +7.1 and a bright Gegenschein and lightbridge perpendicular to the intense Milky Way, all seamed perfect. Alpha Monocerotids were noted right from the moment that the radiant significantly rose above the horizon, though at low rates.
And then, things suddenly changed. Short before 1h UT (2 am local time), rates were going up, almost unnoticably first, but soon seriously noticable. At the same time, a thin cirrus cover began to intrude the sky from the north. Limiting magnitudes quickly ran down. This was a nightmare! Were we going to mis the outburst by only some tens of minutes? The cirrus cover was very thin, and meteor rates still kept increasing dramatically. The lower limiting magnitudes were a disadvantage but did not prevent observations. We turned to one minute counts and became excited. Peter had been right! There was an outburst in progress! After about 1:20 UT, it all happened very quickly. Meteors poured down like droplets from a shower, bright white sparks shooting away from a point just southwest of Procyon. Most of them were of magnitude +2, few were brighter than magnitude 0. Peak rates occured during a five minute interval near 1:27 UT, when on average we counted over five alpha Monocerotid meteors per minute with a limiting magnitude of only +5.7. The real peak was even more concentrated: I remember four meteors sparking from the radiant, like an exploding piece of fireworks, within only a fraction of a second, and on another occasion two meteors at the same time moving from the radiant at exactly opposite directions. At these moments, lasting only a minute or so, I indeed had the impression of a shower, a small storm, of meteors, an impression I did not have during the peak of the 1993 Perseid outburst. Evidently, rates must have been very high during this short period. Observations by several of our observers from Alcudia (which also had thin cirrus), from Zaffaraya and Almedinilla (which had clear skies) and me from Calar Alto, suggest an activity equivalent to a Zenith Hourly Rate near 1000 for this brief period: a small storm indeed!
It was over as quickly as it started. After 1:30 UT, rates decreased quickly, and by 1:50 UT, it was all over again. Only 15 minutes after peak activity, rates had fallen down to ZHR-values near 80. At the same time, the thin cirrus cover above Calar Alto began to disappear! We were horrified: half an hour of meteoric history, and just that little half an hour, a field of cirrus had to pass over Calar Alto! This was Murphy in all it's diabolic strenght. But then the excitement took over. It had happened! We had not been fools believing in the event, we could laugh at all doubting Thomasses who -sometimes quite cynically- had expressed their firm believe that we were crazy and nothing would happen at all: 'such a silly thing to believe in such a fairy tale event!'. We were thrilled, but at the same time that untimely passage of the field of cirrus had given us a tremendous mental blow. We were exhausted, it was cold, windy, and we decided to dismantle the camera's and leave Calar Alto to share our experiences with the people who stayed in Alcudia. When we drove down the mountain an hour later, the sky had become perfectly clear again: the +7.1 sky we had hoped for, but was denied from us just that crucial 30 minutes. Back at Alcudia, we were welcomed by an excited team of ob-

servers who -like us- had had the time of their lives. After continuing the observations for an additional hour, twilight set in, and we opened a bottle of wine for a feast. It had been a hectic night -and it would end even more hectic.

The scientific revenues of the expedition

Of course, we had set ourselves some goals for the expedition. They have all been fullfilled. We observed the enhanced Leonid activity, and managed to obtain several high quality multistation records of outburst members with our photographic and video equipment. More important, we managed to fullfill the same task with regard to the alpha Monocerotid outburst: the first time ever that orbital elements from multistation meteors have been gathered from a far comet type outburst. And the first time that such an event was carefully monitored by other than some occasional observers: we were ready for it, and we had prepared ourselves to what would come.

I would not wish to end this story without some reference to the people who made these results possible. Many thanks to the observers who participated in the expedition, and turned it into a succes. Many thanks to Hans Betlem who organized the larger part of the expedition. I especially would like to mention Luis Bellot and his coworkers of the Spanish SOMYCE: it was a very pleasant and fruitfull cooperation. Peter Jenniskens and I are very gratefull to Dr. Uli Thiele for granting us permission to observe from Calar Alto Observatory. Finally, the expedition would not have been possible without the financial and material support by Canon, Shell, Honda power equipment, Kodak, Sony, Delft Electronic Products, the Prins Bernhard Fund and the Kerkhoven Bosscha Fund of Leiden Observatory.