Kappa-Cygnids: search for periodic activity

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Various observations of the kappa Cygnids – most recently in 2007 and 2014 – have been considered as a hint at periodic rate/flux enhancement which may also be explained from model calculations. We analyzed visual data back to 1977 and found slightly enhanced rates in 1985, 1989 and 2014. This does neither correspond with any of the proposed periods nor can this be associated with a periodic appearance at all.

1 Introduction

The κ-Cygnids have been observed over a long period. Reports back to the 1870s can be associated to meteors of this shower (Tupman, 1873) while less certain detections may go back to the middle ages (Roggemans, 1987). Often the reports refer to radiants in Draco and Cygnus. Obviously, the radiant is complex. A recent study (Koseki, 2014) has shown that radiants extend over a region of the order of 10 degrees in diameter extending into Lyra as well (see *Figure 16* in Koseki's paper).

Not only is the radiant complex, but also the activity from the various sub-radiants is supposed to vary. Papers mention different suspected periodicities for average shower rates and the occurrence of bright meteors. Years with apparently more frequent fireball occurrences are 1879 and 1893 (Denning, 1899) as well as 1922 and 1993 (Jenniskens, 2006). The 1995 IMO visual handbook (Rendtel et al., 1995) mentions a possible period in fireball occurrences of 6.6 years. However, there is no source given for this, but the statement was also mentioned in previous publications (Roggemans, 1987). We were not able to recover the original source of this comment.

Enhanced rates of the κ-Cygnids have indeed been observed in 2007 (Jenniskens et al., 2007) and 2014 (Rendtel and Molau, 2015; Moorhead et al., submitted), using different techniques. Again, a suspected period of rate enhancements is mentioned. This includes a period of 7 years (Koseki, 2014) or 7.116 years (Moorhead et al., submitted) based on assumptions concerning the orbit of a potential parent object. If we simply count backwards from 2014 and 2007, we might expect previous years with higher rates in 2000, 1993, 1986, 1979, … Assuming a shorter period of 6.6 years, we may expect enhanced rates in 2001, 1994, 1988, 1981, … The IMO's Visual Meteor Data Base (VMDB) includes visual data from 1985 onwards, thus covering three of the listed years.

2 Analysis and reanalysis

Generally, the meteors of the κ-Cygnids are easily distinguishable from other sources. The radiant is far away from all other significant sources in August and the low entry velocity of the shower meteors is a good discriminating criterion to associate possible shower meteors with the radiants. Further, the κ-Cygnids occur during the late Perseid period so that the number of reports is sufficiently large for most of the years. Due to this situation it seemed promising to reanalyze visual data obtained before 1985. Despite the fortunate situation it is not possible to derive annual ZHR profiles and to calculate separate values of the population index r. From the average ZHR profile (*Figure 1*) as well as the maxima in 2007 and 2014 we conclude that the ZHR does not significantly vary over an interval of about 6° in solar longitude. Hence we calculated an average ZHR per year, combining all data between 142° and 148° solar longitude, using a constant value of the population index of r=2.5 which is below the usually tabulated value but was determined from the 2014 video data (Rendtel and Molau, 2015).

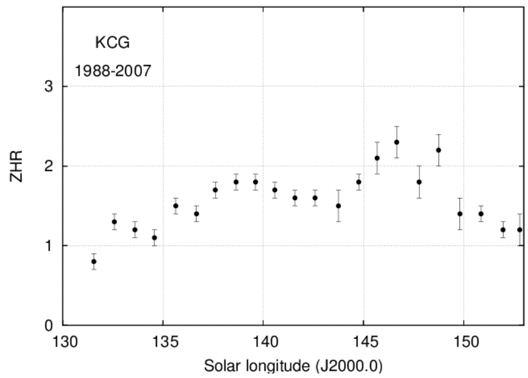

Figure 1 – Average ZHR-profile of the κ-Cygnids derived from visual data of the VMDB in the period 1988 – 2007.

While the analysis of the data stored in the VMDB was simple – we also just used r=2.5 instead of the standard r=3.0 for the shower – the reanalysis of older data required more effort. Fortunately, almost all original reports from the German Arbeitskreis Meteore (AKM) are kept in our archive. The task was to look into the old logbooks and star charts, check for κ-Cygnids and to create a separate set of VMDB entries. For this task, we had a very rewarding meeting of old and new observers in May 2015 in Potsdam (*Figures 2 and 3*). Some of the observers held their own recordings in hand after some 30 years and were surprised that such a reanalysis is possible. So far, we included notes back to 1978 and up to 1988 in this procedure. Some further data back to 1975 are to be processed. This way, we created a data base currently covering the period 1977 to 2014.

Figure 2 – During a meeting to reanalyse visual meteor plots made in the 1970s and 1980s.

Figure 3 – Reanalysing archived data included work with the maps, lists and personal notes taken decades ago.

3 κ-Cygnid activity: results

For four years we have both the derived ZHR from the VMDB, i.e. from κ-Cygnid counts reported by the individual observers at the time of their observation, and the reanalyzed ZHRs at hand. This is suitable for some calibration to ensure that the procedure did not introduce systematic errors. The newly analyzed data only distinguish between κ-Cygnids, Perseids and others („sporadic" in our analysis), assuming that the activity level of the sporadic meteors does not vary significantly within the 142–148° solar longitude interval. As pointed out above, we calculate just one average ZHR for the given period, applying r=2.5 as a constant population index.

First we can check whether the ZHR of the κ-Cygnids in those years with two ZHR values is consistent (*Figure 4*). Next, we checked for outliers in the sporadic rates between the years. We may also use these data at a later stage to calibrate the KCG data as it may be helpful to correct for effects of e.g. moonlight which sometimes seem to remain in the ZHRs despite the standard correction for the limiting magnitudes.

The main result is the ZHR variation of the KCG in the period 1977–2014 which is shown in *Figure 5*. We find higher ZHRs in 1985, 1989 and 2014 as well as insignificantly in 1978, but not in the suspected years which could be associated with either of the periods given in the introduction: our results are not confirming periods of 7.116 years, 7 years or 6.6 years.

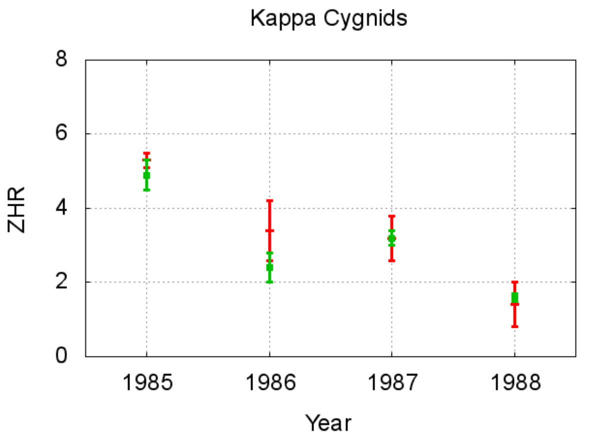

Figure 4 – The comparison of the ZHRs derived from the data stored in the VMDB (dots) and the reanalysed data (crosses) shows a good agreement.

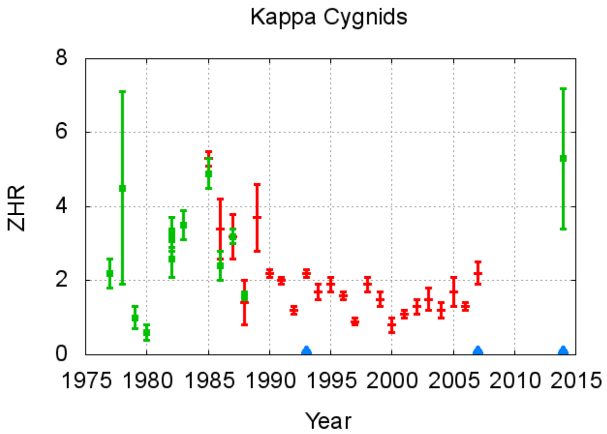

Figure 5 – κ-Cygnid ZHRs determined for the years 1977–2014. As in *Figure 4*, the reanalysed data are represented as crosses.

4 Conclusions

From our data we have to conclude that there is no evident periodicity at all. It is rather long-term trends we see in the ZHR evolution over time. While higher values were observed in the mid-1980-s, a broad low of activity occurred in 1990–2006. In order to complete the data set for all years of the period we currently process the data obtained between 2008 and 2013 and add further reanalyzed data for the years 1975 and 1976.

A factor that is not touched by our data and the video data used for the 2014 analysis (Rendtel and Molau, 2015) is the question whether the stream may have different sections concerning its mass structure and thus differing maxima for bright and faint meteors. The analysis of radar flux data may hint at such an effect. The radar meteor flux of the KCG 2014 was at least 5 times the 2007 flux (Moorhead et al., 2015) while the visual ZHR of 2014 is only about 3 times the 2007 ZHR. If, however, different particle populations show maxima with differing periods it might well be that the available length of the observation series is not sufficient to extract periodicities.

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Jürgen Rendtel during his lecture (Photo by *Christoph Niederhametner*).