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GRB030329: MULTICOLOR LIGHT CURVE AND IONOSPHERIC DETECTION

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The optical afterglow to GRB 030329 was discovered at position $\alpha = 10^{\rm h}44^{\rm m}49\overset{\rm s}{.}5$, $\delta = +21^\circ 31' 23''$ (Peterson et al., 2003). The AAVSO International GRB Network has collected 452 multicolor observations of the afterglow from 03:47 on March 31 to 03:09 on April 17, 2003. All observations have been reduced using field photometry from Henden et al. (Henden, 2003) The full light curve is displayed in Figure 1. The comparison stars are given in the chart in Figure 2. The light curve can be represented by 3 straight lines, with breaks at JD 2452729.0 and 2452736.5.

Additionally, a disturbance of the Earth's ionosphere was observed coincident with the HETE detection time of GRB030329 (Vanderspek et al., 2003). This disturbance was detected with a Sudden Ionospheric Disturbance (SID) detector by P. Schnoor as an increase in the signal strength from a Low Frequency (LF) radio beacon received in Kiel, transmitted as a time signal from station HBG (75 kHz) near Geneva, 920 km from the receiver. See Figure 3. (Note: This is not a radio detection of GRB030329; this disturbance was caused by the prompt X-rays and/or gamma-rays from GRB030329 ionizing the upper atmosphere and modifying the radio propagation properties of the Earth's ionosphere.)

Previously, at least three other transient, high-energy sources have produced detectable ionospheric disturbances, as measured with VLF receivers: GRB830801 (Fishman et al.,

1988); XRF 020427 (Fishman et al., 2002), and the Aug. 27, 1998 super-flare from SGR 1900+14 (Inan et al., 1999).

All raw data shown in these figures, FITS images, and more information about each observation and the SID detection is available for download from the AAVSO WWW site at `http://www.aavso.org/grb/grb030329.shtml` or by e-mail: `aavso@aavso.org` and also through the IBVS website as `5415-t1.txt`.

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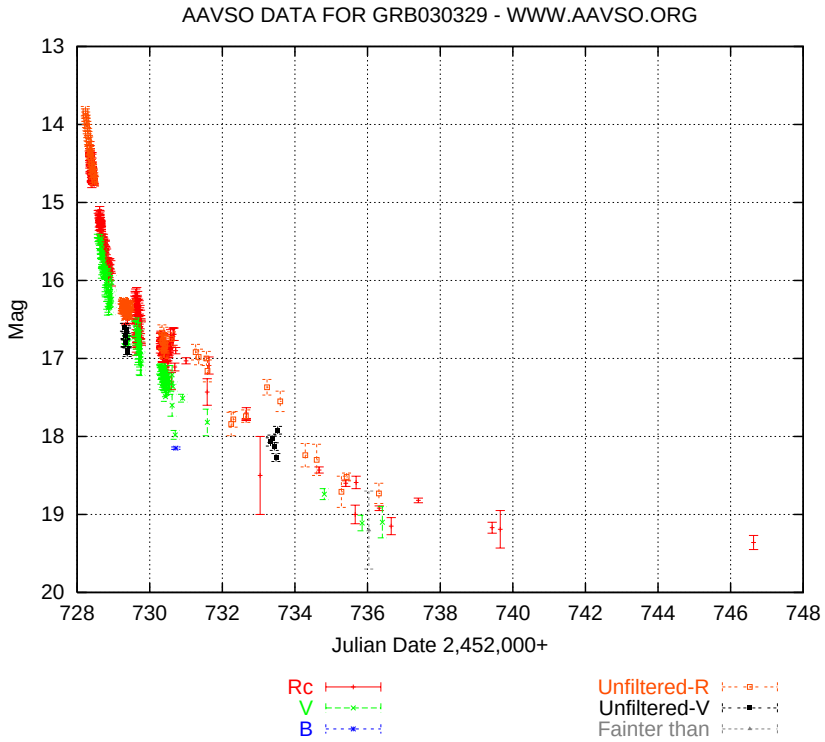

Figure 1. Complete Light curve of all AAVSO data for GRB030329. On the scale of these plots the zeropoint difference between the unfiltered-R observations and Rc is small. The same is true of the unfiltered-V data and Johnson V.

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Inan, U. S., Lehtinen, N. G., Lev-Tov, S. J., Johnson, M. P., Bell, T. F., Hurley, K., 1999, *Geophys. Res. Lett.* , **26**, 3357

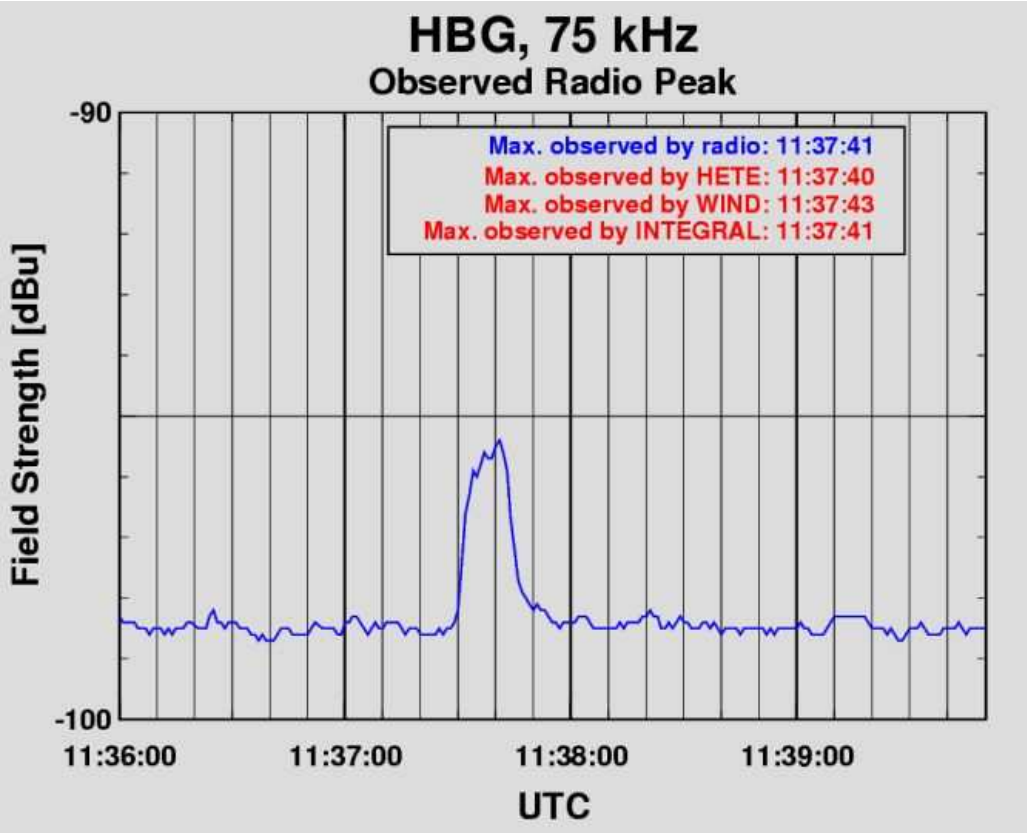

Figure 2. 75kHz signal strength reflecting a sudden ionospheric disturbance coincident with GRB030329. More data is available at `http://www.qsl.net/df3lp/projects/sid/`

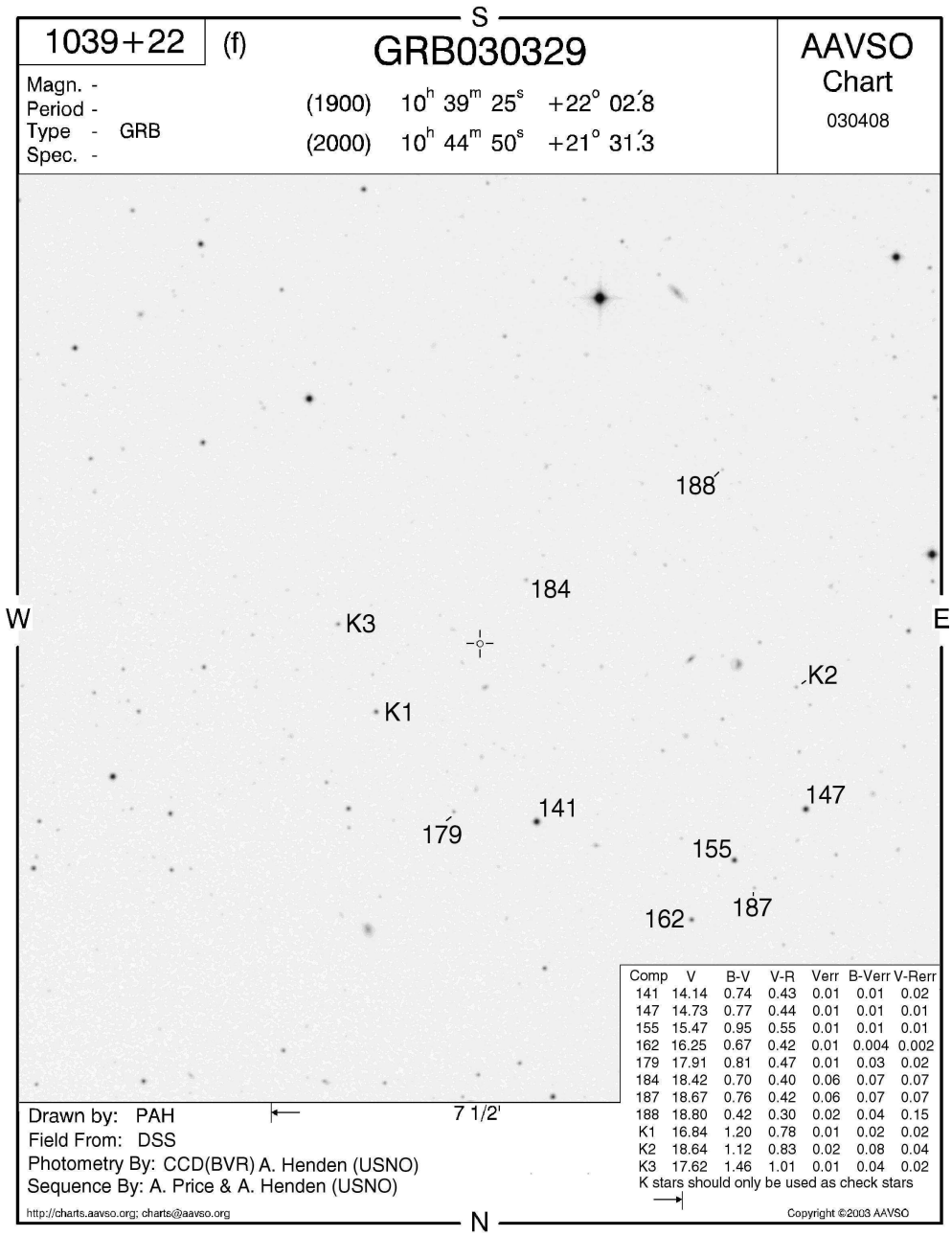

Figure 3. Finder chart of the field of GRB030329 with comparison stars indicated and their photometry in the lower right hand corner.