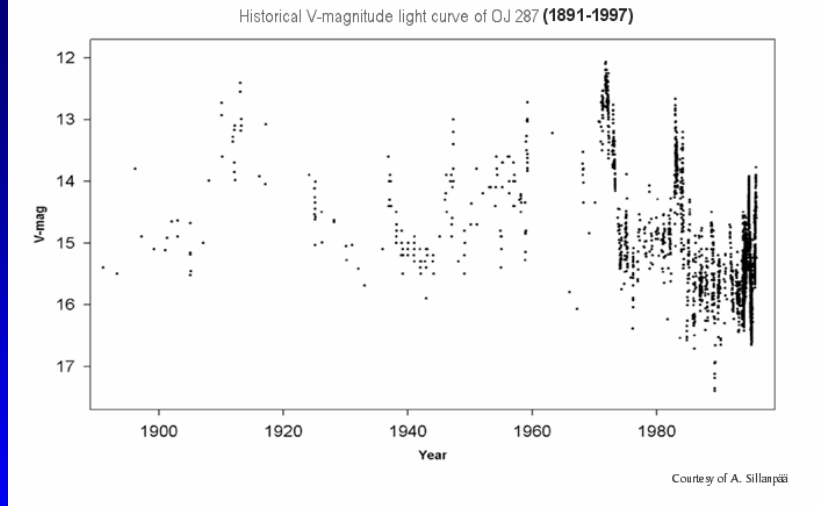


The OJ 287 polarization monitoring programme: current status

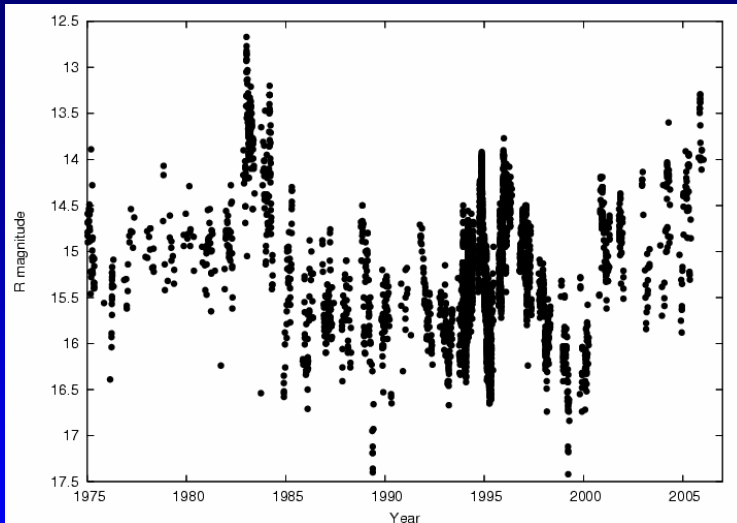
Jochen Heidt (LSW), Kari Nilsson (Turku)
& the ENIGMA-team

in support of
the OJ2005-2008 campaign



Periodic outbursts on timescales of about 12 years:

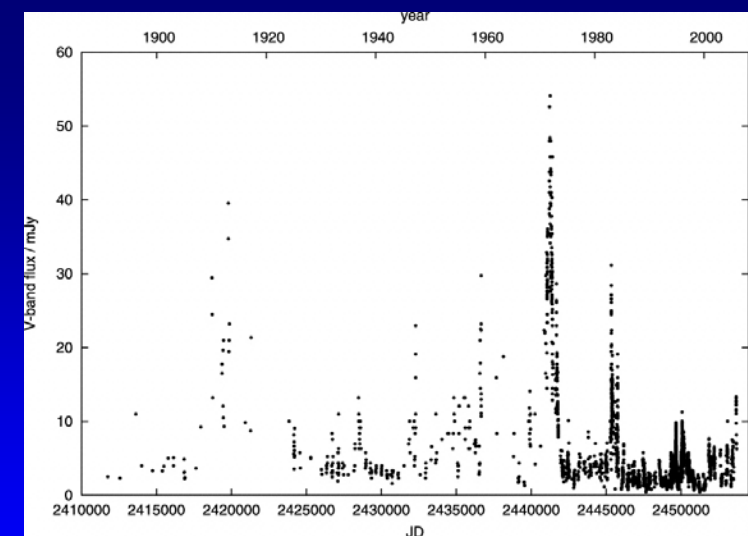
Binary BH in center of OJ 287, flares are caused by secondary hitting the accretion disk of the primary (Sillanpää et al. 1988)



OJ-94 project: monitor the expected outburst in 1994

→ Somewhat unexpected: double-peaked outburst (as in 1982/1983)

→ New (refined) models - **QUITE A LOT!!!!**



From Valtonen et al. 2006: even more models...not all mentioned here...

Models fall in 3 categories:

A: One BH with precessing jet and massive companion (Katz, 1997) or a binary BH system, each BH has a precessing jet (Villata et al. 1998)

B: Binary BH in the center, secondary BH in highly eccentric orbit, hits the accretion disk of the primary twice per revolution (Lehto & Valtonen, 1996, Sundelius et al. 1997, Pietilä et al. 1998, Valtonen et al. 2006a,b)

C: Binary BH in center, secondary BH in strictly periodic orbit, hits the accretion disk of the primary BH once per revolution (Valtaoja et al. 2000)

Category A:

Katz 1997: One massive BH with precessing jet due to massive companion disturbing the accretion disk of the primary (in analogy to SS 433 and Her X-1)

Expected: Poli \uparrow , PA \rightarrow or change

Problem: No prediction for further outbursts $\rightarrow\rightarrow$ Can **not** be tested

Villata et al. (1998): Binary BH system, each BH has a precessing jet

Expected: Poli \uparrow , PA \rightarrow or change

\rightarrow Problem: makes predictions (July 2006, July 2007) but very hard (almost impossible) to test due to observability

Common problem: One naively would expect flare also in radio, not seen and not discussed!

Category B:

Binary BH in the center, secondary BH in highly eccentric orbit, hits the accretion disk of the primary twice per revolution causing two outbursts.

Expected: Poli \downarrow , PA \rightarrow during both outbursts (unless accretion disk is magnetized), all models in category B can in principle be tested

Lehto & Valtonen, 1996: Prediction - Feb.-May 2006, Sept. 2007

Sundelius et al. 1997: Tidal influence of secondary BH on accretion disk shifts outbursts progressively towards earlier times.

Big point: Possibly observed indeed in Nov. 2005 by Valtonen et al. 2006a. Prediction for 2nd burst: Sept. 10, 2006 (Valtonen et al. 2006a)!

Pietilä et al. 1998: Explores parameter space of the Lehto & Valtonen (1996) model \rightarrow Dates of outbursts can change considerably

Valtonen et al. 2006b: More (too many) details on their 1996 model

Finally: No disk-jet interaction due to enhanced accretion flow in jet?

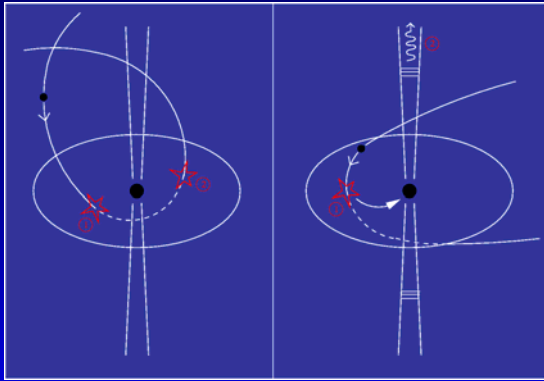
Category C:

Valtaoja et al. 2000: Binary BH in center, secondary BH in strictly periodic orbit, hits the accretion disk of the primary BH once per revolution (first outburst), increased accretion flow to center and finally jet \rightarrow ignites shock in jet (second outburst)

Expected: Poli \downarrow , PA \rightarrow (first outburst)
Poli \uparrow , PA \rightarrow or change (second outburst)

Prediction for 1st outburst: 2006, September 25 \pm 2 weeks

Problem: Timing for secondary outburst difficult to predict, possibly autumn 2007, but how to detect the right one???



Lehto & Valtonen 1996:

I : March-May 2006, Poli ↓, PA →
 II: September 2007, Poli ↓, PA →

Sundelius et al. 2007, Valtonen et al. 2006a:

I: November 2005, Poli ↓, PA →
 II: September, 10 2006, Poli ↓, PA →

Valtaoja et al 2000:

September 25, 2006, Poli ↓, PA →
 Autumn 2007, Poli ↑, PA → or change

Current status of the polarization monitoring:

Running time: Jan 2006 – May 2008 with Calar Alto 2.2m and La Palma KVA telescopes.

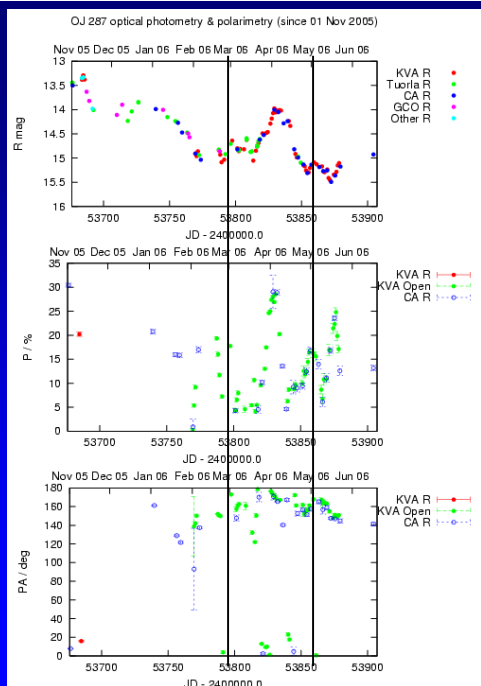
So far: 30/50 data points from Calar Alto (1 measurement every 3rd night whenever CAFOS is mounted and Fabry-Perot not in use at $AM < 2$) until mid-June

63 data points from KVA until mid-May (HA limit ± 3 hrs)

Sampling pretty inhomogeneous due to bad weather on both observatories in Jan/Feb (5 data points). Poor data in the critical Nov/feb. 2005 period

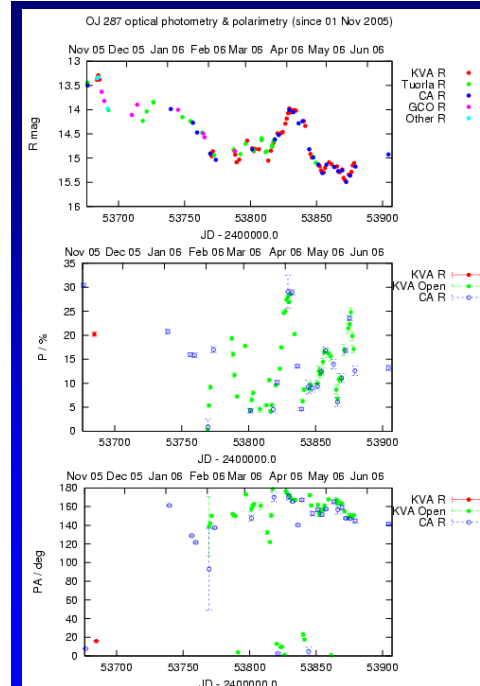
Results always displayed almost in realtime at:

<http://users.utu.fi/~kani>



• Last update: June, 17!

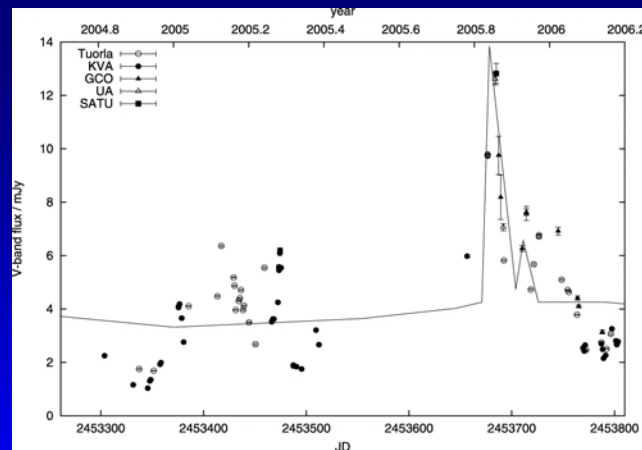
- Outburst detected in period as expected for the Lehto & Valtonen 1996 model (black lines), but 1 mag outburst + increase of polarization by 30°
 → synchrotron, NOT LV



• Last update: June, 17!

- Outburst detected in period as expected for the Lehto & Valtonen 1996 model (black lines), but 1 mag outburst + increase of polarization by 30°
 → synchrotron, NOT LV

- Polarization behaviour in November in principle as expected for the Sundelius 1997 + Valtonen et al. 2006a models (polarization went down while flux increased although polarization is still higher than on average), BUT



But: Proove of the Sundelius 1997 model is based on a poorly sampled flare in November 2005!

In fact: November flare is much broader an shows significant substructure (S. Ciprini, priv.com.)

Outlook

Yes, our long-term monitoring program already has provided great results, but it will be very hard to distinguish any properties expected from the models from the ones OJ 287 shows frequently (it is a crazy source)

Observations will resume soon (September 20) but autumn 2006 will not (dis)prove any model.

The 2007/2008 season will hopefully help us → Especially the Valtaoja et al. 2000 model may be tested then (in case an outburst happens in September 2006 followed by another one in autumn 2007 showing polarization properties expected by that model (and if we can convince people that the flares are not just due to “standard“ OJ 287 jet processes)

Finally: 2 observatories are probably not sufficient, probably the Landessternwarte Heidelberg 70cm telescope will add further data to this project in the near future!