Polarized (spectral) data

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- **Outline**
  - Instruments
  - Observations : *modus operandi*
  - Getting science-ready data
  - Interoperability issues
  - General remarks
  - Conclusions

Stellar spectropolarimetry

- **Echelle spectroscopy**
  - *(very) wide spectral covering : 400-1000 nm*
  - *(very) high spectral resolution ~ 65000*

- **Full-Stokes (IQUV) polarimetry capability**
  - *mostly circular polarisation data (Stokes V)*

- **Instruments**
  - *Espadons@CFHT (ops. since 2005)*
  - *Narval@TBL 2-m telescope (ops. since 2007)*
  - *HarpsPol@3.6-m La Silla (ops. since 2009)*
  - *…*

Modus operandi

- **No direct measurement of Q, U nor V**
  - *needs to combine, with the help of a polarimeter, different spectra carrying, for instance (I±V)*
  - *and use spatial separation (« analyser ») to record simultaneously both orthogonal states*
  - *(double) beam-exchange technique widely used (Semel et al. 1993)*

- **Main difficulty**
  - *typically **V << I***
  - *even **worse** for linear (Q,U) polarisation*

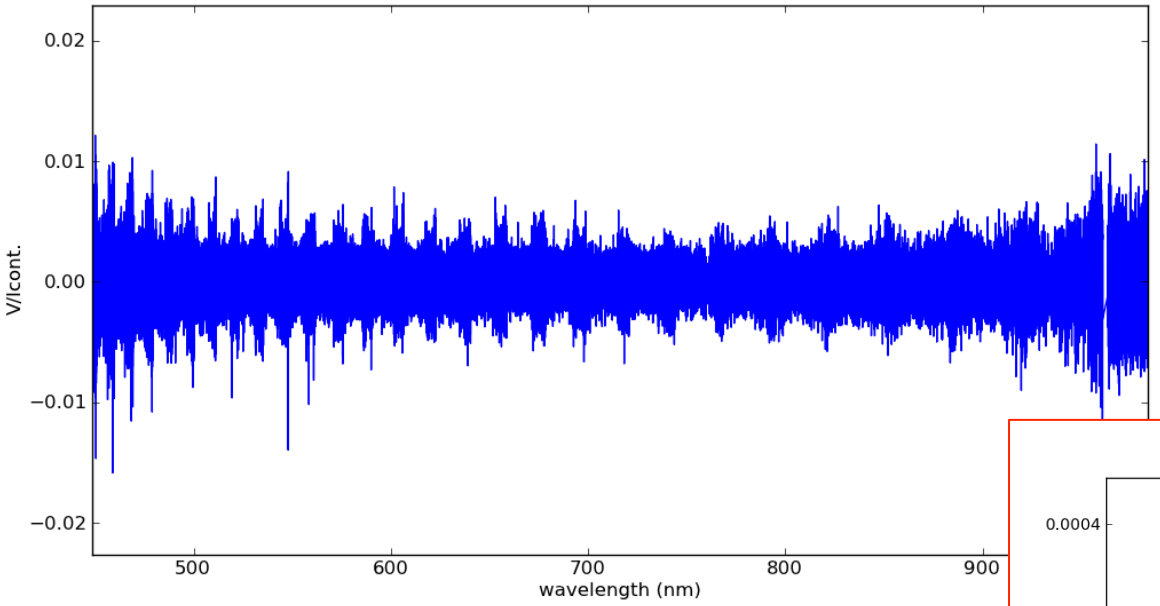
Getting science-ready data (1/3)

- **In general *V(λ)* spectra looks like… noise!?**
  - *but 100's or 1000's of spectral lines (depending on spectral type) observed simultaneously*
  - *extract polarisation signals with « line-addition » technique(s) (Semel et al. 2009, Paletou 2012)*

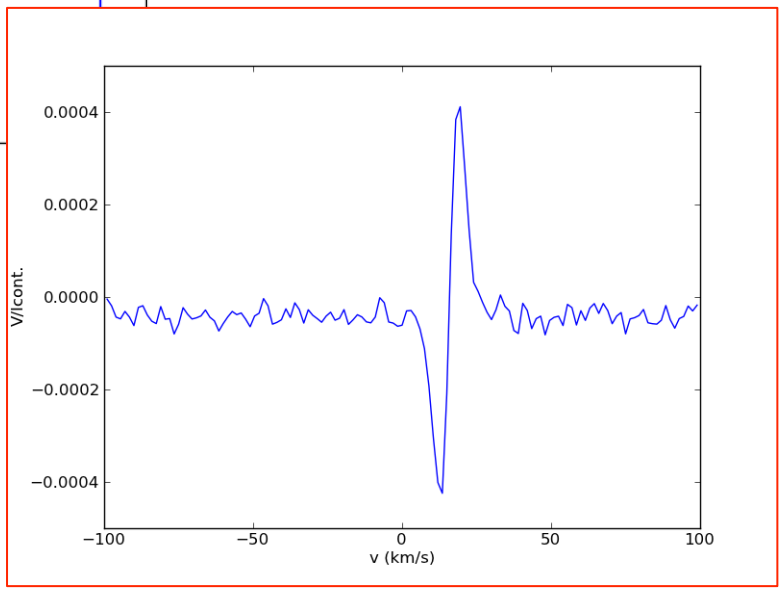
- **A parenthesis: dimensionless data**
  - *spectra we are dealing with usually are* $V(\lambda)/I_{cont.}$ *(i.e., normalized to local continuum)*
  - *need for VO-tools properly dealing with that (e.g., VOSpec)*

Getting science-ready data (2/3)

- **$V(\lambda)/I_c$ spectra looks like… noise!?**



- **Pseudo-line $V(v)/I_c$**
  - *clear Zeeman signature*
  - *$(V/I_c)_{max}$ ~ 4 x 10^{-4}*



Getting science-ready data (3/3)

- ***Polarised pseudo-lines V/I_c vs. velocity***
  - *needs extra-ressources apart from the observations themselves*
  - *at least, a list of spectral lines (« mask ») – a priori **(from spectral type)** expected in the observed spectrum*
  - *could be more: line depths **(from models)** and Landé factors **(atomic/molecular data)** for (line) selection and/or weighting processes*

Interoperability issues

- **Pseudo-line data: $V/I_c(\nu)$**
  - *most interesting ressource to distribute*
  - *all necessary extra-ressources **ought to** be properly documented too*
  - *most used methods (e.g., Least Squares Deconvolution) **not** (always) fully documented*
  - *pointed-out recently by Kochukhov et al. (2010)*
    - *normalisation of weights?*
    - *selection of lines vs. depth (model/mask)*

- **It is timely to propose a standard**

Towards more science-ready data…

- **From polarised pseudo-lines V/I_c *vs.* velocity**
  - *mean line-of-sight magnetic field assuming the Zeeman « weak-field regime »*
  - *time variability of the polarized signatures*
    - *magnetism : starspots, activity cycles…*
    - *asteroseismology : stellar pulsations…*

- **Zeeman-Doppler Imaging**
  - *it relies on heavier modelling*
  - *extra-dimension : mapping **B** @ photosphere*
  - *we can't forecast on a schedule for widespread diffusion*

General remarks

- **IVOA Note on polarization data** *(February 3, 2010)*
  - *too much « radioastronomical » at places*
  - *careful definition of **fractional** polarisation(s)*
  - *common measurements: line-of-sight **B** (also)*
  - *(Q,U) have to come along with a **reference angle** otherwise they are ambiguously determined*
  - *data quality: V/I_c can be **very** small but still usable*
  - *and other minor comments…*

- **Key-references about polarimetric standardization**
  - *Landi Degl'Innocenti et al. (2007)*
  - *Hamaker & Bregman (1996)*

Conclusion

- **Not anymore new data, although diffusion at large is relatively recent** *(and maybe not well-known yet)*

- **From OV-GSO datacenter**
  - ***TBLegacy*** *opened since 2008…*
  - ***PolarBase*** *will soon be opened (Narval and Espadons data, at least)*

http://tblegacy.bagn.obs-mip.fr

http://ov-gso.irap.omp.eu