

# Spectropolarimetry in the VO

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# Science drivers

- Magnetic fields in stars : Zeeman effect
  - mostly circular polarization (Stokes V)
- Other mechanisms exist though
  - scattering/Rayleigh or Hanle effect, dust/Mie scattering, synchrotron/cyclotron, Faraday rotation ...
- Need for a « full-Stokes » documentation
  - V: circular polarization
  - (Q,U): linear polarization (may be ambiguous)



# Specificity of Spectropolarimetric observations.

Reference: Paletou, Heidelberg 2013

- Polarized spectra looks like noise ( $V \ll I$ )
- Line addition technique(s) are required for extracting of meaningful signal
- Normalized spectra [dimensionless]
- Distribute them in the VO as spectra (multi Flux value per spectral coordinates) with a few addons
- ---> spectrum Data Model extension to cover spectropolarimetry



# Extension of spectral data model for polarimetry.

- dataset.type attribute in spectrum
  - Add « spectropolarimetry » as a predefined value (not there today).
- Name an ucd of FluxAxis
  - spectral data model (and Characterisation 2 data model) has this possibility to specify Axes via their name and ucd attributes .
  - This allows in principle accurate definition of the quantity coded along this axis.
- Characterisation also has a polarizationAxis
  - a somewhat degenerate axis containing one single attribute « stateList »
  - polarization "parameters" contained in the dataset.
  - Spectrum datamodel doesn't implement this polarization Axis at the moment (contrary to ObsCore) ----> add it



# Polarization ucds

- Spectrum data model proposes only two ucds:
  - `phys.flux.density;phys.polarization`
  - `phys.polarization`
- Richards and Bonnarel (2010) proposed additional ucds for polarization data.



# Polarization ucds

- some of them (not all) could be added to the previous list:
  - phys.flux.density;phys.polarization.stokes.U
  - phys.flux.density;phys.polarization.stokes.V
  - phys.flux.density;phys.polarization.stokes.Q
  - phys.flux.density;phys.polarization.stokes.V.fraction
  - phot.flux.density;phys.polarization.stokes.RR ?
  - phot.flux.density;phys.polarization.stokes.POLI ?



# Polarization ucds

- Some are missing :
  - Ratios to what? to  $I(\lambda)$  or (more common?)  $I_{\text{cont.}}$  (*local continuum*)
  - Ratio V,Q,U (or combinations of them eg  $\sqrt{Q^2+U^2}$ ) on total intensity ---> should be added

Use of ucd for all these details ? Is that OK ?  
Should we use names instead ?



# Orientation issue

- Ambiguity: Stokes polarizations states must come with an orientation
  - (Q,U) disambiguation
- Need for a reference system with x,y,z axes versus detector plane and direction of observation, or source reference system.
- ---> Extension of STC to Polarization axis





# New DM effort proposed

- Produce a spectropolarimetry WD
  - Extension to spectrum datamodel valid for spectropolarimetry
  - To be proposed before next interop
  - Most of this material should be valid for radio spectra and cubes within the scope of the ImageDM.

