Leibniz-Institut für Astrophysik Potsdam

LARGE BINOCULAR TELESCOPE

Preparing for PEPSI polarimetry

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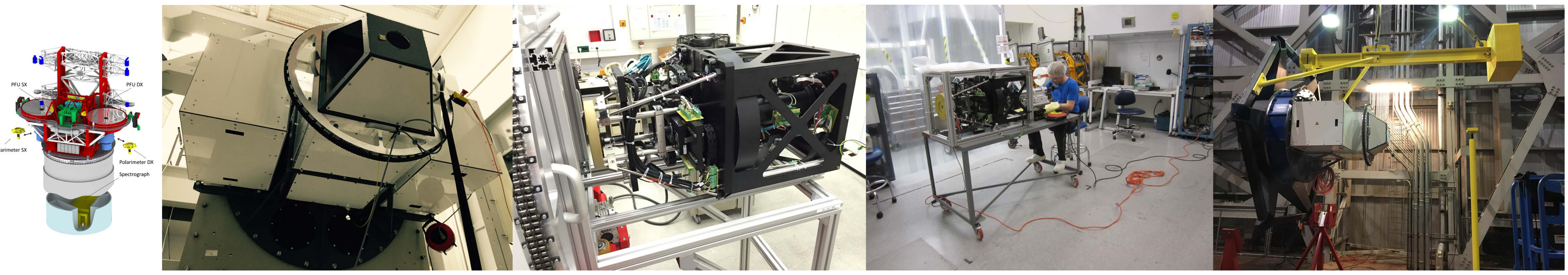
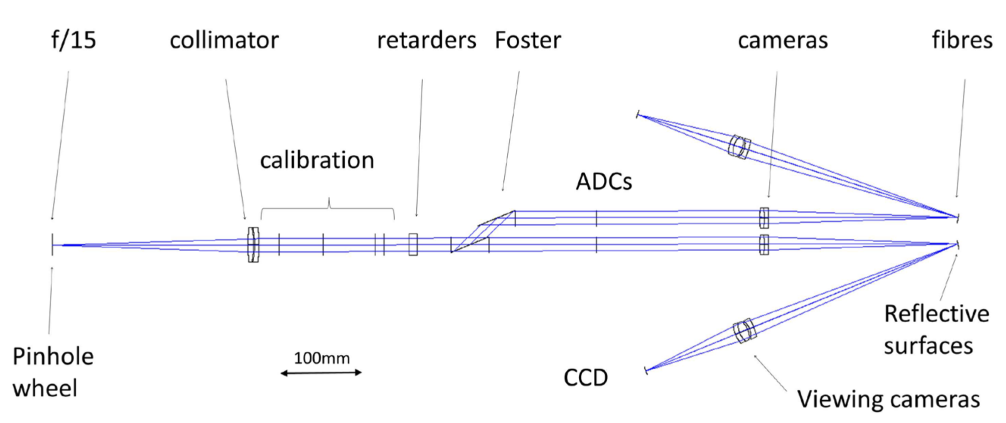
PEPSI – The Potsdam Echelle Polarimetric and Spectroscopic Instrument

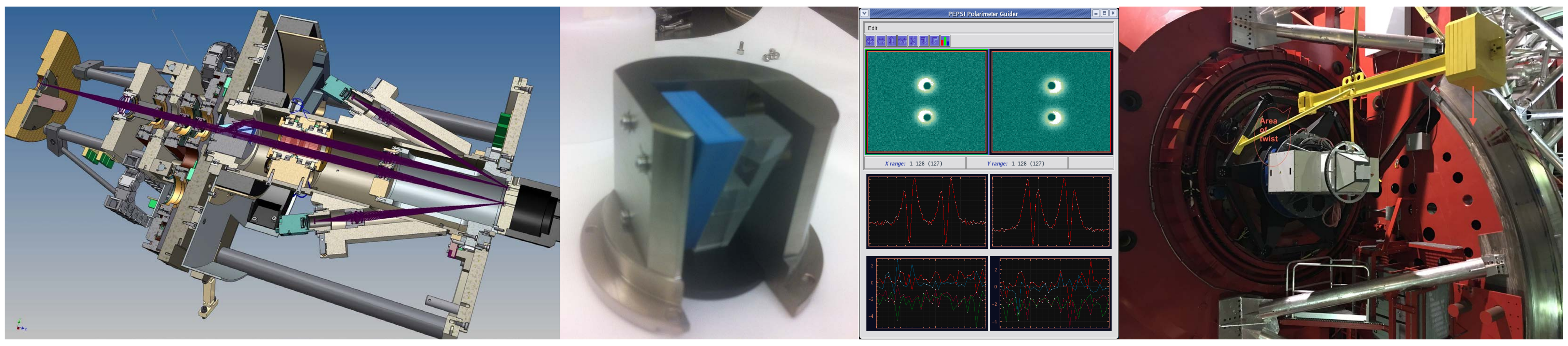
Abstract: Both polarimetry units for PEPSI are on the mountain and are being prepared for commissioning. The two units are foreseen for the symmetric straight-through Gregorian foci usually hosting the two MODS instruments and will fiber feed the PEPSI spectrograph in the basement. Commissioning is planned for September 2017 followed by a science-demonstration run in October. In this poster, we give a status report and an overview of the expected future instrument capabilities.

Design: The dual-beam design concept and a description of the expected system characteristics were partly already presented by Ilyin et al. (2011, AN, 332, 753) and Strassmeier et al. (2015, AN, 336, 324). Its generalized second-order error propagation in the Muellermatrix and the expected error budget were given in Ilyin (2012, AN, 333, 213). We refer the viewer to these papers for all the glory details. Due to the exceptional low cross talk, we expect a polarimetric precision of a single measurement of $dP/P \approx 10^{-4}$. With a Strehl ratio of 84% the polarimeter has a diffraction limited performance. The figure below shows the Zemax design. The two polarimeters are identical and can be used independently if needed. Both units are of a dual-beam design with a quarter-wave retarder (QWR) for circular polarization and a modified Foster prism beam-splitter as a linear polarizer. For linear polarization measurements the QWR is removed from the beam and the entire Foster unit is rotated.

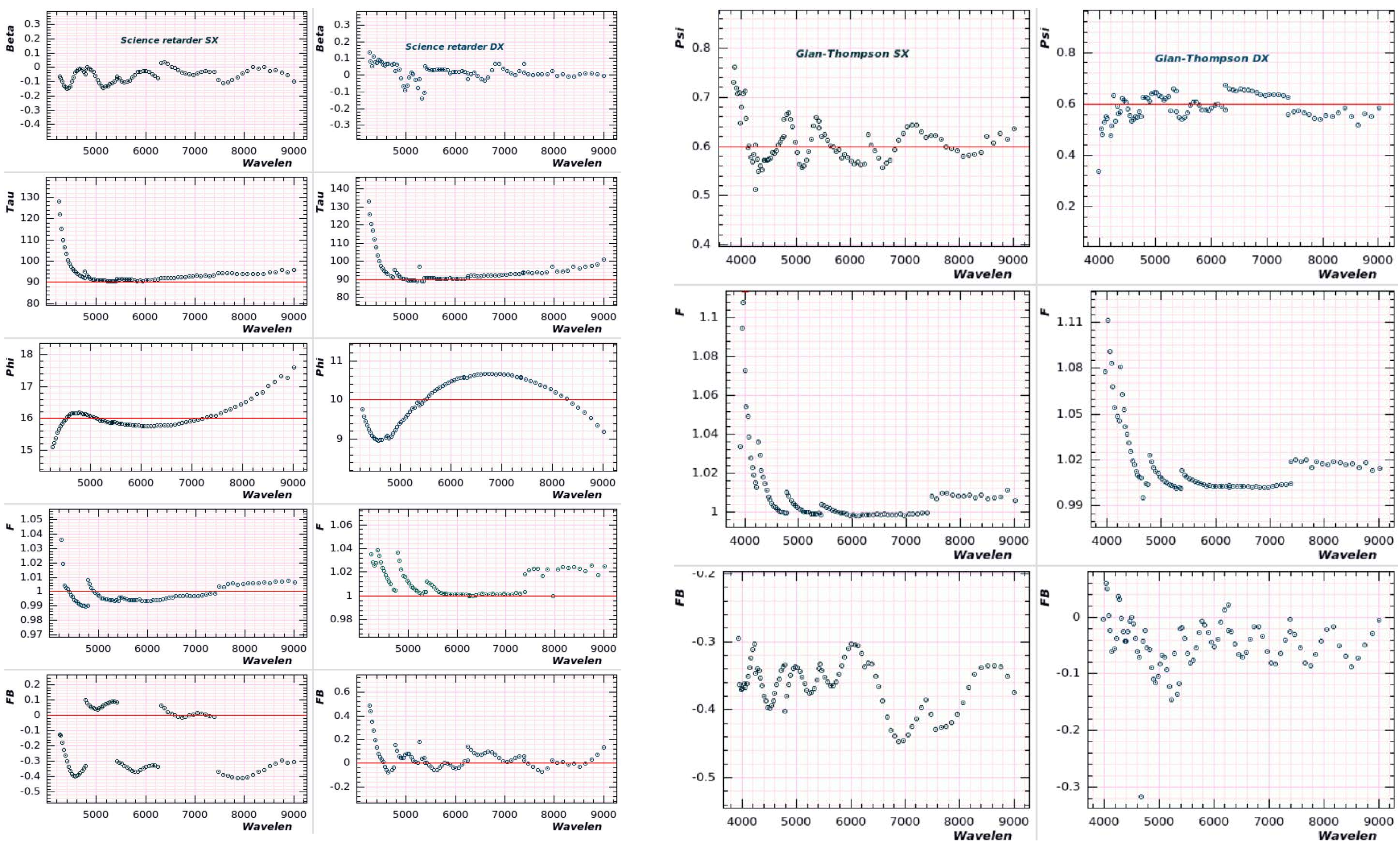


Polarimeter: Optical design





Figs above. Top left to bottom right. System overview and telescope-simulation tests while yet at AIP in Potsdam. Mechanical and optical assembly before and after shipping. First lifting tests of one full unit including AGw#3 and image-derotator mounting flange. After these tests the lifting fixture (in yellow) had to be redesigned due to torque issues. Bottom left shows the optical design based on a Foster beam-splitting prism as linear polarizer and quarter-wave plates as retarder. Mechanical design of the inner unit and the polarimeter heart , i.e., the Foster unit on its carrier plate within the mechanical mount. Guider simulation screen shot (left SX, right DX, with example spectra beneath). First time on the telescope (September 2016).



Figs left. Precalibration of the polarimeters. The calibration procedure is done in two main steps, 1) aligning of the optical axis of the Glan-Thompson polarizing prism with respect to the Foster beam-splitting prism and 2) , aligning of the optical axis of the science retarder with respect to the polarizer. The individual panels summarize the calibration results. Left set of panels is for circular polarization (all cross dispersers (CD) were used except CD-I), right set of panels is for linear polarization (all CDs used). **Beta** is the ellipticity β of the beam exiting from the Glan-Thompson polarizing prism. For linearly polarized light β=0°, and for circularly polarized β=45°. **Tau** is the retardation angle τ of the retarder, so that for the quarter-wave retarder τ= 90°. **Phi** is the orientation angle ϕ of the optical axis of the retarder with respect to the optic axis of the Foster beam-splitter prism. The angle ϕ defines the initial offset of the mechanical orientation of the retarder. **Psi** is the orientation angle ψ of the optic axis of the Glan-Thompson polarizer with respect to the optical axis of the Foster beam-splitter prism. The angle ψ defines the initial offset of the mechanical orientation of the polarizer. **F** is the relative transmission *F* of the two polarized beams of the Foster prism with the linearly polarized co-aligned incident light. For an ideal beam-splitter $F = 1$ and $F < 1$ otherwise. **FB** is the relative transmission *f* of the two fibers from the exit of the Foster prism to the spectrograph up to the resulting echelle image on the CCD. Ideally $f = 0$ for two equal transmissions, in practice misalignment of the fiber injection and different transmission quality of the fibers will result in different values of *f*. The relative transmission *f* is correlating with the retardation angle τ of the retarder in the least-squares model of the polarimeter.

Figs bottom. Storage location at Lower 3rd at LBTO. The clean tent holds the 3m-diameter derotator flanges and the pre-mounted AGw #3 and #4 units. During alignment work at one of the polarimeters. Screenshot from the axis alignment work.