

A (brief) update from the Radebeul RA-Group

HG Zaunick, Dresden



ERAC-Meeting Heidelberg, Sept. 2006

Hardware

Positioning

- robust Full-Bridge Motor Drivers with PWM-Control and Overload/Overtemp Protection driving 48V-Motors@1A nom.
- 1440-step (0.25 deg) optical incremental rotary Encoders
- ATMEL μ Controller driving Motors and tracking Positions from Encoders controlled via high-Level LX200-Interface set upon RS485-Bus

RF

- 1.4GHz Standard UEK21
- Mixer to IF 28MHz
- BP-Filter + log. Detektor (AD8307)

Hardware

Data Acquisition (DAQ)

- 12Bit 250kSps ADC onboard with μ Controller for digital Filtering / Timeshaping and Reference switching
- serial Interface to PC

→ **Positioning/Control works fine now**

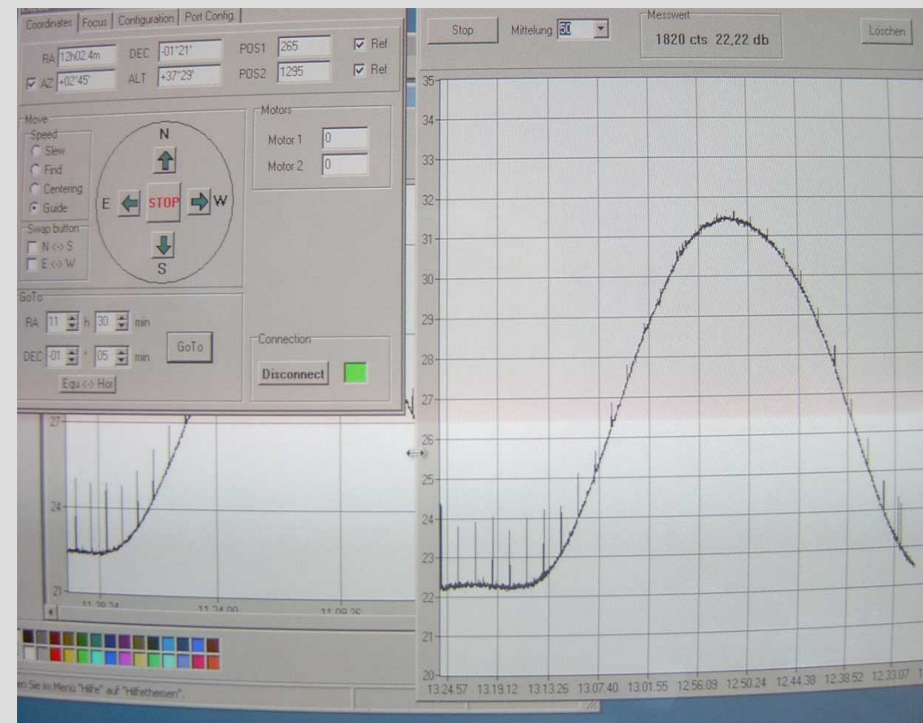
→ **RF/DAQ needs some work:**

- need to replace Preamp (NF>0.8db -> far too noisy)
- DAQ utilizing Direct RF Sampling + DSP with new Generation-FPGAs (Xilinx Virtex Series) under development

Software

Telescope Control and DAQ

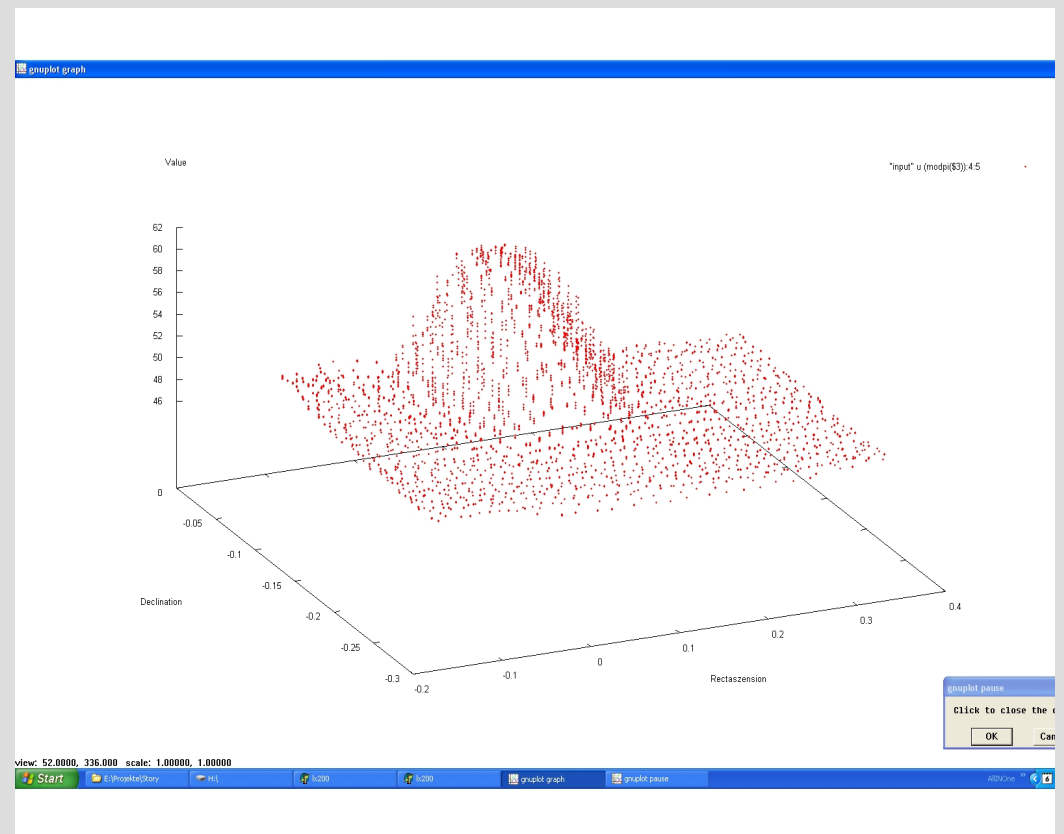
- Backend written in DELPHI (working), rewriting in C++ for platform independance and reusability in progress
 - tracked single point measurements, Driftscans (const Azimuth), Fieldscans (var RA and Dec) and arbitrary Scans controlled by customizable Macros possible



Software

- Raw Data Storage as ASCII-Lists containing timestamp, coordinates, raw+log value, errors in position (covariance matrix) and error of measurement

- Visualisation of raw Data (Measurements vs. Time) and coordinate mapped Data (Meas. vs [RA,Dec])



Software

Data Analysis (in progress)

- Goal: Development of a Framework for Analysis of Radioastronomical Dataseries
- written in C++ consisting of universal STL-compatible classes
- tools for
 - managing Datasets (split/merge/filter)
 - remapping Data to different projections/coordinate systems
 - Fitting Data / error estimation
 - Deconvolution / Unfolding with known Telescope function or without it (blind deconvolution)

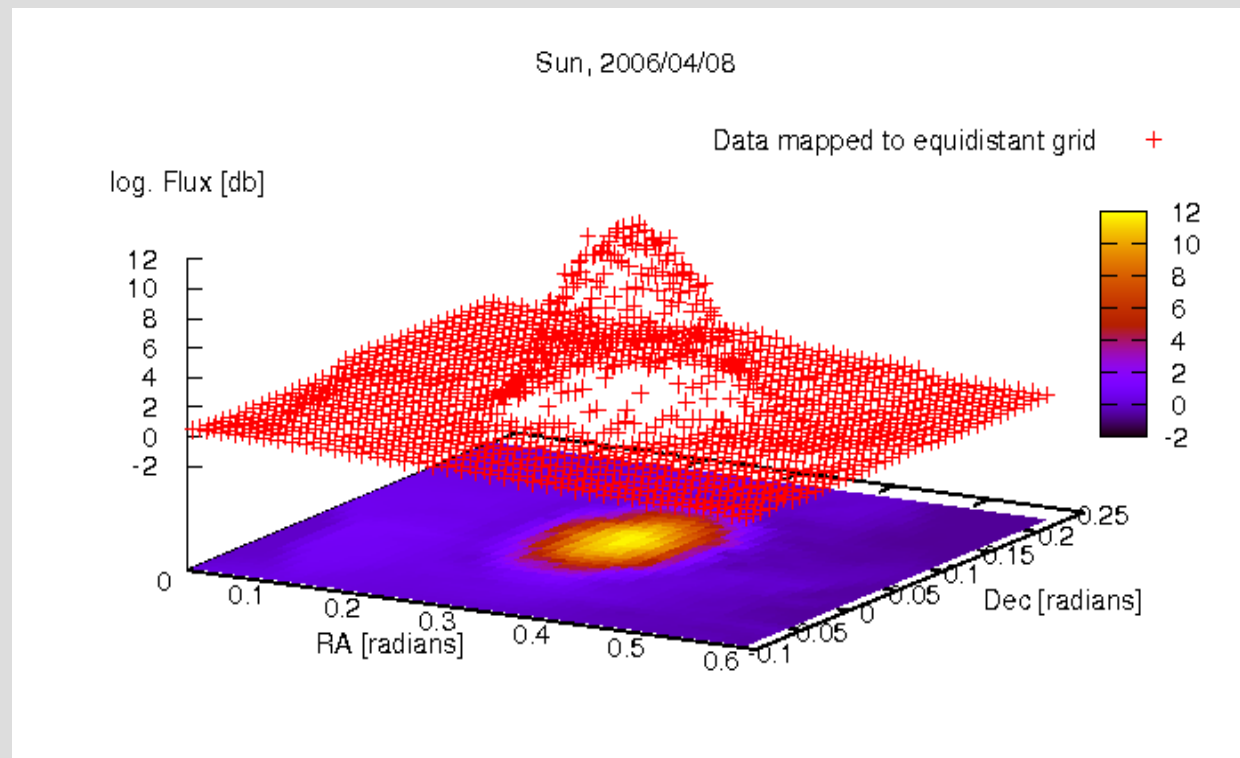
Software

- Simulation Package that synthesizes Analysis inputs to study impact of system parameters on data on a phenomenological basis is under development (first results yet)

Software

Example: 2D-Scan of the Sun

First, Data is mapped to equatorial-coordinate grid



Software

Assuming a Point-like distribution (which is not true for the sun, but ok for first iteration) we can fit a 2d-Gaussian + 2nd order polynomial Underground (14 parameters in total)

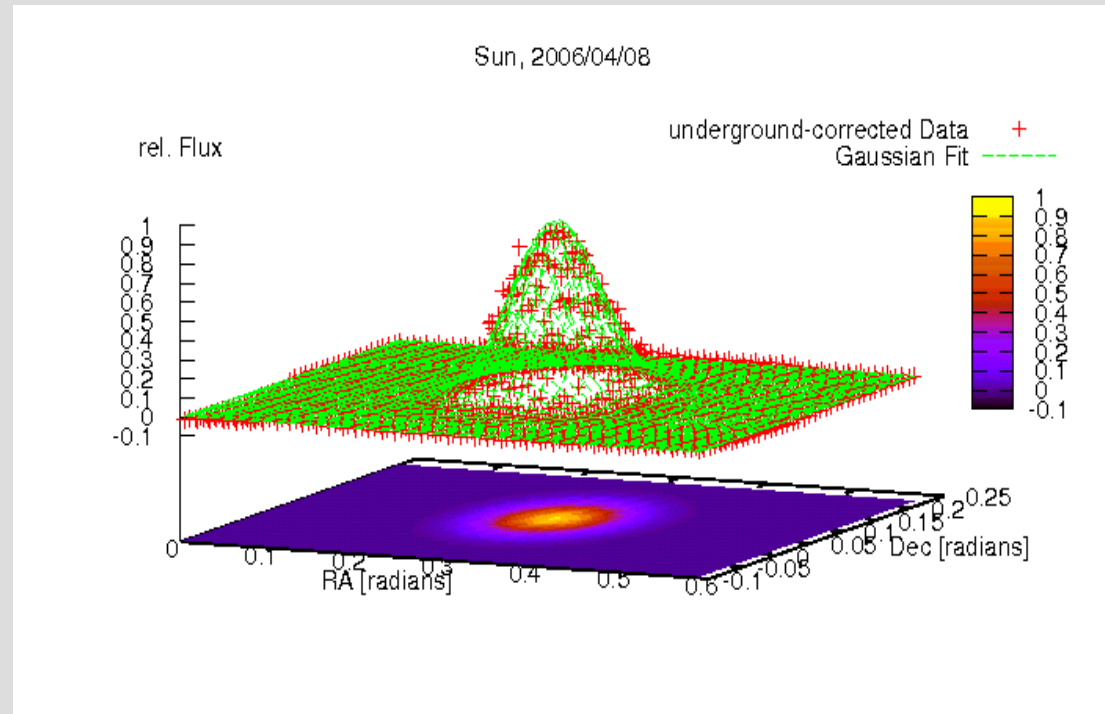
fit function:
 $f(x,y) = a_0 + a_1 \exp(-x^2/a_3^2 - y^2/a_5^2) + a_6 x + a_7 y + a_8 x^2 + a_9 y^2 + a_{10} xy + a_{11} x^2 y + a_{12} x y^2 + a_{13} x^2 y^2$

After 6 iterations the fit converged.
 final sum of squares of residuals : 3.64016
 rel. change during last iteration : -1.84201e-07

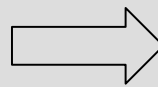
degrees of freedom (ndf) : 4013
 rms of residuals (stdfit) = sqrt(WSSR/ndf) : 0.030118
 variance of residuals (reduced chisquare) = WSSR/ndf : 0.000907093

Final set of parameters Asymptotic Standard Error
 =====

a0	= 0.320229	+/- 0.004982	(1.556%)
a1	= 0.909402	+/- 0.003683	(0.405%)
a2	= 0.293327	+/- 0.0001665	(0.05676%)
a3	= 0.0422815	+/- 0.0002115	(0.5003%)
a4	= 0.0733698	+/- 0.0001604	(0.2186%)
a5	= 0.0381962	+/- 0.0001686	(0.4413%)
a6	= -0.233338	+/- 0.03518	(15.08%)
a7	= 0.236771	+/- 0.09685	(40.9%)
a8	= 0.294649	+/- 0.05394	(18.31%)
a9	= -1.35504	+/- 0.5671	(41.85%)
a10	= -2.34949	+/- 0.5859	(24.94%)
a11	= 3.73479	+/- 0.8147	(21.81%)
a12	= 13.4976	+/- 3.854	(28.55%)
a13	= -23.2089	+/- 5.694	(24.54%)



Fit returns some useful calibration parameters of our system: e.g. main lobe widths (a3,a5), sensitivity limit (a0) and gain (a1)



ToDo/Outlook

- Hardware not in final stage, i.e. RF-part still too insensitive
- Software Development proceeds well, but still 1..2 manyears until working release
- GPS-synchronised LO-Drive for desired time-coherence for Interferometer operation almost complete
- Documentation still to write!