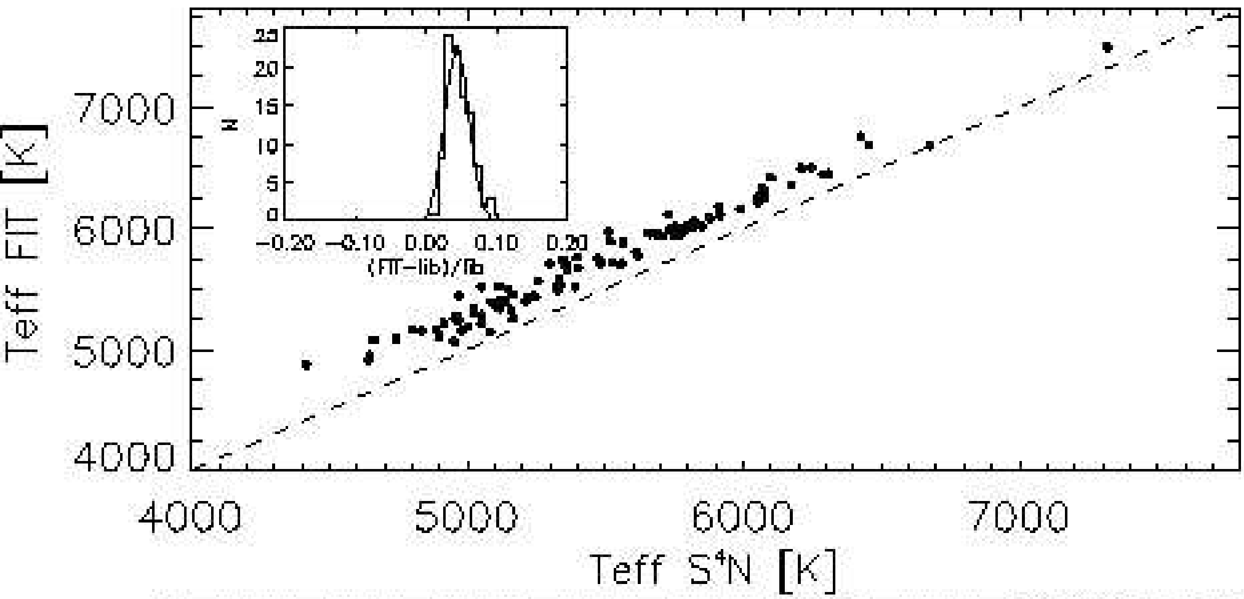
Fri Feb 10 12:51:21 CST 2006

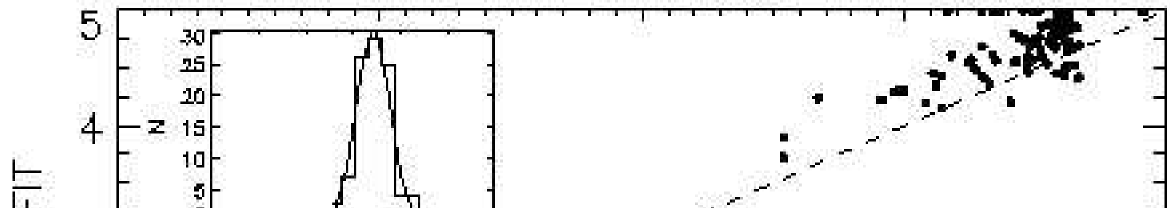
Here is the promised update:

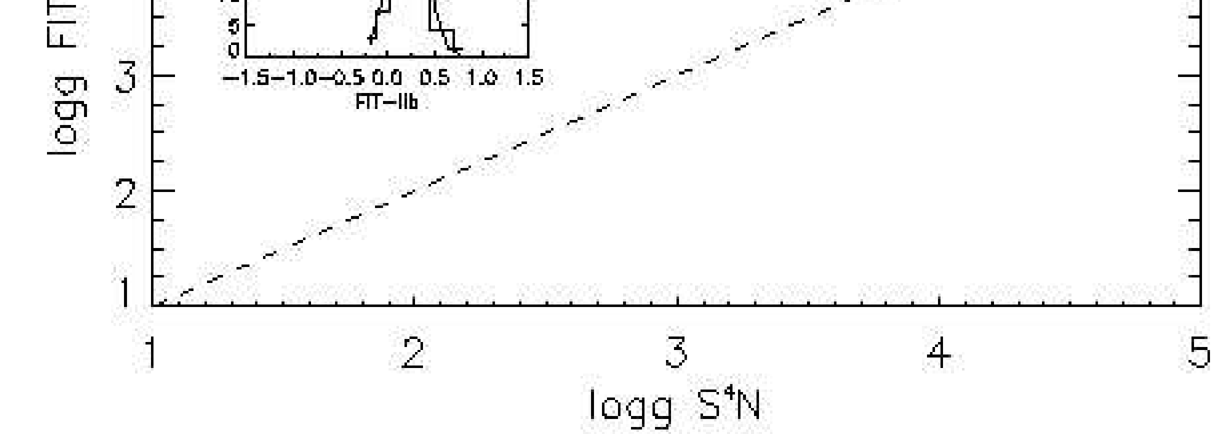
We have now extended the tests from model fluxes (with/out noise) to real stars. We are dealing with late-type stars for now. There is a second grid in the making for warmer spectral types, but there is no use in trying to deal with those until rotation becomes a parameter. All the following refers to stars within the following range of parameters:

4250 < Teff < 7500 K
1.0 < logg < 5.0
-3.0 < [Fe/H] < +1.0

Microturbulence is set to 2.0 km/s to be consistent with the atmospheric structures we are using: Kurucz (1993) models. This is all the same as we described in the previous report (ut1). We have tested on two libraries of stars. The first one is S4N (Allende Prieto et al. 2004) -- some 100 stars within 15pc from the Sun, mostly dwarfs with spectral types earlier than K2 (~4700 K) and therefore pure Pop I (thin-disk) stars. The resolving power is very similar to SES' about 50,000-60,000, and the S/N is pretty high (>300). Regarding the parameters, they have been derived homogeneously: Teff from IRFM calibrations, logg from Hipparcos parallaxes and stellar evolution isochrones, Fe/H from an LTE analysis of FeI/FeII lines. We tested 4 different orders independently (identified with aperture numbers 54,55,56 and 64, see ut1), but it quickly became apparent that the order including Hbeta performed much better than any of the others. Therefore, we used this order for all the tests described below. The tests included two 'ways' of normalizing the data: a 2nd- and a 6th-order polynomials. The normalization process is unsupervised: that is, the order is blindly fit to a polynomial, outliers below a-sigma or above b-sigma from the mean, respectively, are rejected, and then the remaining data are fit again, with the process being repeated a number (n) of times (for now a=0.5, b=3. and n=4). For the aperture #64 (Hbeta order), it turned out that it didn't make a difference whether we used 2nd or 6th-order polynomials -keep in mind that these data have been normalized previously. Three examples of the fittings are shown here: s4n_1.gif, s4n_2.gif, s4n_3.gif. Figure 1 illustrates the results.







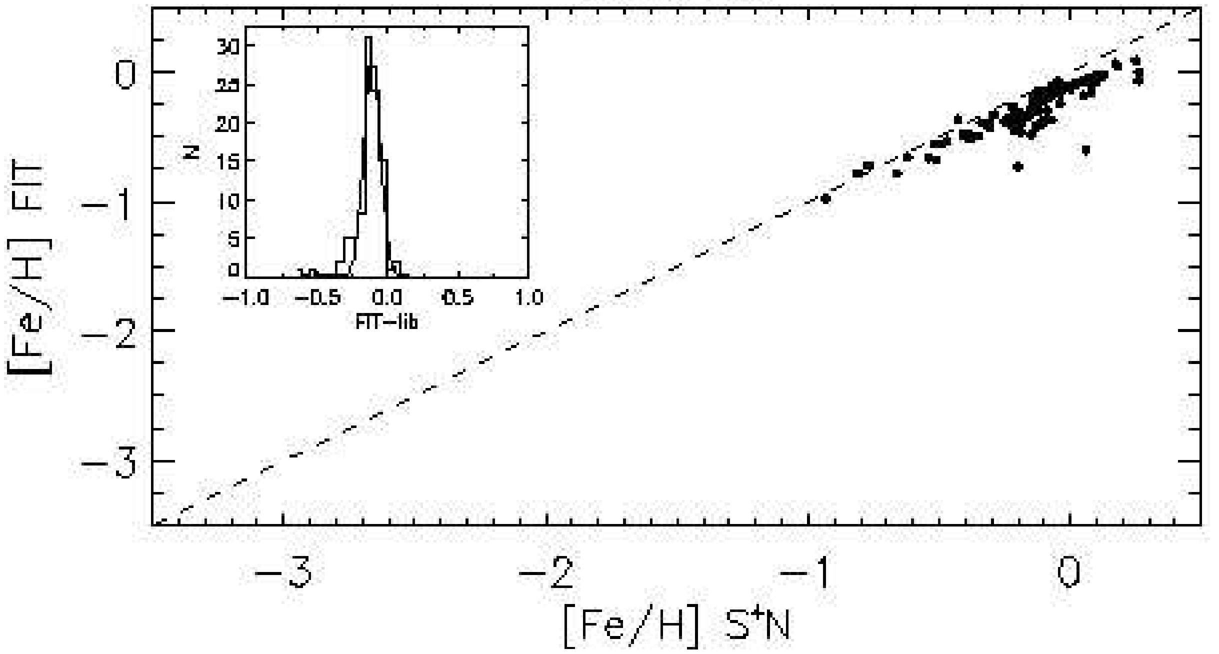


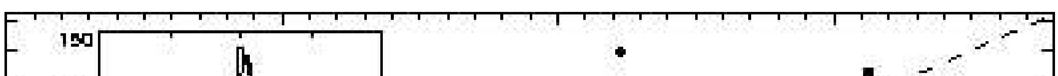
Fig. 1. Comparison with the S4N library.

Numerically, the Gaussian fits to the residuals give:

	Teff	logg	[Fe/H]
<FIT-S4N>	4.3%	0.21	-0.11
sigma(FIT-S4N)	1.7%	0.17	0.06

The second test involves a larger library, the ELODIE's library (Prugniel & Soubiran 2001). Although these data are originally at a resolving power of ~40,000, the version we had on disk has been smoothed/sampled at 10,000. Unfortunately, the website where the library resides (version Elodie.3) was down at the time we needed the data, so these tests were performed at the lower resolution. This library contains also nearby stars (mostly late-type), but up to much larger distances: typically several hundred pc for dwarfs and way beyond for giants. Thus, it samples the two disks, and the halo, with a much broader range of parameters than the other library. The caveat is that the parameters compiled come from the literature, which means a high heterogeneity. Although it is all from high-resolution spectroscopic analyses, the details can differ significantly (e.g. photometry vs. excitation balance Teffs).

The results for this 2nd test are illustrated in the following figure and table. Just like for the previous case, I have excluded stars that didn't fit well: they were, as far as I can tell, outside the Teff range of our grid, fast rotating stars, or double-lined binaries. The comparison involves 644 stars.



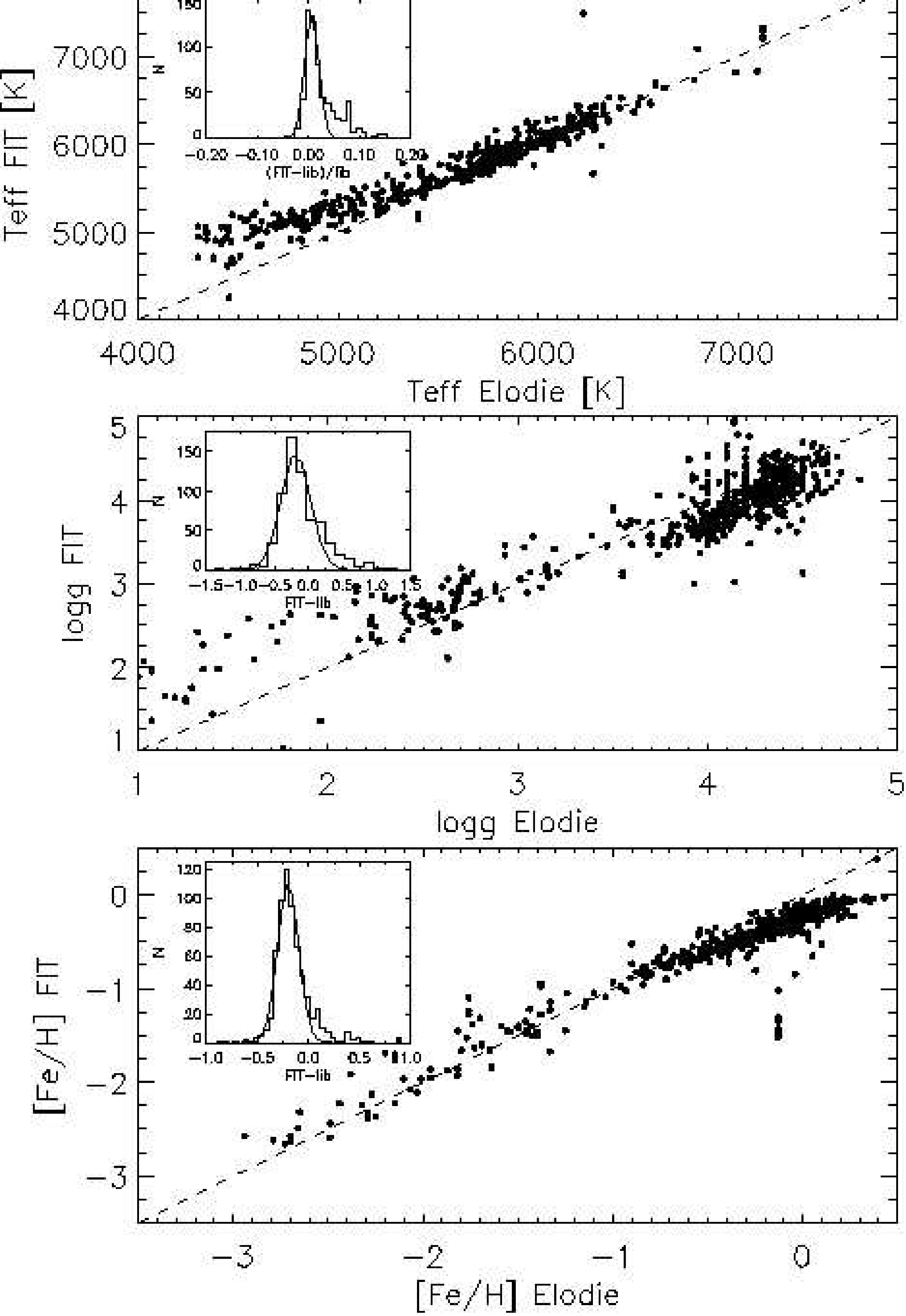


Fig. 2. Comparison with the Elodie.3 library

The Gaussian fits to the residuals give:

	Teff	logg	[Fe/H]
<FIT-Elodie>	0.6%	-0.29	-0.20

sigma(FIT-Elodie)	1.4%	0.22	0.10

To summarize, I think we can derive Teffs to ~ 100 K, gravities to 0.2, and metallicities to about 0.1 dex with no sweat. There are systematic offsets, but they are relatively small, with the exception of [Fe/H] in the high metallicity regime ([Fe/H]>-1), which can probably be corrected by a linear transformation, and Teff, which may need to be offset by a constant (some 250 K) in order to land on the IRFM scale (see Fig. 1), but with a more complicated shape (=0 for Teff>5500 K) if we want to match the Elodie scale used in Fig. 2. The trends in Fig. 2 resemble closely those in Allende Prieto (2003), which is not surprising at all. In that paper, a genetic algorithm was used, instead of the Nelder-Mead simplex method, but the spectral region was the same.

The fine details of the offsets for SES will probably become apparent only after we perform a survey of standards with Stella itself. As these may also change depending on which parameters are finally adopted, we refrain from deriving empirical corrections at this point.

Regarding the software, everything is pretty much ready for delivery. There are two main programs:

1) iq_conv -> takes as input a bunch of ASCII files with spectra (two-column format) and produces a single input file for the next phase, after interpolating and normalizing the fluxes

2) parses -> takes as input the file from iq_conv and fits the spectra to derive atmospheric parameters. On ouput there will be two more files, one with the optimal parameters and error bars and a second one with the best-fitting spectra.

We're doing the final tests on a linux machine with the gnu g95 compiler for the fortran code. The program that preprocesses the data, iq_conv, is written in the bash shell and calls a fortran90 code for the calculations. The code that determines the parameters, parses, is fortran90. We will provide a tar file with everything, including a makefile to Thomas early next week.