STATUS OF FIRS DATA AND PROCESSING

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summary of comparisons

comparison of observations

data taken at the same time with different instruments

seeing, spatial/spectral resolution differences, instrumental systematics

comparison of inversion code forward model

provide each code with the same parameters to generate synthetic spectra

- chosen free parameters, calculation differences

comparison of inversion results

direct comparison of fitted parameters and spectra of different inversion codes applied to the same spectra

- initialization/fit control differences



brief description of Facility InfraRed Spectropolarimeter (FIRS)

Telescope: DST @ NSO/Sacramento Peak

Features: Diffraction limited with HOAO Dual beam 4-slits for high cadence (20 min.) High and low resolution modes

Wavelengths: Simultaneous Fe I 6302/15650 Å or Fe I 6302/He I 10830 Å Runs concurrently with: IBIS Ca II 8542 Å, G-band camera

Now available for general use! For more information see: <u>http:/kopiko.ifa.hawaii.edu/firs</u>

comparison of observations

FIRS vs. Hinode 2009-07-07 SOLIS vs. Hinode 2010-07-01



FIRS vs. Hinode/SP



FIRS vs. Hinode/SP

Hinode boxcar smoothed by 6 pix





SOLIS vs. Hinode/SP



SOLIS vs. Hinode/SP

Hinode boxcar smoothed by 4 pix



comparison of inversion techniques

Two Component Magneto-Optical 2C MO -- our own code for use on FIRS 6302 data

Milne-Eddington gRid Linear Inversion Network Merlin -- obtained from CSAC Hinode client, inversion run with standard parameters, save synthetic profiles

the Original HAO Milne-Eddington code? Solis ME -- you know more about it than I do (Skumanich & Lites, 1987)

Non-LTE Inversion COde using the Lorien Engine Nicole -- pre-release version from H. Socas-Navarro, atmosphere fitting, not ME

2CMO

2 component magneto-optical inversion magnetic + scattered light component

We have a simple gaussian fitting routine for FIRS 15650 Å Fe I and OH lines

- * not appropriate for fitting of 6302 Å Fe I where damping and magnetooptical effect are significant
 - * why write our own code? speed, utility, experience, not a black box

Return to unsimplified equation forms for the Milne-Eddington approximation:

- * basic equations for profiles are some combination of those found in Landolfi & Landi degl'Innocenti (1982) and Jefferies, Lites, & Skumanich (1989)
- * employ approximation of the complex Voigt function in Matta & Reichel (1971)
- * function supplied to IDL curvefit

ME code fit parameters

	parameter	2C MO/ Merlin	SOLIS ME
Bo	source function	X	
B ₁	source function gradient	X	X
B	magnetic field strength	X	X
χ	magnetic field azimuth	X	X
ψ	magnetic field inclination	X	X
λο	line center	X	X
$\Delta \lambda_{DW}$	doppler width	X	X
ηο	absorption coefficient	X	X
a	damping parameter	X	X
f	magnetic fill factor	X	X
$\Delta\lambda_{SL}$	scattered light profile shift	X	

Nicole

- * Assumes:
 - * statistical level populations(for NLTE)
 - * hydrostatic equilibrium
- * SVD + Levenberg-Marquardt minimization
- * Uses the LoRIEn engine
- * Written in fortran90 with a python wrapper for performance and cross-platform compatibility

Nicole model parameters

		parameter		
	Z	height		
	Т	temperature		
	τ	optical depth		
	Q	mass density		
	Pgas	gas pressure		
	Pel	electron pressure		
	В	magnetic field strength		
	χ	magnetic field azimuth		
	ψ	magnetic field inclination		
	Vlos	line of sight bulk velocity		
*	Vmic	micro-turbulence		
k	Vmac	macro-turbulence		
k	f	stray fraction		
k	exp	chromospheric fill factor expansion		
	*ontional/constant parameters			

fit parameter degeneracy?

thoughts?

can produce multiple minima through a combination of line parameters when line damping not very large

B and f in the weak field limit (etao?)

synthetic profile comparison

Provide same input to forward model Merlin > 2C MO



2C MO vs. Merlin for FeI 6302.5



comparison of inversion results

2C MO vs. Merlin (2009-07-07 Hinode) 2C MO vs. SOLIS ME (2010-07-01 Solis) Nicole vs. Merlin (2009-07-07 Hinode)

On Sarah's Mac Pro, 3.5 GHz dual quad-core w/ 16 Gb RAM:

* 2C MO 0.6 sec steps (150 x 150 pixel map -4 hrs), (in IDL 6.3, not multi-threaded)

* Nicole 5.5 sec steps (150 x 150 pixel map -34 hrs), (unoptimized, non-MPI)



2C MO vs. Merlin for FeI 6302.5





Data vs. Merlin and 2C MO for Fe I 6302.5

Data vs. Merlin and 2C MO for Fe I 6302.5

2C MO vs. Merlin for Fe I 6302.5

SOLIS ME vs. 2C MO

SOLIS ME vs. 2C MO

Nicole vs. Merlin

Nicole vs. Merlin

Nicole vs. Merlin Fe I 6302.5

Data vs. Merlin and Nicole for Fe I 6302.5

Data vs. Merlin and Nicole for Fe I 6302.5

Nicole vs. Merlin for Fe I 6302.5

ending thoughts

* Merlin and 2C MO in agreement

* 2C MO needs more robust initial guesses, scaling of η_0 between lines

- * SOLIS ME needs help...or I do
- * Nicole...looks promising...needs comparison among same class of inversions (SIR...others?)