Measuring Stellar Parameters with q²

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```
> git clone https://github.com/astroChasqui/q2_PS2017
```

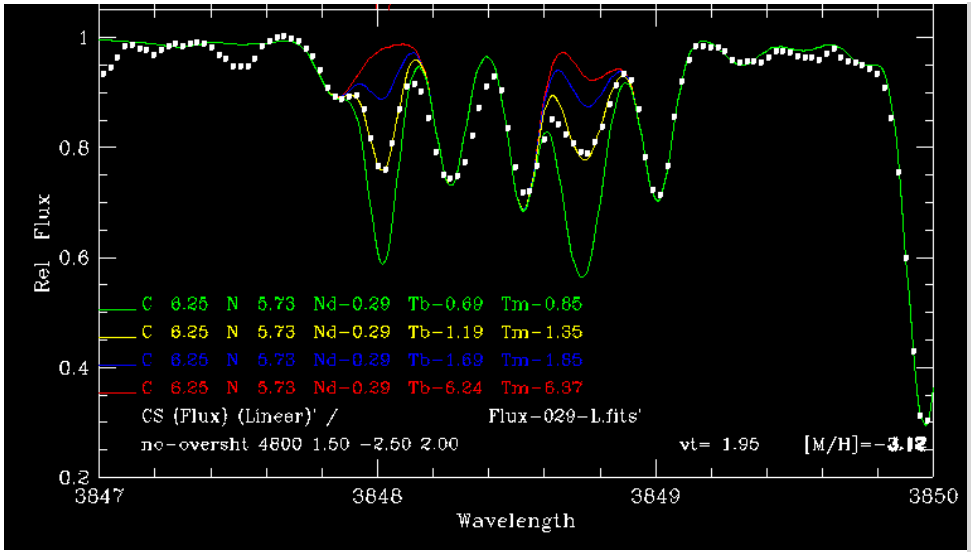
Using MOOG to measure elemental abundances

Model atmosphere: $T_{\rm eff}$, log g, [Fe/H], $v_{\rm t}$
[τ, T, P, $N_{\rm e}$, ...]

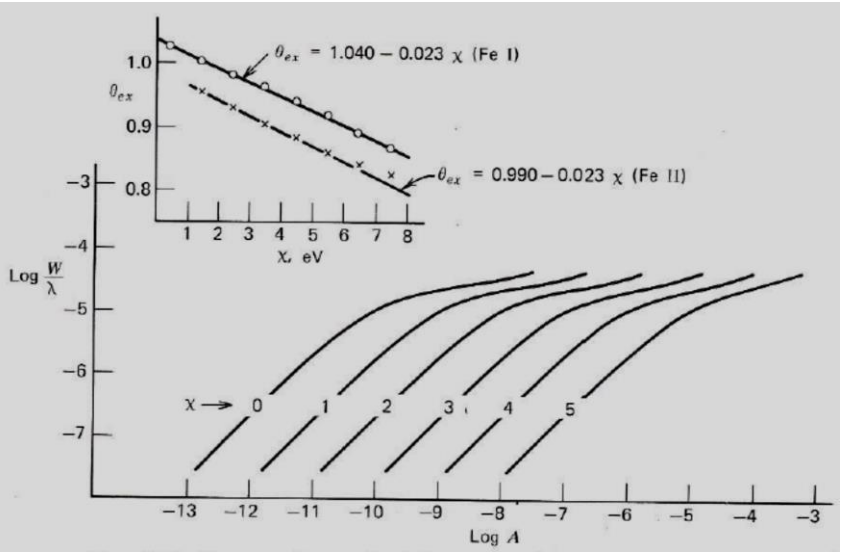
Line-list:
λ, species, EP, log gf, EW, …

MOOG: opacities, radiative transfer

Synthetic spectrum (“synth”)



Curve of growth (“abfind”)

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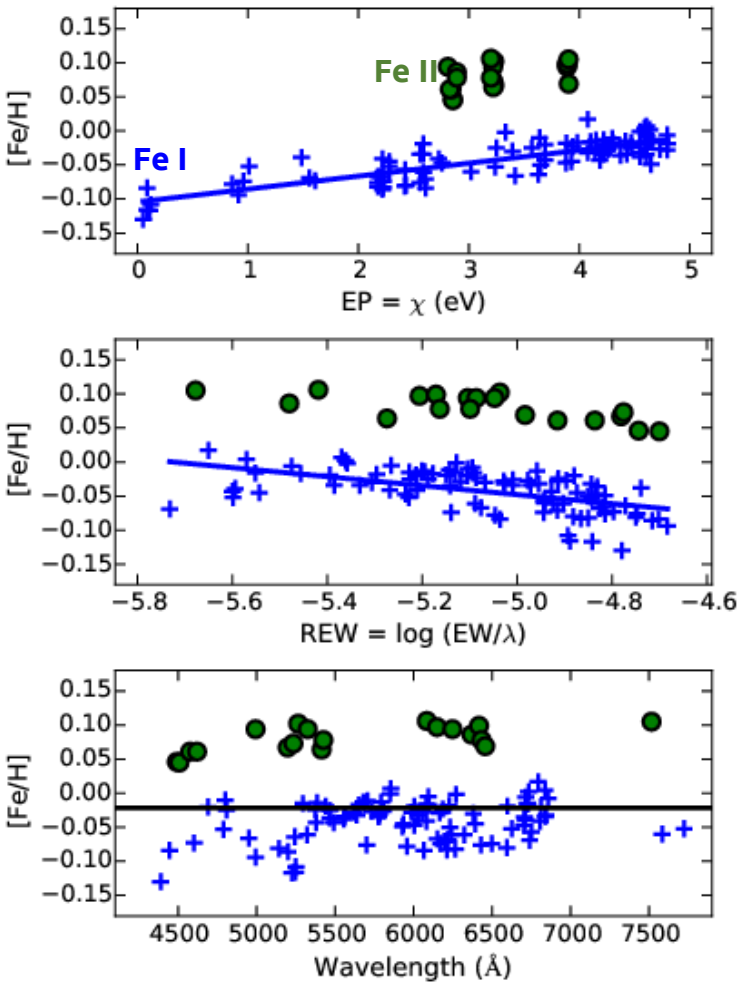
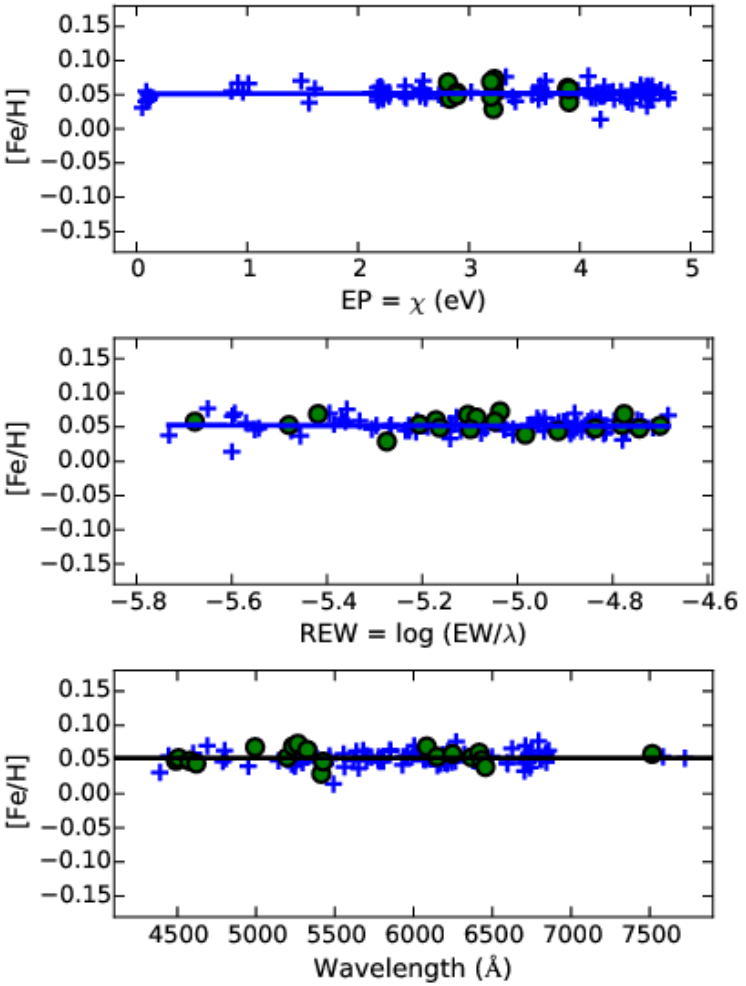
Spectroscopic parameter determination

T_{eff} = 5700 K, log g = 4.50, [Fe/H] = 0 , v_t = 1.05



T_{eff} = 5814 K, log g = 4.45, [Fe/H] = 0.06 , v_t = 1.02

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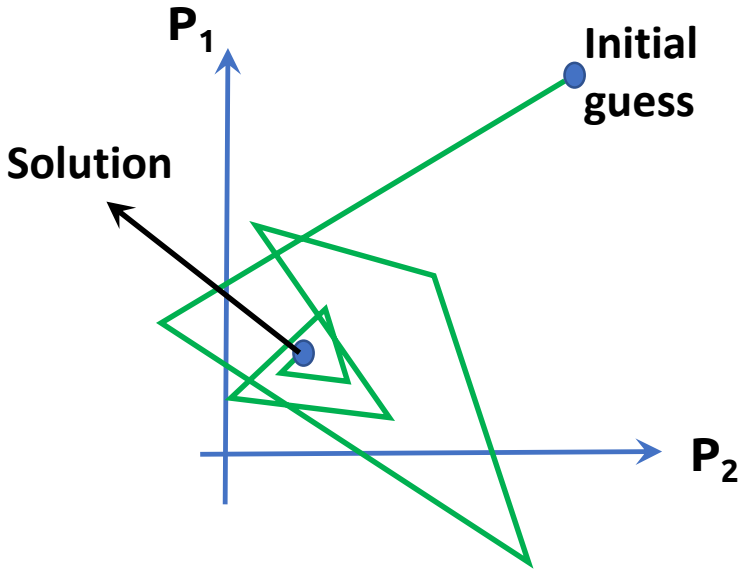
How to achieve spectroscopic equilibrium

Make educated
guesses iteratively



+ Fast
– Degenerate solutions
– No robust error

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```

Qoyllur quipu (q^2)

All data needed are placed in two files:

- Stars: id, T_{eff}, log g, [Fe/H], v_t
- Lines: λ, species, EP, log(gf), **EW**
  (**EW** represents one column per star)

- Manages MOOG input/output files
- Analyzes stats to approach spectroscopic equilibrium
- Estimates errors
- Can be interactive

Code: https://github.com/astroChasqui/q2
Tutorial: https://github.com/astroChasqui/q2_tutorial
This week's exercises:

```
> git clone https://github.com/astroChasqui/q2_PS2017
```

Measuring Abundances and Isochrone Stellar Parameters with q²

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```

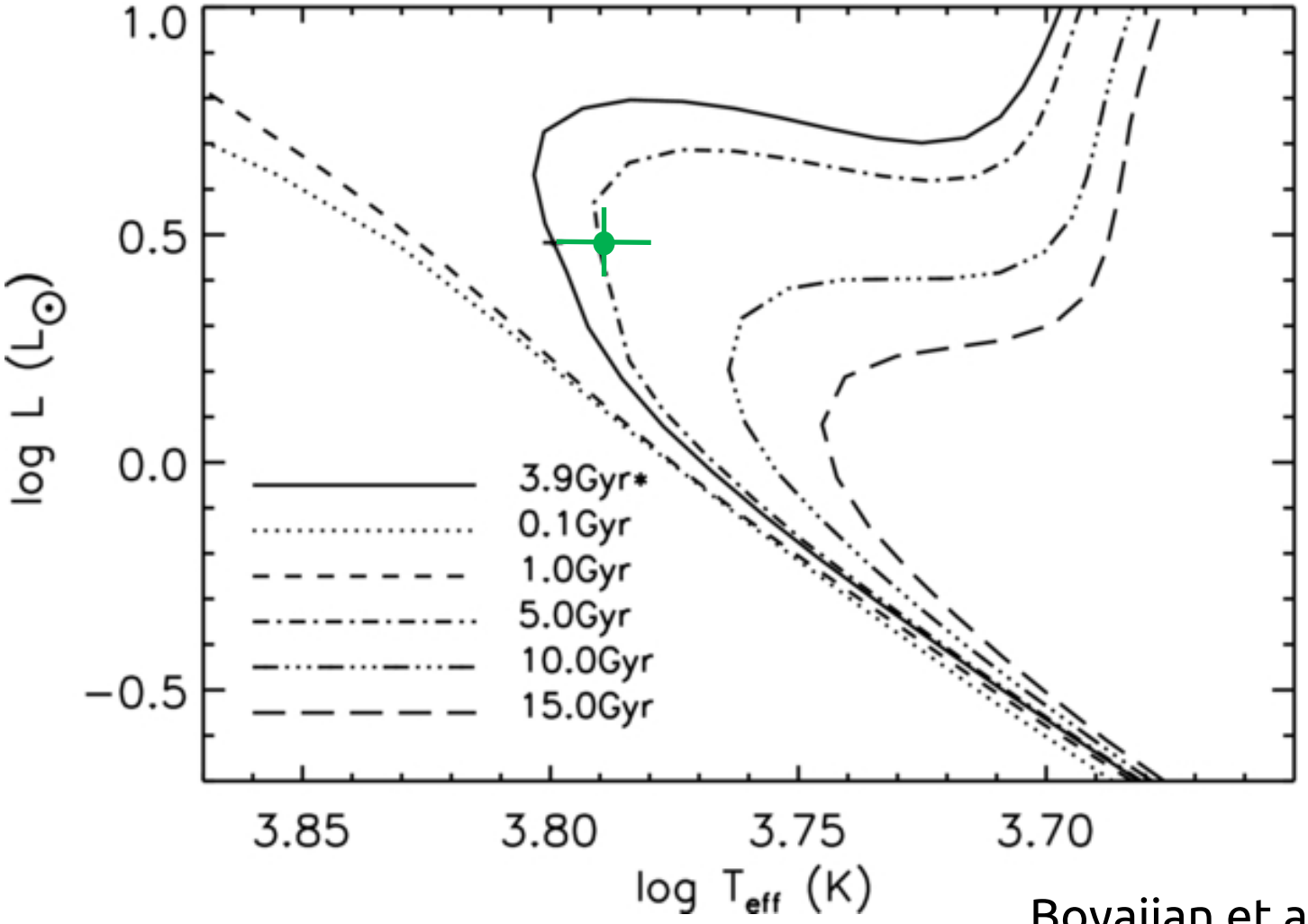
q2 (user)

- star
  - Data — *Manage data*
  - Star
- specpars
  - solve_all — *Spectroscopic parameter determination*
  - solve_one
- abundances
  - get_all — *Elemental abundance measurements*
  - get_one
- isopars
  - solve_all — *Calculation of isochrone stellar parameters*
  - solve_one

q2 (core)

- tools, config
- modatm, moog, errors

Stellar ages from isochrones



Boyajian et al. (2012)

```
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```
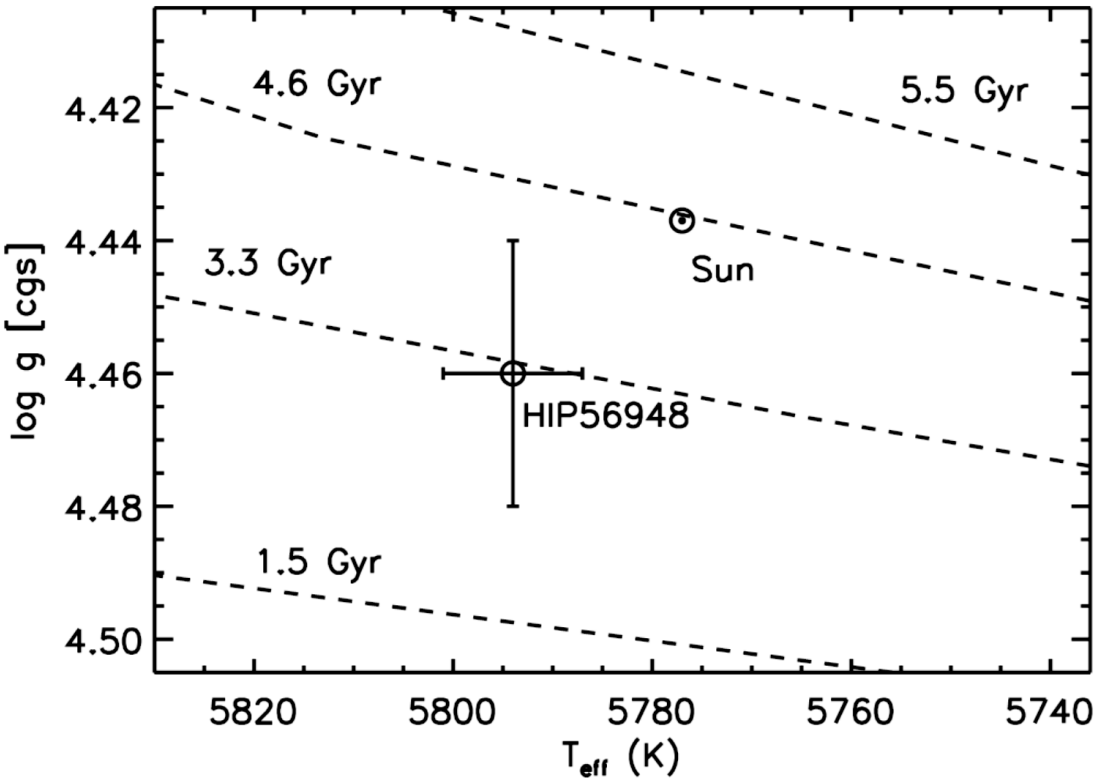
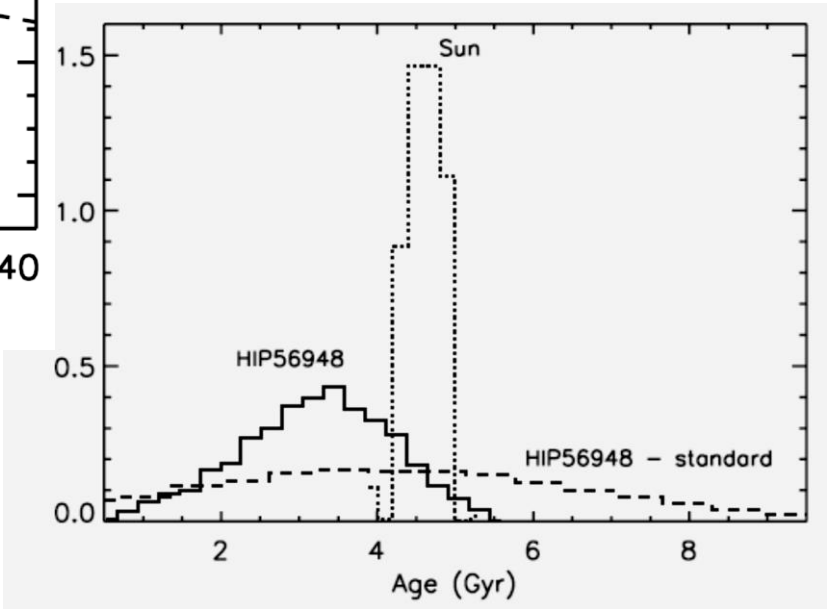

Isochrone ages of main-sequence solar twin stars



Meléndez et al. (2012)

Use the very precise spectroscopic log *g* instead of the uncertain luminosity (which depends on uncertain parallax)




```
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```
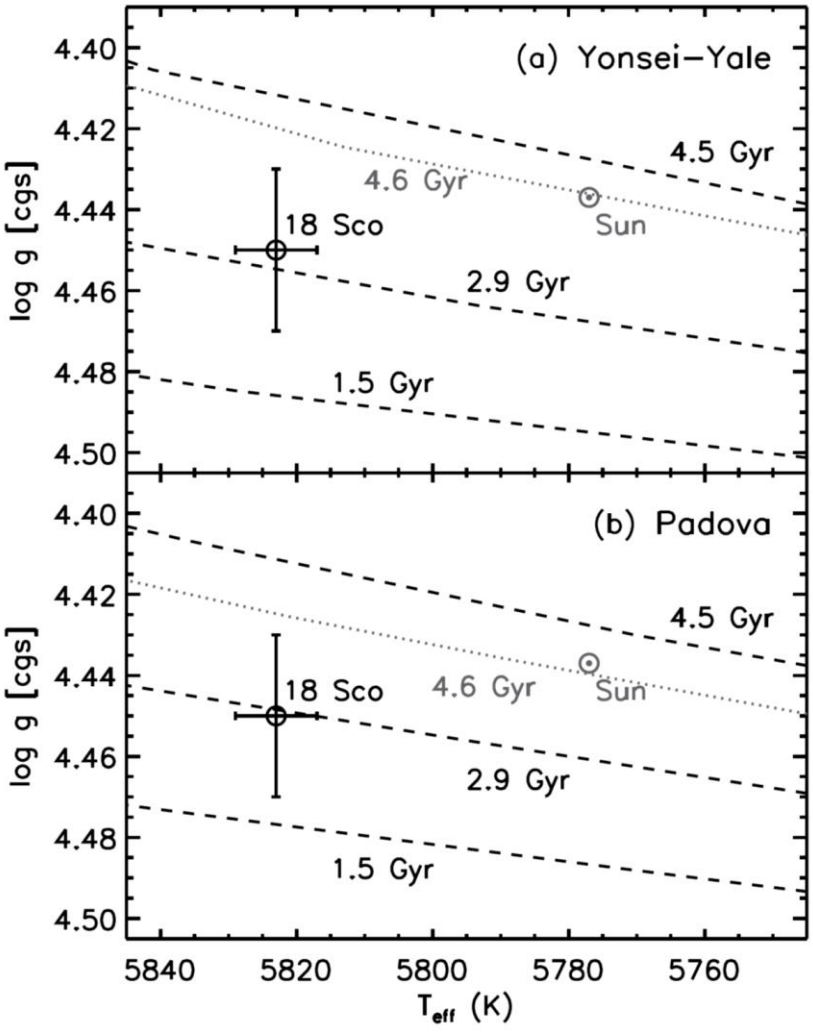

Ages of solar twins: different isochrones grids



Precise
and
accurate

Meléndez et al. (2014)

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