

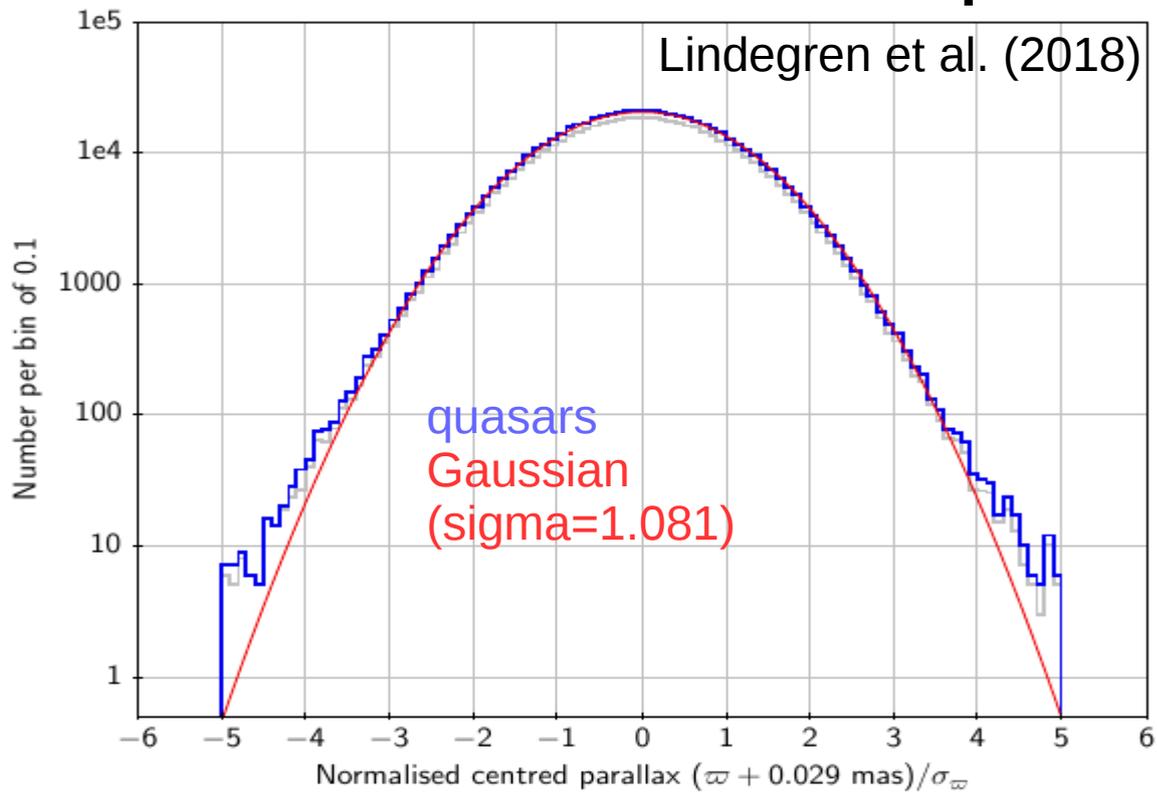
Inferring stellar ages from Gaia data

Rene Andrae
MPI for Astronomy, Heidelberg

Overview

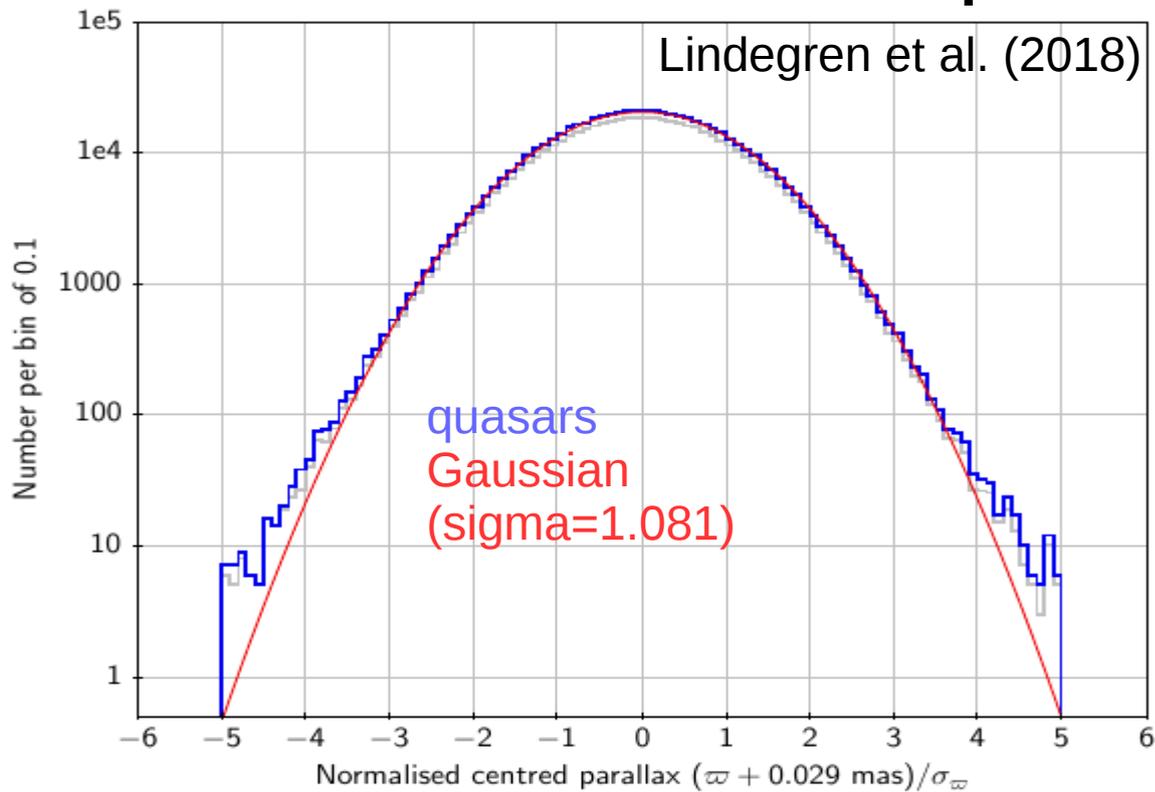
- (1) basic Gaia data products
- (2) stellar ages in GDR3
- (3) future developments
- (4) summary

Basic Gaia data products: Astrometry

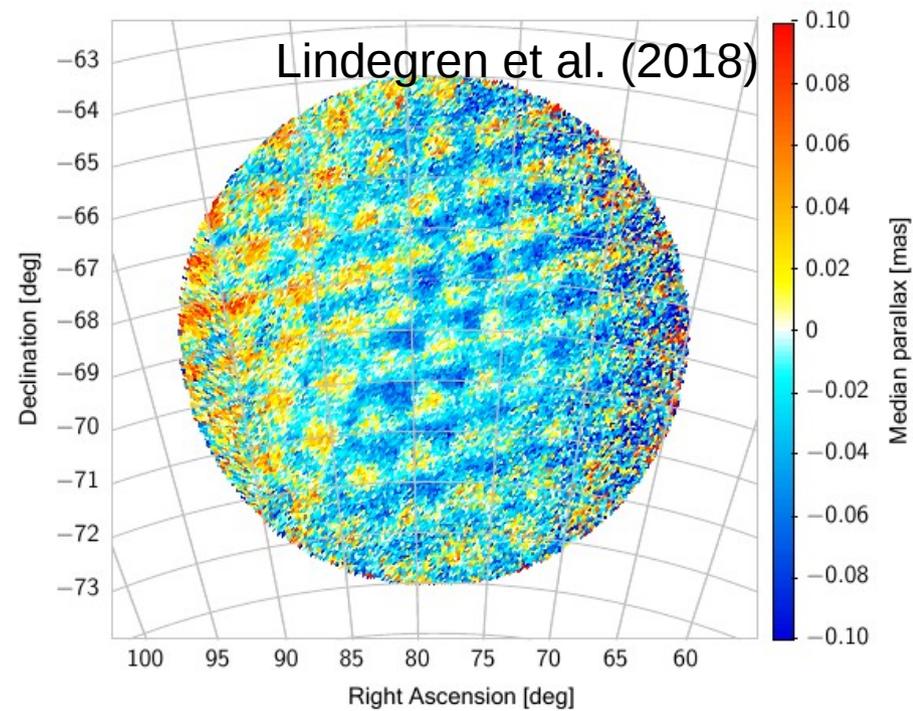


- parallax Gaussian errors
- 0.029mas zero-point

Basic Gaia data products: Astrometry

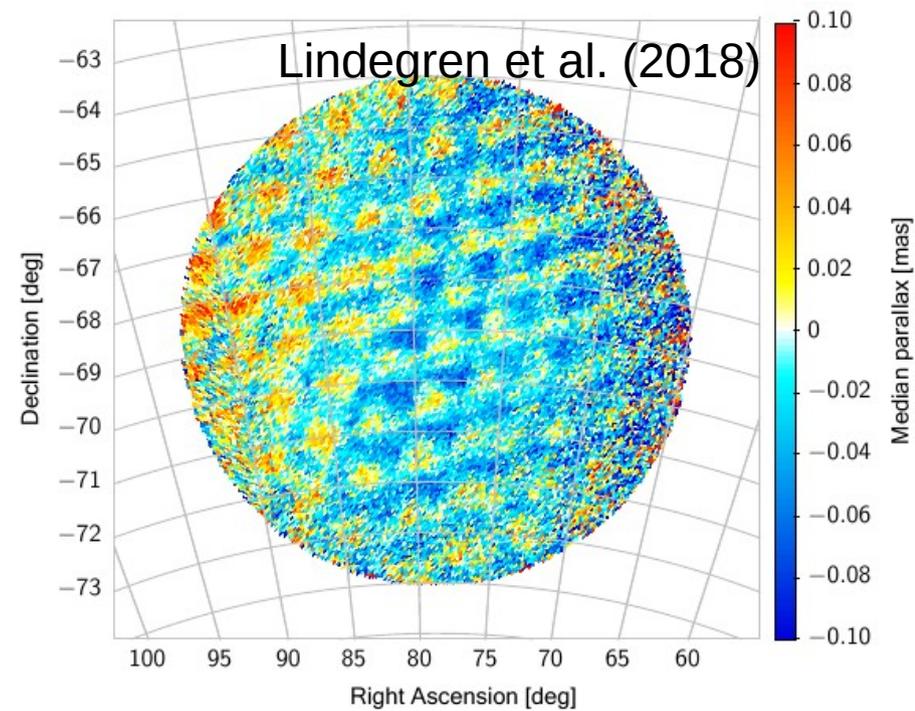
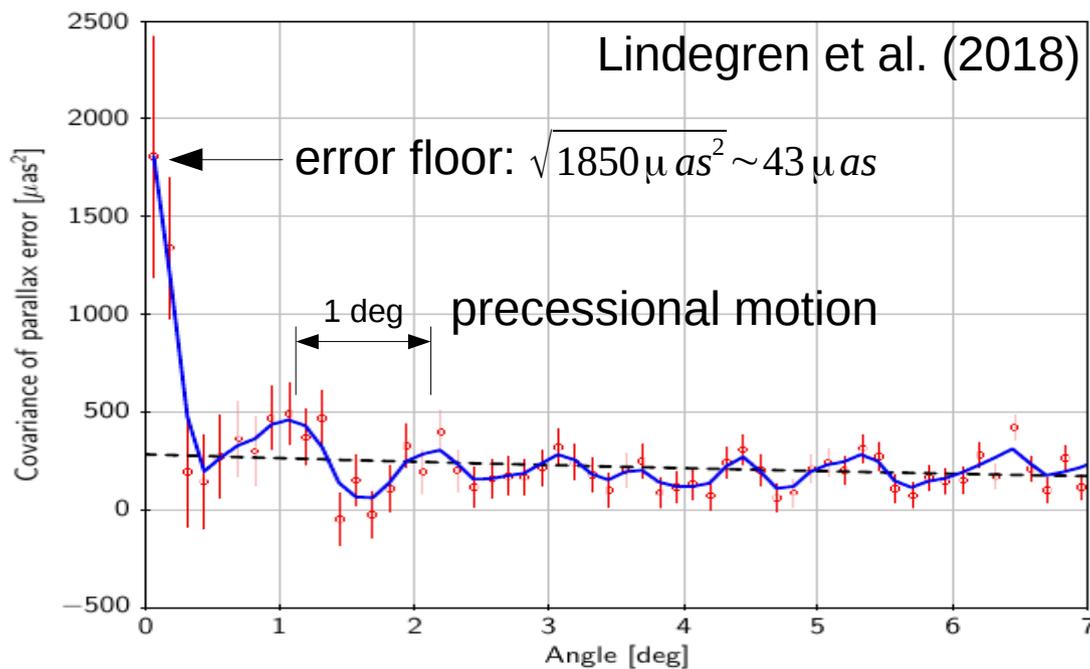
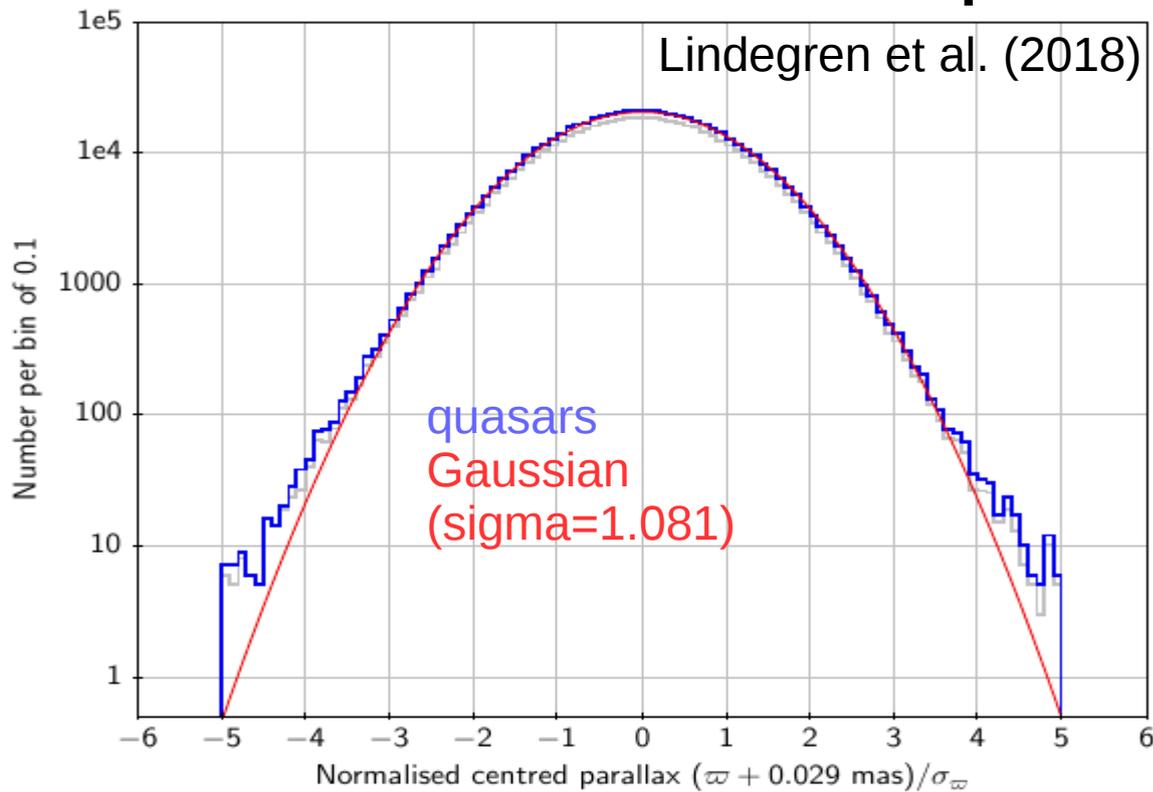


- parallax Gaussian errors
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- spatial correlations

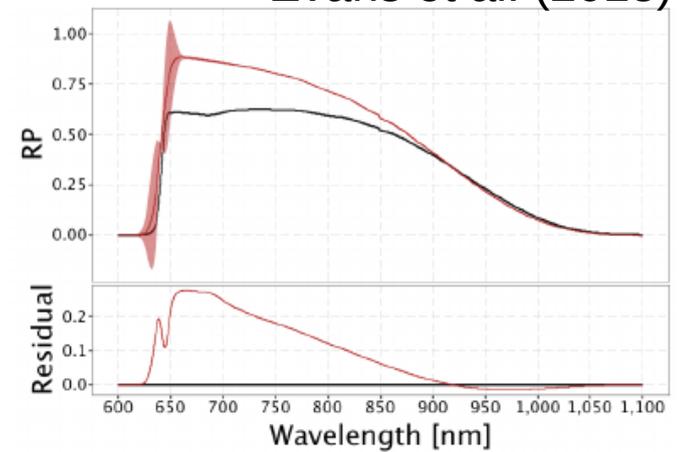
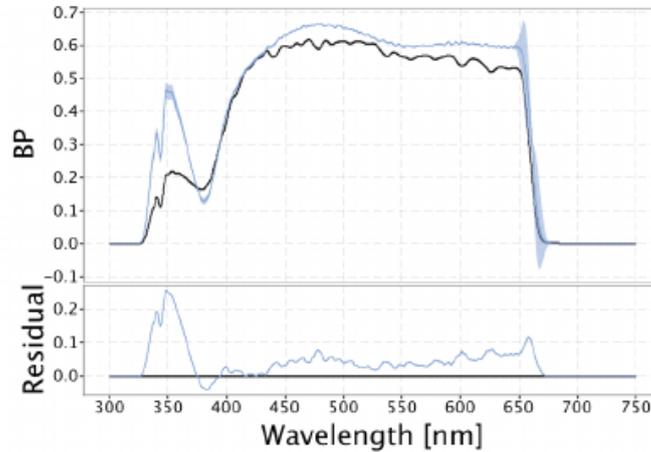
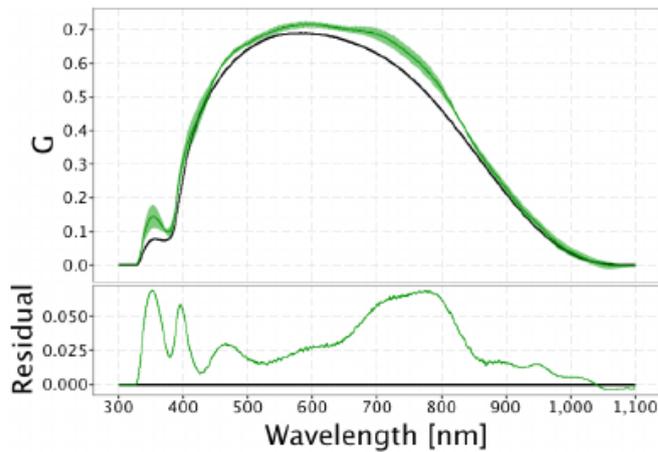
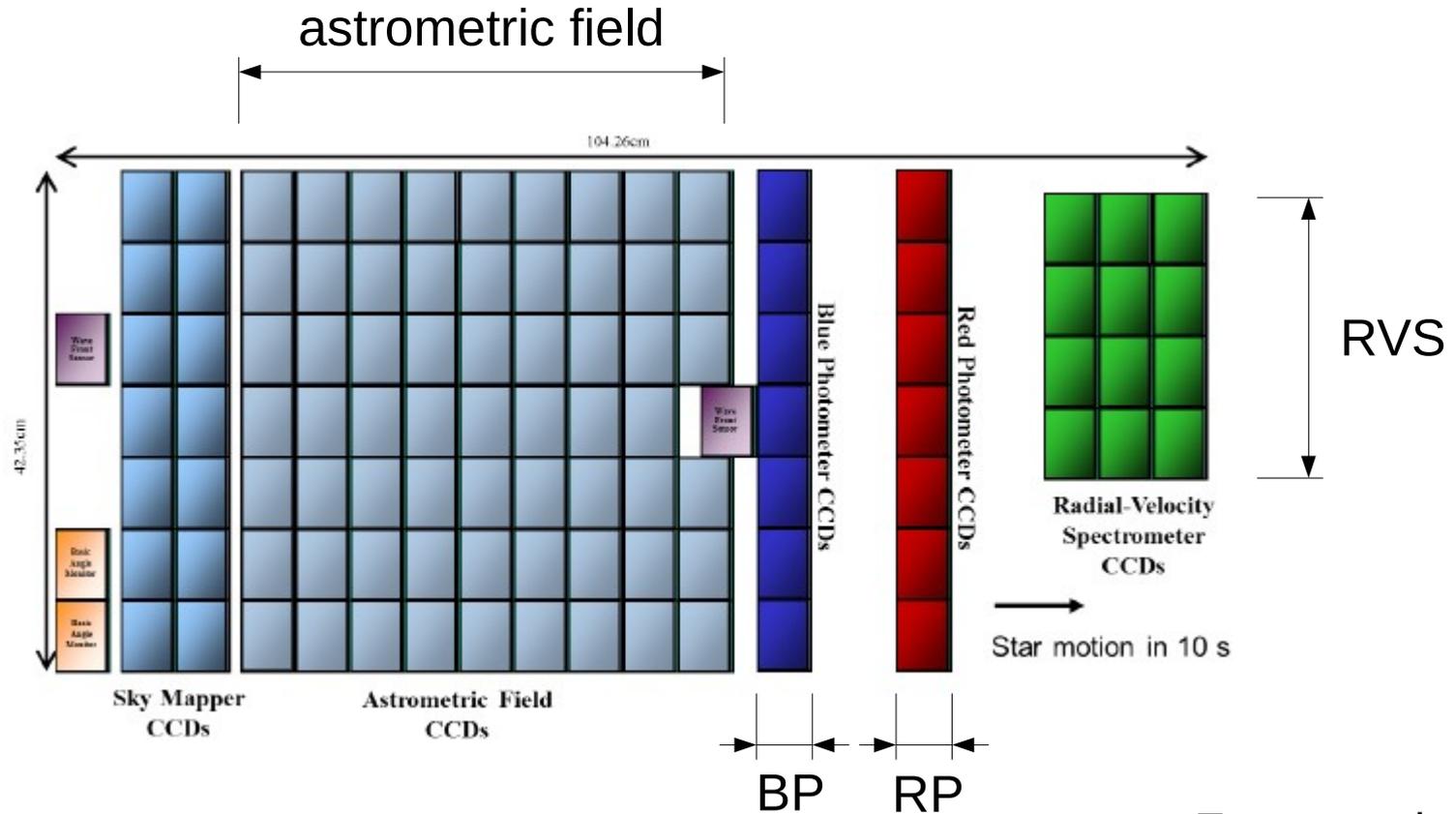


Basic Gaia data products: Astrometry

- parallax Gaussian errors
- 0.029mas zero-point
- spatial correlations: long-range (40 degrees) short-range
- similar for proper motion



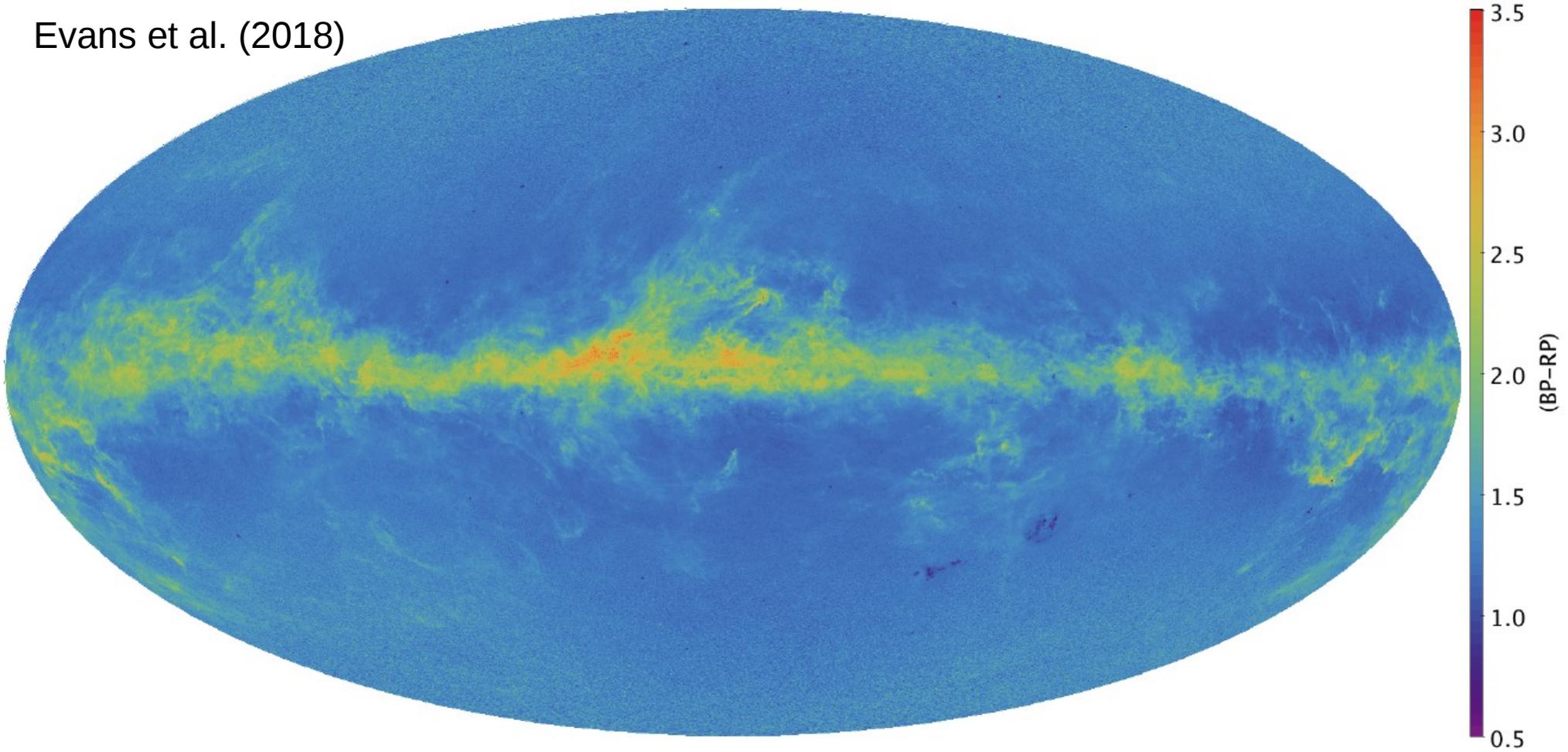
Basic Gaia data products: Photometry



Evans et al. (2018)

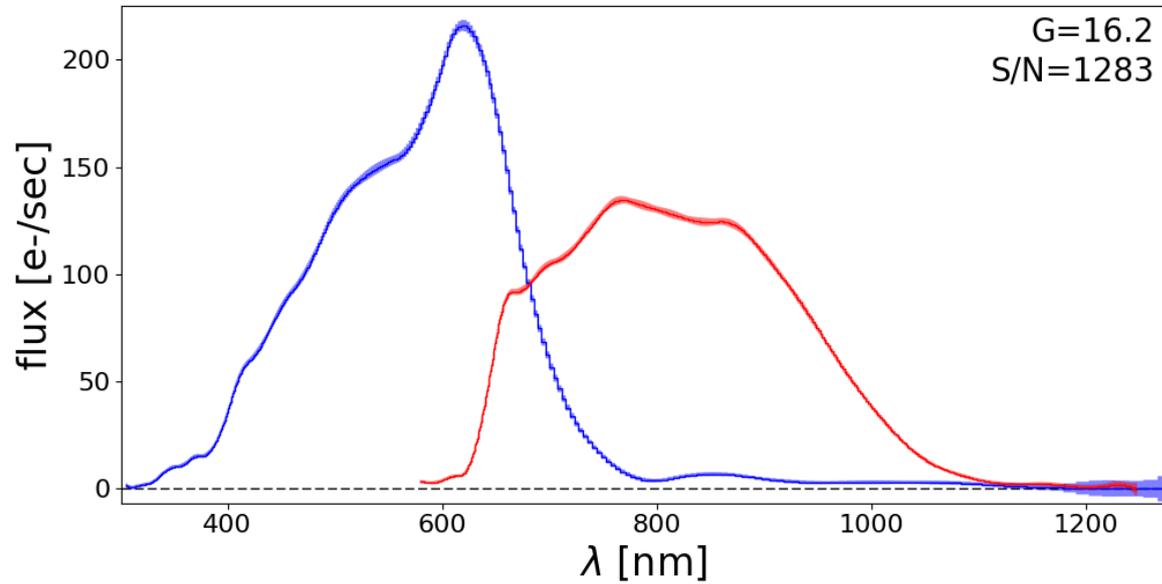
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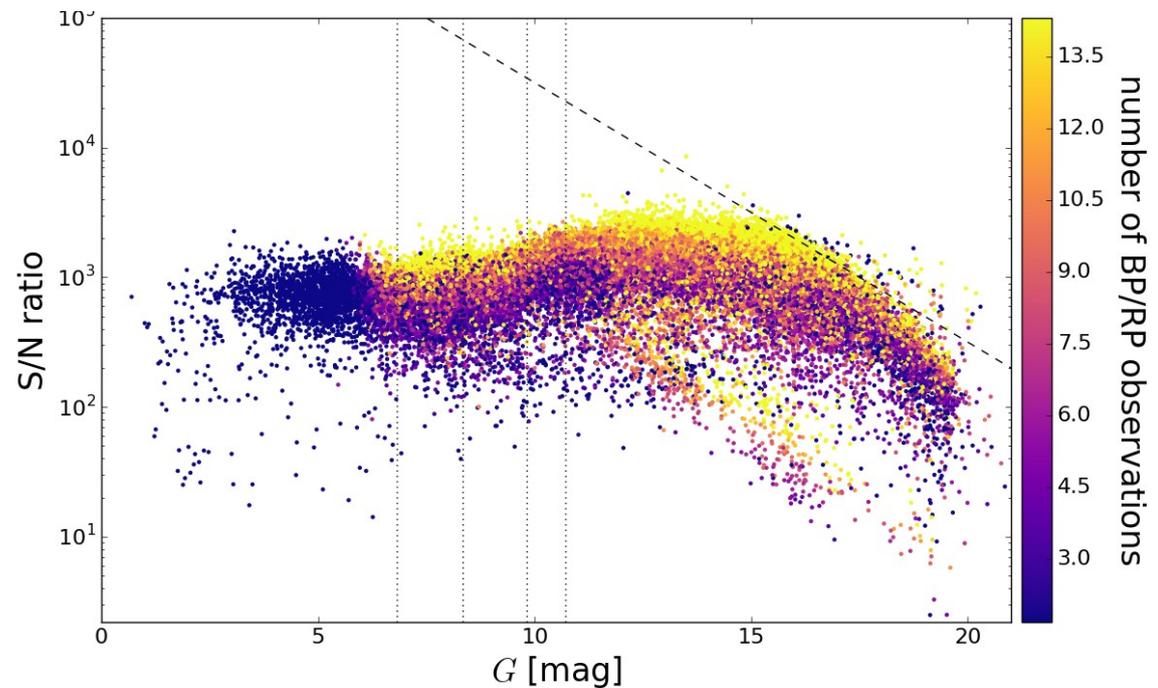
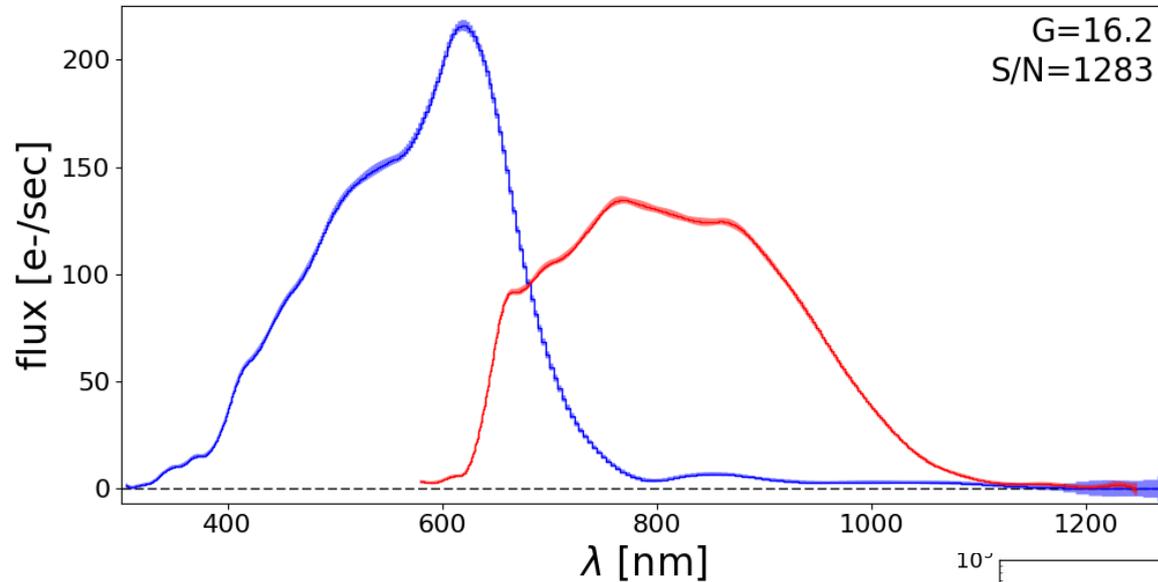
Basic Gaia data products: Spectra

- RVS (Recio-Blanco et al. 2016)
- low-resolution BP/RP prism spectra



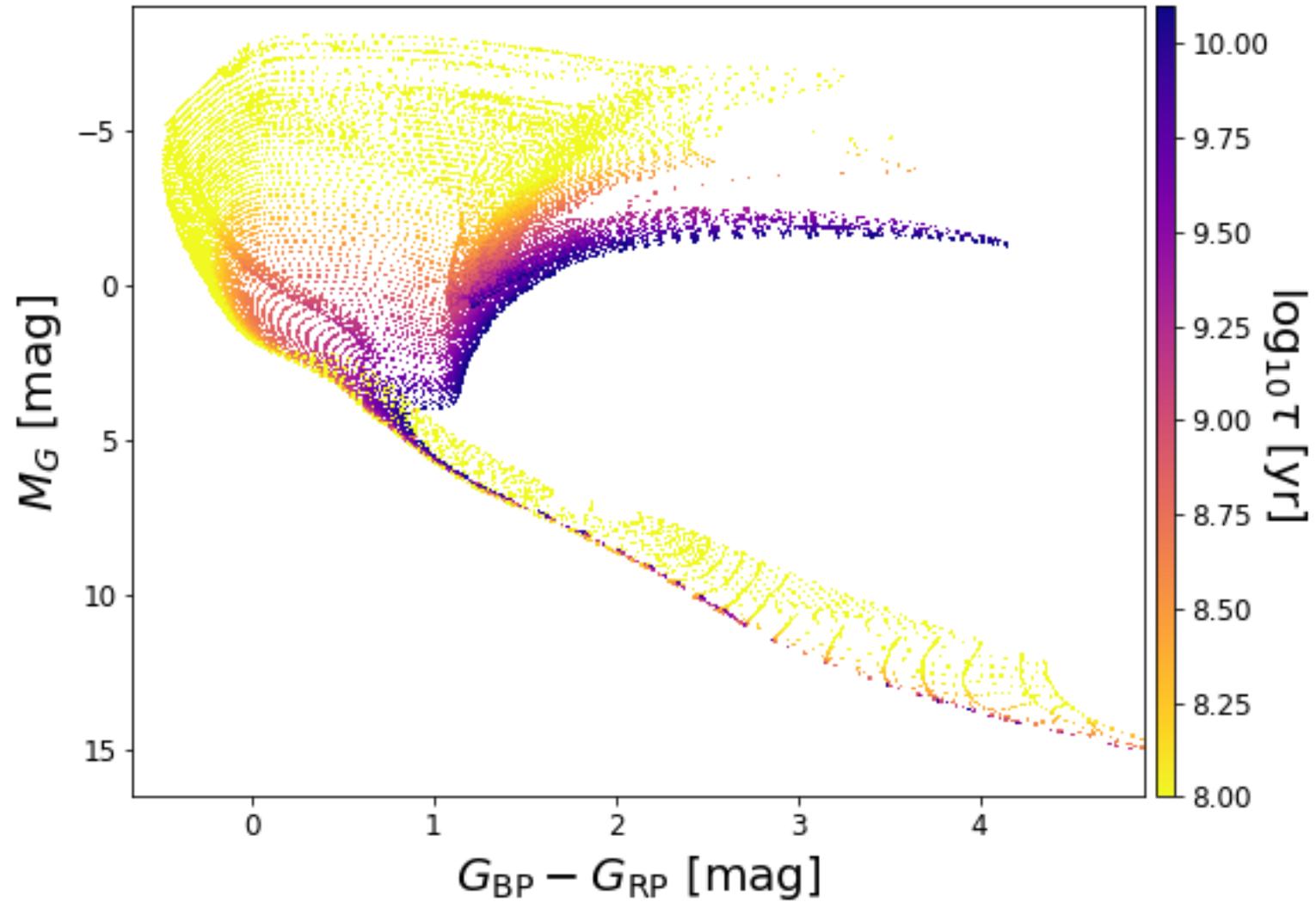
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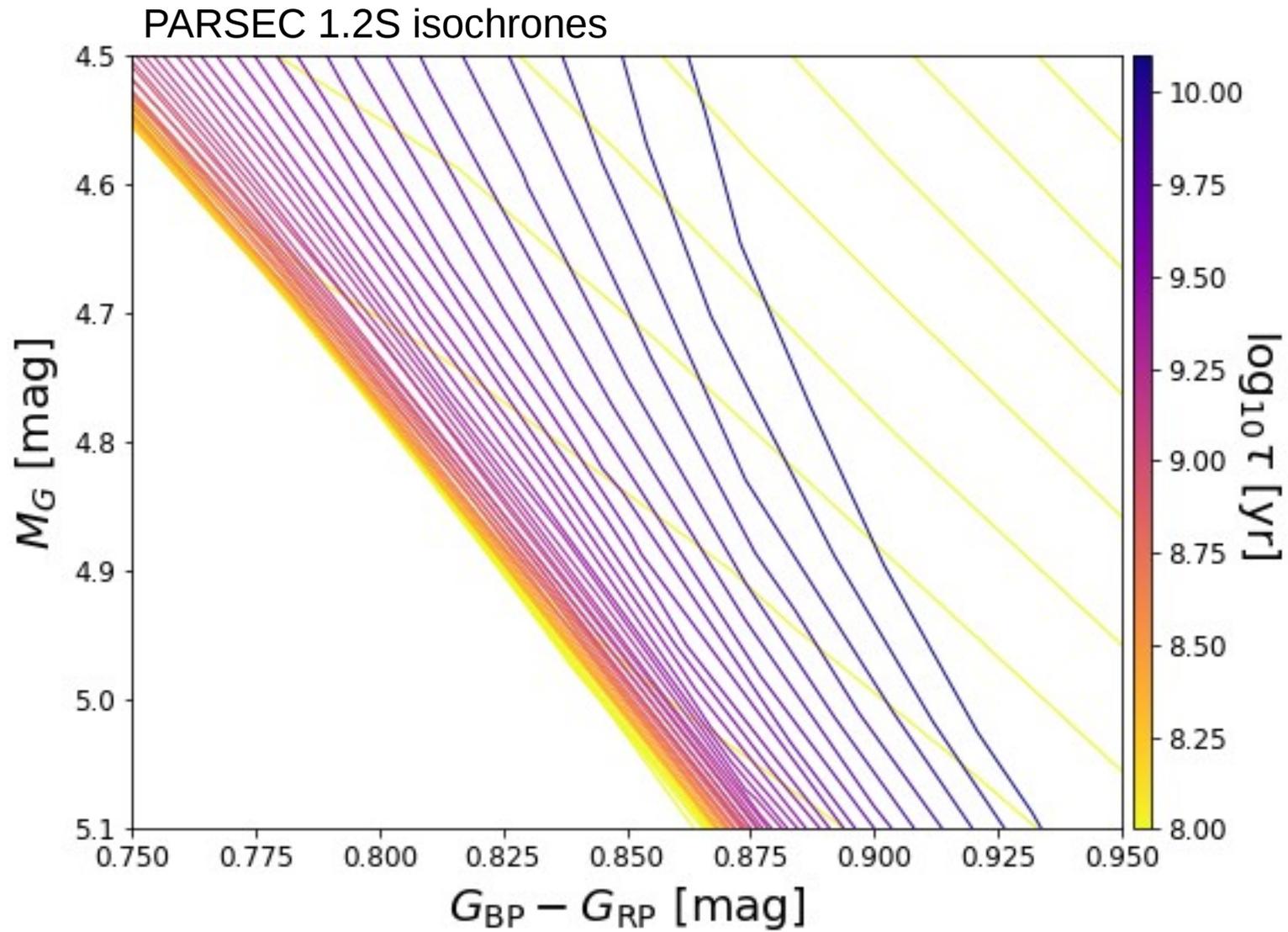


Basic Gaia data products

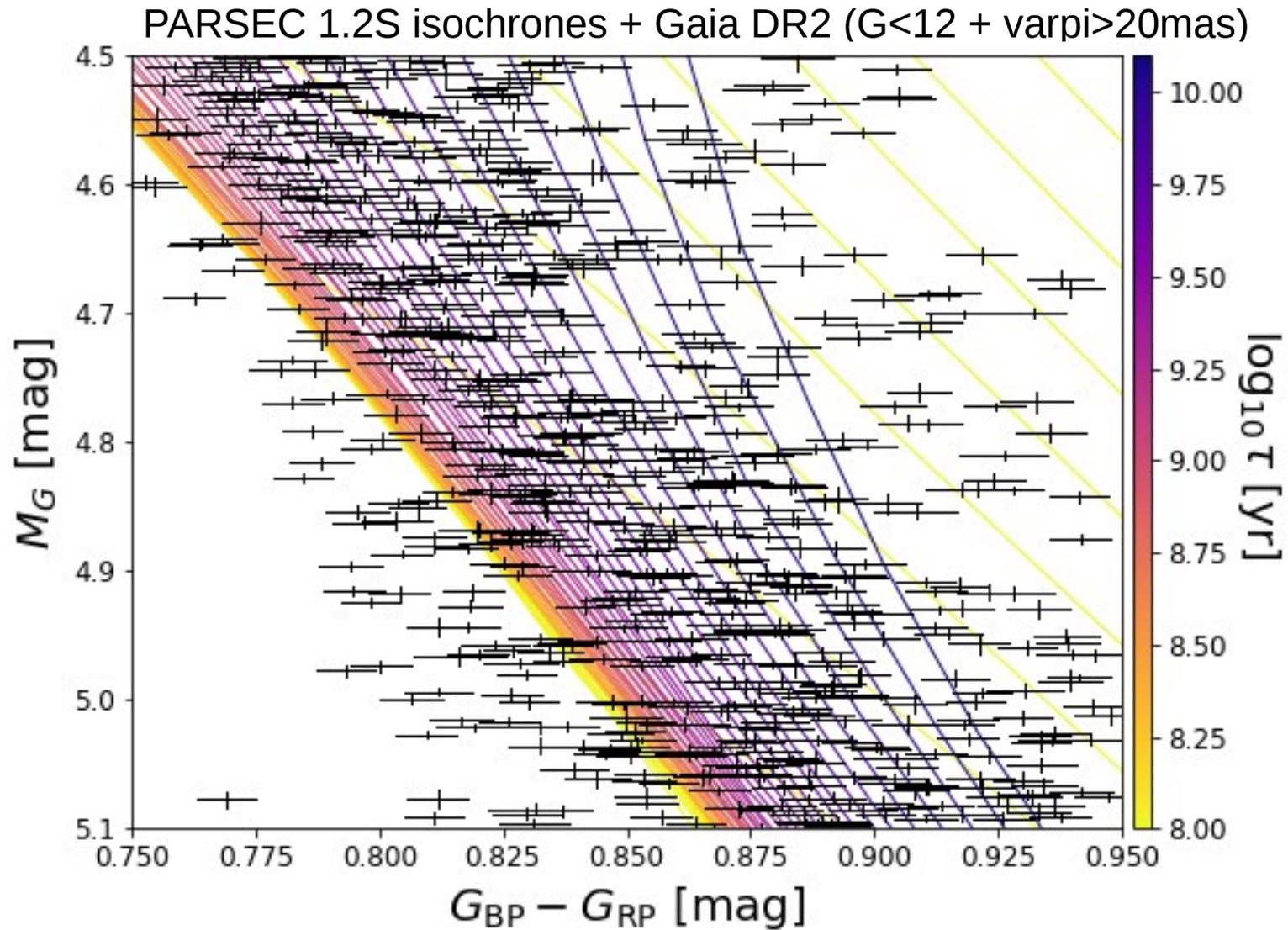
PARSEC 1.2S isochrones



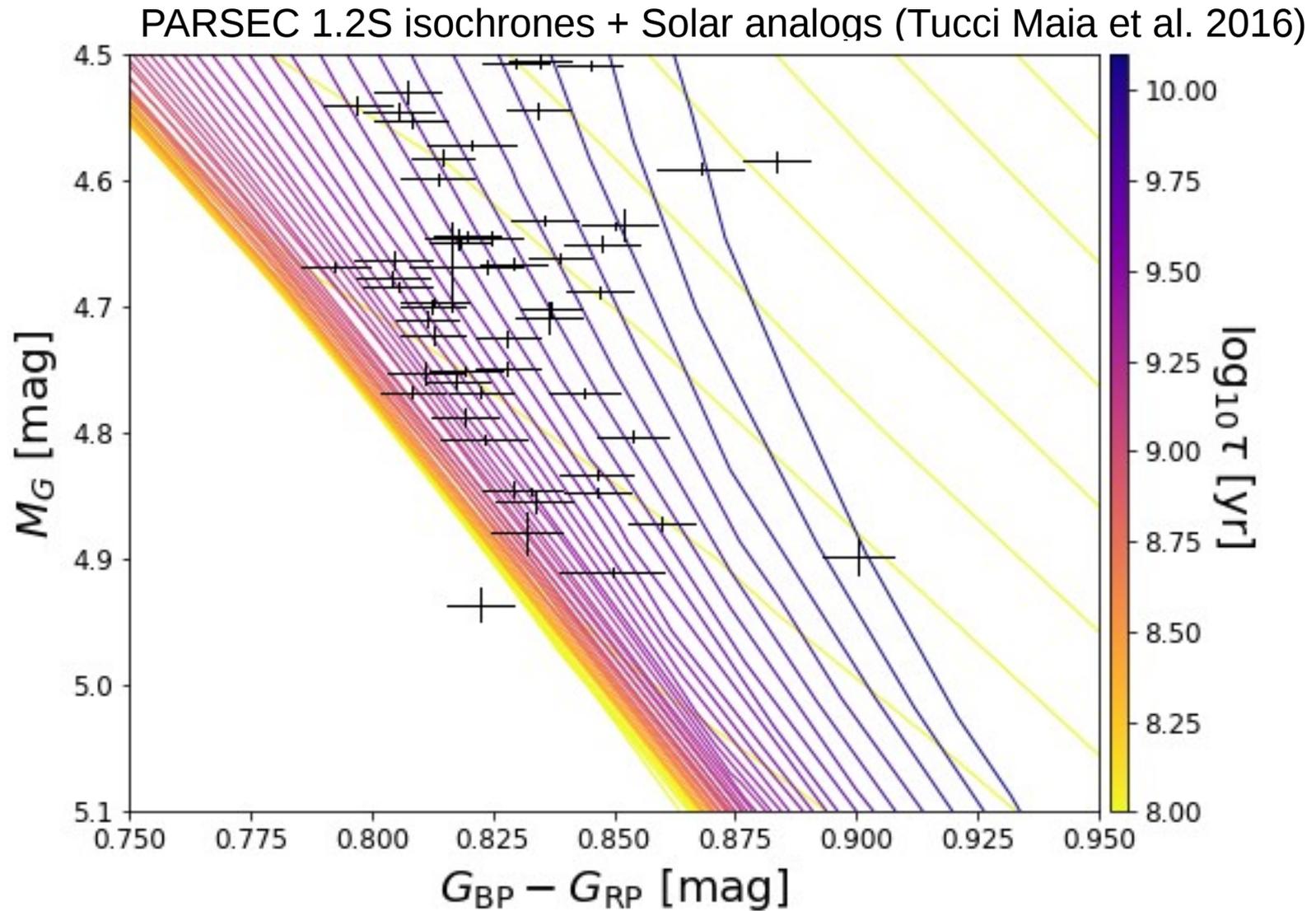
Basic Gaia data products



Basic Gaia data products



Basic Gaia data products

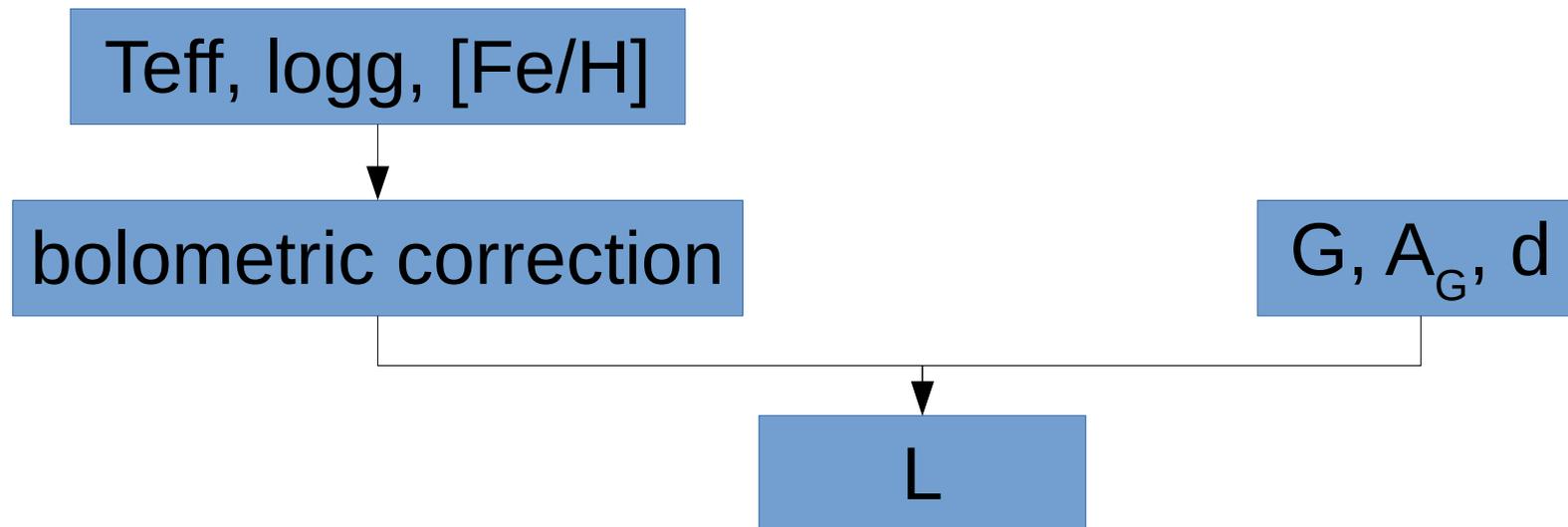


Overview

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Stellar ages in Gaia DR3

- Gaia Apsis (Bailer-Jones et al. 2013)
- Final Luminosity Age Mass Estimator (FLAME)

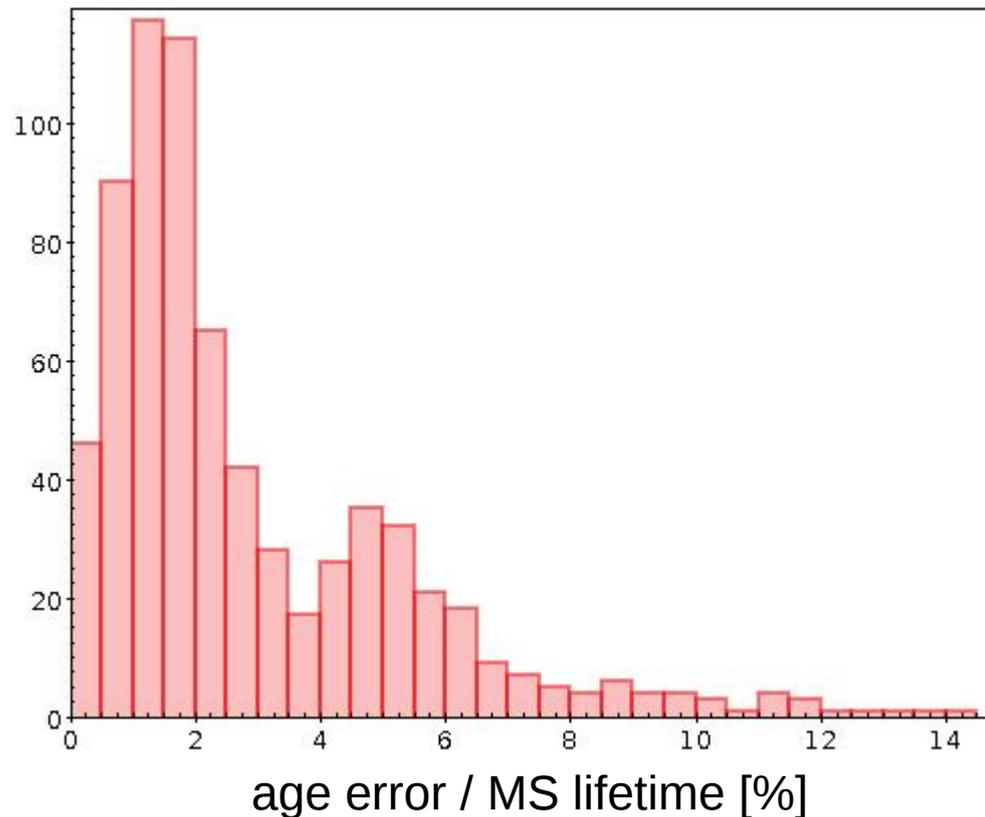


BASTI evolutionary tracks (provided by Santi Cassisi)
infer age and mass from given parameters:

- 1) Levenberg-Marquardt (Y. Lebreton)
- 2) Bayesian inference (Guédé, Lebreton et al 2012)

Stellar ages in Gaia DR3

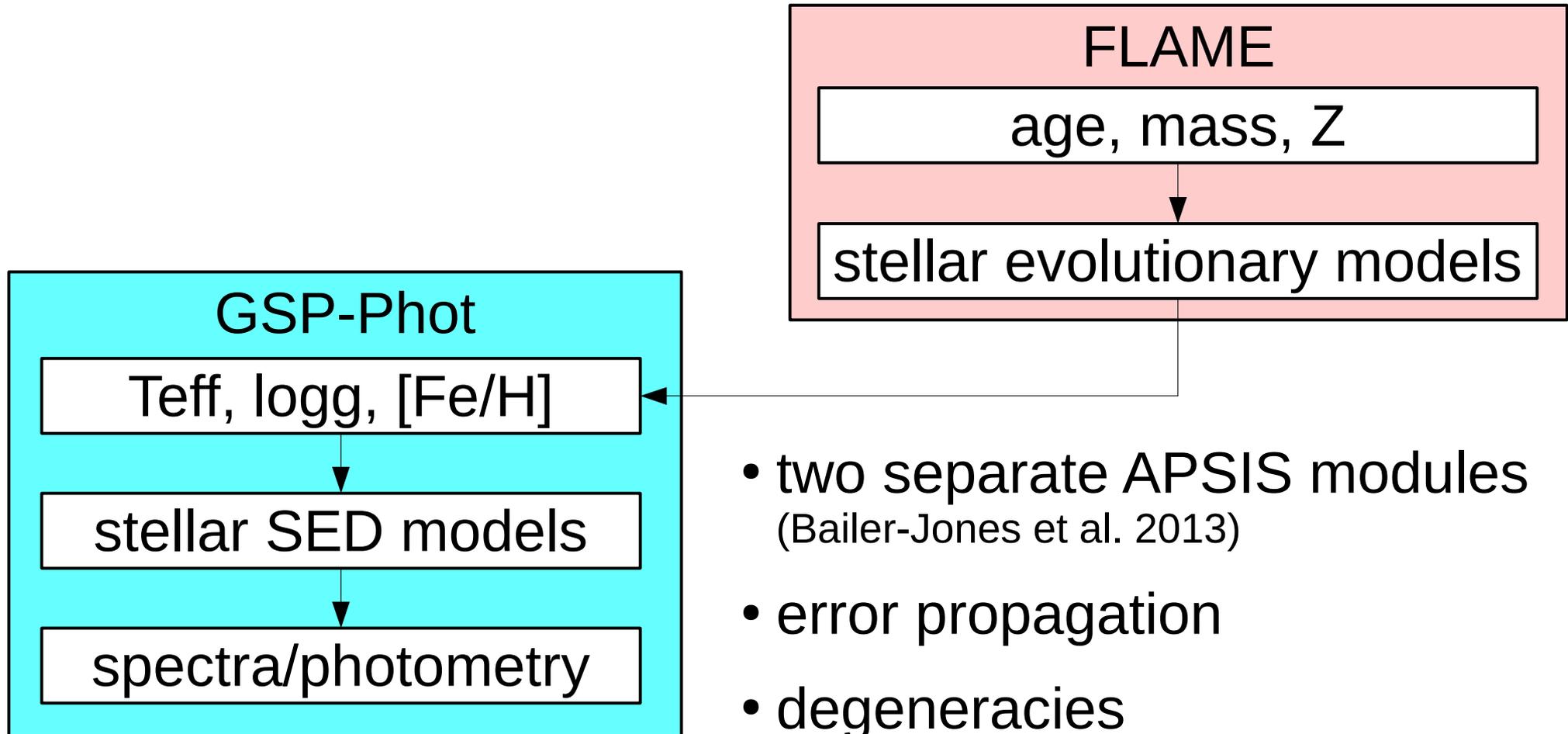
- multiple outputs
- objective: not compete with asteroseismology
but statistically useful, all-sky, homogeneous



Stellar ages in Gaia DR3

- DR3: maybe only evolutionary stages and ages in DR4
- main caveat: Gaia instrument model
not yet good enough
(Weiler et al. 2018, Evans et al. 2018, Weiler 2018)

Future developments



Future developments

Fouesneau, Andrae, Creevey et al.
(in prep)

age, mass, Z



stellar evolutionary models



T_{eff} , $\log g$, $[\text{Fe}/\text{H}]$



stellar SED models

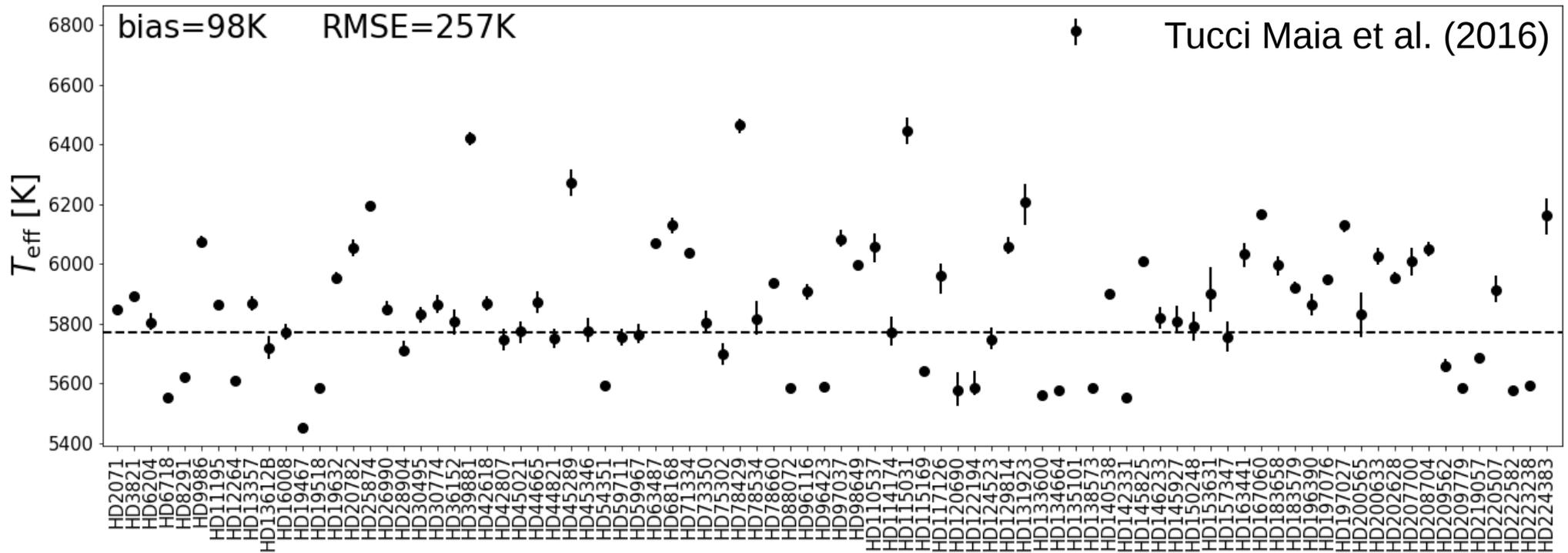


spectra/photometry

- joint inference problem
- no need for error propagation
- all degeneracies
- no BP/RP spectra yet
- photometry (GALEX, 2MASS, ALLWISE)
- main limitation:
Gaia instrument model

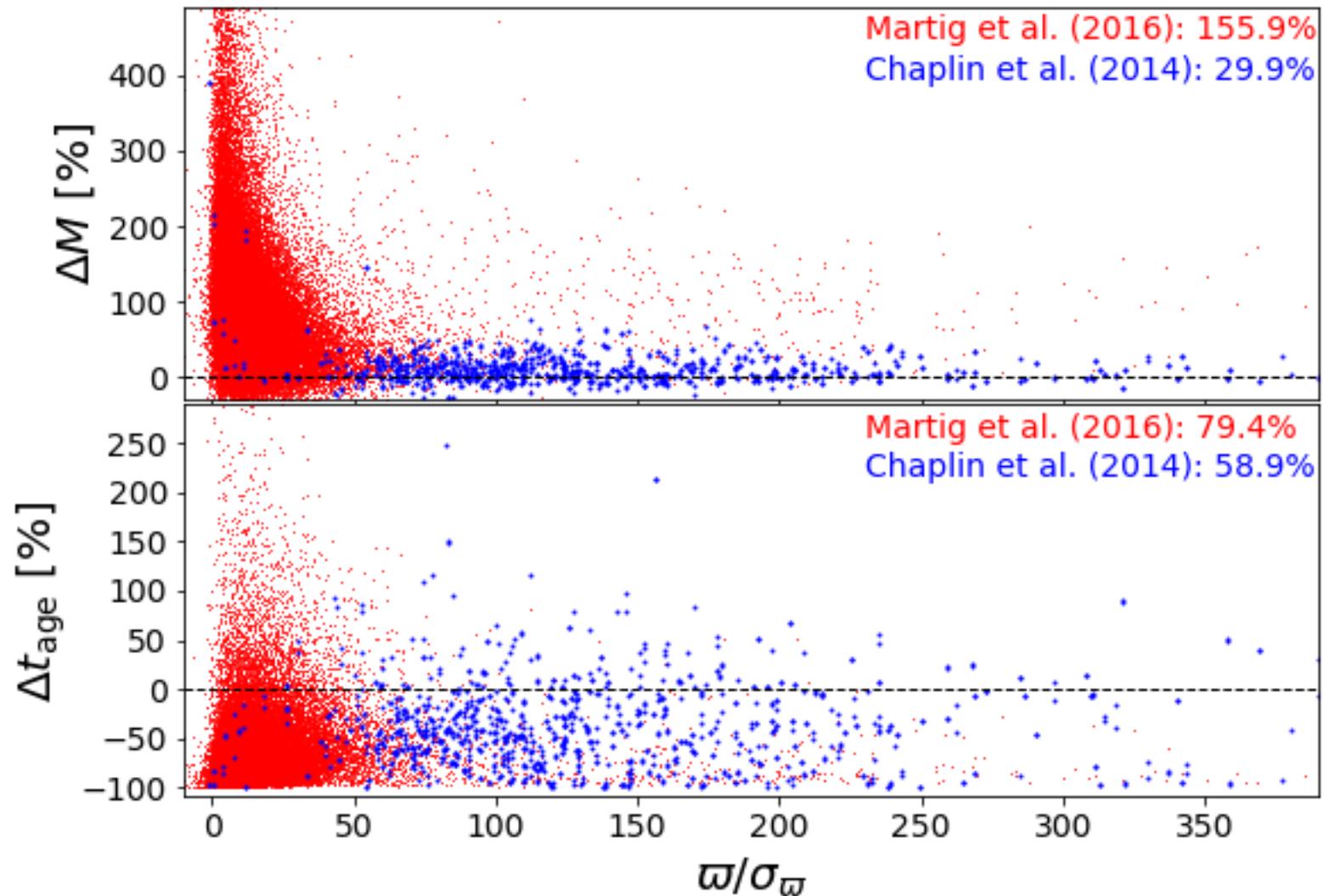
Future developments

- solar analogs: worse than GDR2 (Andrae et al. 2018)
SED models + Gaia instrument model!



Future developments

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SED models + Gaia instrument model!
- ages $\sim 60\%$ error, masses $\sim 30\%$ error

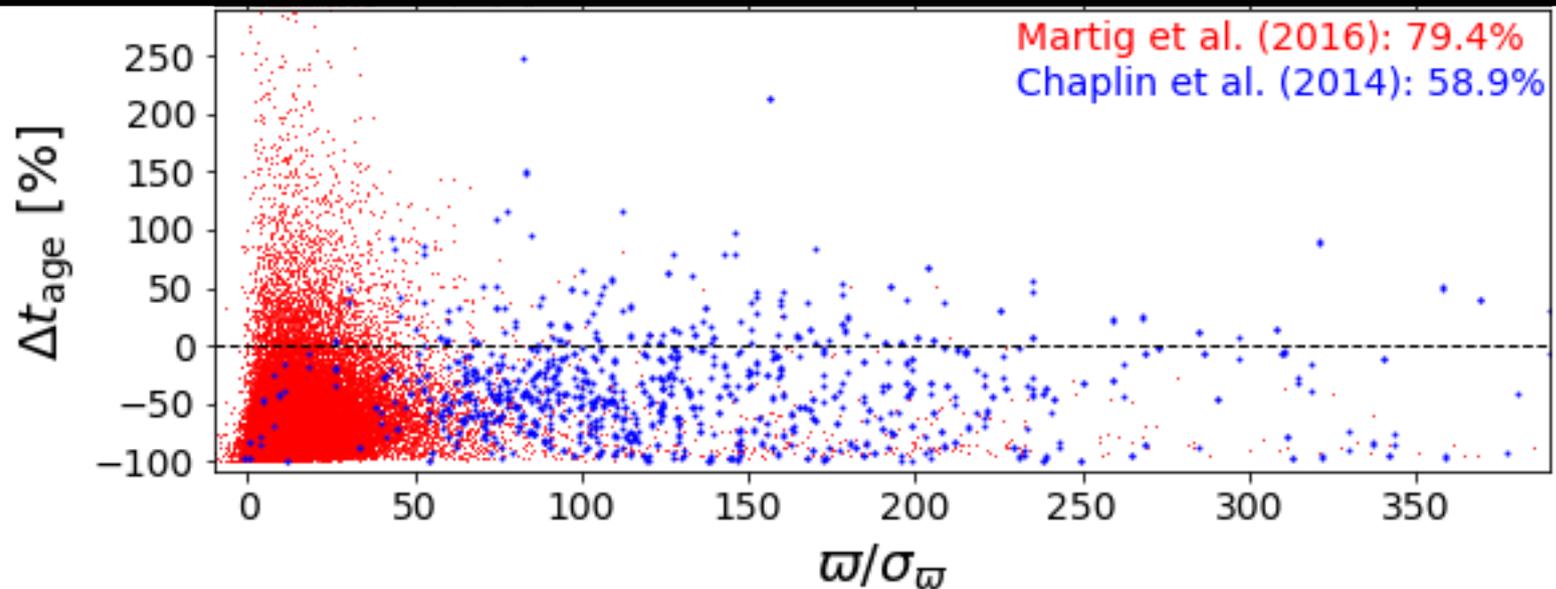


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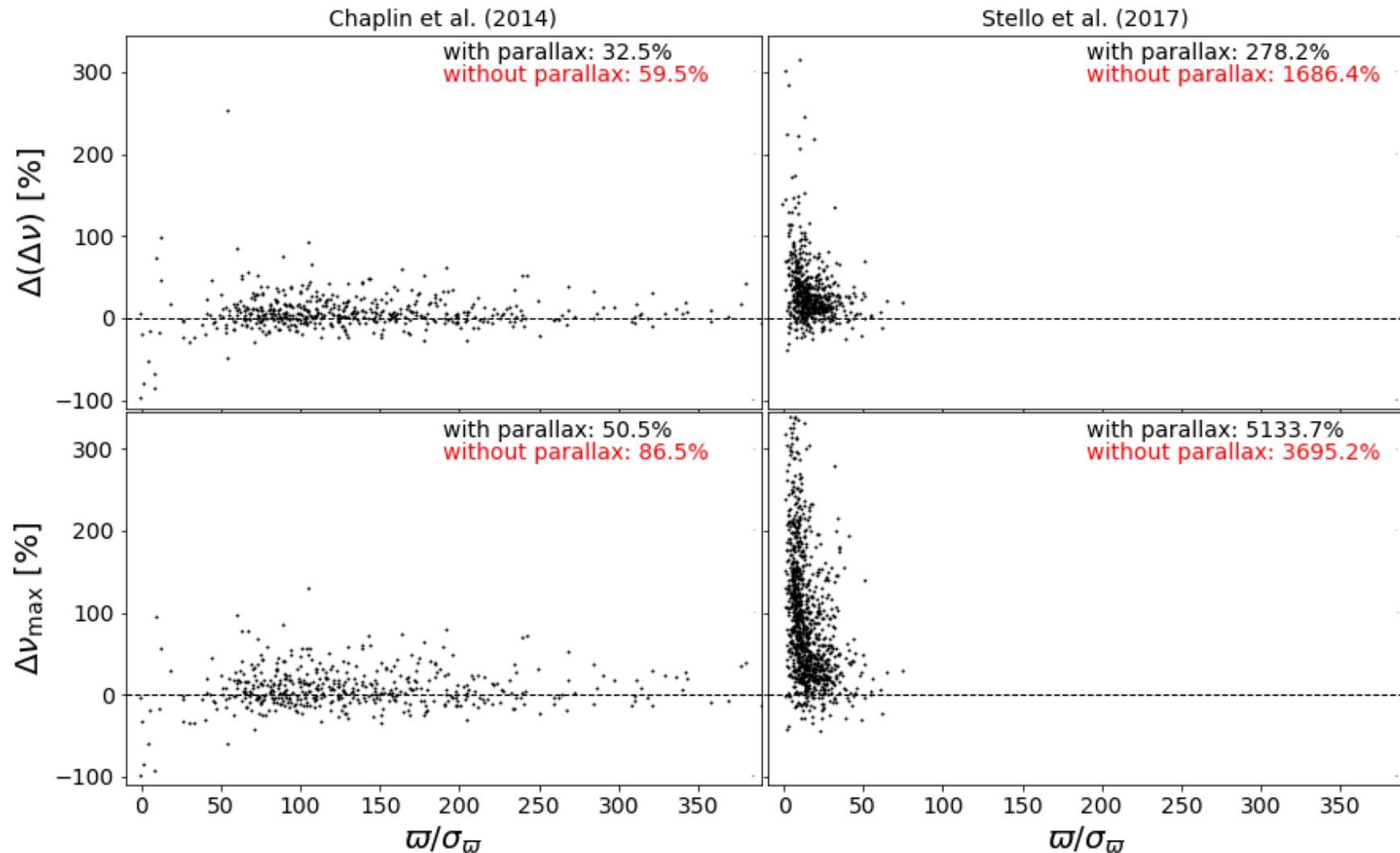


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Future developments

- solar analogs: worse than GDR2 (Andrae et al. 2018)
SED models + Gaia instrument model!
- ages $\sim 60\%$ error, masses $\sim 30\%$ error
- consistent with asteroseismic observables



Summary

- Gaia DR2 good enough for ages
- FLAME in DR3: evolutionary stages (maybe ages)
- evolutionary + atmospheric models used together

Take Home Message

Gaia ages in DR3

not competitive with asteroseismology
but statistically useful, all-sky, homogeneous