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Bayesian Determination of Ages of Open Cluster Stars as a Method to Constrain the MW SFR History

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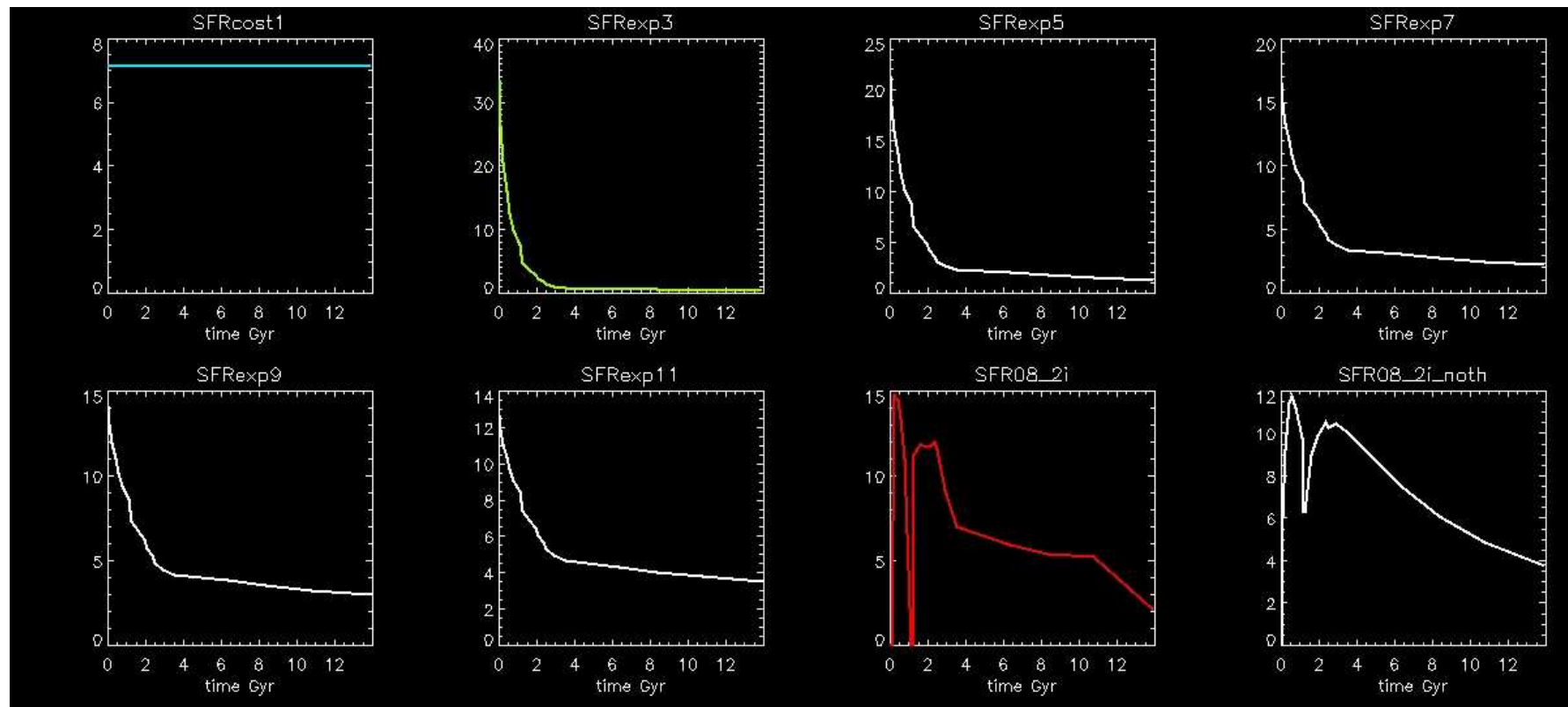
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$$P(\mathbf{M}|\mathbf{D}) \equiv P(\mathbf{D}|\mathbf{M}) \cdot \frac{P(\mathbf{M})}{P(\mathbf{D})}$$

$$P(\mathbf{D}|\mathbf{M}) \propto \frac{-(\log T_{obs} - \log T)^2}{2\sigma_{T_{obs}}^2} \cdot \frac{-(\log g_{obs} - \log g)^2}{2\sigma_{\log g_{obs}}^2} \cdot \frac{-(\log[\frac{M}{H}]_{obs} - \log[M/H])^2}{2\sigma_{[M/H]_{obs}}^2}$$

$$P(\mathbf{M}) \equiv P(\mathcal{M}) \cdot P(\tau) \cdot P(Z), \quad P(\mathcal{M}) \xrightarrow{\text{Scalo, Kroupa, Chabrier}} \text{IMF}; \quad P(\tau) \xrightarrow{\text{?}} \text{SFR}; \quad P(Z) \xrightarrow{\text{AMR}}$$

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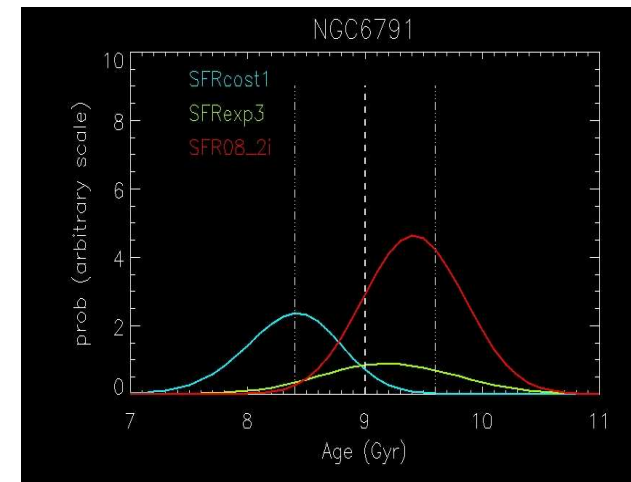
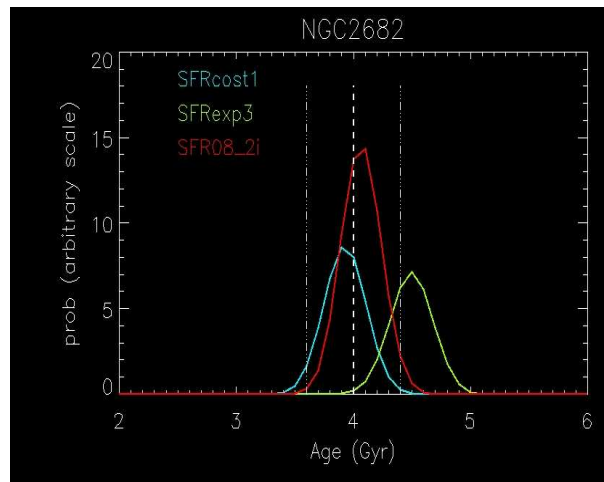
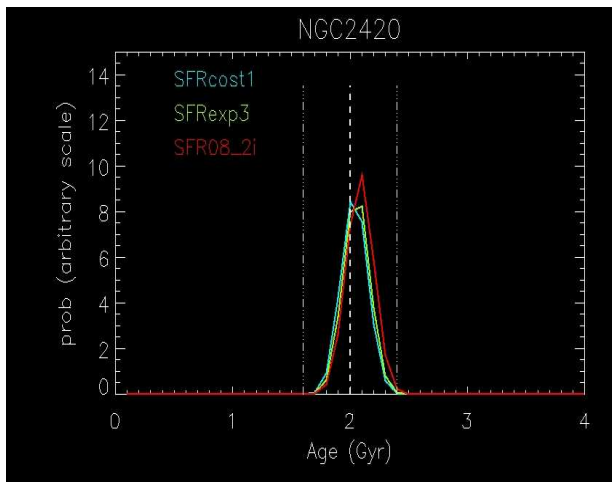
(Spitoni & Matteucci, 2011 A&A, 531, A72)

Assuming the same SFR history for field and open cluster stars we can use stars in clusters with “known” ages to find the “correct” MW SFR history

- **NGC 2420:** age = 2.0 Gyr $\pm$ 0.4
Meszaros 2013, AJ 146,133; Jacobson 2011, AJ 142, 59; Cayrel 2001, A&A,373, 159;
Cenarro 2007, MNRAS, 374, 664; Pancino 2010, A&A 511, 56; Lee 2008, AJ 136, 2050
- **NGC 2682:** age=4.0 Gyr $\pm$ 0.4
Reddy 2013, MNRAS 431,338; Lee 2008, AJ 136, 2050; Friel 2010, AJ 139, 1942;
Jacobson 2013, AJ 145, 107; Yong 2005, AJ 130, 597; Randich 2006, A&A 450, 557;
Meszaros 2013, AJ 146,133; Pancino 2010, A&A 511, 56; Pace 2008, A&A 489, 403;
Santos 2009, A&A 493, 309; Shetrone 2000, AJ 120, 1913; Hobbs 1991, AJ 102, 1070;
Tautvaisiene 2000, A&A 360, 499;
- **NGC 6791:** age=9.0 Gyr $\pm$ 0.6
Bragaglia 2014, ApJ 796, 68; Smolinski 2011, AJ 141, 89;

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	N_{star}	SFR_{cost}	SFR_{exp3}	SFR_{exp5}	SFR_{exp7}	SFR_{exp9}	$\text{SFR}_{\text{exp11}}$	SFR_{2i}	$\text{SFR}_{2i_{\text{not h}}}$
NGC 2420	64	47 %	44 %	46 %	47 %	47 %	45 %	44 %	45 %
NGC 2682	81	51 %	51 %	64 %	59 %	60 %	57 %	78 %	58 %
NGC 6791	81	30 %	23 %	26 %	26 %	27 %	26 %	63 %	37 %



Summary and conclusion

- **Accurate estimates of stellar ages from isochrones require a Bayesian approach**
- ***Prior* knowledge of SFR history is needed to infer the age posterior probability**
- **Assuming the same SFR history for field and open cluster stars it is possible to find the “correct” MW SFR history by using stars in open clusters with “known” ages.**
- **SFR history based on a Galactic Chemical-Evolution Model (Spitoni & Matteucci, 2011 A&A, 531, A72) is found to be a much better choice than exponential or constant SFR histories**