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The Milky Way and its Stars: Stellar Astrophysics, Galactic Archaeology, and Stellar Populations

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

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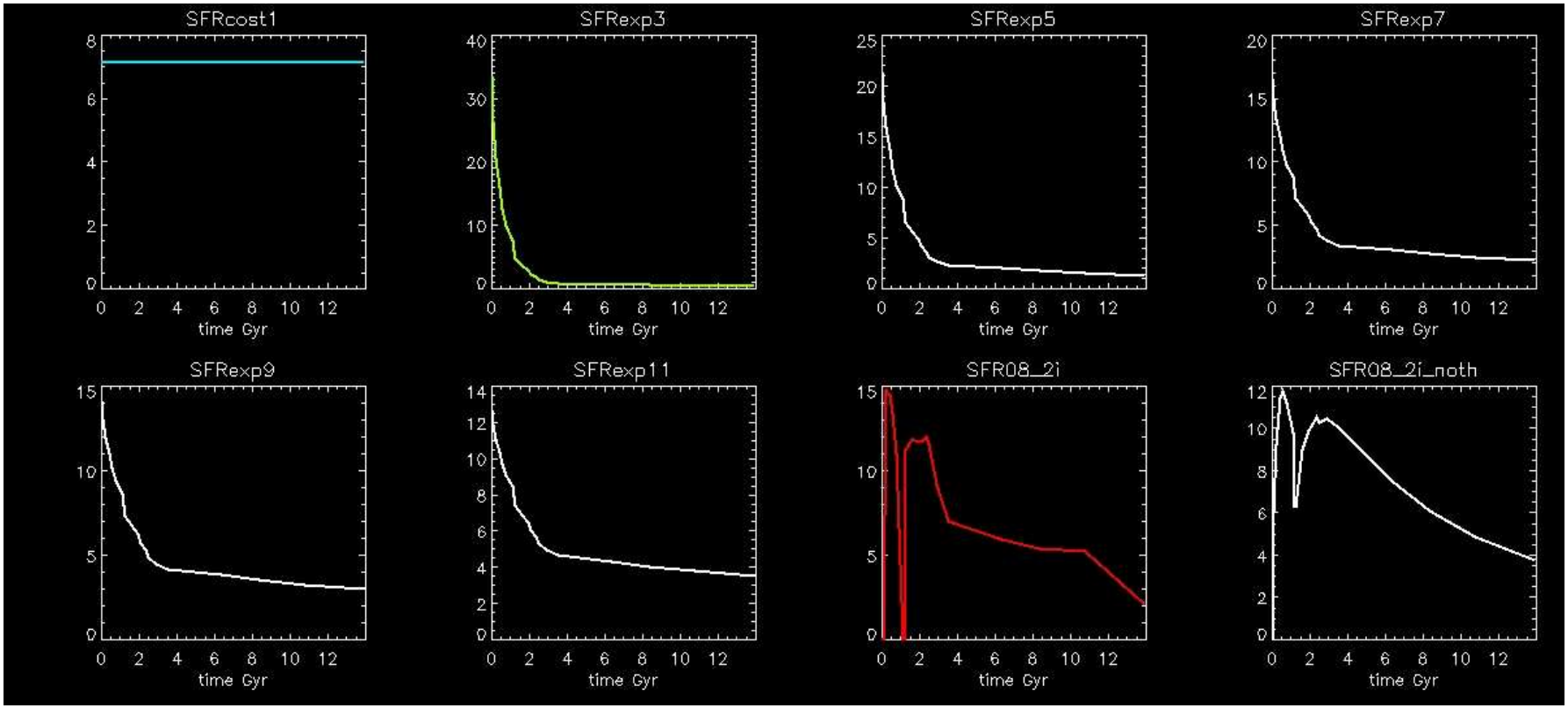
$$P(M|D) \equiv P(D|M) \cdot \frac{P(M)}{P(D)}$$

$$P(D|M) \propto \frac{-(logT_{obs} - logT)^2}{2\sigma^2_{Tobs}} \cdot \frac{-(\log g_{obs} - \log g)^2}{2\sigma^2_{log\ gobs}} \cdot \frac{-\left(\log[\frac{M}{H}]_{obs} - \log[M/H]\right)^2}{2\sigma^2_{[M/H]_{obs}}}$$

$$P(M) \equiv P(\mathcal{M}) \cdot P(\tau) \cdot P(Z),$$

$P(\mathcal{M})$ ⇒ IMF; $P(\tau)$ ⇒ ? SFR; $P(Z)$ ⇒ ~~AMR~~

Scalo, Kroupa, Chabrier



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

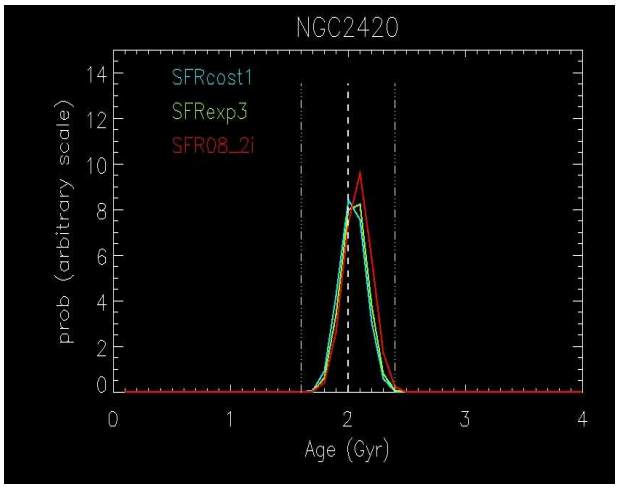
Assuming the same SFR history for field and open cluster stars we can use stars in clusters with "known" ages to find the "correct" MW SFR history

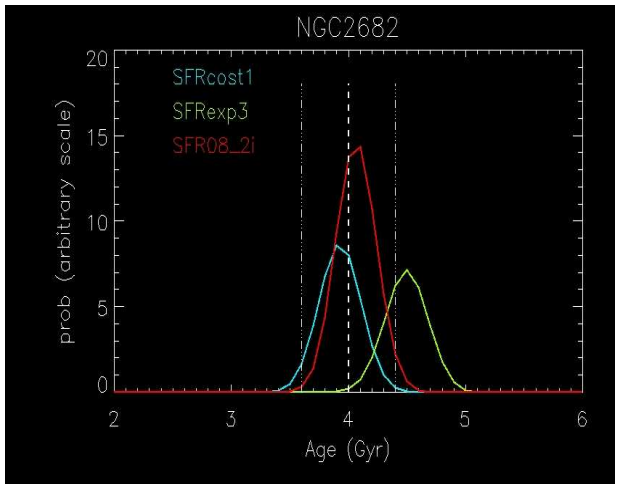
- **NGC 2420**: age = 2.0 Gyr+/- 0.4
  Meszaros 2013, AJ 146,133; Jacobson 2011, AJ 142, 59; Cayrel 2001, A&A,373, 159; Cenarro 2007, MNRAS, 374, 664; Pancino 2010, A&A 511, 56; Lee 2008, AJ 136, 2050

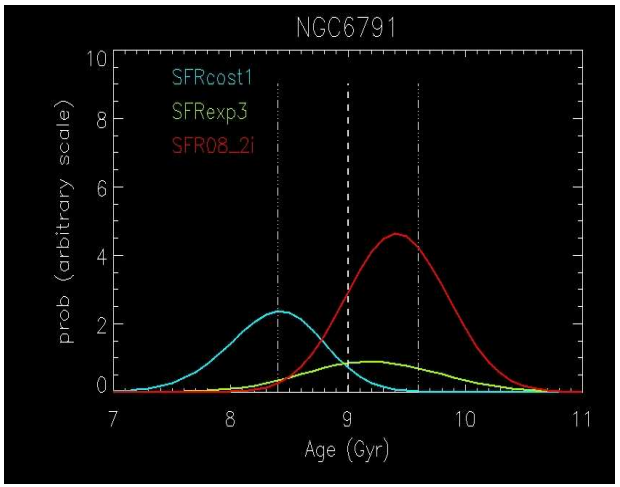
- **NGC 2682**: age=4.0 Gyr +/- 0.4
  Reddy 2013, MNRAS 431,338; Lee 2008, AJ 136, 2050; Friel 2010, AJ 139, 1942; Jacobson 2013, AJ 145, 107; Yong 2005, AJ 130, 597; Randich 2006, A&A 450, 557; Meszaros 2013, AJ 146,133; Pancino 2010, A&A 511, 56; Pace 2008, A&A 489, 403; Santos 2009, A&A 493, 309; Shetrone 2000, AJ 120, 1913; Hobbs 1991, AJ 102, 1070; Tautvaisiene 2000, A&A 360, 499;

- **NGC 6791**: age=9.0 Gyr +/- 0.6
  Bragaglia 2014, ApJ 796, 68; Smolinski 2011, AJ 141, 89;

	N_{star}	SFR_{cost}	SFR_{exp3}	SFR_{exp5}	SFR_{exp7}	SFR_{exp9}	SFR_{exp11}	SFR_{2i}	SFR_{2i_noth}
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**