

The True Duration of Starbursts in Nearby Dwarf Galaxies



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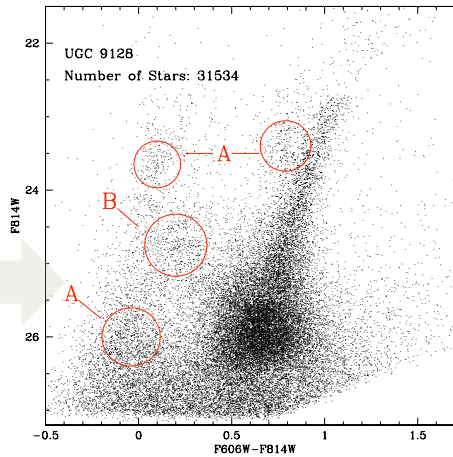


Summary: The duration of a starburst is a fundamental parameter affecting the evolution of galaxies yet, to date, observational constraints on the durations of starbursts are not well established. Here we study the recent star formation histories (SFHs) reconstructed from HST optical observations of nearby dwarf galaxies to rigorously quantify the duration of their starburst events.

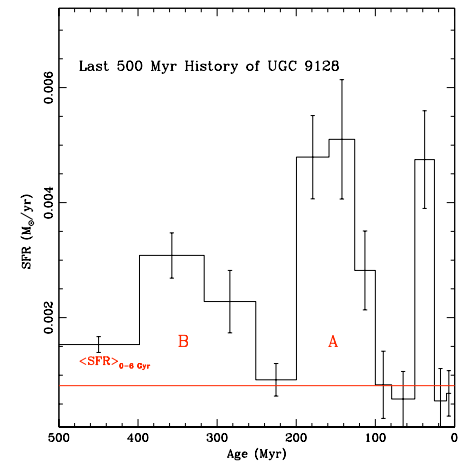
Method

- Using the location of stellar populations in the color-magnitudes (CMDs), the evolutionary states of the stars can be deduced and translated into a rate of star formation.
- Helium burning (HeB) stars are signs of recent star formation and can unambiguously be dated.
- As an example, we present a CMD derived from HST observations of UGC 9128 and the SFH for the last 500 Myr. The most recent star formation event (A) is traced by the blue and red HeB stars and the main sequence (MS) stars. The earlier event (B) is traced by the blue HeB stars, red HeB blended with the red clump, and MS stars below our photometric limit.

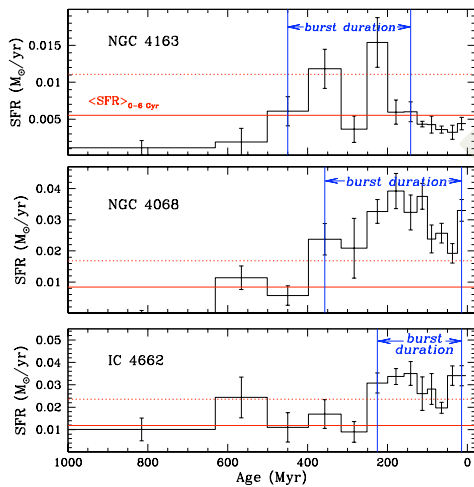
HST derived CMD of UGC 9128



SFR over last 500 Myr of UGC 9128



SFRs over 1 Gyr for Three Nearby Dwarfs

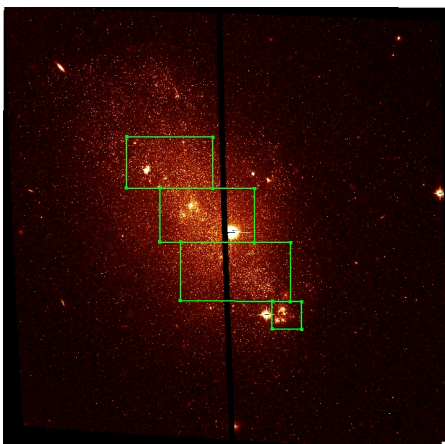


The Duration Measurement

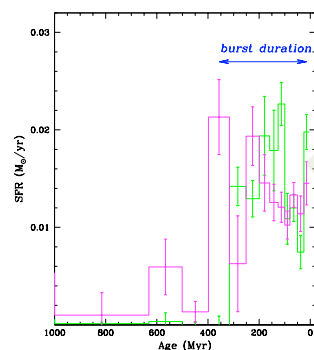
- We find that the bursts range from **200 - 400 Myr** in duration as seen in the figure on the left. The solid (dotted) red line is the average (twice the average) SFR over the past 6 Gyr. The duration is determined from the time period for which SFRs exceed twice the past average.
- If these starbursts are typical of starbursts in dwarf galaxies, then the **short timescales (3 - 10 Myr)** (Babul & Ferguson 1996) associated with starbursts in previous studies are best understood as "flickering" events which are simply small components of the larger starburst.
- A complete starburst event most likely includes multiple generations of star formation including the "flickering" associated with individual star clusters.
- The longer duration of these starbursts resolve the tension between the shorter timescales often derived observationally with the longer timescales derived from dynamical arguments and suggest that bursts may not be self-quenching through energy or mass transfer feedback mechanisms (Thornley et al. 2000) but may, in fact, be self-regulating (Meurer 2000, Elmegreen 2000).

Galaxy	Duration (Myr)	Rotation (Myr)	Duration/Rot.
NGC 4068	360±40	265±35	1.4±0.2
NGC 4068	308±50	240±35	1.3±0.2
IC 4662	225±25	46.5±3.1	2.3±0.3

HST Image of NGC 4068



Regional SFRs of NGC 4068



Global Starbursts

- Bursting levels of star formation are found in regions of high stellar density highlighted in green in the NGC 4068 image and correspond to the green SFR.
- Bursting SFR are also found in regions of low stellar density consisting of the stars *outside* the green regions and corresponding to the magenta line in the SFR plot indicating a time lag in the SF.
- The enhanced star formation moves around the galaxy during the bursts and covers a large fraction of the area of the galaxy.
- These massive, long duration bursts can significantly affect the structure, dynamics, and chemical evolution of the host galaxy and can be the progenitors of "superwinds" that drive much of the recently chemically enriched material from the galaxy into the intergalactic medium.

Conclusions: The duration of the starbursts measured in this small sample of nearby dwarf galaxies range from 200 to 400 Myr while migrating around regions of both high and low stellar density. Our new work expands this analysis to 20 nearby starbursts and includes a spatial comparison of the HST predicted UV emission with GALEX observations.

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