A pixel analysis is carried out on the interacting galaxy system M51 (NGC 5194 + 5195), using the HST/ACS images in the F435W, F555W and F814W (BVI) bands. After 4 × 4 binning of the HST/ACS images to secure a sufficient signal-to-noise ratio for each pixel, we derive several quantities describing the pixel color-magnitude diagram (pCMD) of M51: blue/red color cut, red pixel sequence parameters, blue pixel sequence parameters and blue-to-red pixel ratio. For NGC 5194 (Sbc type), the red sequence pixels (corresponding to the bulge or dusty area) are mostly older than 1 Gyr, while the blue sequence pixels (corresponding to the disk or spiral arms) are mostly younger than 1 Gyr, in their luminosity-weighted mean stellar ages. For NGC 5195 (SB0 type), most pixels form a red pixel sequence and only a very small fraction of pixels form blue pixel sequences. The blue pixel sequences of NGC 5195 seem to originate from the tidal interaction between the two galaxies, whereas almost all pixels in the NGC 5195 main body form the red pixel sequence. The pixels corresponding to the central AGN area of NGC 5194 show a tight sequence at the bright end of the pCMD, of which spatial extent is R=100 pc.

### ABSTRACT

A pixel analysis is carried out on the interacting galaxy system M51 (NGC 5194 + 5195), using the HST/ACS images in the F435W, F555W and F814W (BVI) bands. After 4 × 4 binning of the HST/ACS images to secure a sufficient signal-to-noise ratio for each pixel, we derive several quantities describing the pixel color-magnitude diagram (pCMD) of M51: blue/red color cut, red pixel sequence parameters, blue pixel sequence parameters and blue-to-red pixel ratio. For NGC 5194 (Sbc type), the red sequence pixels (corresponding to the bulge or dusty area) are mostly older than 1 Gyr, while the blue sequence pixels (corresponding to the disk or spiral arms) are mostly younger than 1 Gyr, in their luminosity-weighted mean stellar ages. For NGC 5195 (SB0 type), most pixels form a red pixel sequence and only a very small fraction of pixels form blue pixel sequences. The blue pixel sequences of NGC 5195 seem to originate from the tidal interaction between the two galaxies, whereas almost all pixels in the NGC 5195 main body form the red pixel sequence. The pixels corresponding to the central AGN area of NGC 5194 show a tight sequence at the bright end of the pCMD, of which spatial extent is R=100 pc.

### Introduction

M51 is one of the nearest interacting galaxy system and consists of NGC 5194 (Sbc type) and NGC 5195 (SB0 type). Since this system provides a very close view of an interaction between a face-on late type galaxy with grand design spiral arms and a dusty barred lenscilar galaxy, M51 is a very good target to study the effect of a galaxy interaction on the stellar populations in detail.

### Data and Analysis

The Hubble Heritage Team observed M51 using the HST/ACS with F435W, F555W, F814 and F658N filters. The observation was completed in January 2005 and the data were publicly released in April 2005, covering about a 6.8′×10.8′ field centered on M51. Here, we use F435W (B), F555W (V) and F814 (I) images.

### Pixel Analysis

Extended sources with sufficient angular size but not nearly enough to resolve their stars can be investigated using the pixel analysis methods (e.g. Conti et al. 2003; de Grijs et al. 2003; Lanyon-Foster et al. 2007).

We present a pixel analysis of M51. The main goals are to improve our understanding of M51 properties and to establish the pixel color-magnitude diagram (pCMD) analysis methods for future photometric studies of galaxies.

### Bright-end Pixels in the NGC 5194 pCMDs

The bright-end pixels of the NGC 5194 pCMDs have a ‘reverse’ slope: brighter pixels are bluer than typical red sequence pixels. The pixels forming the tight sequence at the bright-end of the pCMD are within ~100 pc from the NGC 5194 center. Since NGC 5194 hosts an AGN (Ford et al. 1998; Ishihara & Wilson 2000), the AGN may significantly affect the photometric properties of the central area of NGC 5194. It is interesting that the size of the area occupied by the bright-end sequence population is approximately consistent with the estimated size of the AGN torus in the AGN unification model (Pier & Krolik 1993). However, such an agreement does not explain the origin of the tight and reverse sequence. If the light from those central pixels were stellar light, the obscuring torus would make those pixels redder, rather than bluer. In short, the ESP may be a photometric indicator of the central AGN properties, but its physical origin is an open question for now.

Two papers with more details are coming soon (hopefully).