Galaxies at High Redshift and Their Evolution Over Cosmic Time
Proceedings IAU Symposium No. 319, 2015
S. Kaviraj, ed.

doi:10.1017/S1743921315009916

The evolution of the spiral galaxy M51a

Xiaoyu Kang[1,2,3], Fenghui Zhang[1,2] and Ruixiang Chang[4]

[1]Yunnan Observatories, CAS, Kunming, 650011, China
email: kxyysl@ynao.ac.cn

[2]Key Laboratory for the Structure and Evolution of Celestial Objects, CAS, China

[3]University of Chinese Academy of Sciences, Beijing, 100049, China

[4]Key Laboratory for Research in Galaxies and Cosmology, Shanghai Astronomical Observatory, CAS, 80 Nandan Road, Shanghai, 200030, China

Abstract. A simple model for M51a is constructed to explore its evolutionary history by assuming its disk grows from continuous gas infall, which is shaped by a free parameter−the infall-peak time $t_{\rm p}$. By adopting a constant infall-peak time $t_{\rm p}$ = 7.0Gyr, our model predictions can reproduce most of the observed constraints and still show that the disk of M51a forms inside-out. Our results also show that the current molecular gas surface density, the star-formation rate and the UV-band surface brightness are important quantities to trace the effect of recent interactions on galactic star-formation process.

Keywords. galaxies: abundance, galaxies: evolution, galaxies: individual: M51a, galaxies: spiral

---

1. Motivation. M51a (NGC 5194) is a grand-design spiral galaxy and undergoing interactions with its companion galaxy NGC 5195. Many studies about M51a have been carried out. With respect to dynamic study, M51a is a very good target to explore the nature and origin of spiral structure. In addition, M51a is also a test bed to understand the effect of galaxy interacting on its star-formation (SF) process by investigating its stellar populations. However, there is still lack of investigation on the evolutionary history of M51a by using the simple model.

2. Method. A simple model for M51a is constructed to build a bridge between its SF history and its observed properties. Its disk is assumed to grow up gradually by cold gas infall and the gas infall rate is parameterizedly described by a Gaussian form with a free parameter−the infall-peak time $t_{\rm p}$. By comparing the model predictions with the observed data, we can discuss the probable ranges for free parameters in the model and then know more about the main properties of the evolution and SF history of M51a.

3. Result. It can be found that the model predictions are very sensitive to the free parameter and the model adopting a constant infall-peak time $t_{\rm p}$ = 7.0Gyr can reproduce most of the observed constraints of M51a. Although our model does not assume the gas infall time-scale of the inner disk is shorter than that of the outer disk, our model predictions still show that the disk of M51a forms inside-out. A 'toy' model is also introduced to allow an additional cold gas infall occurred recently to imitate the influence of the interactions between M51a and its companion. Our results show that the current molecular gas surface density, the SF rate and the UV-band surface brightness are important quantities to trace the effect of recent interactions on galactic SF process (See Kang *et al.* 2015 for more details).

Acknowledgements. This work is supported by the National Natural Science Foundation of China (NSFC) grant No. 11403092, 11273053, 11373053, 11573062.

Reference

Kang, X., Chang, R., Zhang, F., Cheng, L., & Wang, L. 2015, *MNRAS*, 449, 414