

# Ionization Mechanisms and Chemical Properties of the Star-Forming Blob BK2 in the Galactic Wind Region of the Starburst Galaxy NGC 6240

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## Abstract

We investigate the ionization mechanism and chemical properties of BK2, a star-forming blob located in the galactic wind of the merging galaxy NGC 6240 ( $z = 0.0245$ ), using Subaru/FOCAS-IFU integral-field spectroscopy. Emission-line diagnostics indicate that BK2 is predominantly ionized by star formation, although it lies near the boundary between star-forming and AGN/shock-ionized regions in the BPT diagram. The gas-phase metallicity is estimated to be  $\sim 0.2\text{--}0.3 Z_{\odot}$ , lower than that of the main body of NGC 6240. These results suggest that BK2 is a localized low-metallicity star-forming region embedded in the galactic-wind environment.

## Observations

Telescope / Instrument	Subaru / FOCAS-IFU
Observation Date	2022 Jul 7 (UT)
Grism	300B
Filter	None
Exposure Time	$5 \times 600$ s
Airmass	1.11–1.21
Field of View	$28'' \times 10''$
Spatial Scale	$0.435'' \times 0.211'' \text{ spaxel}^{-1}$
Spectral Sampling	$1.34 \text{ \AA pix}^{-1}$

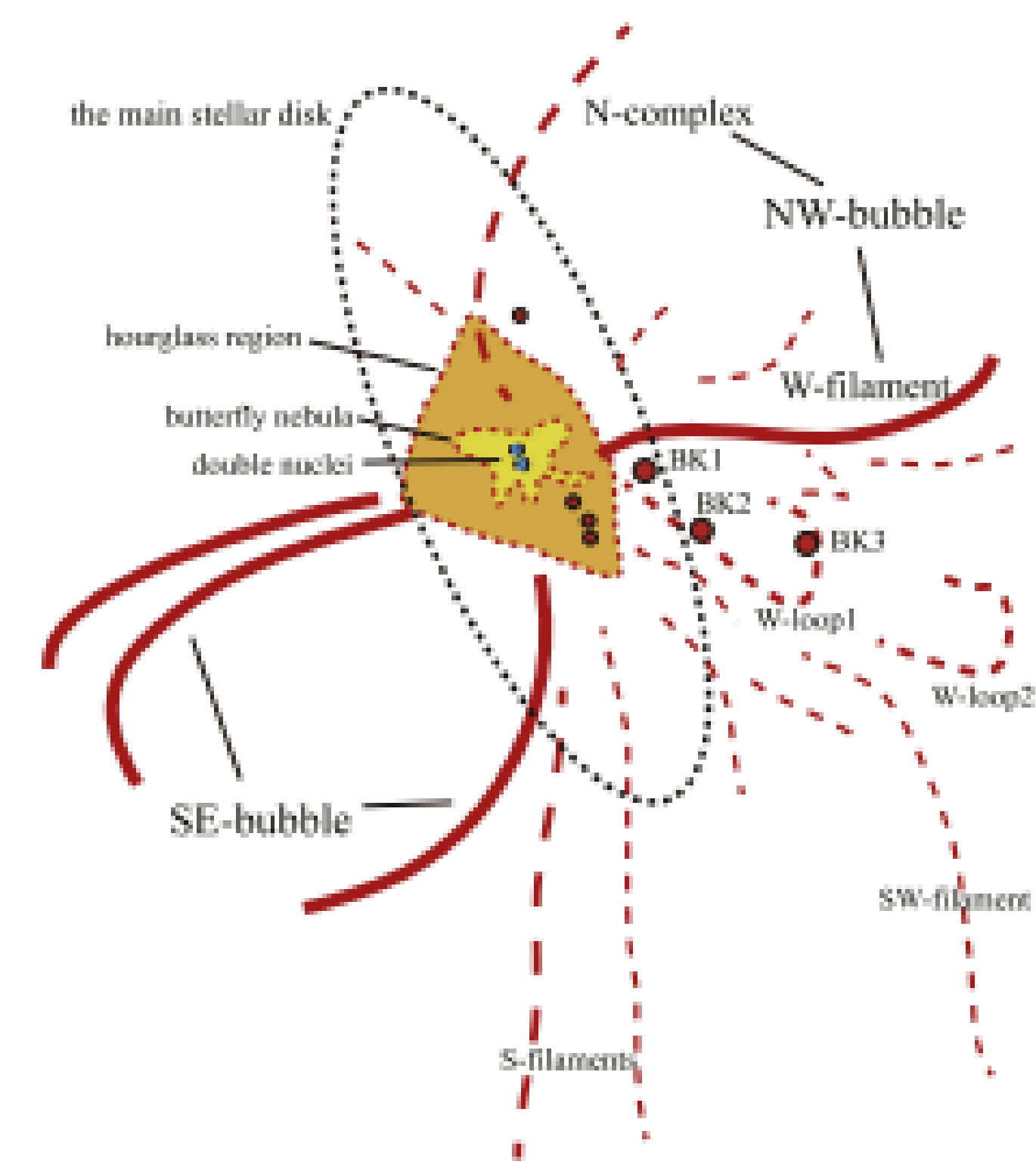


Fig. 1. False-color image of NGC 6240 and a schematic view of its H $\alpha$  nebula (Yoshida et al. 2016).

## Definition of Analysis Regions

$5 \times 600$  s exposures  $\rightarrow$  Alignment using the H $\alpha$  peak position  $\rightarrow$  Stacked H $\alpha$  image

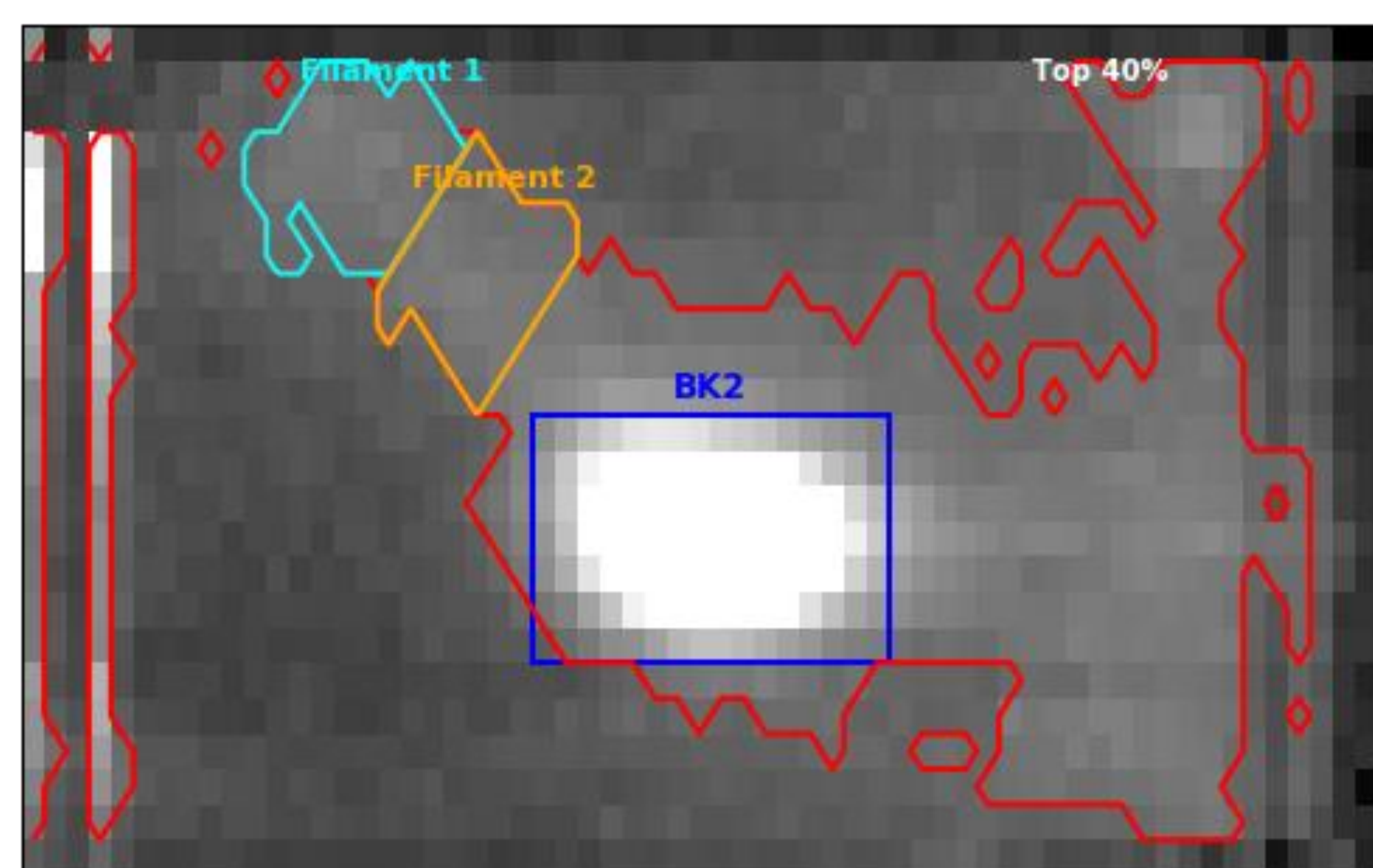


Fig. 2 H $\alpha$  image around BK2. The BK2 region ( $3.38 \times 3.05$  arcsec;  $1.7 \times 1.5$  kpc) and two filament regions were selected from the brightest 40% H $\alpha$ -emitting regions.

Region definition (Fig.2)  $\rightarrow$  Integrated spectra extracted from each region (Fig.3a,3b)

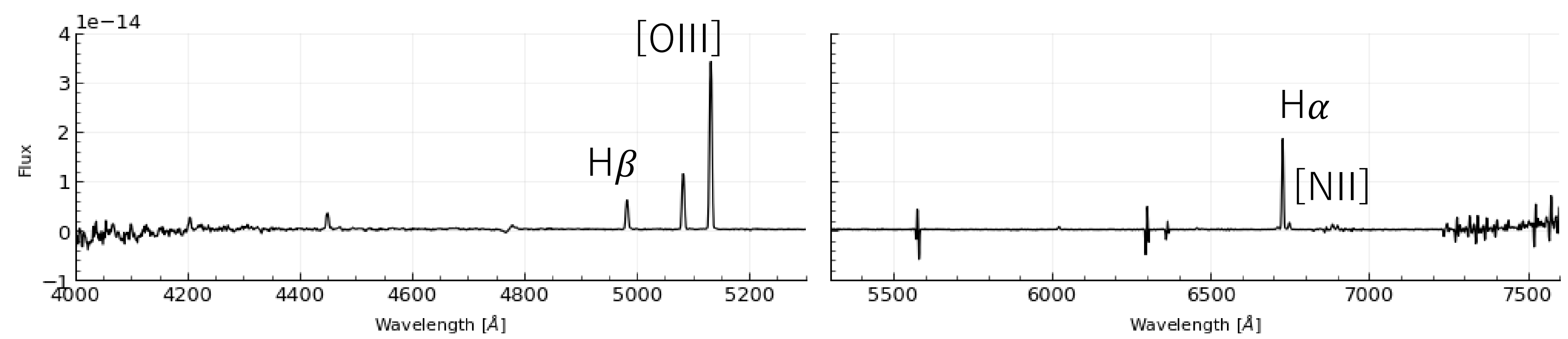


Fig. 3a Integrated spectrum of BK2.

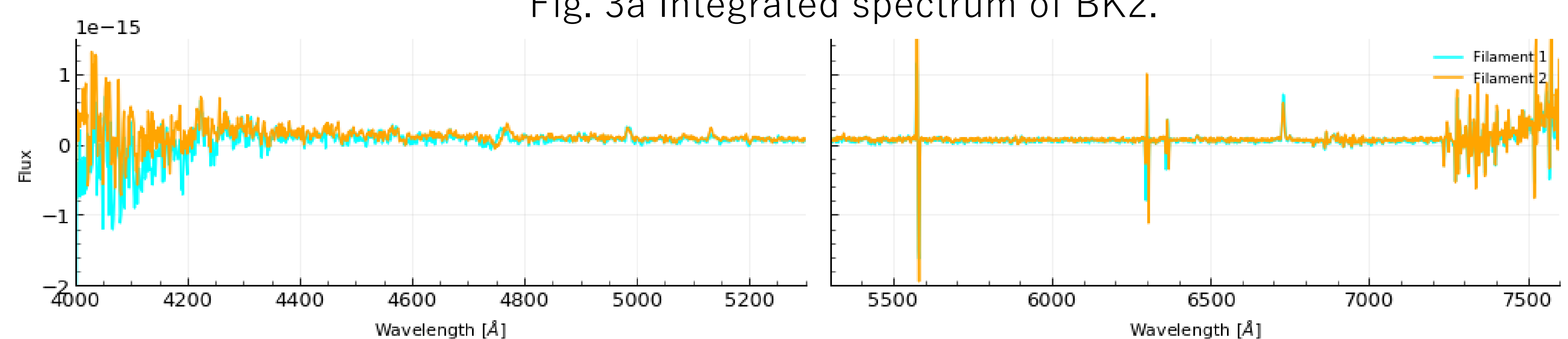


Fig. 3b Integrated spectrum of filament.

## Ionization Diagnostics and Metallicity

BPT diagnostic diagram

$\rightarrow$  Star-formation dominated

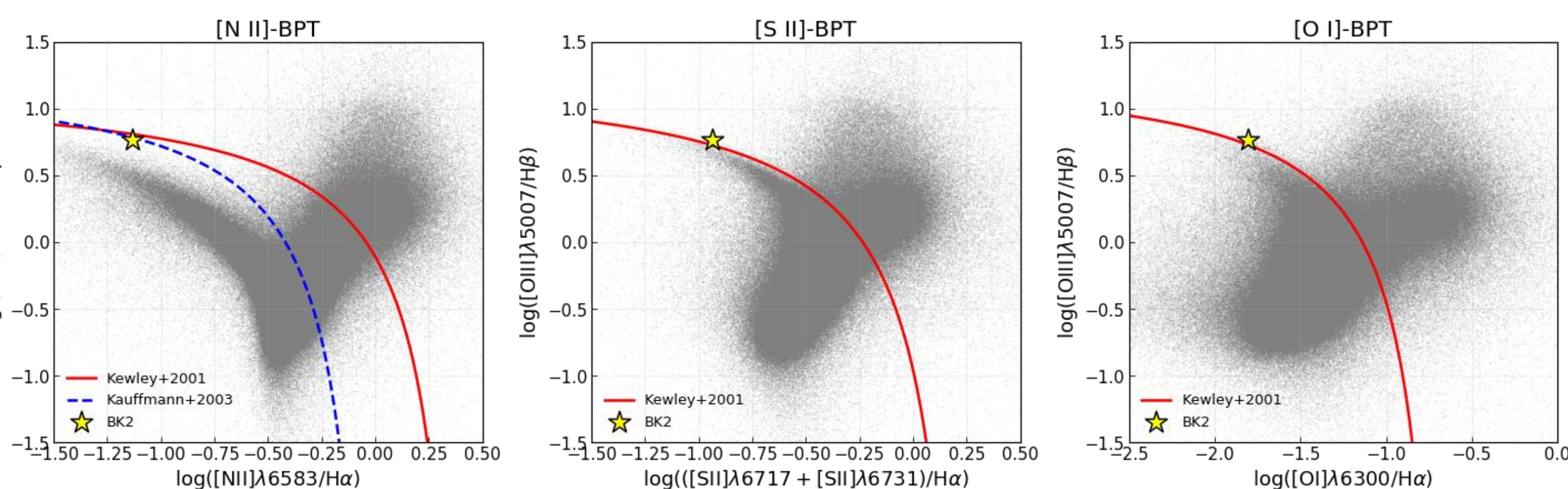


Fig 4. BPT diagnostic diagram of BK2. Gray points represent galaxies from the SDSS DR7 MPA-JHU catalog ( $0 < z < 0.05$ ). The yellow star indicates the position of BK2.

Metallicity estimation (method from Nakajima et al. 2022)

$\rightarrow Z/Z_{\odot} \sim 0.2\text{--}0.3$

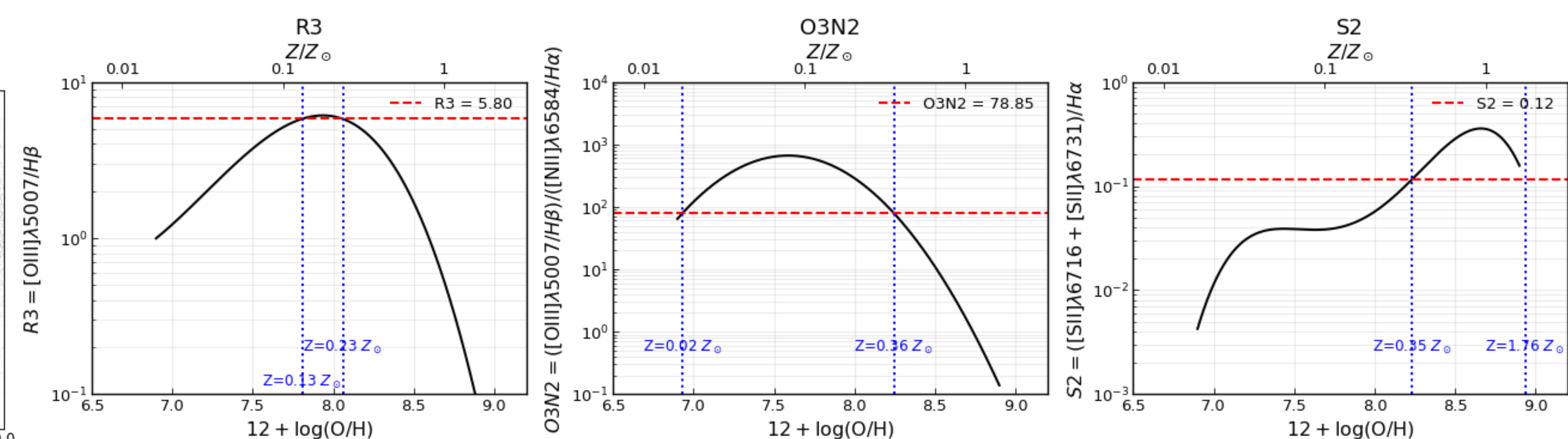


Fig 5. Gas-phase metallicity estimates for BK2. The red dashed lines indicate the observed values, while the blue dotted lines show the corresponding metallicity solutions.

## Discussion & Conclusion

The BPT diagnostic diagram suggests that **BK2 is predominantly ionized by star formation**, although it lies near the boundary between star-forming and AGN/shock-ionized regions. **The gas-phase metallicity is estimated to be  $\sim 0.2\text{--}0.3 Z_{\odot}$** , lower than the near-solar oxygen abundance reported for the main body of NGC 6240 (Contini 2012). These results suggest that **BK2 is a localized low-metallicity star-forming region embedded in the galactic-wind environment**.

## References

Contini 2012, MNRAS, 426, 719  
 Kauffmann et al. 2003, MNRAS, 346, 1055  
 Kewley et al. 2001, ApJ, 556, 121  
 Medling et al. 2021, ApJ, 923, 160  
 Nakajima et al. 2022, ApJS, 262, 3  
 Yoshida et al. 2016, AJ, 151, 117