

# Questions

1. For a given AR, how much spatial variation is observed in the FIP bias?
2. Is the core different from fan loops?
3. What is the spatial variation across fan loops?

## Active region structure



- EIS active region observation from 12-Dec-2007
- Continuous sequence of Fe ions from +6 to +16

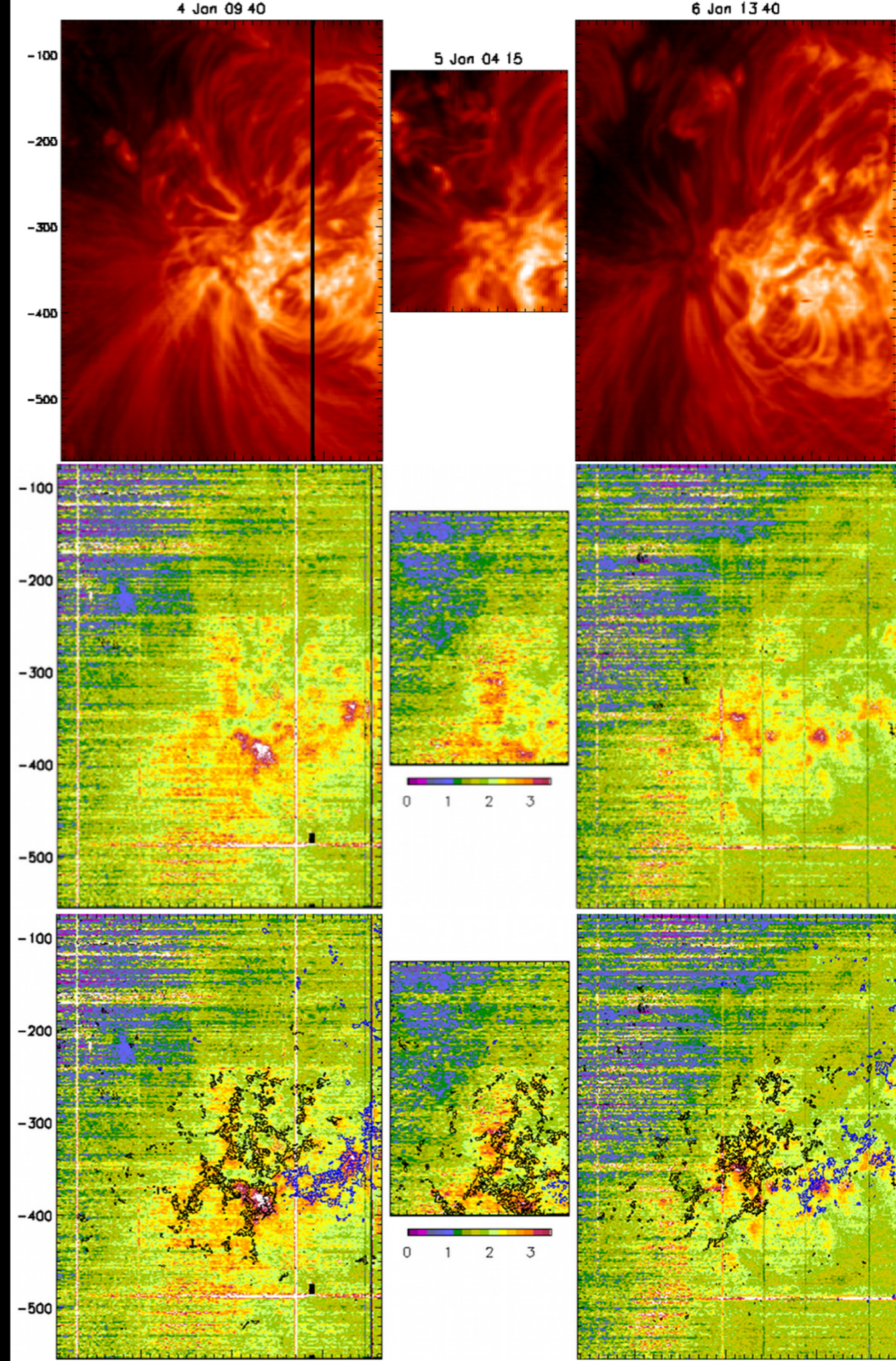
## EIS abundance methods

Ratio	Temperature/MK	Authors
Mg/O	0.4	Young
Si/S	1.5	Brooks, Baker
Fe/Ar	3.0	Del Zanna

# 1. Spatial Variation

Baker et al. (2015, ApJ)

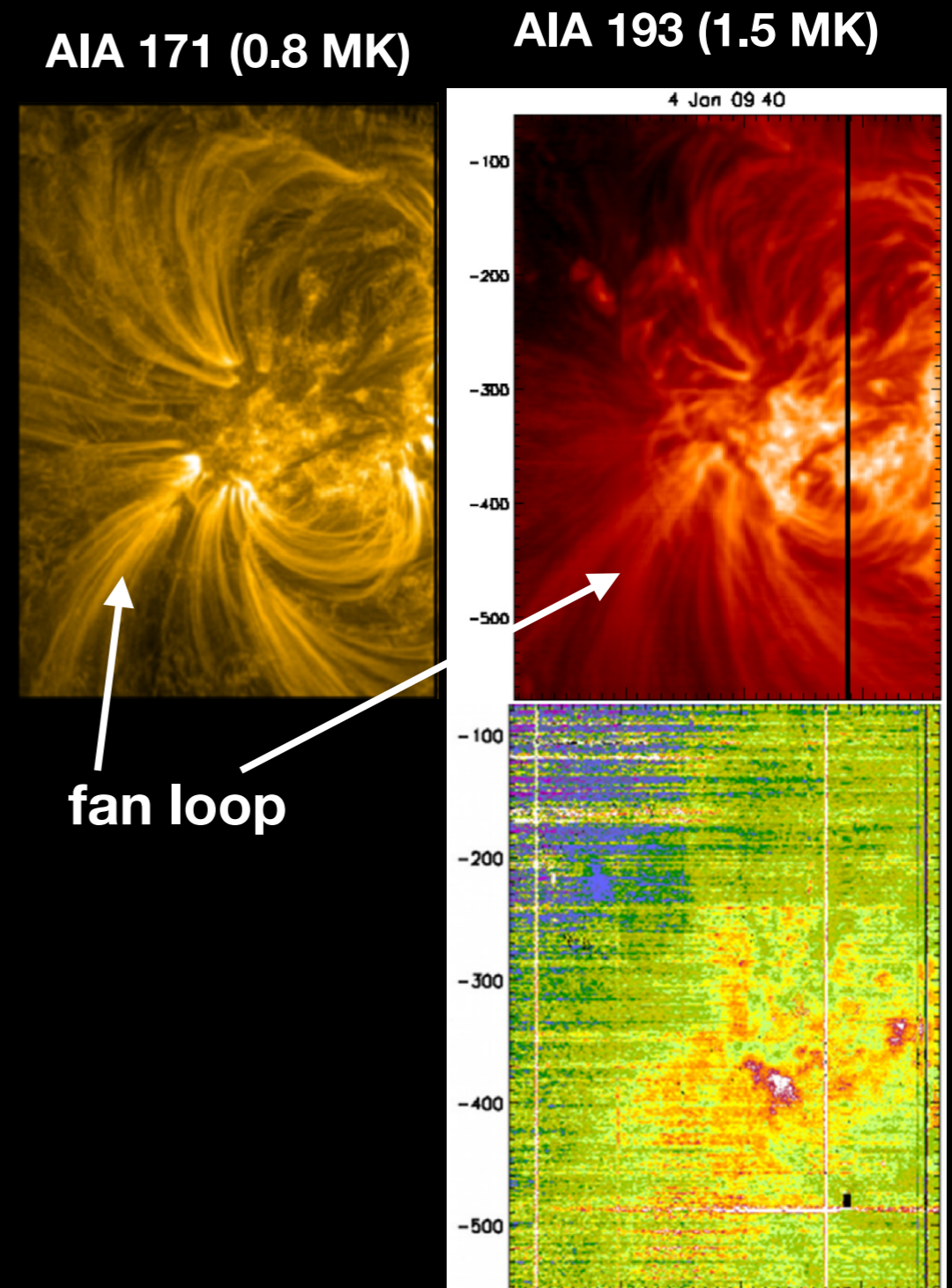
- Produced a FIP bias map for a decaying active region
- Bias derived using Si/S ratio at 1.5 MK
- Bias fairly uniform over center of AR
- Paper argues that the FIP bias is reduced by small-scale flux emergence



## 2. Core different from fan loops?

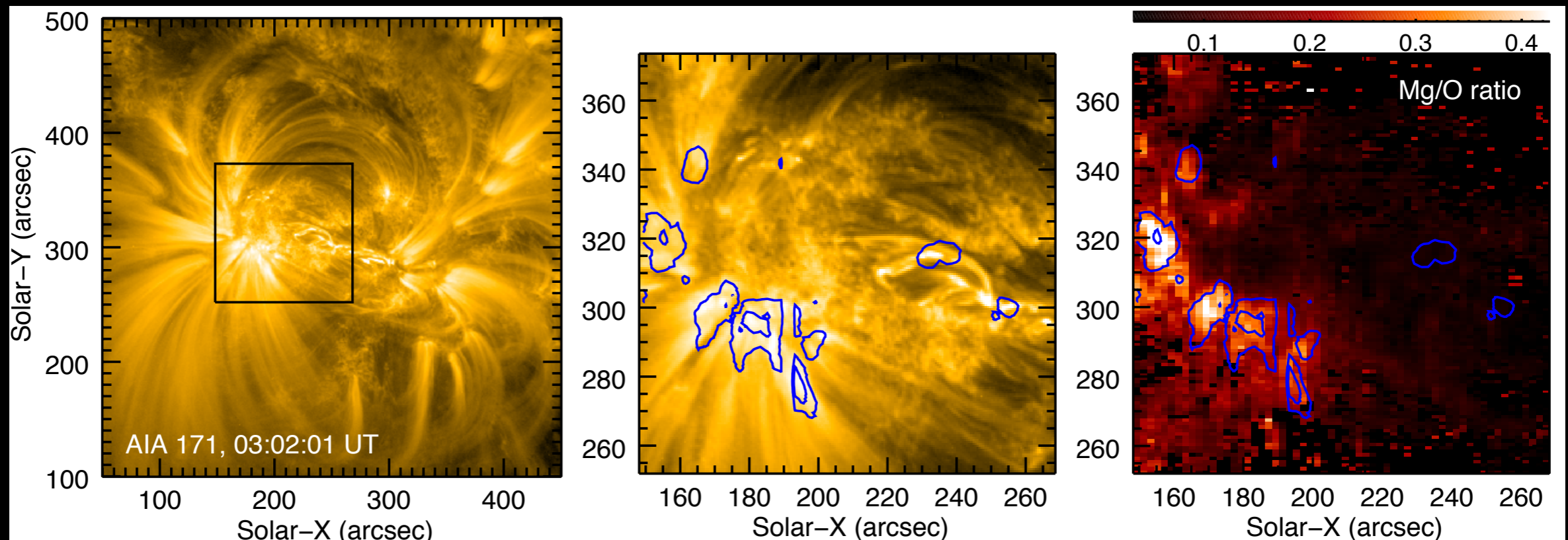
Baker et al. (2015, ApJ)

- Fan loops are cooler than core
- In the Baker et al. (2015) map, the fan loops can't be distinguished from core
- **but**, they are probably not the same structures as the AIA 171 fan loops



## 2. Core different from fan loops?

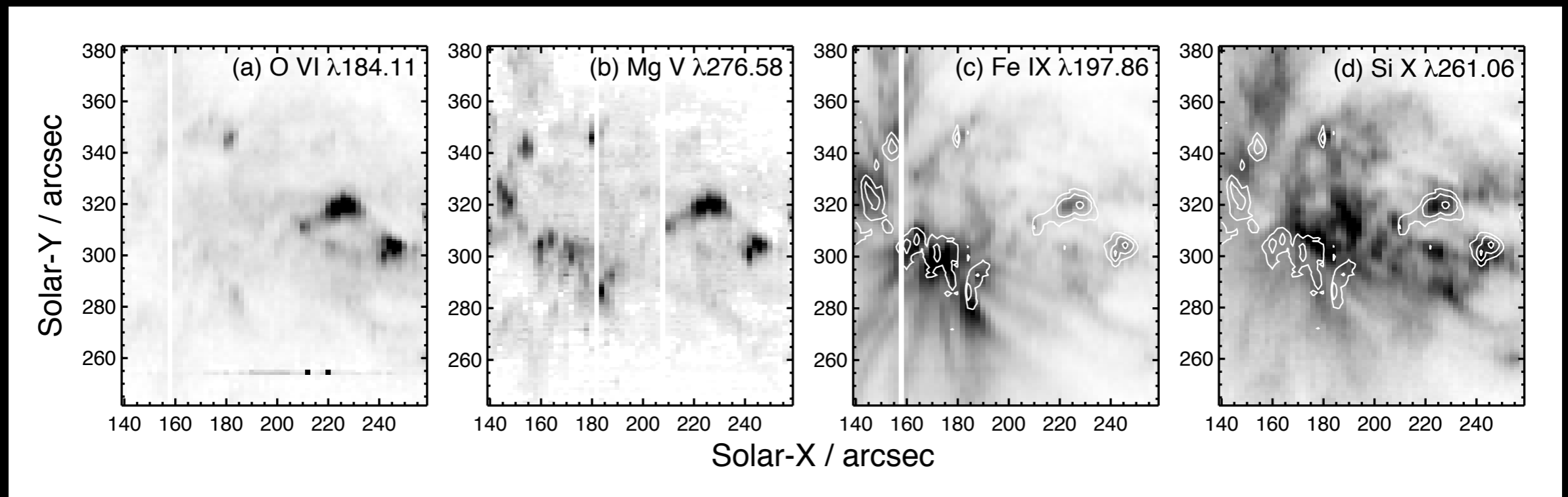
- EIS can measure the Mg/O ratio at about 0.4 MK (footpoints of fan loops)
- Fan loop footpoints show FIP bias values between 3 and 10
- The rest of the AR is close to photospheric at this temperature



## 2. Core different from fan loops?

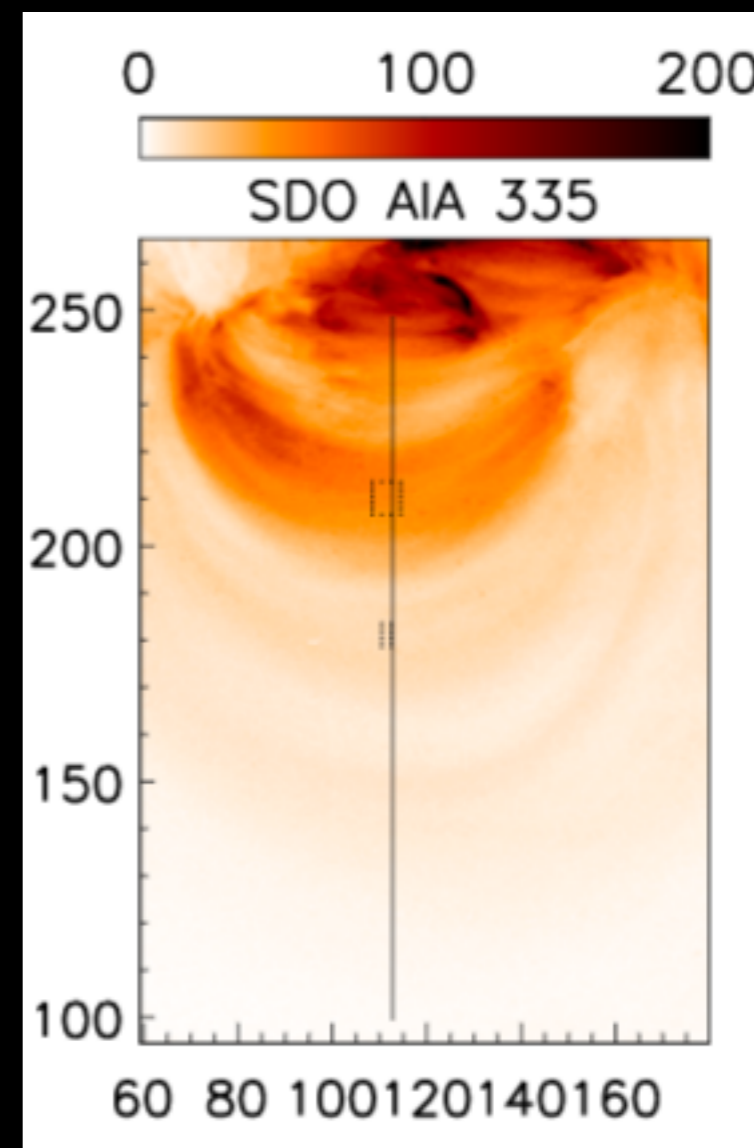
### Comparison of EIS images

- Comparing O VI and Mg V clearly shows locations of strong Mg/O enhancement
- These locations are at the base of fan loops seen in Fe IX
- The locations are not visible in Si X (line used for coronal FIP measurements)

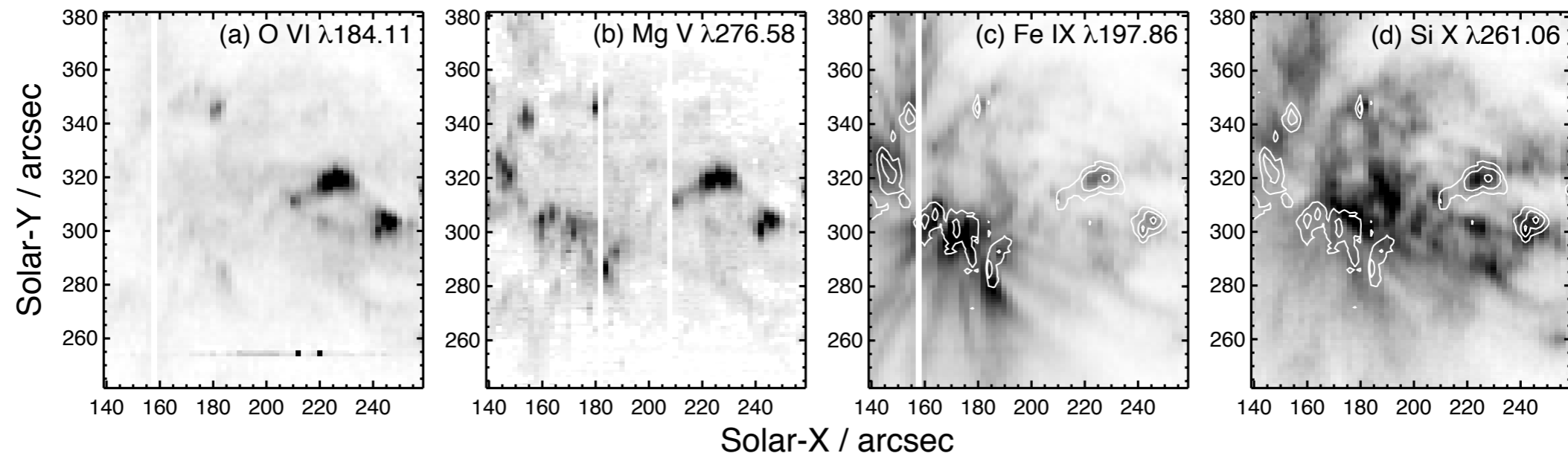
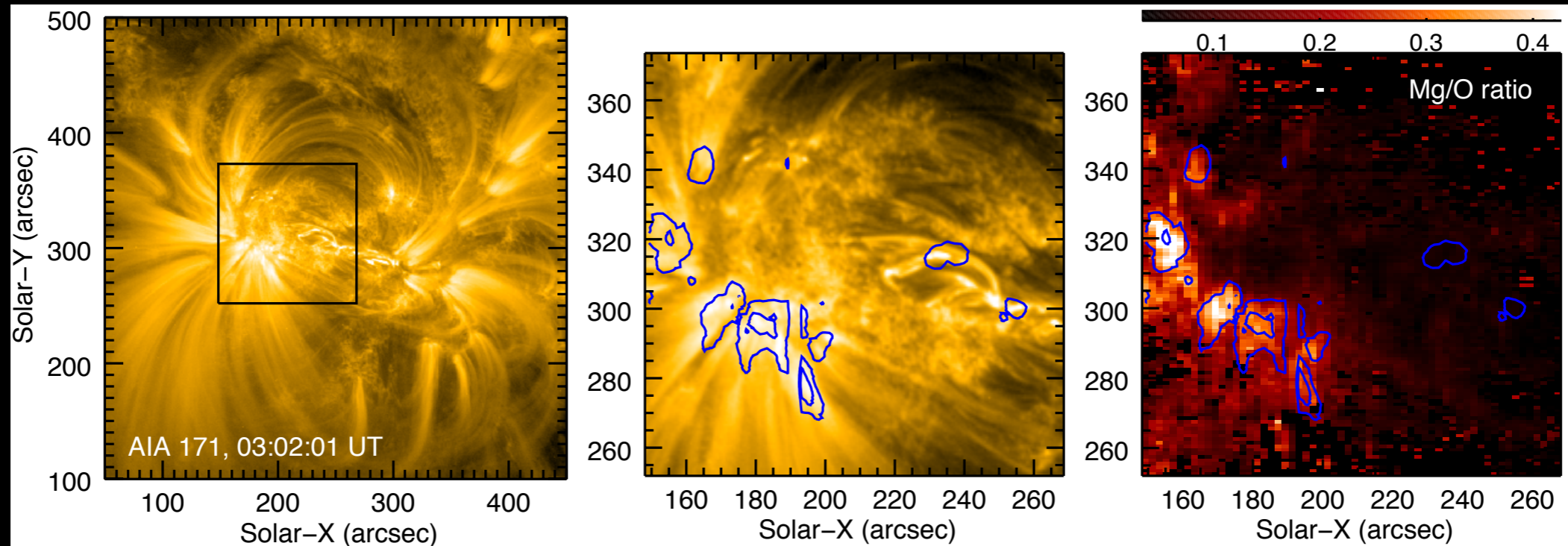


## 2. Core different from fan loops?

- Del Zanna (2013, A&A) measured FIP bias of AR core loops with EIS
- These loops have a temperature of 3 MK
- Found Fe/Ar and Fe/S FIP bias values of 4 and 3, respectively
- Del Zanna (2014, A&A) revisited old X-ray data and found Fe/O and Fe/Ne FIP bias values of 3



### 3. Spatial variation across fan loops



Impression that there are many more loops than there are footpoint

# Summary

- Active regions mostly show a FIP bias of 2-4 at temperatures of 1-3 MK, with typical value of 3; no extreme values
- This includes the “outflow regions” at edges of ARs
- The bases of fan loops (0.4-1.0 MK) can show extreme values of up to 10
- The average FIP bias decreases as the AR ages until merging with quiet Sun value

## To do

- Statistics are poor: mostly individual active regions
- The origin and rise-time of the FIP bias in fan loops has not been studied
- Consistent tracking of ARs for multiple days from birth is rare