



# Heating and Dynamics of Two Flare Loop Systems Observed by AIA and EIS

**Ying Li<sup>1,2</sup>**, Jiong Qiu<sup>2</sup>, Mingde Ding<sup>1</sup>

<sup>1</sup>Nanjing University

<sup>2</sup>Montana State University

July 9 2013

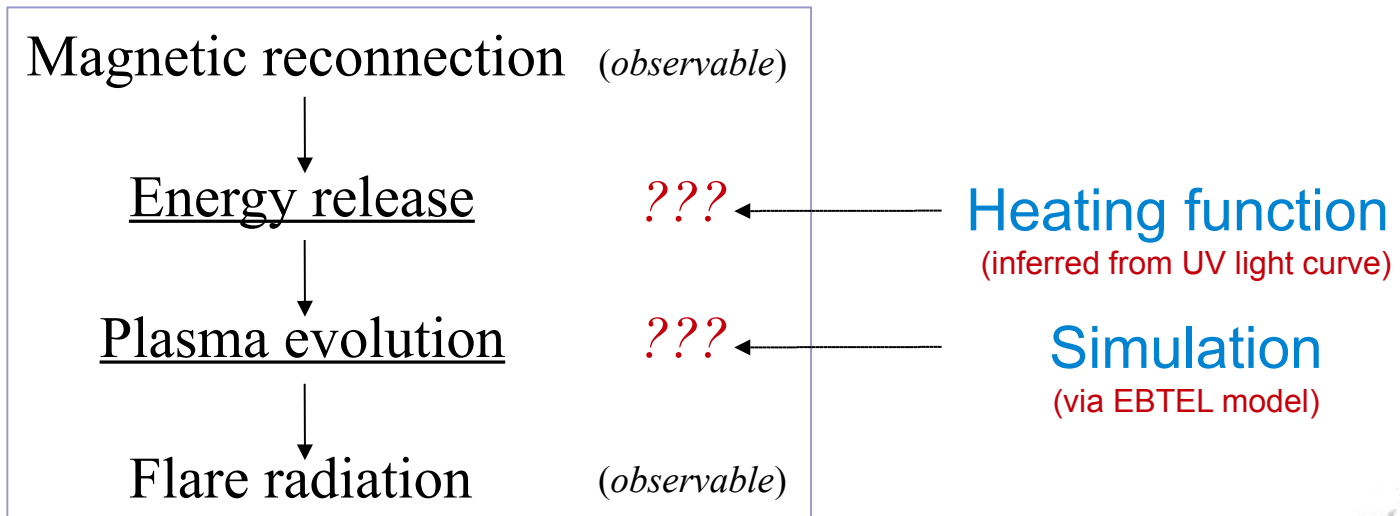
# Contents

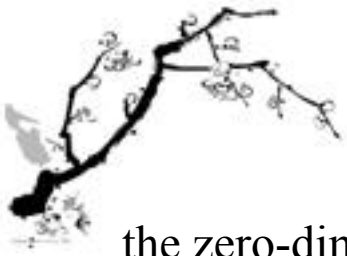
- Background
- Method
- Results
- Summary



# Background

## Flare heating issue





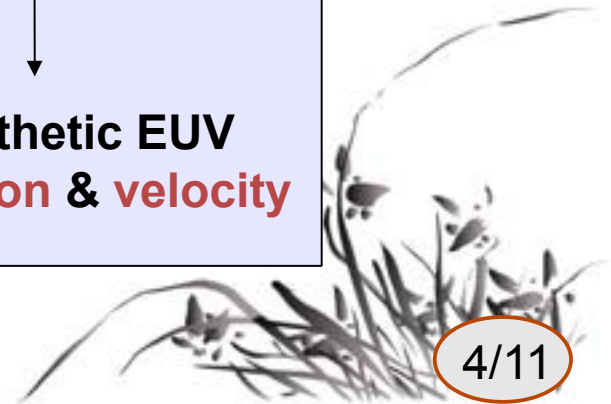
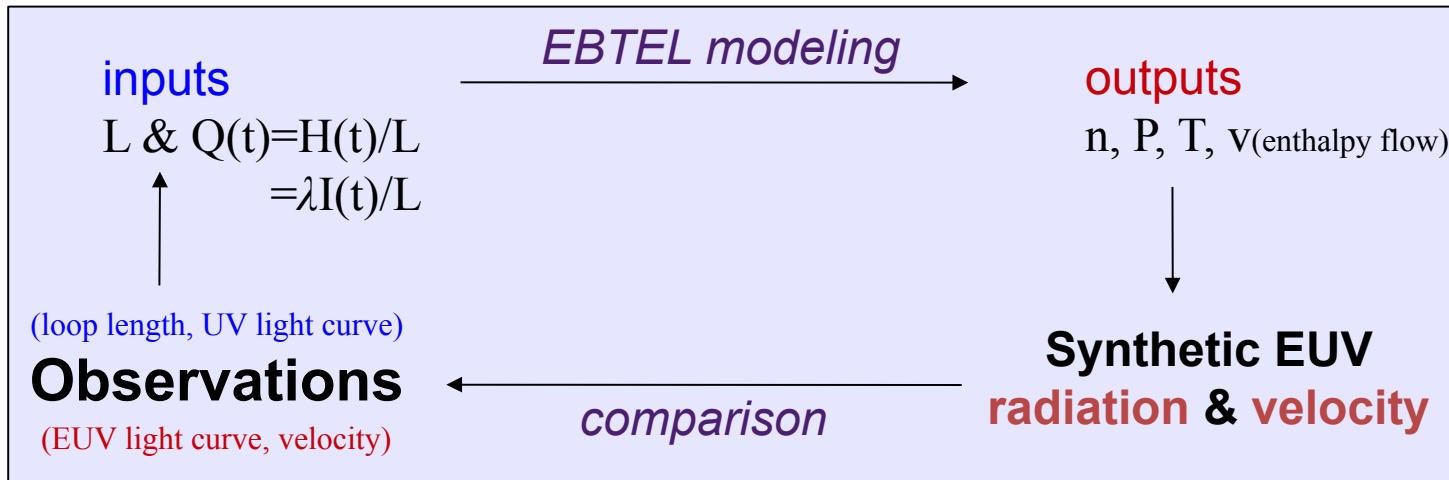
# Method

the zero-dimensional “**E**nthalpy-**B**ased **T**hermal **E**volution of **L**oops” model (**EBTEL**; Klimchuk et al. 2008, Cargill et al. 2012)

$$\frac{dn}{dt} = -\frac{2c_2}{5k_B T} \left[ \frac{F_c}{L} + c_1 n^2 \Lambda(T) \right]$$

$$c_1 = \frac{R_{tr}}{R_c}$$

$$\frac{dp}{dt} = \frac{2}{3} [Q(t) - (1 + c_1) n^2 \Lambda(T)]$$





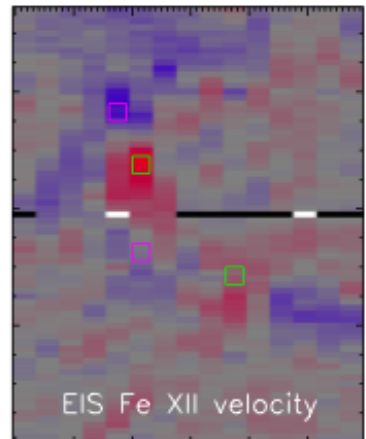
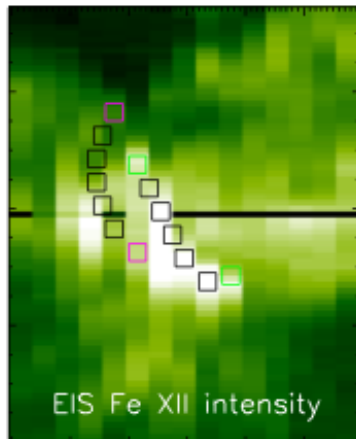
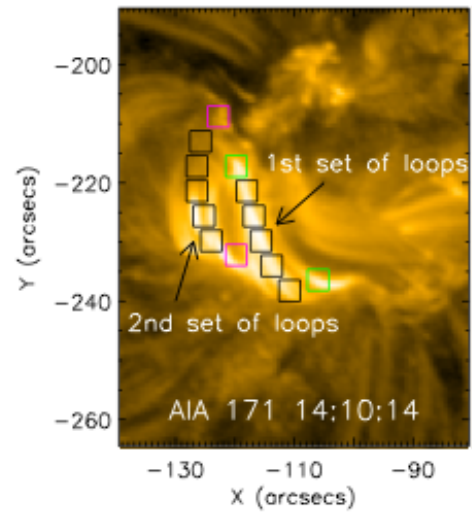
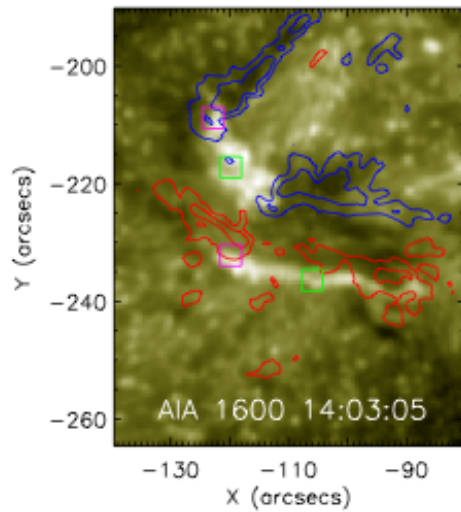
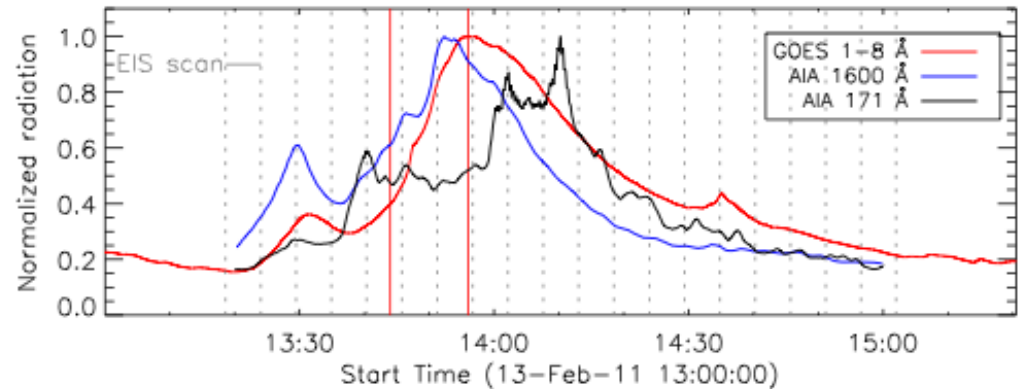
# Observations

a C4.7 flare  
on 2011 Feb. 13  
in AR 11158

AIA imaging data  
EIS spectroscopic data

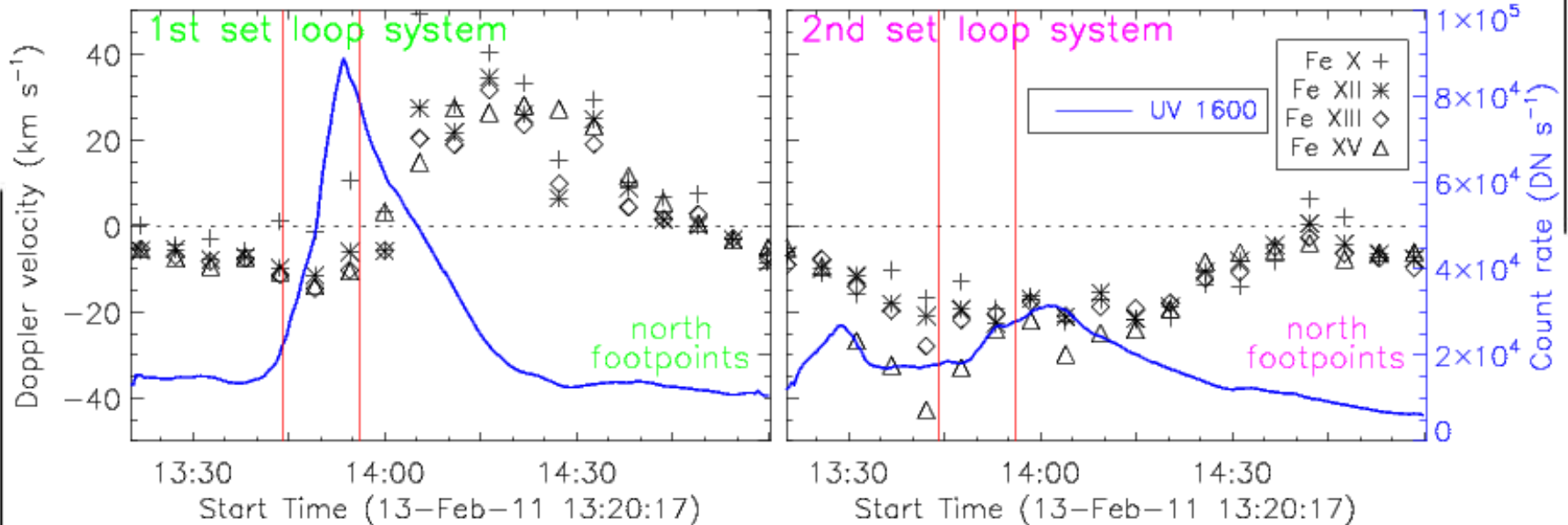
identify two flare loop systems  
treated as 49 individual loops

each footpoint area: 4" by 4"  
AIA pixel size: 0.6" by 0.6"

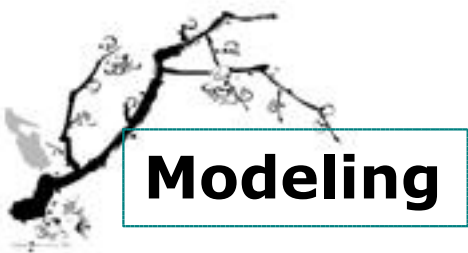


# Observations

Doppler velocity & UV light curve at footpoint patches

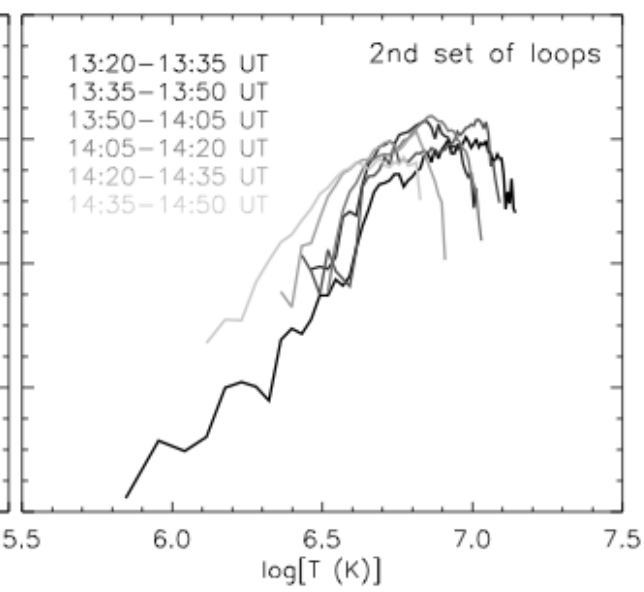
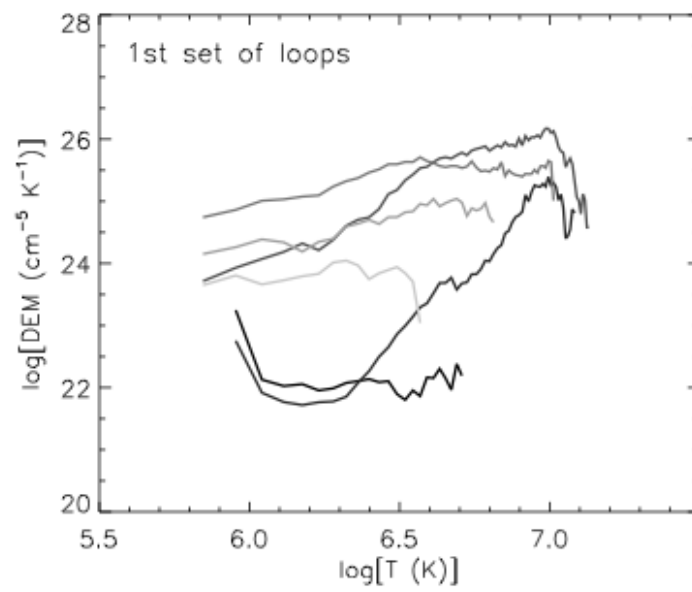
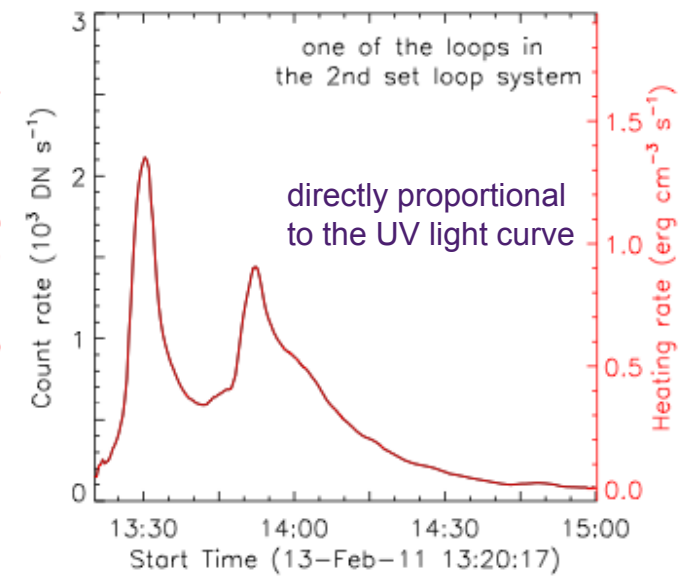
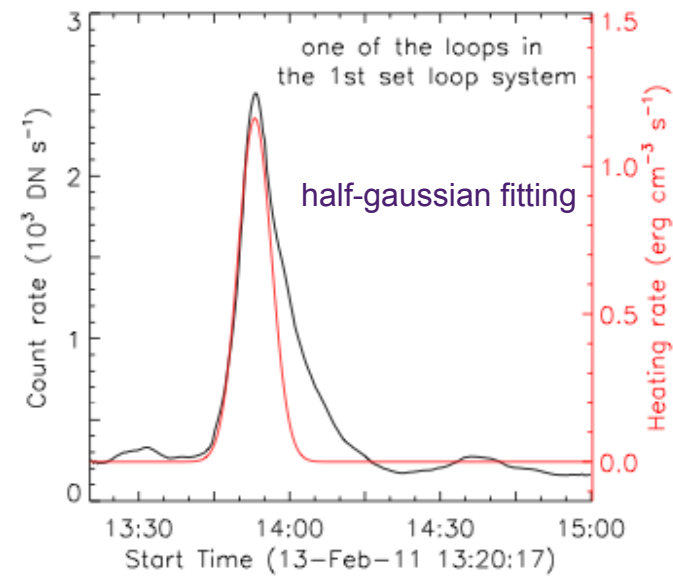


long-lasting blueshifts  
& twice-brightenings  
→ continuous heating



# Modeling

## Heating function



## DEM evolution

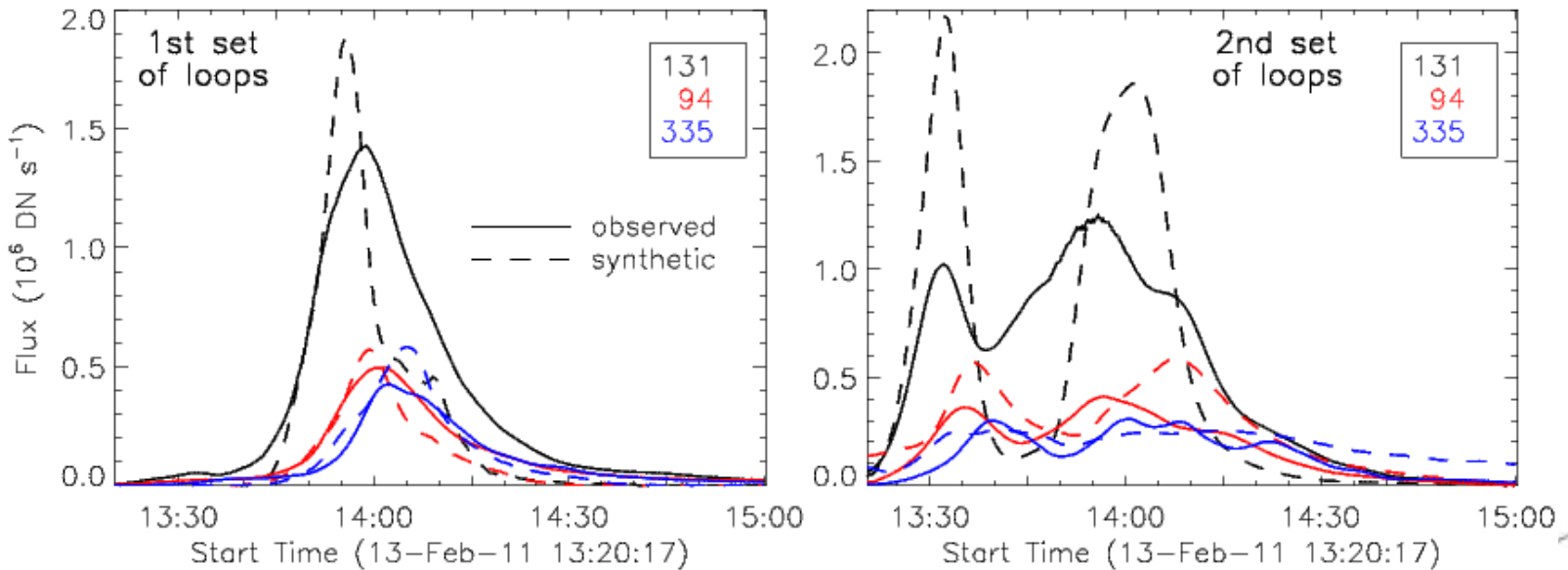




# Comparison

with AIA flux

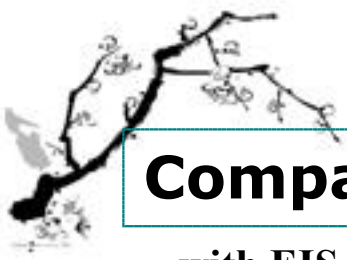
## synthetic VS observed EUV fluxes



basically consistent



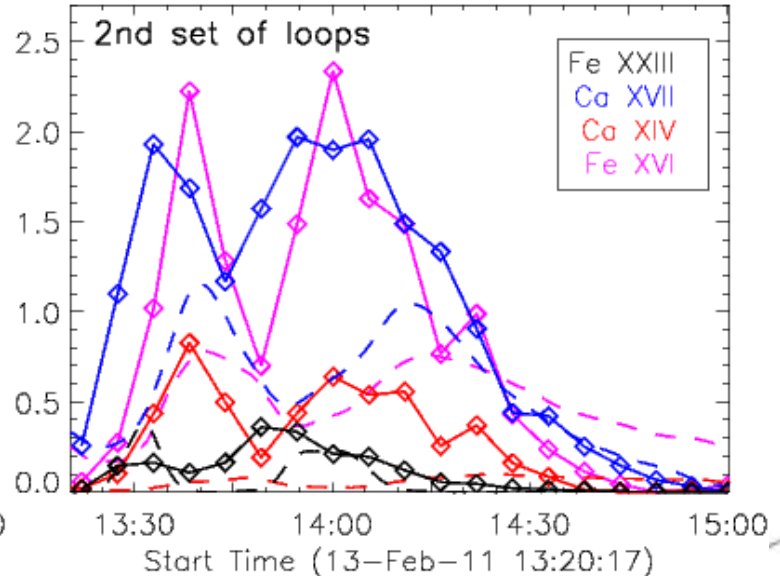
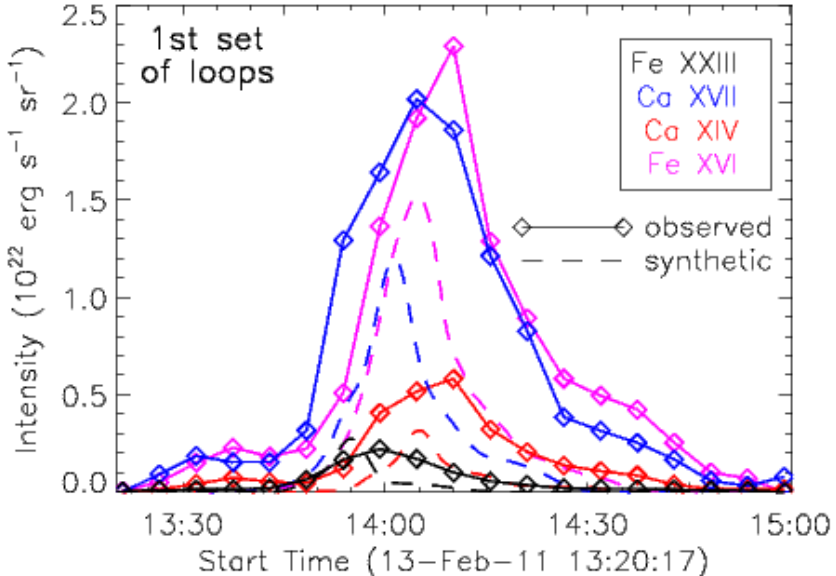




# Comparison

with EIS intensity

synthetic VS observed EUV intensities



basically consistent

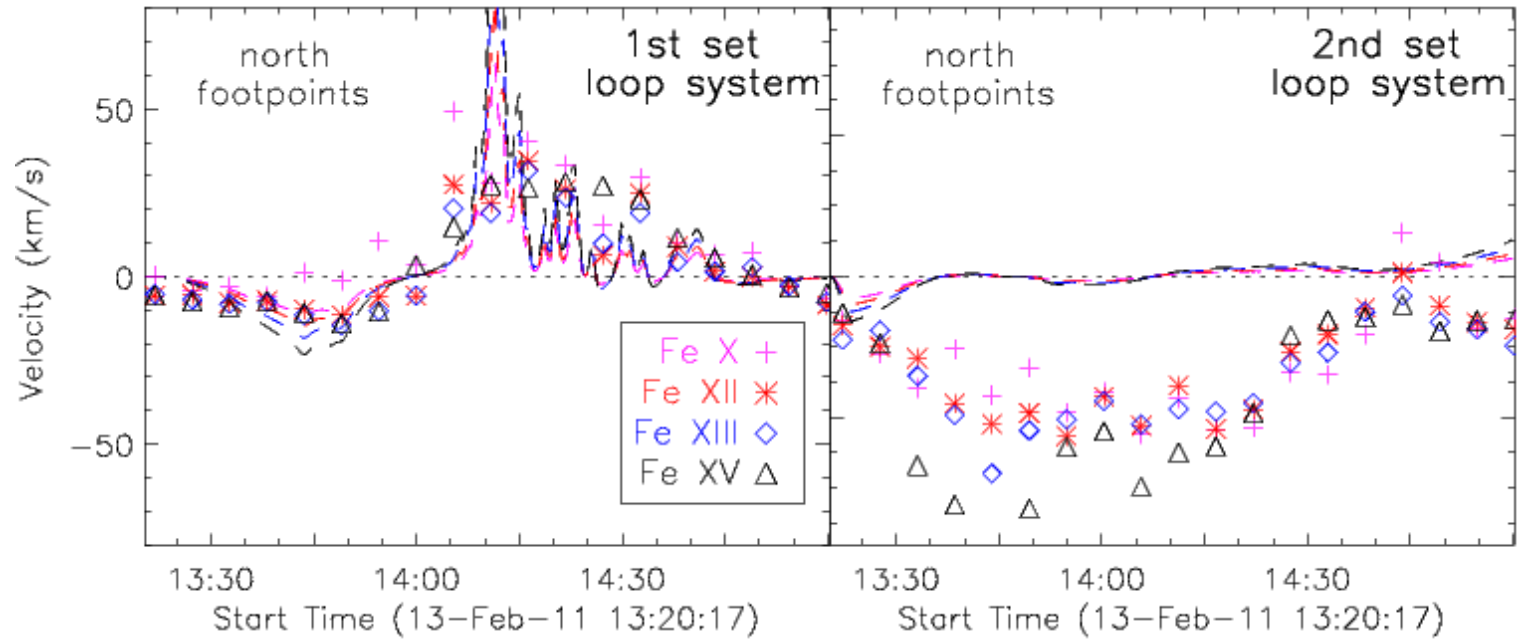




# Comparison

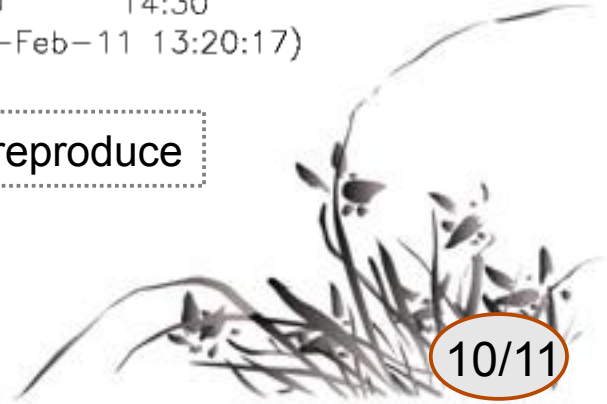
with EIS velocity

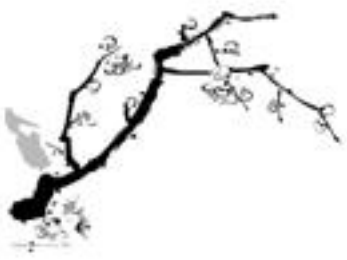
synthetic VS observed EUV velocities



agree well

not fully reproduce





# Summary

**The two loop systems show quite different heating and dynamics** (2<sup>nd</sup> loop system: continuous heating and long-lasting blueshifts).

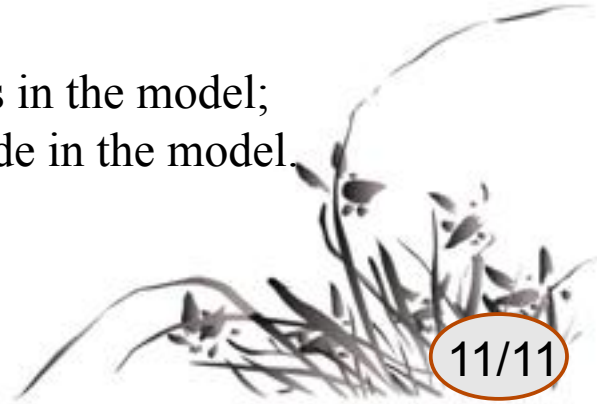
**The comparisons between model and observations are different in these two loop systems.** (may exist different heating mechanisms)

**The prominent discrepancies between model and observations in the 2<sup>nd</sup> loop system may be caused by:** (1) non-uniform heating; (2) exist unresolved fine flare strands.

## **0D EBTEL model:**

although with simplified assumptions, fast speed & few parameters be valid to constrain the flare heating model & provide reference for 1D models.

**Spectroscopic diagnostics:** determine the free parameters in the model;  
examine the assumptions made in the model.



Thanks for your attention!

Thank the meeting organizers!