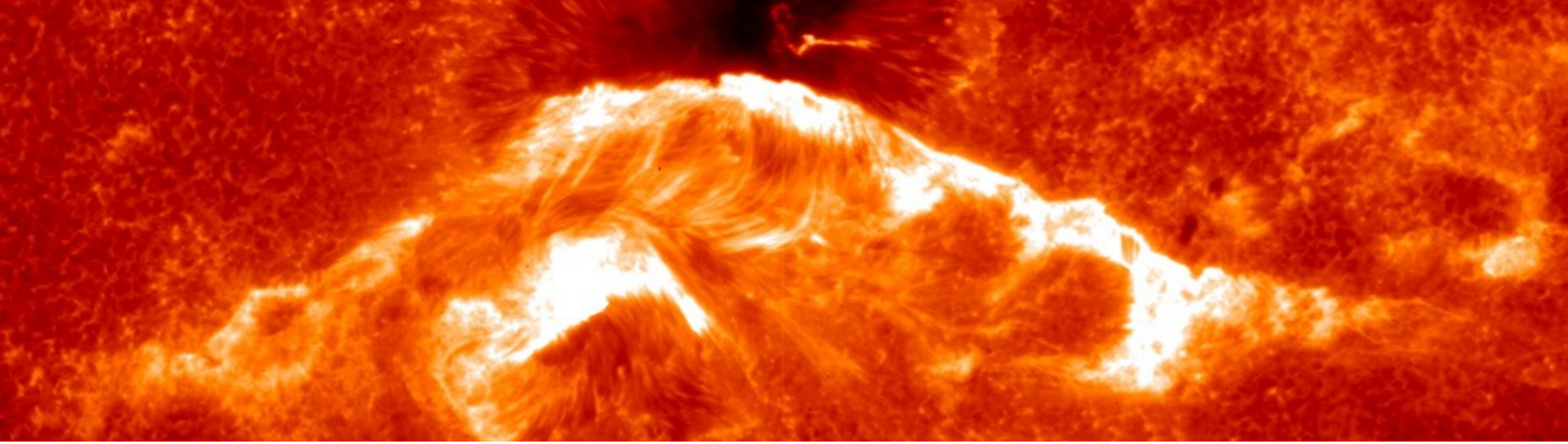

VANESSA POLITO BAERI & LMSAL (SHE/HER) GRAHAM KERR CUA & NASA/GSFC (HE/HIM)

DATA DRIVEN MODELS OF SOLAR FLARES: WHERE ARE WE AND WHAT IS NEXT?

SESSION INTRODUCTION

The goal of this session is to focus on what we have learnt from flare models (both 3D and 1D), what we can do to improve them, the ways in which observations can be used to constrain or interrogate the models, and the steps required to build towards the next generation of data-driven flare models.

1) What are the strongest observational constraints on flare models that we can obtain from existing observations?
2) Using 1D models can we determine the most important physical processes that are currently omitted from 3D models?
3) What are we missing both in terms of observational capabilities and modelling efforts, in our drive towards the next generation of realistic flare models?

Scene-setting speakers:

- **Kathy Reeves (SAO):** ***"Constraints on models from observations of Thermal plasma"*** **-** Morning session
- **Joel Allred (NASA/GSFC):** ***"Challenges in Comprehensive Flare Modeling"*** **-** Afternoon session

DISCUSSION POINTS

- Recent UV/EUV spectra (especially IRIS observations!) have started to spatially resolve the sites of chromospheric evaporation, which can be largely explained by 1D models.
- Broadened, symmetric high-temperature UV/EUV spectra cannot yet be explained by models unless turbulence is considered (this is very new, lots of work to do in this area).
- Flaring Chromospheric and transition region emission require sophisticated physics (e.g. NLTE Radiation Transfer). Only tractable to model in 1D, yet contain lots of diagnostic potential to constrain models (e.g. inversions).
- Flare cooling timescales in models are sometimes orders of magnitudes shorter than observed

  ➡ Turbulence can suppress thermal conduction, or can continue to heat the loop, to produce timescales more consistent with observations.
- Dynamics above the looptop region are hard to model in 1D.

DISCUSSION POINTS

- Chromosphere and transition region are vital to understand eruptive energy release on the Sun – ribbon structure, spectra etc., can carry information about the dynamics of the flaring current sheet.
- Turbulence is ubiquitous in flares, likely playing a role in ALL aspects of the flaring problem.
- Making strong headway in understanding particle acceleration but need a concerted effort to identify discriminating features in models to observe which mechanisms dominate.
- We almost always neglect accelerated ions in flares – potentially we are omitting a significant amount of the flare energy budget.
- Going forward we really need sub-arcsecond observations (spectra and imaging) on ~1s timescales over the full flaring atmosphere (e.g MUSE, EUVST, DKIST)… though we are sorely lacking high dynamic range HXR and γ ray observations!

TOWARDS A JOINED UP MODEL FRAMEWORK

Image courtesy Meriem Alaoui, Joel Allred

- Relevant physical processes span 10 orders of magnitude from nonthermal particles interacting at the kinetic scale to global MHD.
- These disparate scales are coupled in space and time.
- Currently not possible to encapsulate all physical processes within a single model.
- How can people studying various aspects of flares work together to comprehensively understand and model solar flares?