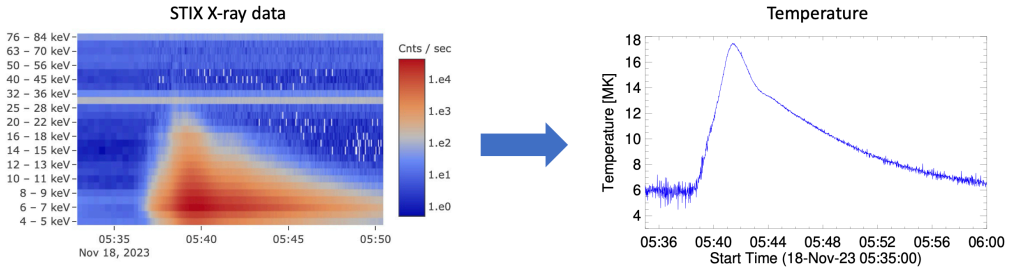
Fachhochschule Nordwestschweiz

ML Alg | Data Science

25HS_I4DS20: Using Machine Learning to Measure Temperatures of Solar Eruptions

			Priority 1	Priority 2
Advisor:	Säm Krucker	**Work scope:**	P5 oder P6	---
	Paolo Massa	**Team size:**	2er Team	---
Languages:	German or English			
Study course:	Computer Science and Data Science			



Initial situation

Solar flares are eruptions in the Sun"s atmosphere creating hot gas with temperatures up to ~50 millions of degrees Celsius. Such hot sources emit strong X-ray radiation. By measuring these X-rays, the temperature of the flare can be retrieved.

Over the past decade, FHNW has developed and built the X-ray telescope STIX onboard ESA"s solar Orbiter mission [1]. STIX, which can be considered as a "flare thermometer" operating at temperatures above 10 million degrees Celsius, has observed over 80"000 solar flares since 2021.

Objective

We propose to train a Machine Learning (ML) model to predict flare temperatures from STIX observations without manual intervention.

Problem statement

We generally use fitting of spectral STIX data to derive flare temperatures. This is a slow and manual process based on a 30-year-old software package, which we intend to replace by an ML approach. There are existing python routines to derive the X-ray spectrum for a given flare temperature [2]. Hence, we are able to create a dataset of simulated STIX flare observations and corresponding temperatures, which will be used to train an ML model to predict the flare temperature from STIX data. The resulting model will be applied to the STIX database to derive flare temperatures as a function of time (see above figure).

Technologies/Technical emphasis/References

Existing phyton tools can be used to simulate STIX data and to download real STIX observations [2,3]. In case of a P6 project, the obtained model will be implemented and tested on the STIX webpage [4] to derive the time evolution of the flare temperature for each observed event.

[1] https://www.esa.int/Science_Exploration/Space_Science/Solar_Orbiter
[2] https://github.com/sunpy/sunkit-spex
[3] https://github.com/TCDSolar/stixpy
[4] https://datacenter.stix.i4ds.net/

Note

This is a cutting-edge research project that will be carried out within an international team. No prior knowledge of the physics of the Sun is required. Please note that most of the STIX documents are in English, but the thesis may be written in German or English.