ML-based diamond feature extraction from scatter images

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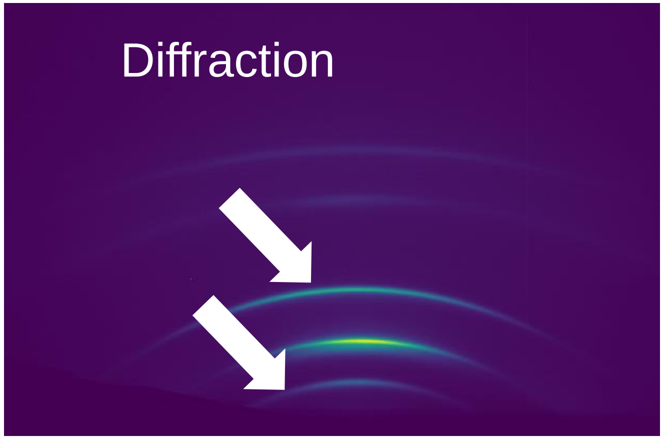
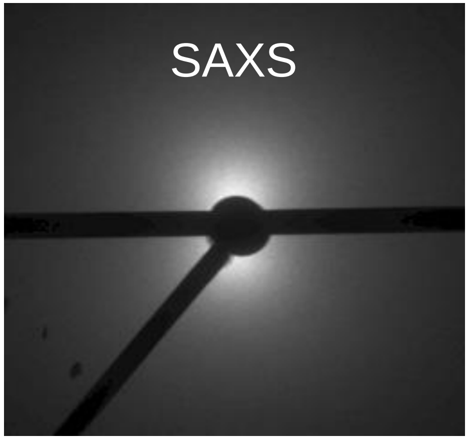
ML-based diamond feature extraction from scatter images

- Experiments modelling the environment of gas-filled planets
- Diamond formation under extreme conditions [1]
- Done by Dominik Kraus et al (FWKH, HZDR) at SACLA

[1] Kraus et al., Formation of diamonds on laser-compressed hydrocarbons at planetary interior conditions. Nature Astronomy 2017





Diffraction and SAXS are performed in parallel

- Visualization of diamond features in diffraction images works
- Detection from SAXS images?
- CNNs for diamond feature detection also from SAXS images?
- Images labelled according to diffraction images

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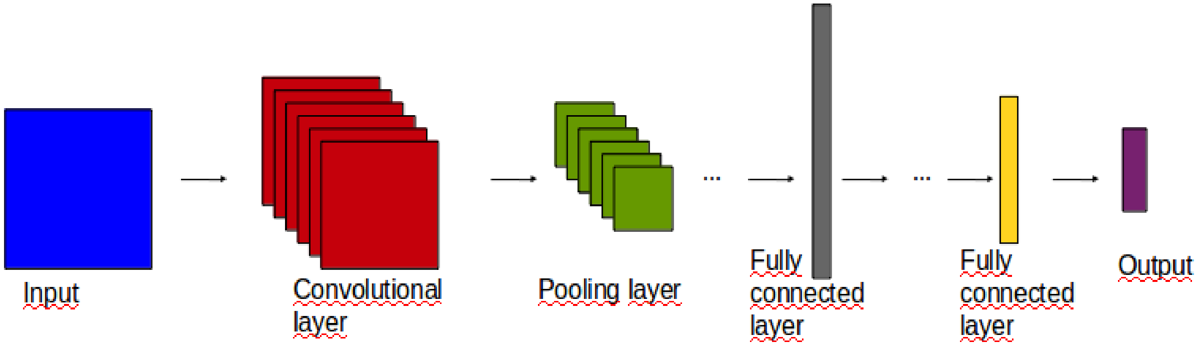
Aim: image classification and determine decisive parts of the image

Method:

- 90 images with PET target
- Diamond (main shot): 45, non-diamond (preshot): 45
- Test data set: 10 (5/5), training: 80, batch size 1-2, 10-20 epochs
- Pytorch: CNN with 3 convolutional layers plus max pooling and 3 fully connected layer, kernel size: 5
- Class activation mapping [2]: identify the importance of the image regions by projecting back the weights of the output layer onto the convolutional feature activation map



[2] Zhou et al, Learning Deep Features for Discriminative Localization. IEEE CVRP 2016

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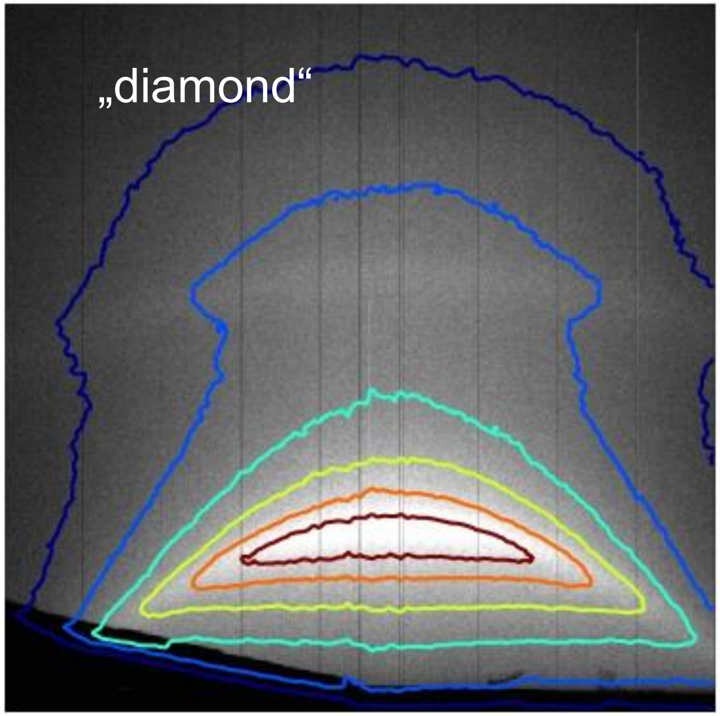
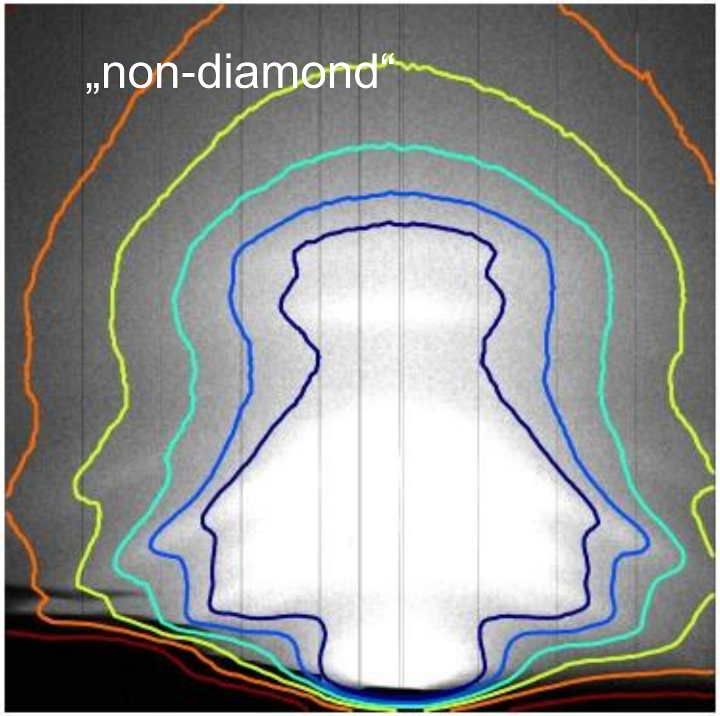
Results: Classification of diffraction images

- Diffraction images correctly classified (100 %)

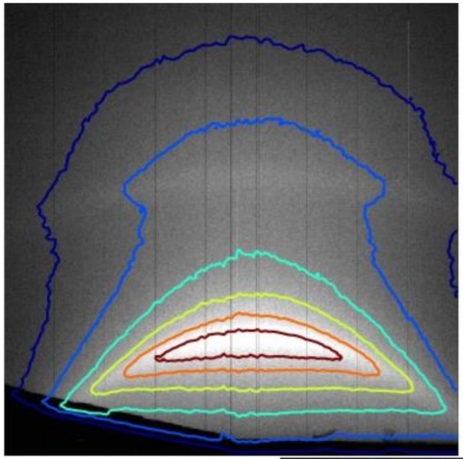
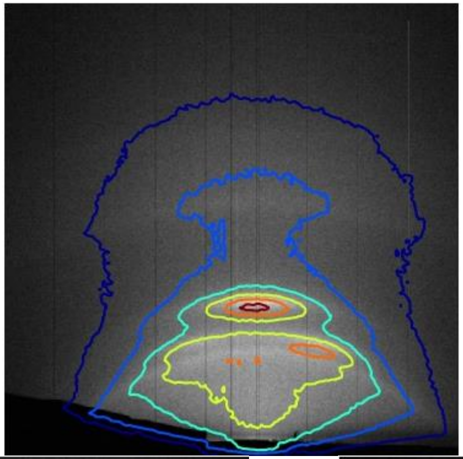
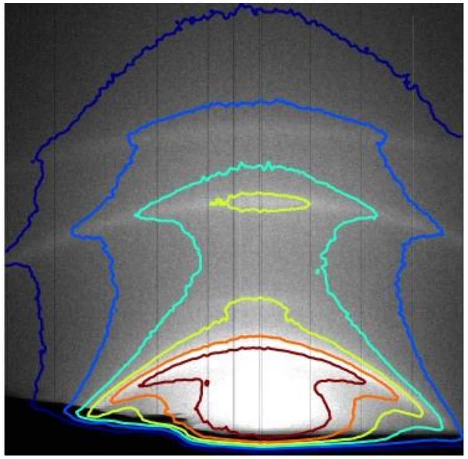
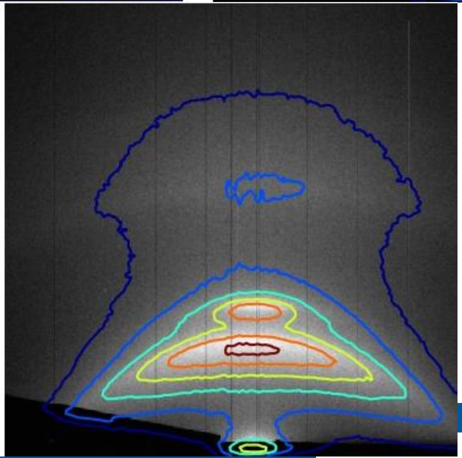
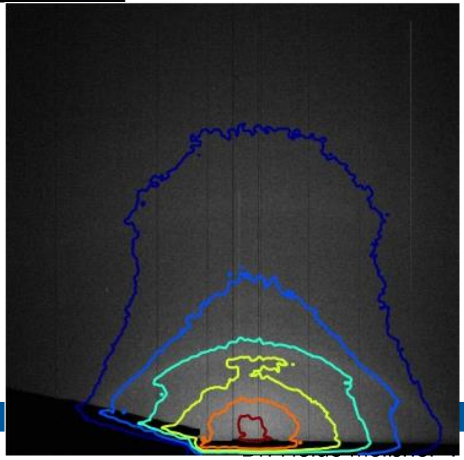




ML-based diamond feature extraction from scatter images

Results: Classification of diffraction images

- Diffraction images correctly classified (100 %)
- Discriminative parts of the image are not always „diamond curves“

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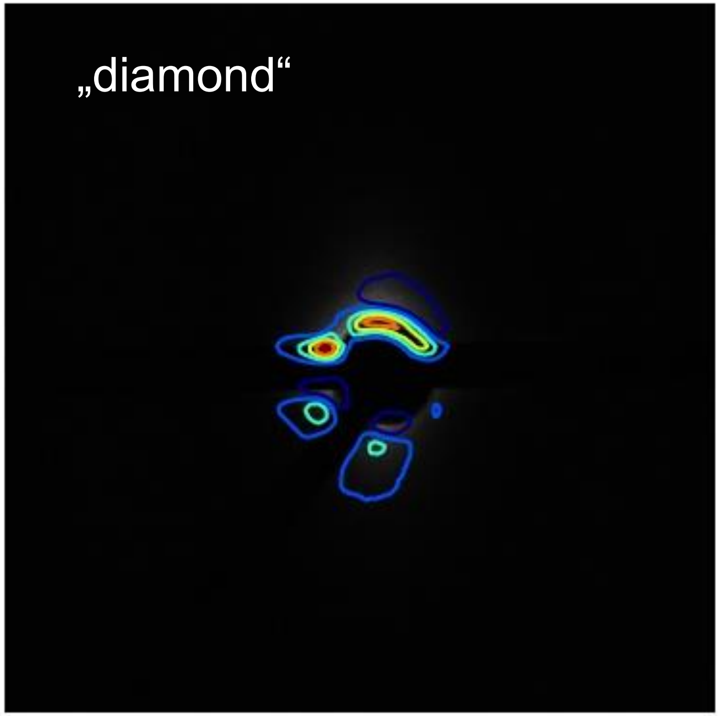
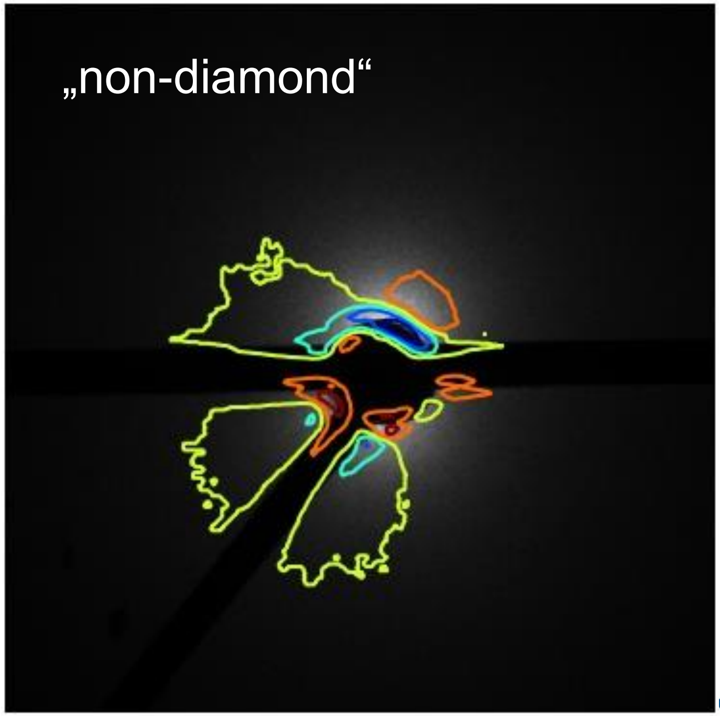
Results: Classification of SAXS images

- SAXS images mainly correctly classified (80-90 %)
- Highest intensity regions seem most relevant
- Analysis of discriminative features not straightforward





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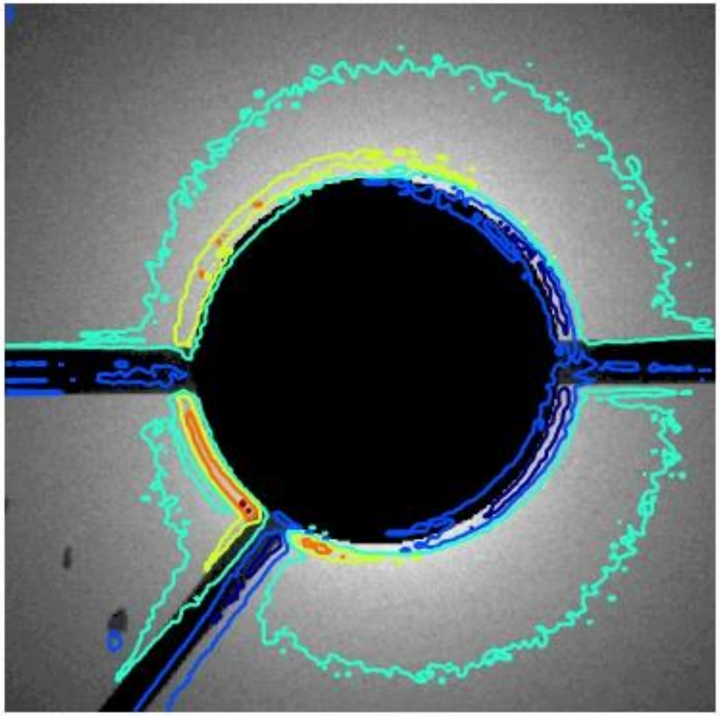
Results: Classification of SAXS images, cut out of central region

- SAXS images mainly correctly classified (80-90 %)
- Highest intensity regions seem most relevant
- Analysis of discriminative features not straightforward



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Outlook, Options

- First learn material, then do classification => more data
- Fully connected network => needs more ressources
- Close comparison of found features with „diamond“ features found manually...

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