Scientists

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PSI Fellows (LSF)

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Zhibin Sun

PhD student

Jonas Knurr

Engineer

Florian Amrein

Technician

Simon Tiefenbacher

MALOJA

Molecules, **A**toms, **L**ight **O**bserved in a **J**oint **A**pparatus

Maloja pass: 1815 m

Most important event: First Beam in Maloja 26.06.2020

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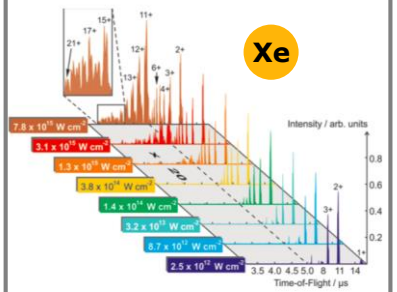
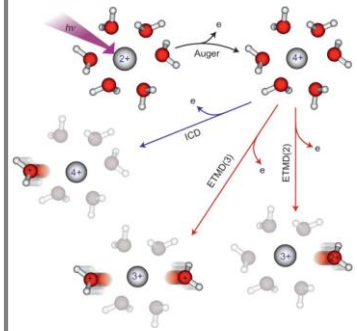
Science Opportunities

High-intensity X-ray interaction



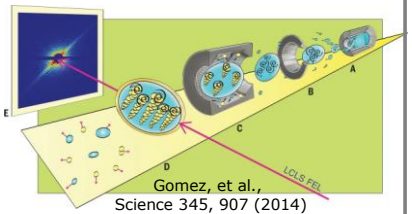
Sorokin et al., PRL 99, 213002 (2007)

X-ray induced chemistry



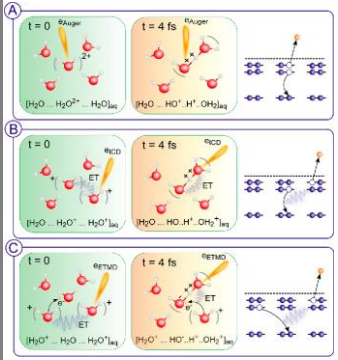
Stumpf et al., Nat. Chem. 8, 237 (2016)

Dynamics and structure of short-lived aggregates



Gomez, et al., Science 345, 907 (2014)

Charge and energy transfer

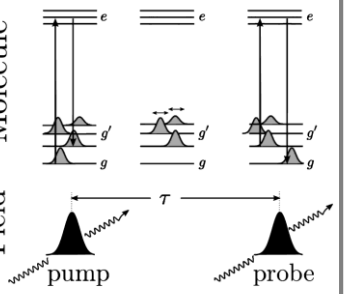


Slavíček et al., JACS 2014 136 (52)

+

MALOJA

Non-linear photon-matter interaction



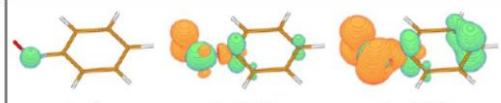
Biggs et al., PNAS 110, 15597 (2013)

Athos CHIC

250 – 1800 eV

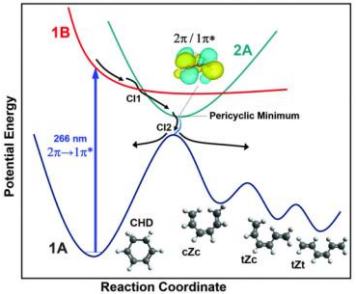
- Intense few to sub-fs pulses
- Multiple X-ray colors
- Tunable bandwidth and polarization

Charge migration



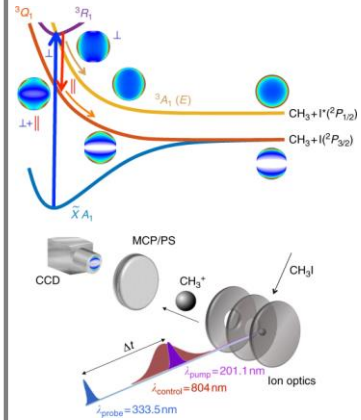
Kuleff et al., PRL 117, 093002 (2016)

Femtochemistry/ Molecular movie



Attar et al. Science 356, 54-59 (2017)

Quantum control



Corrales et al., Nat.Comm.8, 1345 (2017)

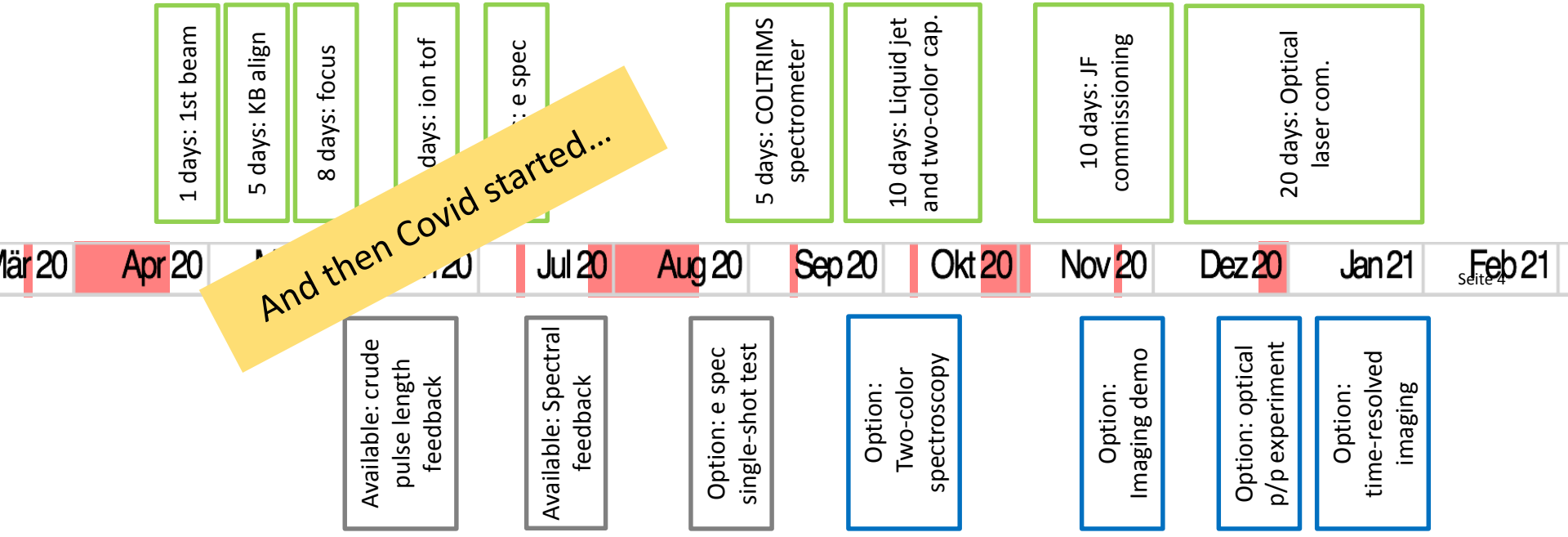
Maloja commissioning: Last Workshop!!!

Tasks/experiments

- 1st FEL in Maloja (1 day)
- KB alignment (5 days)
- Focus optimization frames (8 days)
- Ion time-of-flight spectra (5 days)
- Hemispherical analyzer commissioning (5days)

Tasks/experiments

- Jungfrau commissioning
- Diffraction experiments on clusters
- Gas jet and COLTRIMS commissioning
- Electron and ion spectroscopy with two-color X-ray pulses
- Optical pump X-ray probe



Maloja commissioning: Adjusted schedule

Achieved Tasks/experiments
- 1st FEL in Maloja
- KB alignment
- Focus optimization frames
- Ion time-of-flight spectra
- Hemispherical analyzer
- Photon spec.
- Gas jet

Tasks/experiments 2021
- Jungfrau commissioning
- Diffraction experiments on clusters
- COLTRIMS commissioning
- Electron and ion spectroscopy with two-color X-ray pulses
- Optical pump X-ray probe

1st beam
Ion TOF
e-spectr.r
Photon spetr.

Gas jet

KB align

Focus characterization

We are here

JF commissioning

Optical laser com.

COLTRIMS spectrometer

Liquid jet

Jun 20 | Jul 20 | Aug 20 | Sep 20 | Okt 20 | Nov 20 | Dez 20 | Jan 21 | Feb 21 | Mär 21 | Apr 21 | May 21

Available: spectral feedback avg. and single shot from electrons and photons, pulse energy

Option: Two-color

Option: Imaging

Option: optical p/p experiment

Option: time-resolved imaging

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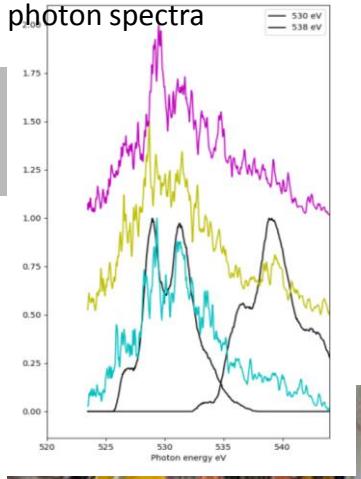
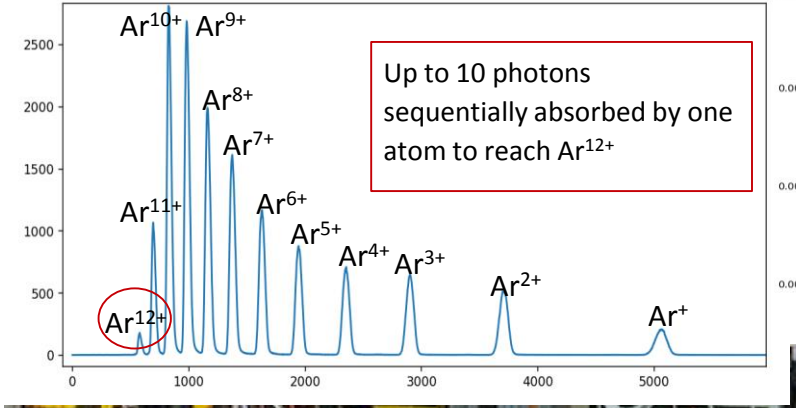
Status Maloja

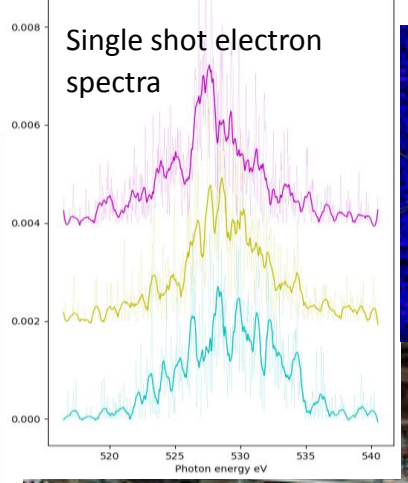
Single shot photon spectra

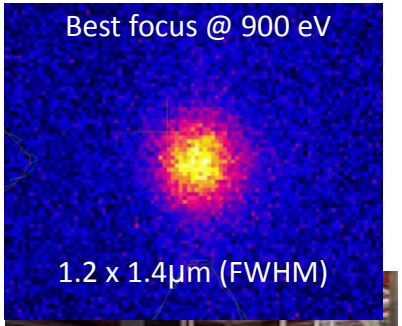


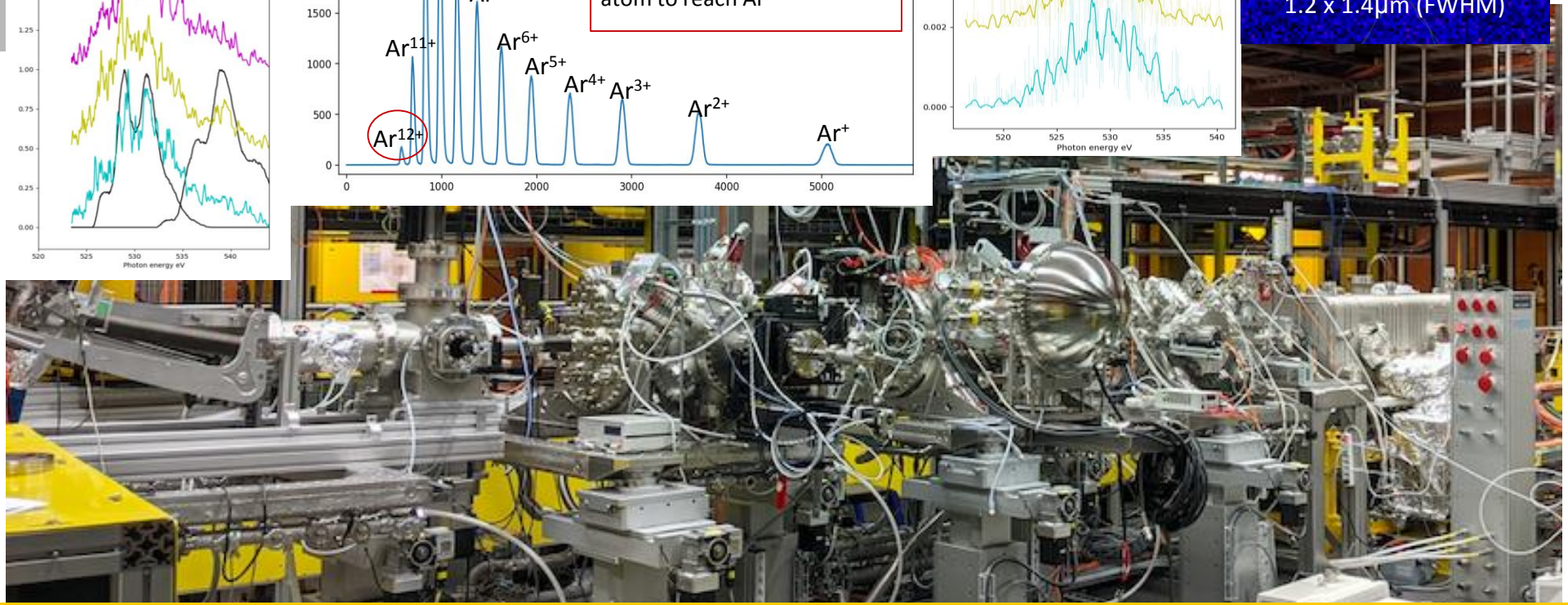


Up to 10 photons sequentially absorbed by one atom to reach Ar^{12+}

Single shot electron spectra







KB commissioned, main components working Ready to move on to Jungfrau + laser commissioning

Challenges and Achievements in 2020

Biggest Challenges

COVID restrictions

- Hutch access (Fachgruppen and beamline team), coordination, infrastructure installation
- Split teams in home office and experimental floor
- Restricted manpower/support on site
- Delays from internal and external sources

Instrument development

- Adaption of program to dynamic schedule
- Varying Athos lasing performance
- Commissioning of multiple complex systems at the same time
- Competition of commissioning and build-out
- Learning SwissFEL/PSI communication pipelines, scheduling, points of contacts, etc

Major Achievements

For Maloja

- First beam milestone in June reached (2 months delay compared to pre-Corona schedule)
- Simultaneous operation of ion, electron and photon spectrometers from day 1
- Commissioning of key systems: DAQ, controls, KBs…

For Athos

- Dual operation worked right away in June
- Peak performance in September in dual operation (> 1mJ at 540 eV with incomplete undulator line)
- November/December difficult, following actions led to well-operating machine
    - Yielding a good 2021 start

Plans and Goals for 2021

Goals	• Friendly user operations in 2nd half of year
Requirements	• Demonstrate endstation capabilities by summer • CHIC modes for new science opportunities and compatitiveness • Reliable parallel operations at full rep rate
Questions	• How to establish stable parallel operations with full flexibility for Athos and CHIC modes?

Plans and Goals for 2021

Parallel operation **can so far not be disentangled from** **Reliable operation**

Requirements:

- Reliable beam delivery with dependable conditions
- Independent operation of Athos line and CHIC capabilities
- Avoid need for branch line prioritization
- Routine setup from operators, quick response to user demands

Limits:

- Occasional cross-talk of both lines
- Worries about ”the unknown”, e.g. timing feedback, DAQ and computing resources, etc
- Very dependent on expert know-how

Questions:

- What are the bottle necks for bringing SwissFEL to full parallel operations and Athos to full versatility anywhere from gun laser to endstation (feedbacks, diagnostics, timing, communications, etc)