- **ESTABLISH A STORY**
- **Also introduce more in the beginning of each section. Vincent wants to see context**
- **How much in detail need to describe KAP?**
- **Need to discuss with Paul what the Main goals of the thesis should be**

Structure of outline:

Chapter:

- Stuff for introduction to chapter

Section:

- In introduction of section
- Information of section if no subsections
- **Subsection:**
    - Information in subsection

Introduction: DEAL WITH INTRODUCTION AFTER EVERYTHING ELSE IS DONE

- Add a paragraph discussing the basic ideas of types of x-ray emissions from plasma
    - Introduce each type of backlighter target, mentioning what the general advantages of each are
    - This is to allow for discussion later on about spectrometer, backlighter combinations
    - This could possibly be an extra, smaller section in the fundamentals section. Discuss with Philipp
- Extend the current sentences elaborating on the different methods for x-ray and WDM production
    - Here can use experiments from MIC in America and HIBEF in Hamburg
    - Check the papers sent by Philipp for more info
- Generally needs further elaboration on why we're making new spectrometers, i.e. whats special about them. For this add extension onto current introduction, placed where the spectrometers are currently mentioned
    - In this extension establish the main ideas and features of an x-ray spectrometer.
    - Then give example of use of a crystal X-ray spectrometer for XAFS of alu in an experiment, along with what quantities they were able to extract. Make sure to show a graph of this in spectrometer fundamentals section
    - Finally, set up the overarching idea of comparing a simpler, two-channel flat crystal geometry with a more complex, spherically bent crystal geometry
    - This should give a why for the spectrometers we chose
- Another option is to give an example of a XAFS plasma experiment, then comparing our experiment and theirs. This would give context to our decisions and act as a primer for someone not in the field.

XAFS

- Describe XAFS in more detail, similar as in the proposal presentation. Can use the schematic graph from the presentation here as well
- Give an example of XAFS from a WDM experiment, describing how the quantities are extracted
- Transition into fundamentals section by saying that we use x-ray spectrometers to perform XAFS

- Can cut down the XAFS section in the introduction

Fundamentals of X-Ray Spectrometers:

- Can elaborate a bit more in introduction to section. For example that x-ray spectrometers is nowadays a mature field, which many experiments of spectrometers with plasma backlighters conducted before. Mention why bent crystals are becoming popular (lack of optics for x-rays, so everything in one device). Reiterate the overview of flat vs. bent and dual channel vs single channel spectrometer styles

Flat crystal:

- Much the same as in proposal section "Crystal spectrometers", but without part with von hamos.
- Mention advantages of flat crystal, i.e. simpler and allows for more crystal materials etc.

Bent crystal:

- Introduce story of advent of johann geometry, and the main advantages that bent crystals offer (less background, higher intensity etc)
- **Von Hamos:**
    - Explain von hamos geometry (like in proposal)
- **FSSR:**
    - Have FSSR subsection as is in proposal

Resolution:

- As in proposal
- Extend the explanation of the integrated reflectivity, as this plays a central role in the Auswertung. Write out the formula we used for the calculation

Spectrometer Design:

- Put spectrometer design in context by recalling the XAFS examples from the previous chapter
- Mention that spectrometer specs only appears at end of chapter in a comparison section

Spectrometer Considerations

- Keep the same as in proposal

Schemes (? not sure what to call it)

- Add on that will briefly introduce KAP design for completeness, since is relevant for data analysis, but was not designed in the scope of this work (maybe say was already available?)
- **DUCC:**
    - describe geometry (as in proposal but without the parameters paragraph and table)
- **FSSR-1D:**
    - keep like in proposal, but without specs
- **KAP:**
    - Maybe compare to DUCC, since geometry is similar. Emphasis that is single channel spectrometer
    - Talk about extension capabilities?
    - I'd like to call it something other than KAP, since the other two spectrometers are referred to by their geometries, not the crystal type

Specifications and Comparison:

- Explain choice of crystals. Do here because need it for the specifications
- Approximately describe simulations and source of numbers.
- Put shortened simulation and calculation section (from proposal) in appendix
- Combine the parameters into one table, bring over paragraphs about the parameters from proposal, then finish with paragraph comparing the spectrometers
- Only DUCC and FSSR-1D

Experimental Setup

- Reiterate the overarching goal of setup (Al WDM with XAFS) and that this is a preparatory experiment

General Setup:

- Describe the setup, but not going into too much detail about the laser and backlighter setup, as will probably not be relevant for the discussion. More important is that the central parameters, i.e. laser energy, phase plate, backlighter type, placement of alu sample etc., are described
- Show a scheme of the setup, as well as pictures from the experiment
- Point out central aspects of the setup
    - focus diagnostics
    - phelix laser
    - future location of ion beam
    - spectrometer locations
    - TCC and target
- List main parameters of laser, phase plate, backlighters etc. This is to avoid having individual subsections for these, as would confuse the focus of the thesis

Mechanical Design of Spectrometers:

- Touch on how the CAD models were made and produced. Outline main goals for the design (like in presentation)
- **DUCC:**
    - Keep as in proposal, but shift some angles of CAD model to appendix, as well as the table with color code (maybe)
    - Move alignment procedure to this section
- **FSSR:**
    - Same as proposal, removing some pictures and table (maybe) and moving to appendix
    - move alignment procedure to appendix

Measurement procedure

- Give simplified version of measurement procedure, so that main steps are present
- Mention switch from no phase plate to phase plate, as well as focusing and unfocusing of FSSR

Data Analysis and Results

- Briefly describe the work flow of the code and the main steps to go from raw image to spectrum (no details of code unless necessary), as well as the goals of the analysis. What should each quantity say about the spectrometers?
- Use series of pictures to show processing steps
- State that will start with small section introducing x-ray emission from plasma, since needed for discussion

X-Ray Emission from Plasma

- Briefly describe three main types of emission. Show formula for Bremsstrahlung if use it to get plasma temperature
- Show source spectrum examples for each backlighter material, pointing out some main emission types

Absorption Spectra

- Describe how absorption coefficient spectra are created
- Show examples for each spectrometer, including the pretty one from KAP as proof of concept
- Point out some XAFS features

Resolution

- For DUCC, present resolution extracted from peak, transmission edge, and absorption edge respectively, averaging over as many usable shots as possible
- For FSSR, get resolution from peak. Not sure if possible with transmission edge yet.
- In both cases, briefly compare to simulation values

Relative Integrated Reflectivity

- Most likely need to use Al for ADP, hence integrate over the He alpha peak and/or show the result from manually linearly correcting the background from left channel
- For FSSR, will have to just use He alpha line, since other areas likely to have higher order in it. Can check Teflon shots to see if useable

Gold Plasma Temperature Estimation

- Note that is not likely to be accurate, but just used as a “sanity check” that the data seems reasonable
- Use bremsstrahlung from gold. For this use the formula found in the plasma emission textbook. Requires N_total, so use a literature value of R_int

General Performance

- What stood out about the spectrometer performance? Examples:
    - Mica crystal showing many higher order reflections and maybe weaker k-edge
    - intensity of the DUCC very weak compared to KAP or FSSR. Compare using N_ph after correcting out filters. Mention causes and if is expected
    - Necessary filtering wasn’t as expected. What filters could we prepare for the next experiment?
    - Quality of crystals and influence of spectrometer design on the spectra.

Discussion (still very preliminary, need to discuss with Paul before moving forwards)

- Here will summarize and discuss the consequences of the analysis, ending with some suggestions for the spectrometer setup of next experiment

Summary

- Summarize results (compare to expected values) and list off advantages and disadvantages of each spectrometer by itself

Backlighter and Spectrometer Combinations (first observations)

- Discuss backlighters in relation to spectrometers, i.e. rare earths good for intensity, but presence of lines at k-edge

Future Spectrometer Design

- Then subsection discussing possibilities for design of spectrometer in next experiment and reasoning them

Conclusion

- Keep shorter than in proposal, maybe a page
- Give very general outlook on the information gained by experiment. One sentence for each spectrometers performance.
- Touch on the overarching theme of flat vs bent and single vs dual channel. Discuss the implications of each in combination with the choice of backlighter
- Give a final recommendation for the spectrometer design going forward