# Minutes of PITZ Physics Seminar, 03.03.2022

Project: PITZ
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## Agenda:

1) AOB
2) Presentation by A. Novokshonov: Cherenkov Studies Proposal
3) Presentation by X. Li & Z. Aboulbanine: Simulations of electron beams for X-ray fluorescence experiments (XFI)

## Results:

1) AOB
    a. FS: We have a number of posters in the tunnel, can sb. Get them out? In the 2nd tunnel are some posters, put them to the pre-room outside the second tunnel, where the big concrete door is. Posters from the 1st tunnel should go into the kitchen.
    b. FS: What is up with the preparation with the advanced lab for Humboldt students? MK: Meeting with mechanical people needed.
    c. RN: It would be nice if we had a protocol in each PPS. MK: Can you Raffael create a schedule who is on duty for this.

2) Talk by A. Novokshonov:
    a. GK: So far, the effect inside the Ch. Radiator was considered, but your detector is outside. Since you have a finite crystal length, your spectral width gets wider, which is now included in this theory for the first time.
    b. FS: How are these experiments affected by the sanctions? GK: Colleagues from Tomsk cannot join any experiments, but the theory has already been published, so we can proceed with the theory, but cannot get human power from Tomsk.
    c. FS: Is it known, why the spectra shift? GK: One of the goals of the experiments at PITZ would be to understand this shift, seen in simulation/theory
    d. GK: We have some data, and we were surprised. We could not analyse it systematically, that's what we want to do at PITZ.
    e. FS: Can't you not measure the refractive index for the crystal? GK: It is not in our hands. If we had the crystal, we could totally determine the refractive index
    f. FS: So that is a proposal for a series of experiments. AN: Not necessarily, we might not need to exchange the samples.
    g. MK: Be aware, that in air, the electron beam has to move through the window, which enlarges the beam, to mm size.

h. GK: To understand what you measure, you have to understand the theory. No one ever looked (so) deeply into the theory, especially in the visual range, even though the idea of using Cherenkov detectors is old. This would allow to determine the beam size and emittance
i. HQ: What is the difference to OTR? AN: OTR has lower light output, and is not affected by coherence effect. MK: In OTR only the transition surface, i.e. a single point emits light, while in a Cherenkov radiator the light is generated in the bulk.
j. HQ: What energy do you want to apply it? AN: That is not defined yet, we first want to understand it.
k. AN: Measurement of the beam size is our main interest, measurement of the beam divergence would be a neat side effect.
l. HQ: Measurement of the divergence is difficult because it is small, our emittance is too good.
m. AN: Besides understanding the Cherenkov radiator detector, we might also understand coherence effects, which can play a role in (C)OTR
n. FS: regarding feasibility, what bunch structure you need? GK: Single bunches are sufficient for it. FS: Then the load on the window is small, and we can do it in air.
o. Beam size? HQ: The simulations are quite challenging, so they don't exist yet. Scattering in air also has to be considered
p. FS: We'd set this experiment up anyway in the radiation therapy beamline, which does not exist at all right now.
q. GK: We anyway don't expect any experiments in Spring 2022, rather autumn/winter 2022.
r. AN: So far, we only considered to do the experiment in air. We could also do it in vacuum, which is more complicated from mechanics point of you, as the crystal needs to rotate.
s. FS: Human power wise, we cannot help in building/constructing the screen station. We are fully at capacity. But if HH people constructed it, we could just mount it. The plasma cell would be a location, but there are also stringent space constrains from our side.
t. AN: Can you estimate the limitation design parameters, so that we know if we can do the experiments in air or vacuum

3) Talk by X. Li:
   a. FS: For setup 1, do we have any spare quadrupole magnets available, which we could put in air downstream the window? AO: Nothing is left. FS: Does anyone know if there are any quadrupole anywhere available for us, even for a short time? AO: Daresbury might have one, I will ask them if we could have it.
   b. FS: At some point we have to concluded, and order everything to install it. As far as I know, the beamline must be settled. We have to fix the beamline design.
   c. FS: Both tumor painting and non-painting has to be considered, so setup 2, where both are considered. MK: TDS? FS: A second TDS has a lower

priority, consider the space for it, nothing else. Also check whether our uninstalled sweeper can be used for this.

d. FS: Will there be a field distribution possible, which allows imaging?
e. MK: Beam size seems to be around 100 um rms
f. FS: Why are there two hot-spots in the beam distribution? XKL/MK: I think it is because of the quadrupole focusing.
g. NA: And the solenoid follows exactly after the window? XKL: Yes.
h. NA: Why don't you keep some clearance between the window and the solenoid? FS: Air scattering will increase the divergence, so you try to minimise the spacing. Therefor you move the solenoid as close the window as possible
i. PB: What does secondaries mean? XKL: Primaries are the electrons from the beam. Secondaries are non-primary particles, which are 'new' particles, which have been 'created' (from the atoms actually) by scattering
j. FS: Question to the procedure. XKL: Air scattering is included in the Monte-Carlo simulation
k. ZA: Shifting the beam off axis will make things worse. Here, it was always assumed that
l. MK: What is the current the solenoid would have? XKL: I didn't calculate this, but can send you the numbers after the meeting. The field strength is 10 Tesla.
m. FS: We have to ask Gregor if this will be possible.
n. PB: Which code did you use it. ZA: We used a code based on Geant4. The simulation in the Monte Carlo studies started 4 mm before the window.
o. RDS: What will be the energy spread. XKL: The photoinjectors has a small energy spread, but after the window the primaries will have an energy spread on .5%, but the secondaries have very low energies, making the total energy spread enormous.
p. RDS: Do you have someone on your side working on the tumor painting part? FS: We just started looking into that, but just started.
q. PB: What space charge models did you include in the simulation? Here there are no space charge forces included, as the scattering at the window is the main defocusing effect, but they make the simulations very heavy.
r. XKL: I showed some results in this to Zakaria before, done in ASTRA, assuming a high divergence (as you have it after the window), and at 1 nC the space charge forces are negligible. FS: But repeat with 5 nC.
s. PB: So, what is the space charge model? XKL: 3D FFT, as it is in ASTRA.
t. FS: Do you XFI people need more input right now, or is this fine for now? RDS: This is fine for now, we are satisfied!

Protocol prepared by
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(Name, Date)