Summer students 2019

Sinsunthithet Nontaphat:

- Software Skills:
  Unity, C++, Python, Matlab
- Science Skills:
  Feels free in Physics Theory and High Energy Physics
- Comment from student:
  "... I am interested in free electron laser because this are used to observe the movements of atoms and molecules and I also interested in accelerator physics..."

Hannah Norman

- Skills Gained:
  - Experience with analysing and interpreting MRI scans in a medical physics facility.
  - Condent programming abilities (C++, Python). Competent use of ROOT, Mathematica, UNIX and Git.
  - Used BDSIM for particle beam simulations and to run diagnostics on a beam. Produced code in Python to produce shielding for the beamline, visualised in Geant4. Used a computer program to interpret slices of an MRI scan with tools for enlarging and highlighting possible metastases.
- Comment from student:
  "... I have a keen interest in particle physics and the research that takes place at DESY: specifically accelerator physics... Though my aspired career is in particle therapy, I have an interest in accelerator physics and beam simulating and am open to any projects within these areas..."

PITZ-related tasks for summer students 2019

Task	Tools to be used	Expected results	Contact person (PITZ)	Priority
Simulation of MeV electron diffraction process through a metal thin film (Al, Gold, ...)	ASTRA, Matlab	Report on simulations	Houjun	
UED detector characterization and optimization	Matlab, …	efficiency characterization of current detector, optimization setup of future UED detector	Houjun	
Coupling between quads and steerers	CST, Matlab		Raffael	
LEDA scan fit for MMMG, other OMA improvements (e.g. NoP/gain adjustments)	ASTRA, Matlab	OMA modifications	Mikhail	
Routine measurements of the Li vapor density: • measure Li plasma vapor density vs temperature • Make code for spectrum analysis		Measurements comparison Code for analysis	Osip (Gregor, Matthias)	
Analyze scattering signal transport through downstream quadrupoles	Geant4, matlab / python	Simulation results	Houjun	
Modeling of the slit-scan procedure for Transverse Ph.Sp. measurements	matlab	Working script	Georgi	

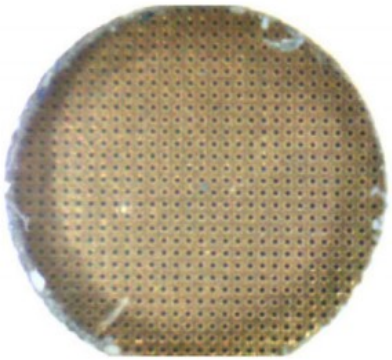
Hannah

Sinsunthithet

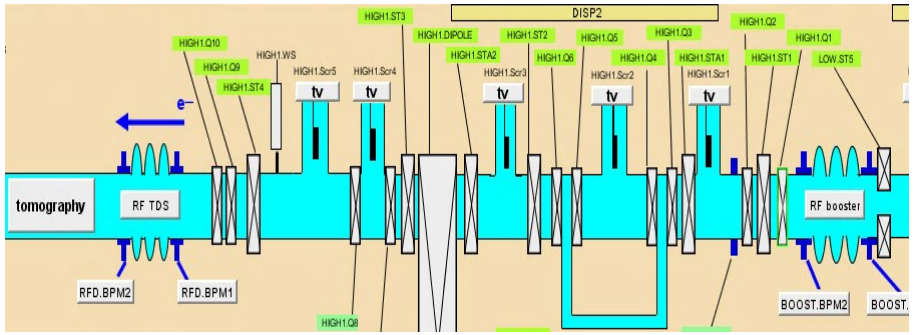
Possible ways to improve SNR for future PITZ emittance measurement

- Another way to measure PITZ emittance
  - Insert a pepper pot mask at EMSY station (remove space charge effect)
  - Use quadrupole scan to measure both projected and slice emittance (improved SNR)

Compared to low charge beamlet during slit scan, the charge is much higher



Example from UCLA:
- laser-drilled pepper pot
- circular holes of 15 μm diameter
- 85 μm spacing
- ~3% transmission.



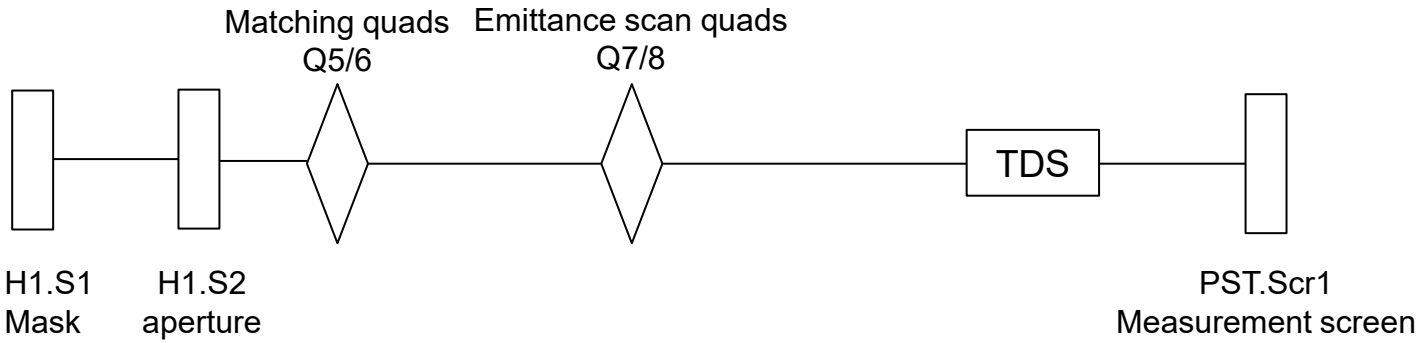
Pros:
1) both issues of space charge & SNR are improved.
2) In principle only single to few pulses are needed with efficient imaging system (good for facilities without long pulse linac or high energy (>~50 MeV) linac).

Cons:
1) Needs good uniformity of holes
2) Scattering signal may be focused again by quadrupoles
   - intensity of scattering signal
   - emittance of scattering (scattering angle)
   - beam aperture between mask and quadrupole
3) Need good calibration of quadrupole model

Summer student task

Analyze scattering signal transport through downstream quadrupoles

- Step1: Use geant4 to analyze the mask scattering signal intensity, energy spectra, angle spectra
- Step2: Use quadrupole transfer matrix to compare the scattering signal & main beam signal on a downstream screen
- Step3: Add an aperture in between mask and quadrupole, repeat step2
- Step4: Optimize the aperture size for best signal to noise ratio
- Step5: Vary mask thickness, repeat step1 to step 4



Skills required: Geant4, matlab/python, basic knowledge of beam transfer matrix, data analysis

Modeling of the slit-scan procedure for Transverse Ph.Sp. measurements

- Generate 6D phase space of e-beam assuming possible correlations
- Simulation of ph.sp. measurement procedure: single-slit scan technique
- Desired output – full imitation of fastscan output files
  - Musthaves
  - EMSY
  - MOI
  - X-, Y-scan
- Check with tools (emcalc, VPP)
- Supervisors: G. Georgiev (M. Krasilnikov)
- Tools: Matlab, Python
- Expected results: slit-scan simulation and output files like from fastscan, report (including manual)