X-Band Linac Based X-FEL Facility Proposal of Turkey

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Workshop on X-Band technology for FELs
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SASE FEL Proposal of TAC

SASE-FEL based on 1 GeV linac proposal was the second FEL project of TAC after TARLA.

It has been preliminary studied based on SC linac similar to FLASH.

The new idea is using X - Band linac for TAC SASE FEL project proposed by CERN CLIC team by end of 2012

The benefits of the collaboration;

- CERN will have the opportunity to demonstrate the performance of the CLIC accelerating structures in a realistic operational environment as a user facility.
  - Using RF sources instead of using CLIC Drive beam..
- Turkey will have opportunity o transfer new technology to Turkish accelerator community and industry, and will have SASE FEL with huge support of CERN
  - Know-how, training, infrastructure, development..

X-band Based SASE FEL Proposal

Meeting on X-band Linac based FEL facility in Turkey (17-18 January 2013, Ankara, Turkey)

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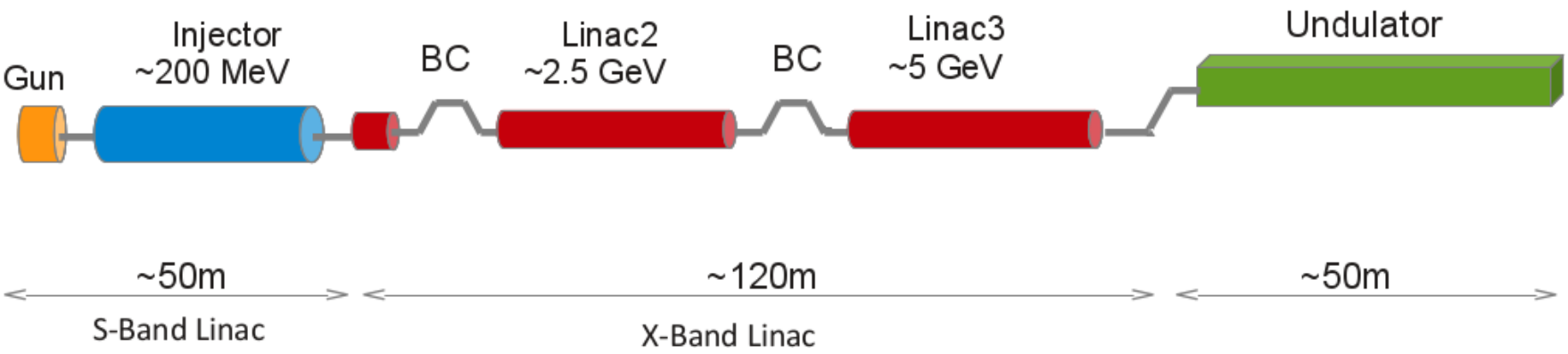
Layout of proposed SASE FEL



Facility consists of

- 200 MeV injector based on S band linac
- 2 stages of main accelerating section based on X-band up to 5 GeV
- Lasing section: several undulators or single undulator
- Expected FEL range 1$\mathring{A}$ - 100 $\mathring{A}$

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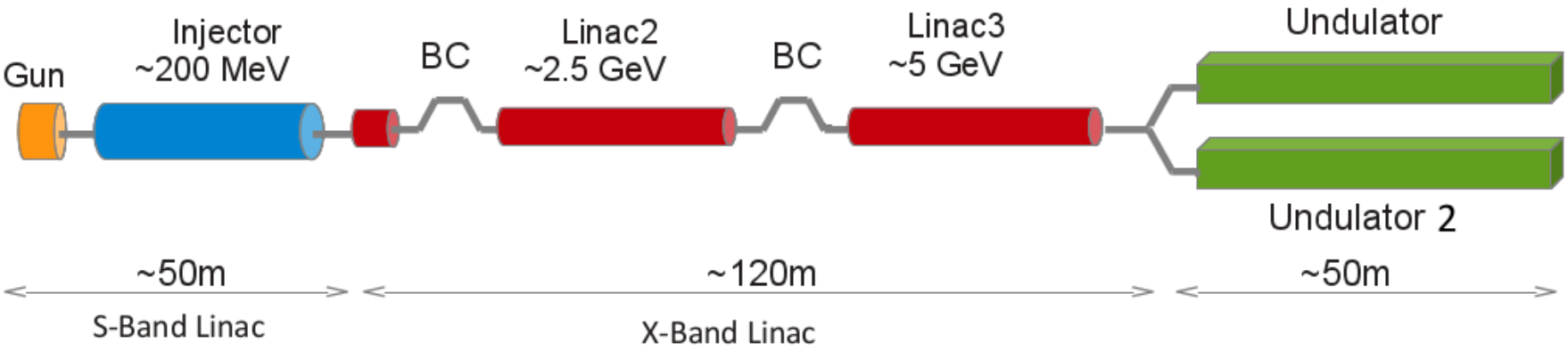

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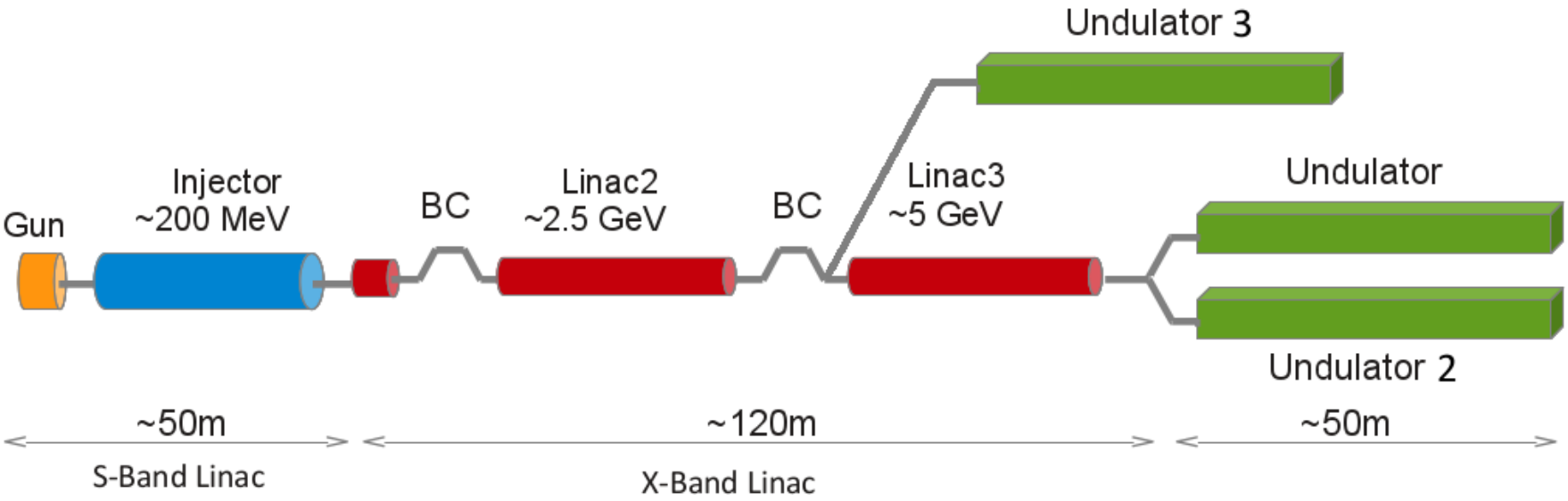

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Main Linac Parameter

Parameter	Unit	Value
Beam Energy	GeV	5
Linac frequency	GHz	12
Accelerating Gradient	MV/m	$\sim$ 70
Bunch Charge	pC	250
Normalized Emittance	mm.mrad	$<$1
Bunch Length	fs	30
Energy spread (rms)	%	0.02
Rf pulse length	ns	150
Number of pulses per train	#	??
Bunch repetition rage	MHz	??
Pulse repetition rate	Hz	??
Klystron power	MW	??
Number of klystron	#	??

Module Parameters based on 50 MW klystron

Parameter	Unit	Value		
Structures per RF unit		12	16	10
Klystrons per RF unit		2	2	2
Structure length	m	0.23	0.23	0.75
a/lambda		0.145	0.145	0.125
Allowed gradient	MV/m	100	100	80+
Operating gradient	MV/m	77	67.5	65
Energy gain per RF unit	MV	213	248	488
RF units needed		27	20	10
Total klystrons		54	40	20
Linac active length	m	74	75	78
Cost estimate	a.u.	76.2	71.5	51.7

Road Map

The preparation phase, including

- The Conceptual Design Report phase ($\sim$ 1 Year)
- The Technical Design Report phase including demonstrations ($\sim$4 Years)
  - Development of RF gun
  - Development of pulse compression scheme
  - High reprate Klystron (if necassary)
  - 12 GHz test stand
- Construction phases
  - Phase 1 ($\sim$ 2+2 +1 Years) ;
    - Injector and first stage of accelerator
    - Undulator beamline based on 2.5 GeV beam energy
  - Phase 2 ($\sim$ 2+2 Years) ;
    - Second stage of accelerator
    - Undulator(s) beamline based on 5 GeV beam energy

Road map for CDR

- Available budget for CDR 40 k€+ 20 k€
- Available staff
  - Beam Physics and Diagnostics (2 Staff + 1 Student)
  - FEL (2 Staffs)
  - Structure (1 Staff)

Near future

- Meeting with users from existing FEL facility to define beam timing parameters (beginning of 2014)
- Studying cost optimization in terms of RF structure and RF sources according to user requirements, decision on parameters.

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- Meeting with users from existing FEL facility to define beam timing parameters (beginning of 2014)
- Studying cost optimization in terms of RF structure and RF sources according to user requirements, decision on parameters.
- Completing draft version of CDR by the mid of 2014 and representing it to ISAC
- Finalizing the CDR by the end of 2014

Table of Contents of CDR (draft)

TDR Plan

- Review of CDR and being sure about user requirements
- Development of
  - A gun test stand (2 men)
  - RF module test stand (3 men)
  - RF pulse compressor and power combination test stand (2 men)
  - Klystron modulator (depending on beam requirements (2 men)
  - LLRF system (2 men)
  - Control systems for the items above (2 men)
- Designing the injector, accelerator and FEL beamlines (3 men)
- the FEL related subjects (3 men)
- Designing the building and infrastructure civil engineering (3 men)

- Turkey plans to hire about 20 staff..
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- Expected budget for TDR is about 10 M€
- During the TDR can all development stands be installed at CERN ??
- During the TDR can CERN take the technical co-ordination responsibility??

Conclusion and Discussion

- In order to start TDR by the beginning of 2015 we should submit the project by the mid of 2014.
- The budget requirements for TDR and its steps should be clarified before CDR completed.
- Turkey has less number of employee to complete the CDR in short time.. Collaboration with other facilities would help us..
- During the meeting the subjects and responsibilities should be defined and deadlines shall be clarified
- Clarification of CERN's support for this project will help us to convince the government for the next step.