FEL Parameters

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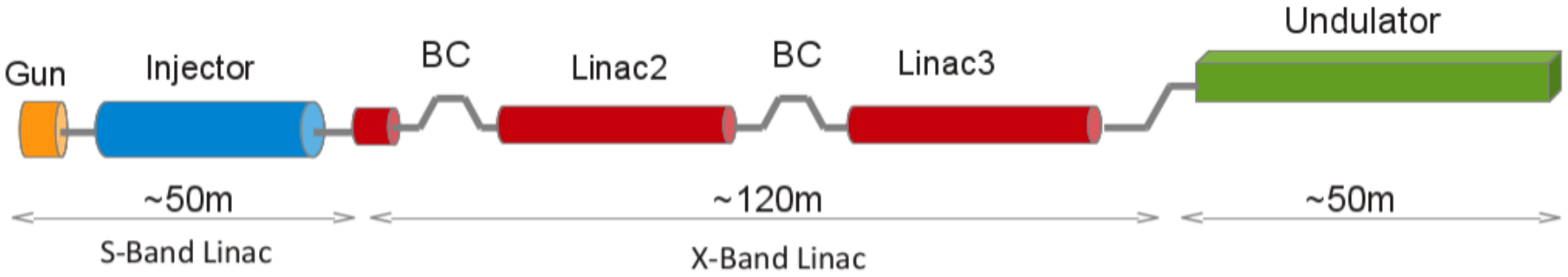
Goals for Today

- Define some baseline to work on
  - Energy goal
  - Will probably change later
  - But good to have something that you can criticise
- Identify key questions for the other groups
- Plan the integrated studies
  - Which studies can we perform before February?
  - What needs to be done afterwards?
  - What can be analytical?
  - Where are simulations required?
  - Who does what?
- Exchange news

Some News

- We will develop an improved cost model for the klystron-based CLIC
  - Igor reviewed RF unit cost
  - Germana Riddone (and Philippe Lebrun) will review scaling of cost with numbers and cost of the linac
  - This can be applied nicely to the FEL
    - Some small differences exist (e.g. no damping)
- Discussion with Marco Pedrozzi (PSI) indicated interest in O(15keV) photons (sub-Angstrøm)
- We announced the activity in the CLIC project meeting

Energy Target



What is the energy range at the end of the linac?
Is the maximum 0.07nm or 0.15nm?
Are the bunch parameters the same for different energies?

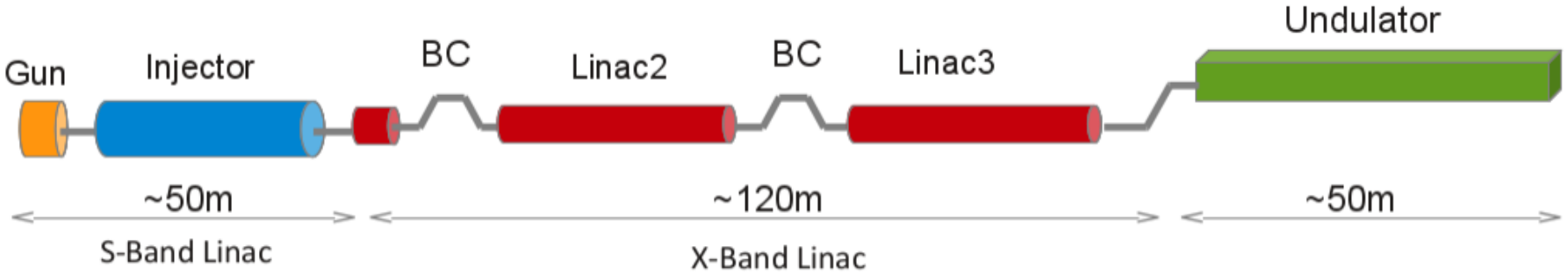
- lower energy implies lower gradient (or additional extraction points)
- lower gradient changes the longitudinal and transverse wakefield effects
  - either need more margin in linac wakefields
  - or need to only change gradient in Linac3, but have to check longitudinal effects

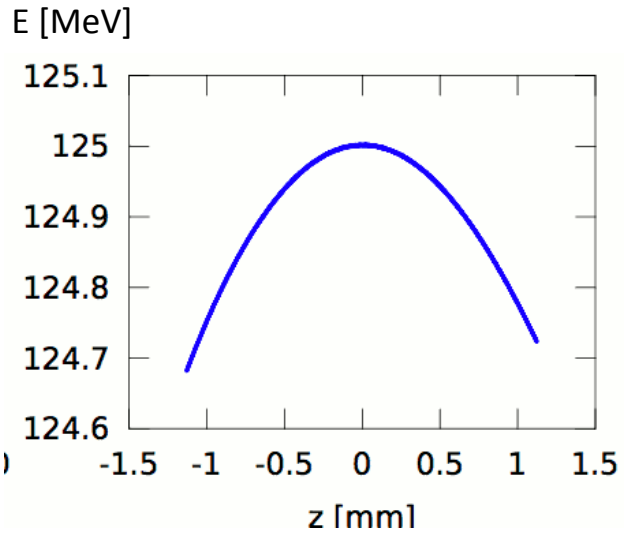
Need to understand operation at lower energy
Who finds out which range is required?

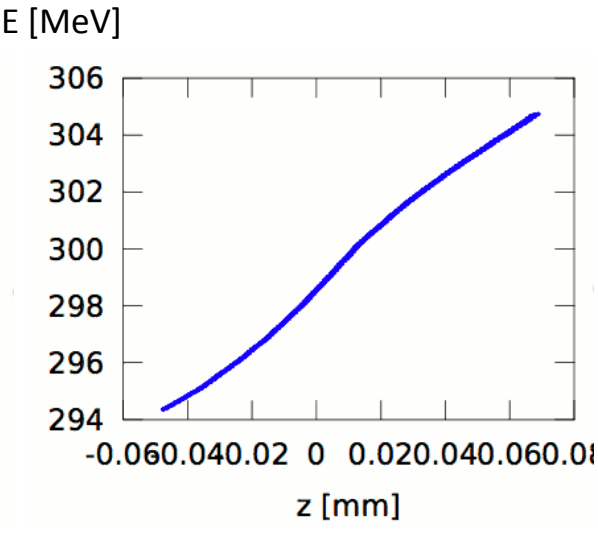
Repetition Rate and Bunch Number

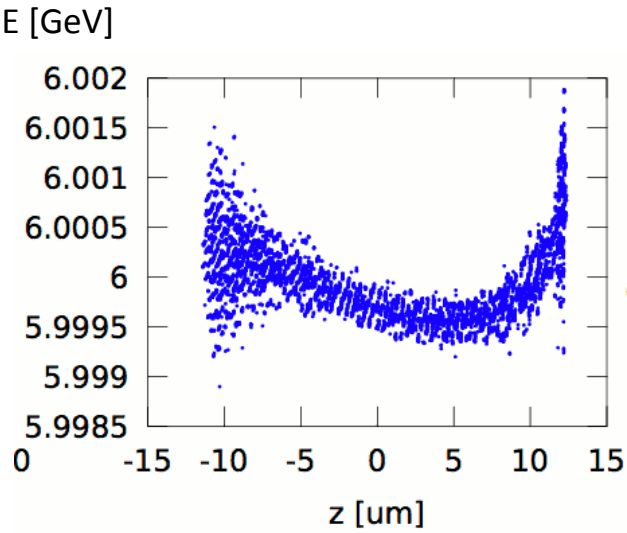
- Baseline is 50Hz, single bunch
  - For beam dynamics there is no difference to 500Hz, single bunch
  - For a few bunches per train, we have to check wakefield effects
    - Who will do this (in the linac group?)?
  - 500Hz, single bunch means higher heat load in the structures and puts constraints on the injector
    - The groups will address the issue
  - 500Hz, multi-bunch will not change much for the linac RF but might change things for the injectors
    - The groups will address the issue

Longitudinal Dynamics









Longitudinal design needs to be optimised keeping in mind the transverse effects

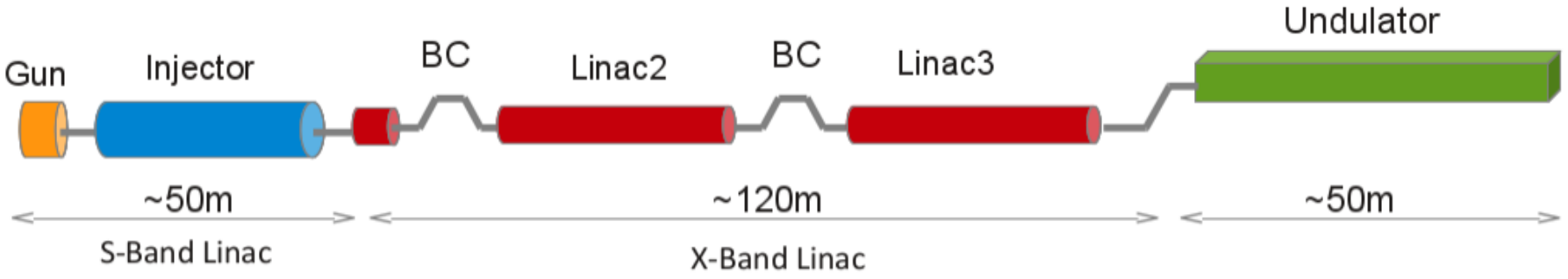
- shorter bunches in linac2 reduce transverse wakefield effects

Fast optimisation routine is required (Andrea did it for one structure)

Some photon production model is needed (Avni did some work, but can we have something analytical?)

Who can put together a fast longitudinal model?

Transverse Dynamics



Transverse effects are also critical

Have simplified model for the main linac (partly analytical)

But need to also understand impact on photon production
- Do we need a simulation? Do we have some analytic estimates?

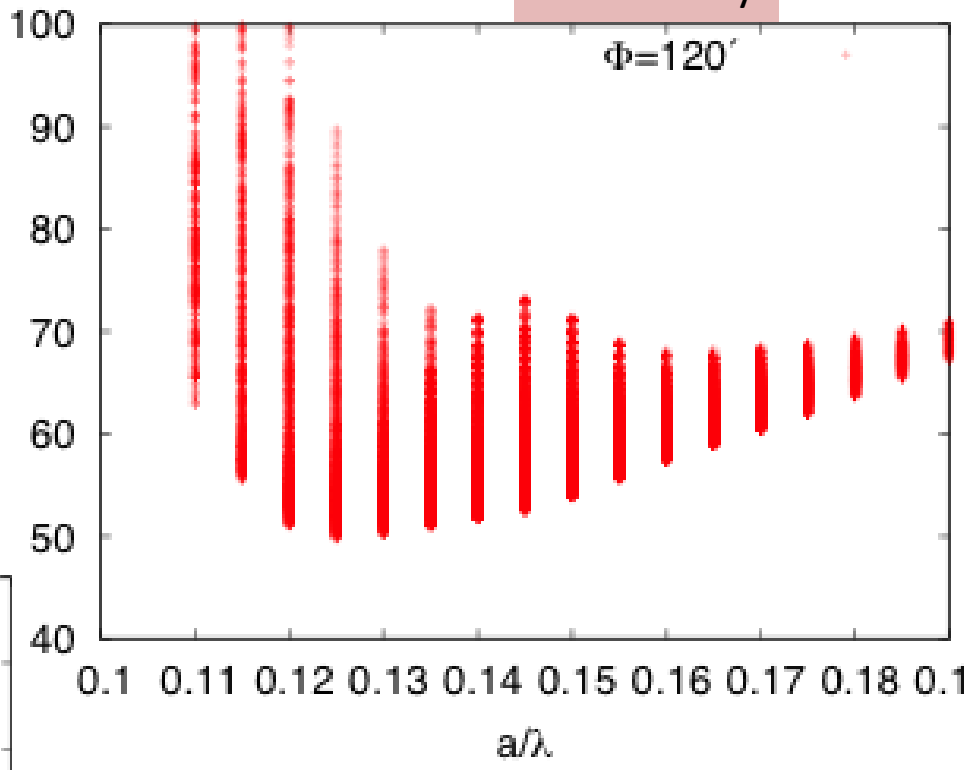
In the long run need full 6D simulation

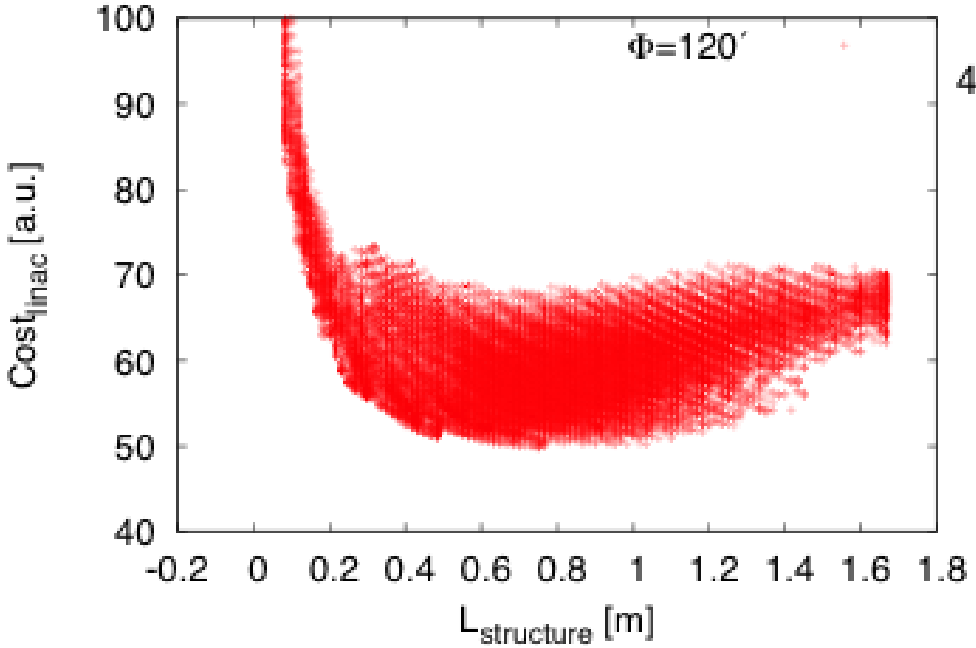
Who can check analytical estimates for photon production/rules of thumb?
Who will start to integrate 6D simulations?

Preliminary Structure Choice?

Preliminary

$a_1/\lambda=0.15$, $a_2/\lambda=0.1$
$d_1/\lambda=0.9$mm, $d_2/\lambda=1.7$mm
L=0.75m, G=65MV/m
P_{in}=41.8MW, τ=149.6ns
11 RF units
11 structure per unit?
Cost=49.7 a.u.

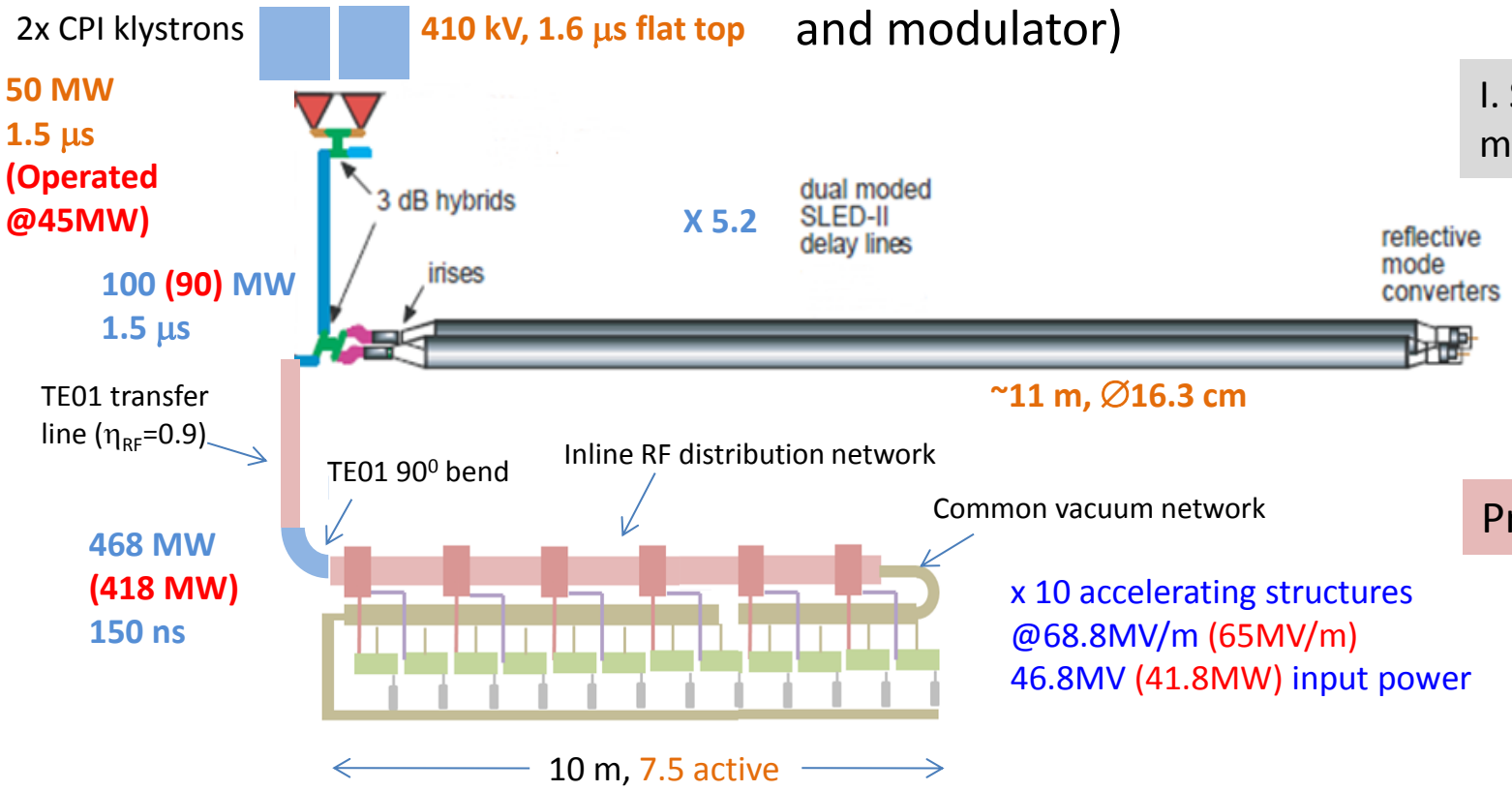




This structure has happened to be the cheapest
Should we use it as a GUINEA-PIG to set up the simulations?

Electron linac RF unit layout based on the existing (industrialized) RF sources (klystron and modulator)

I. Syratchev, modified by me



Preliminary

This unit should provide ~516 (488) MeV acceleration beam loading.
Need 12 (12) RF units.
Cost 51.7 a.u., 4% more than optimum

More Examples for Basic Parameters

Preliminary

	unit	CLIC_502		Opt.	Swiss
Structures per RF unit		12	16	10	4
Klystrons per RF unit		2	2	2	1
Structure length	m	0.23	0.23	0.75	1.98
a/lambda		0.145	0.145	0.125	
Allowed gradient	MV/m	100		80+	
Operating gradient	MV/m	77	67.5	65	27.5
Energy gain per RF unit	MV	213	248	488	203
RF units needed		27	23	12	26
Total klystrons		54	46	24	26
Linac active length	m	74	85	88	206
Cost estimate	a.u.	76.2	71.5	51.7	

Conclusion

- Will try to put names to the tasks
  - Energy range choice
  - Energy range operation considerations
  - Simplified longitudinal model
  - Simplified transverse model/considerations
  - Complete longitudinal and transverse model