FLASH2020+

FLASH2020+ Start to End Simulation Workshop

Summary and Update on Electron Beam Studies

Pardis Niknejadi
On behalf of FLASH2020+ team

Hamburg, December 7th, 2022

HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

DESY.

Outline

Review and status of past work and result

- **Electron beam chirp**
- **Working point 1 and 2**

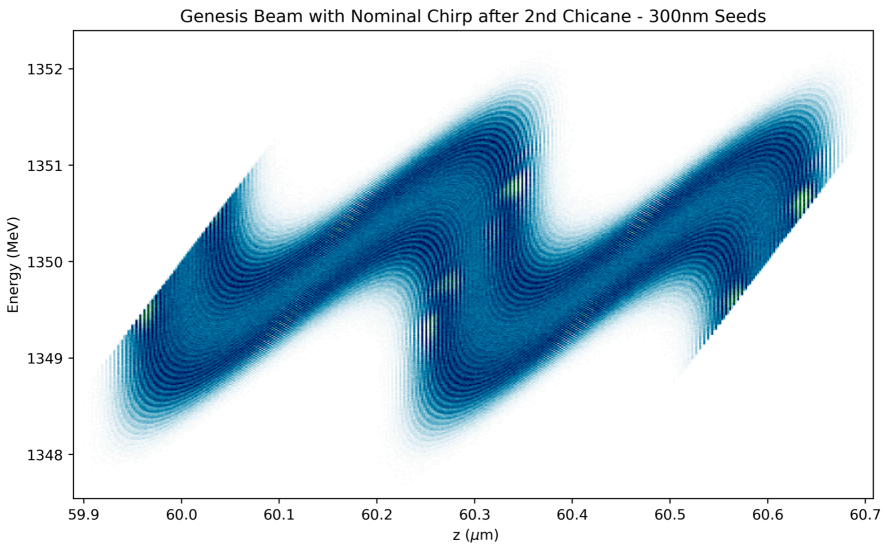
Status of Handshaking Scripts

Some examples of how well handshaking scripts work

Issues to keep in mind

Plan for the next few months

Effect of Chirp on wavelength, bandwidth and Power of EEHG

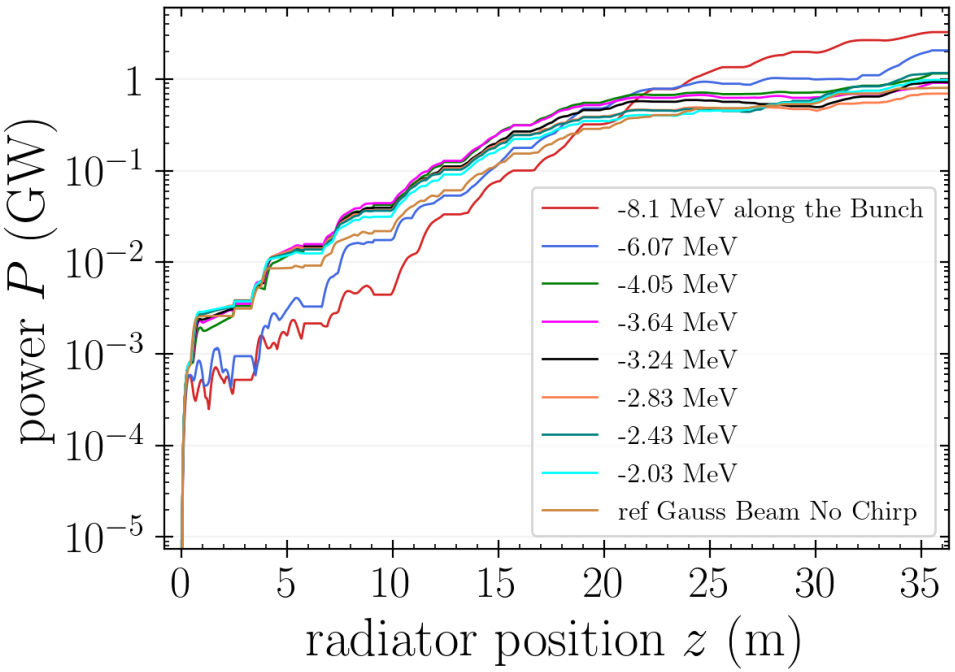


FLASH2020+ Summary of Chirp Scans 4nm Working Point

H (m^{-1})	energy variation along the pulse (MeV)	Max E	C0	C1
-100	-8.1	1358.1	2657.73	-264188.4
-75	-6.07	1356.07	2653.77	-198141.3
-50	-4.05	1354.05	2649.81	-132094.2
-45	-3.64	1353.64	2649.01	-118884.8
-40	-3.24	1353.24	2648.22	-105675.36
-35	-2.83	1352.84	2647.43	-92465.94
-30	-2.43	1352.43	2646.64	-79256.52
-25	-2.03	1352.02	2645.84	-66047.10

4 Genesis Input

Effect of Chirp on wavelength, bandwidth and Power of EEHG



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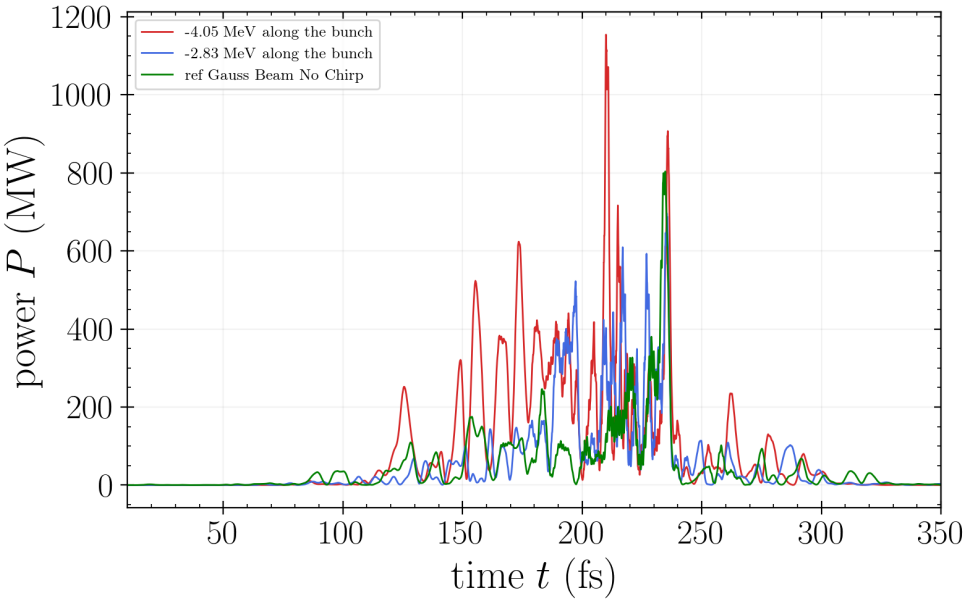
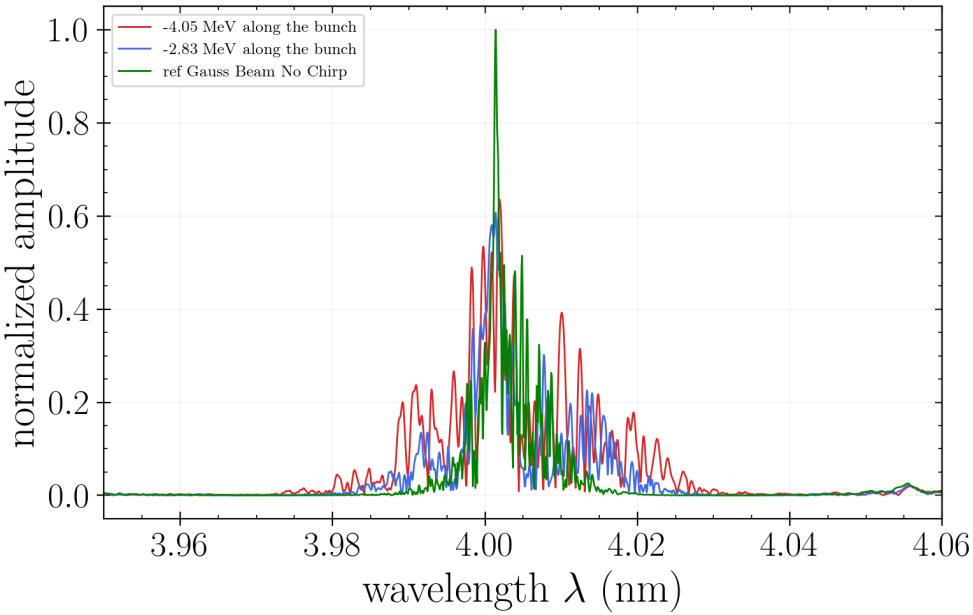




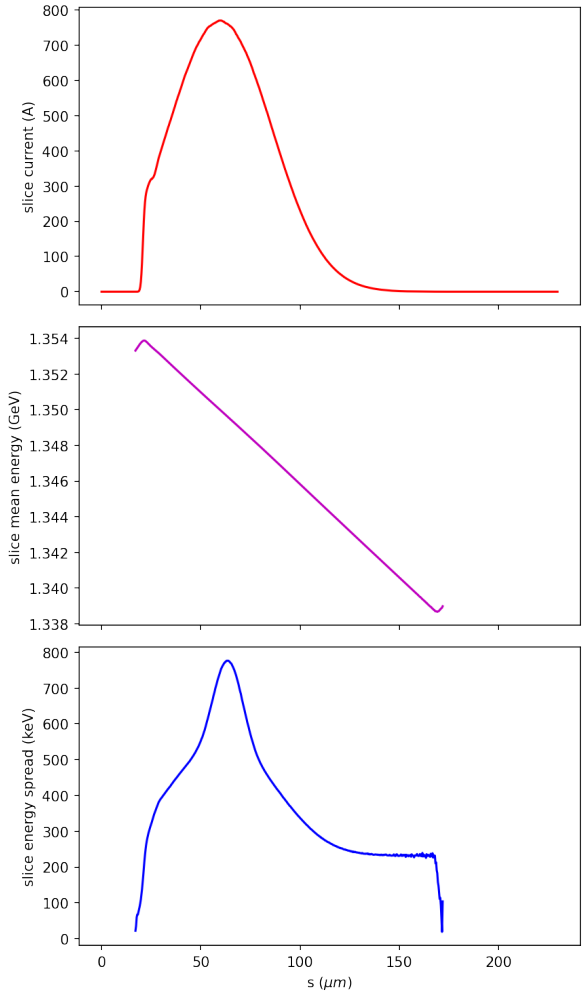
Effect of Chirp on wavelength, bandwidth and Power of EEHG

In optimum EEHG Setup, 4-8MeV per ps chirp

does not change the wavelength

broadens the bandwidth

Simulations have to be done carefully



WP1 Summary:

-30 Amps and 4x4 compression

-Puts too much constraint on Compression, relaying on beam heating

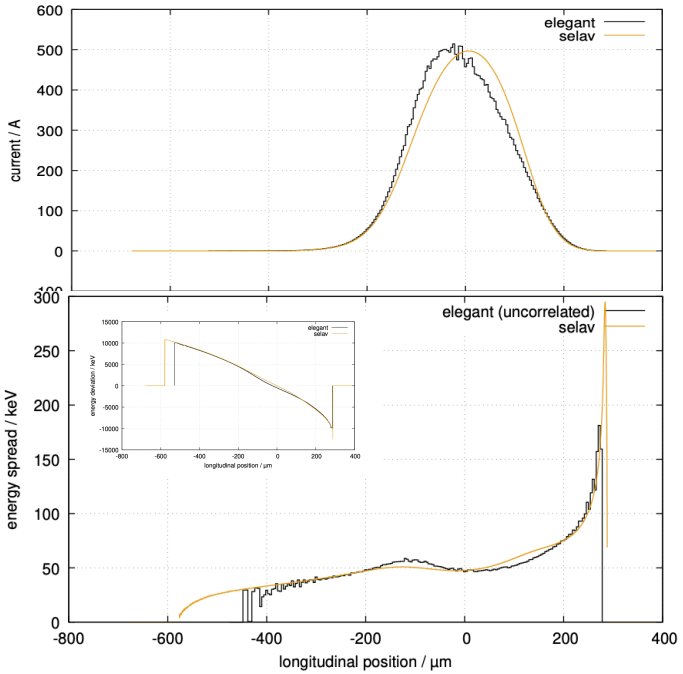
-Used for Bench marking, Problems finding/ solving

Highlights from FLASH2020+ Start to End Work Flow

Pseudo Start 2 End approach: Acceleration and Compression stage, Results after BC2

Excellent agreement between Elegant & SelaV

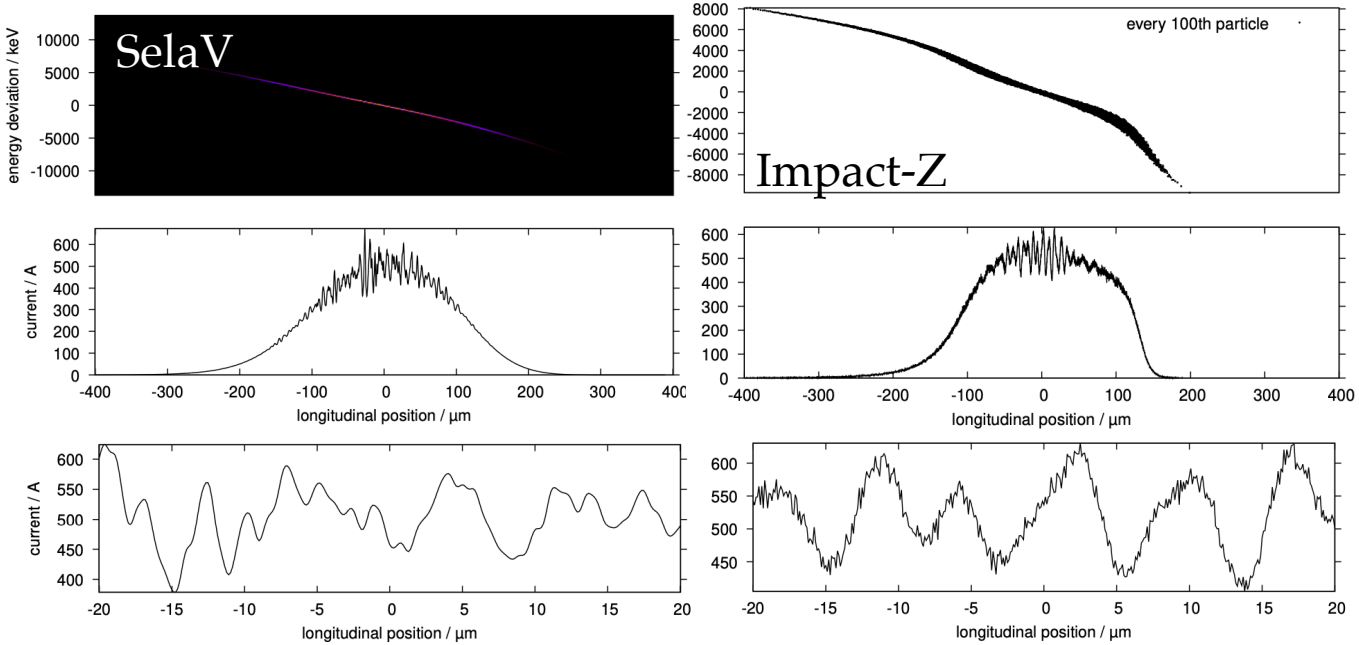
Includes Longitudinal space charge from quite start



Slight differences due to diff. In transverse beam size

Good Agreement between SelaV and Impact-Z

Plotting one in every 1e4 particles for Impact-Z (one in every 100th is saved and one in every 100th of that is plotted)



P. Amstutz, M. Dohlus, D. Samoilenko

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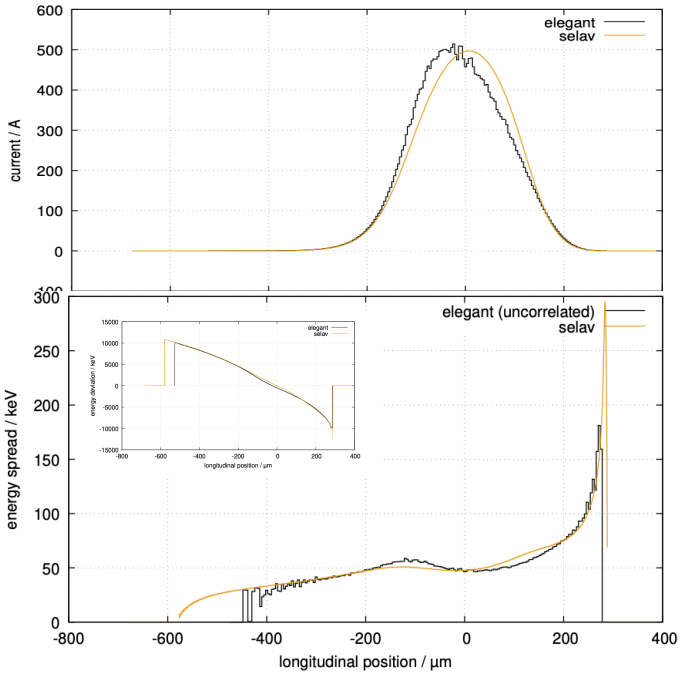

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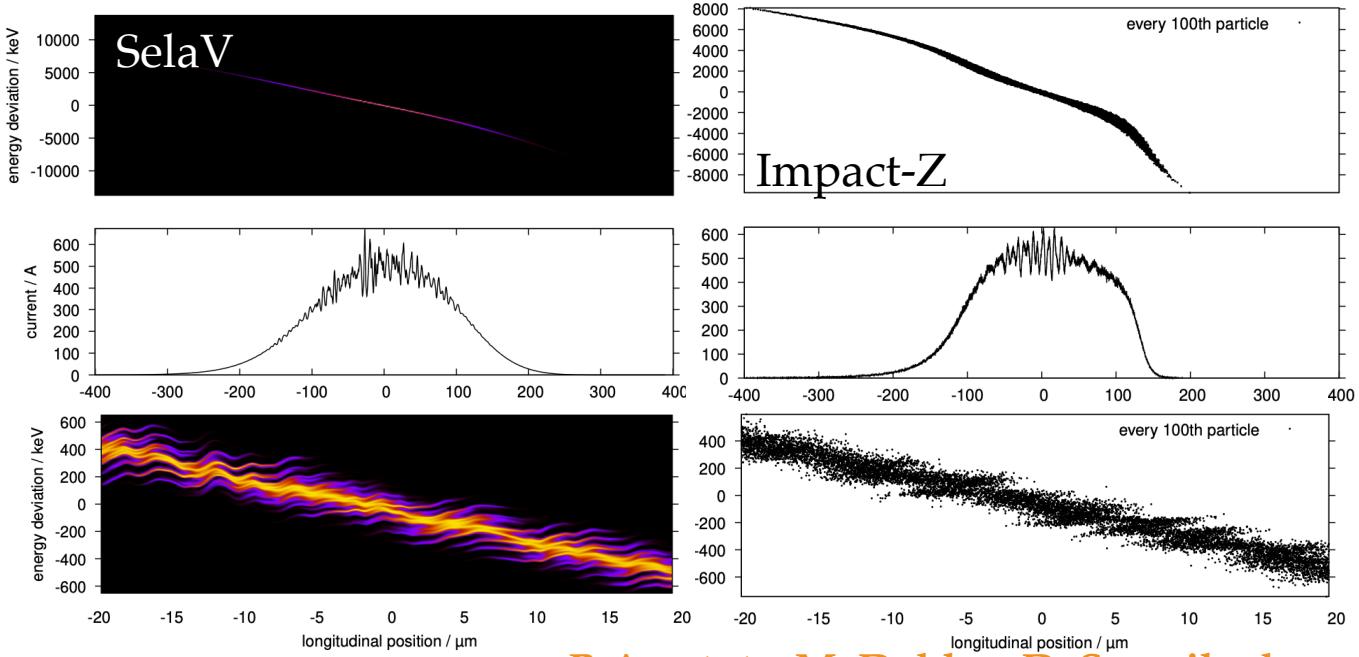

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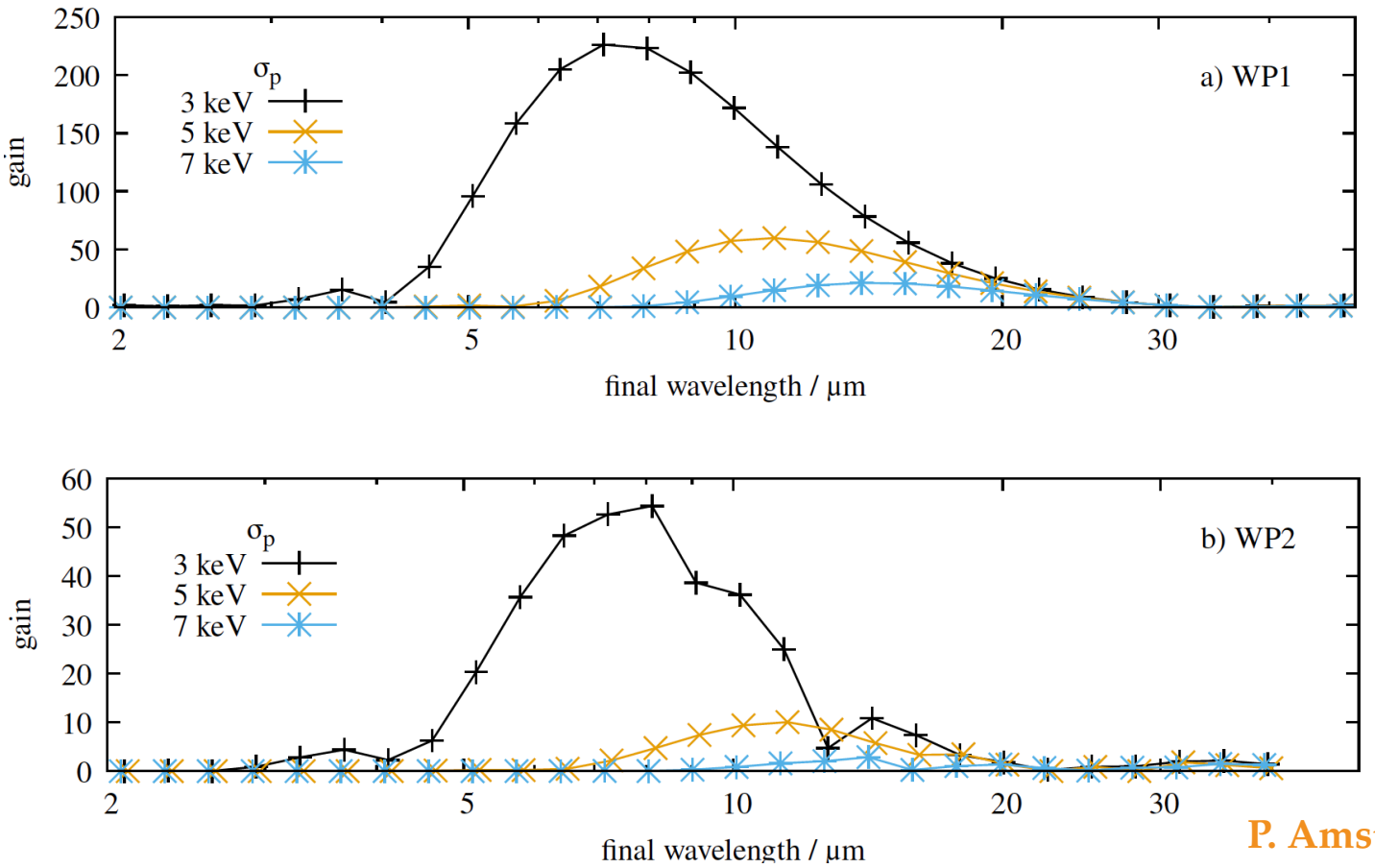
WP2: Reducing the Micro-bunching Gain (SelaV)



P. Amstutz

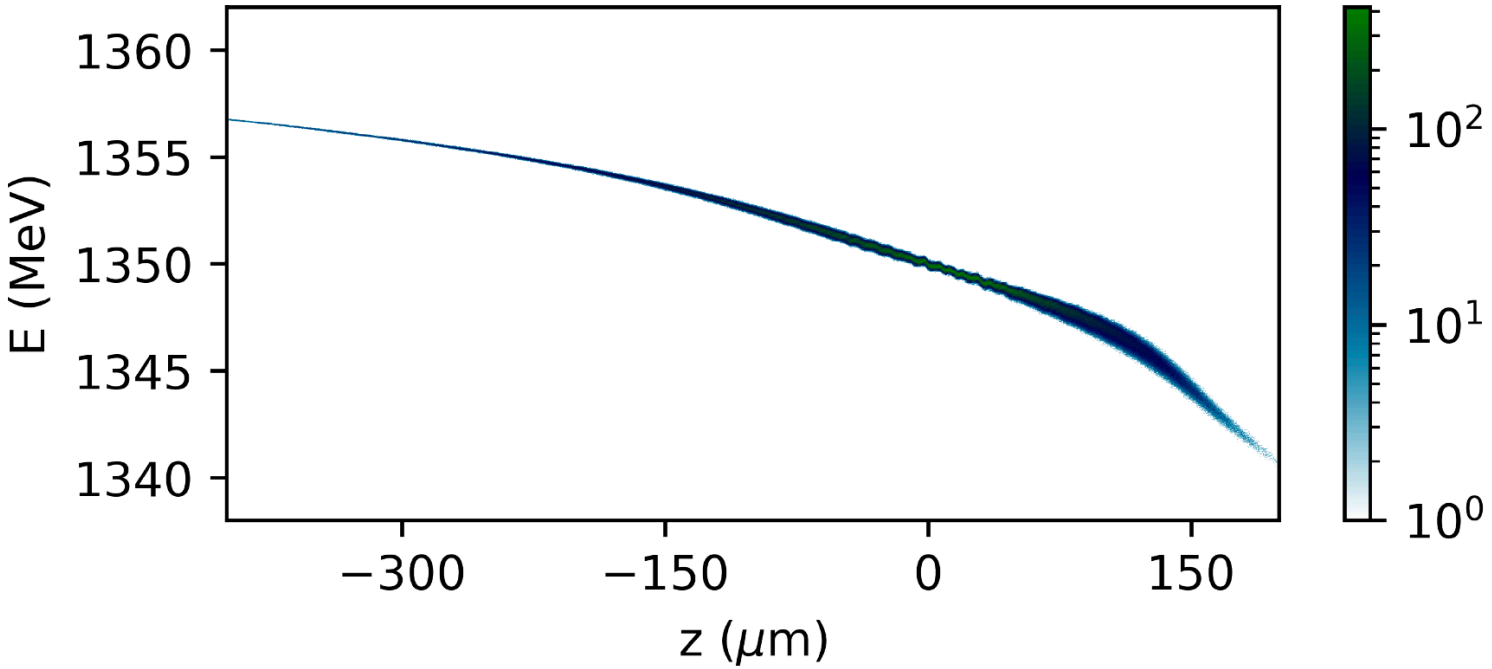
WP2: Impact-Z >> matched in elegant to Mod 1

Best of Impact-Z simulations

With different number of particles

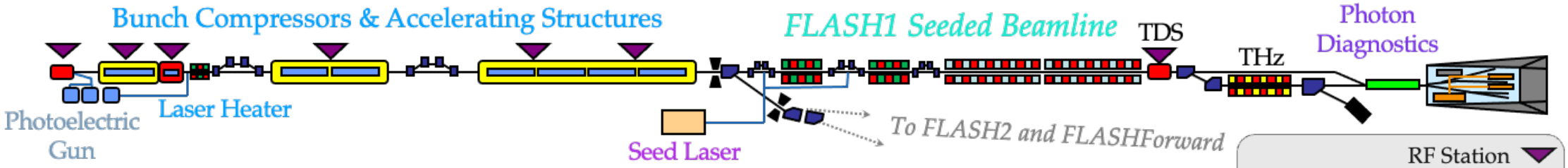
With different grid sizes

2^32 particles seems to be the bottleneck



FLASH2020+ Start to End Simulations and Categories

The Current Statues: Focus is on Benchmarking and handshaking between the 3 Categories to produce the first example of reliable S2E



Add compression and tweak optics

Start with an on crest file with design optics

Tracking in Elegant

Design File in MAD

Seed1 and Seed2

Chi2 3D

Intermediate step for tool development

Resolving issues with integration

Impact-Z

SelaV

Start with a realistically modeled beam from the Gun

Genesis/Puffin

(a) Genesis

(b) SelaV

Radiators

Chicane 1

Elegant

Chicane 2

(c) Tracking Single Particle in Elegant

Beam & Seed1 in Mod 1

Beam & Seed2 in Mod 2

End with Transport to Photon BL

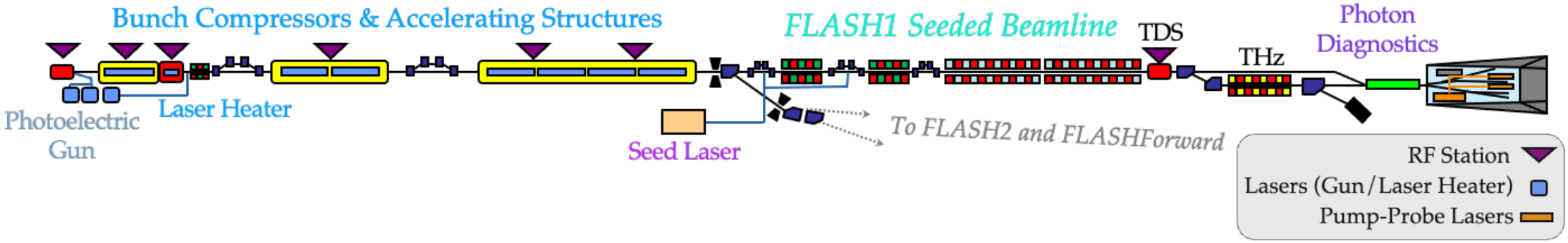
Synchrotron Radiation Workshop

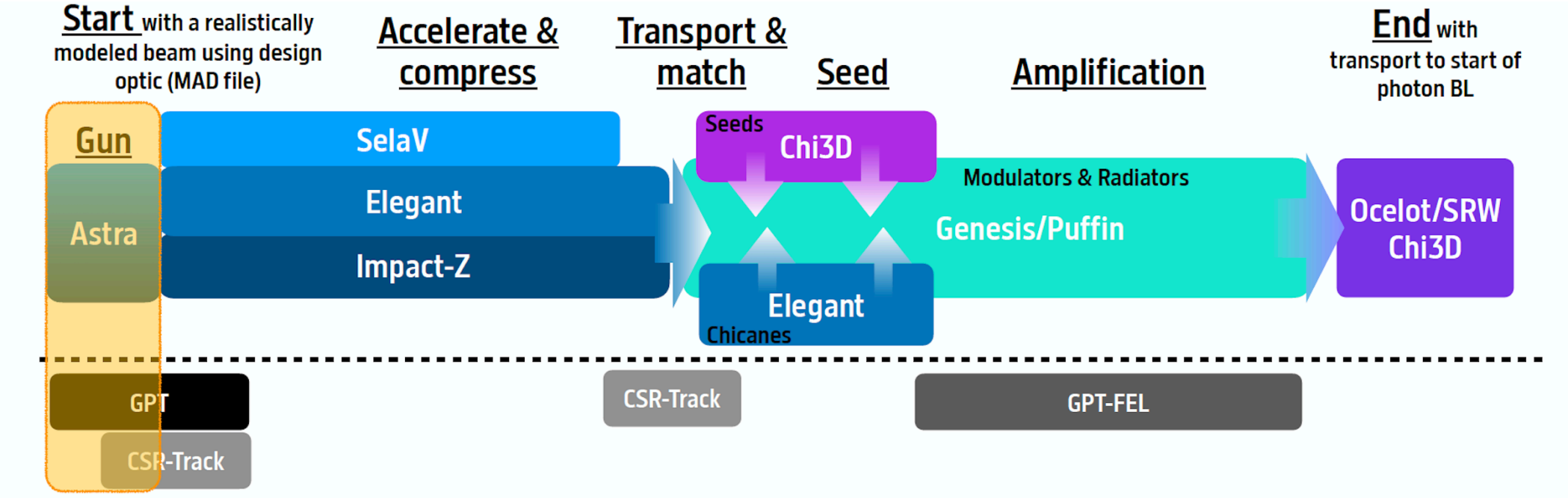
Benchmarking and comparing three approaches (a-c) for Seeded Beamline

Operational **Work in progress**

FLASH2020+ Start to End Simulations

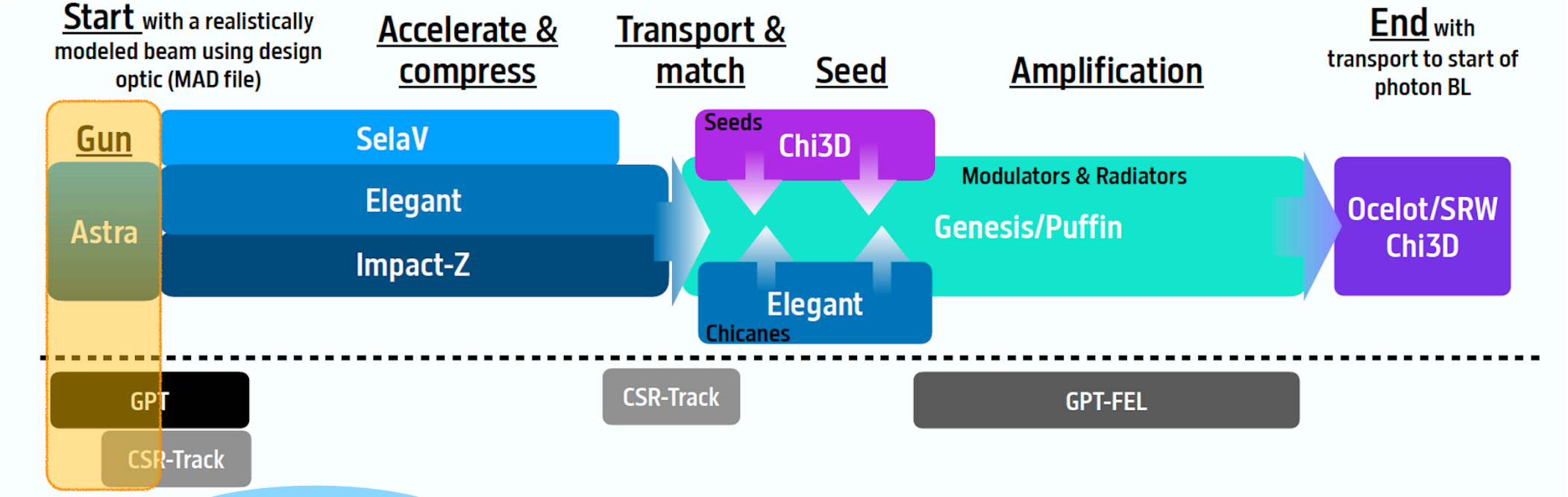
Final main working flow and a few additional planned benchmarking





FLASH2020+ Start to End Simulations

Status of handshaking scripts



Impact-Z 2 SU

Elegant 2 SU

SelaV 2 Genesis**

Resampler**

Chi3D 2 Genesis*

SU 2 Elegant

Genesis 2 SU*

SU 2 Genesis

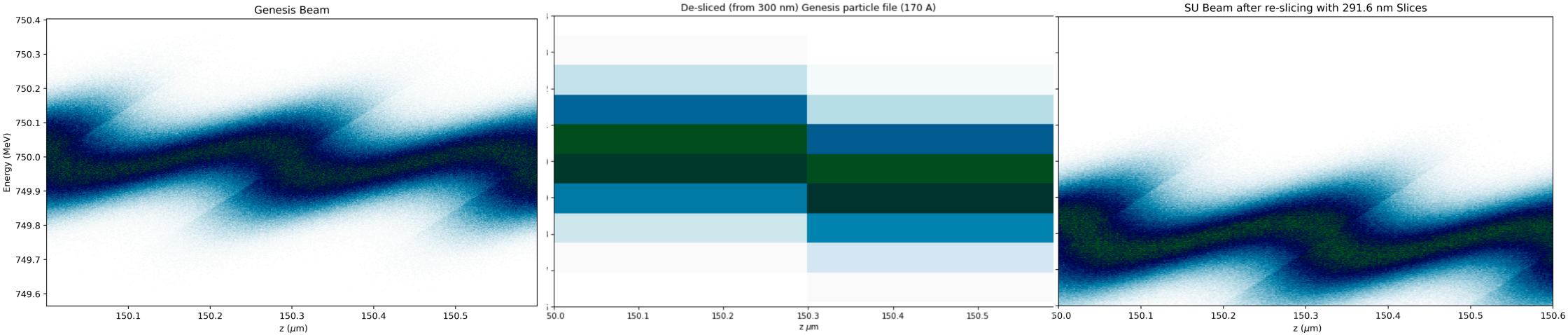
** Currently has limited function

* minor bugs detected but should be fixed soon

SU to Genesis for two different cases:

Case 1: (testing script with relatively low R56)

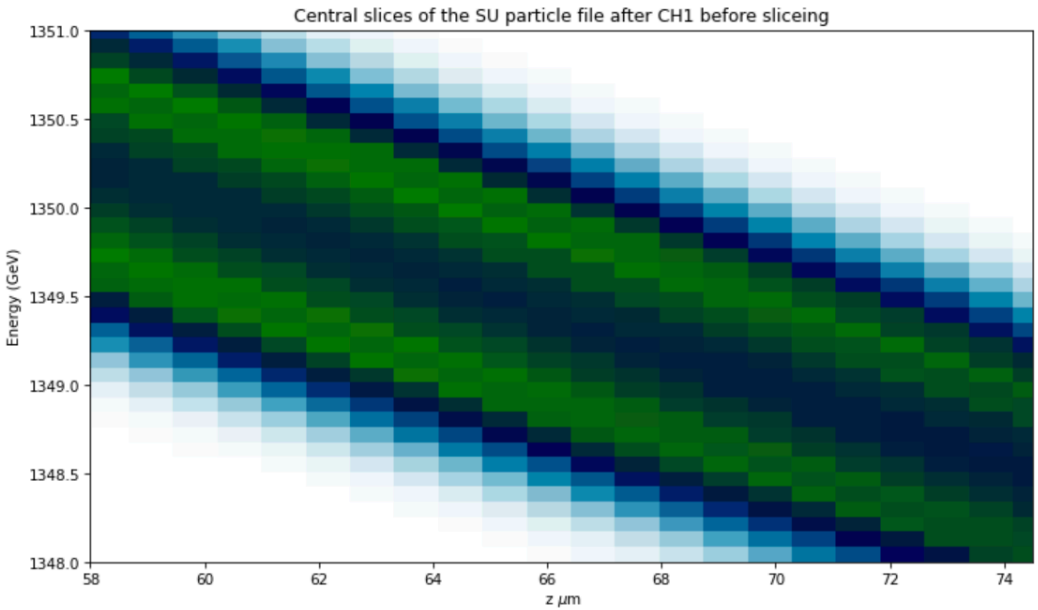
Optical klystron beam from Genesis is de-sliced after the chicane

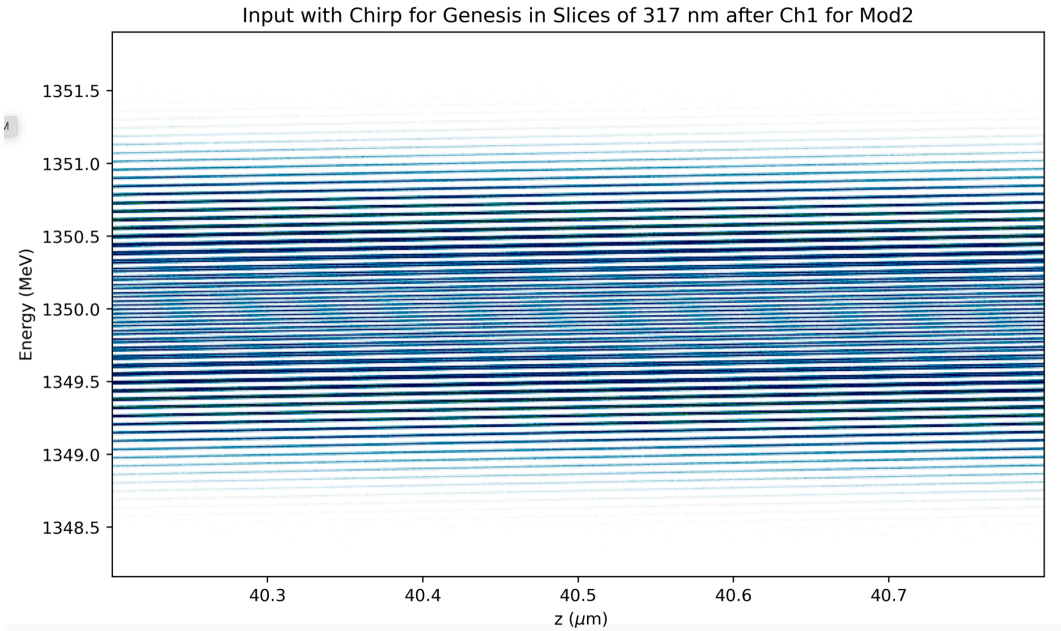


The beam is re-sliced with a different slice length

SU to Genesis for two different cases:

Case 2: EEHG Chicane





Need to make sure peak current is more or less in center of slice

Might need to cut the beginning of the beam

Consistent bunching needs to be checked

Iterative process

Summary

Working point 2 is promising

Handshaking and full S2E workflow is nearly done

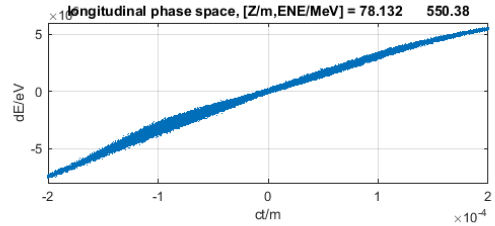
Some numerical effects (high slice parameter in some of the Impact-Z solution) which are not supported by XFEL results or other codes suggest it is a good idea to move toward using a benched-marked SelaV

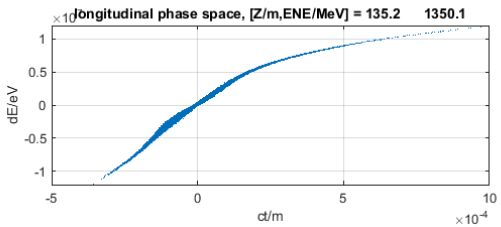
Thank you

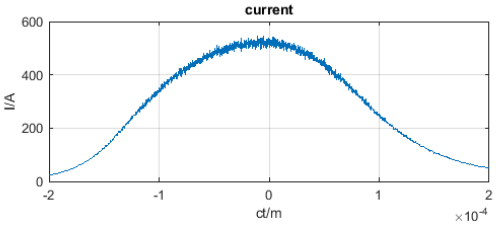
Next:

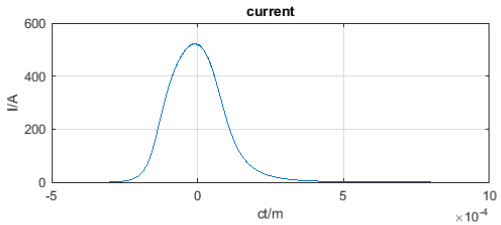
Wednesday 7/12/2022	
	Hands on session (electron beam)
09:00 - 09:30	- Coffee and Breakfast
09:30 - 11:30	- Introduction and Hands on Session with SelaV
12:00 - 13:00	Lunch (CSSB)
	Discussion and Studies for Core FLASH2020+ Simulation
13:30 - 14:00	- Summary of Studies for Electron Beam
14:00 - 14:30	- (Very) Recent Results and Comparison for the Laser Heater Setup
14:30 - 15:00	- Coffee Break
15:00 - 15:20	- Short Tutorial (working with large date)
15:20 - 15:50	- Studies of EEHG and HGHG
15:50 - 16:00	- Q&A
19:00:-20:30	Meeting at Christmas market (Take Number 3 around 6 to meet at Jungfernstieg)

Back up


longitudinal phase space, [Z/m,ENE/MeV] = 78.132 550.38
dE/eV
ct/m


longitudinal phase space, [Z/m,ENE/MeV] = 135.2 1350.1
dE/eV
ct/m


current
I/A
ct/m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I/A
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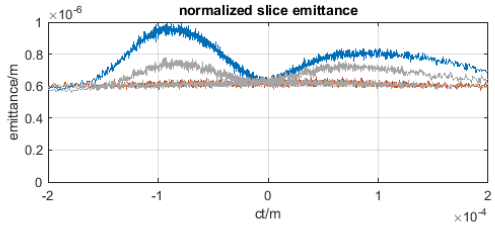
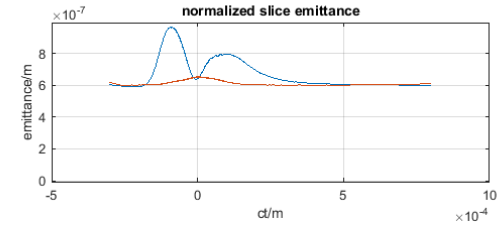
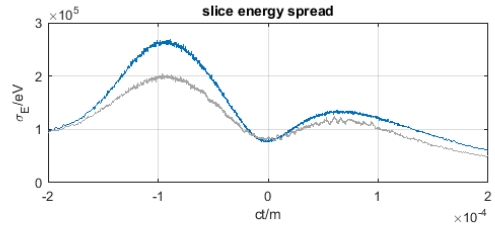
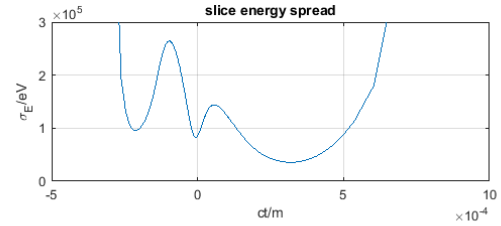
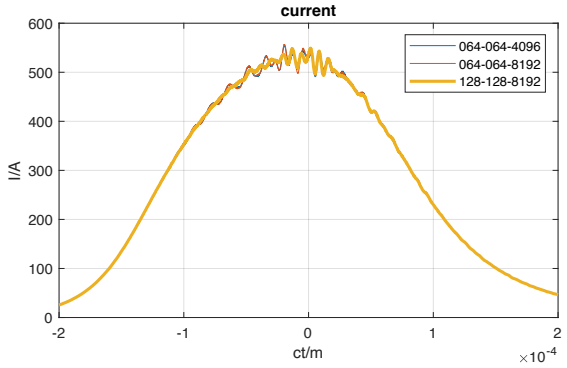
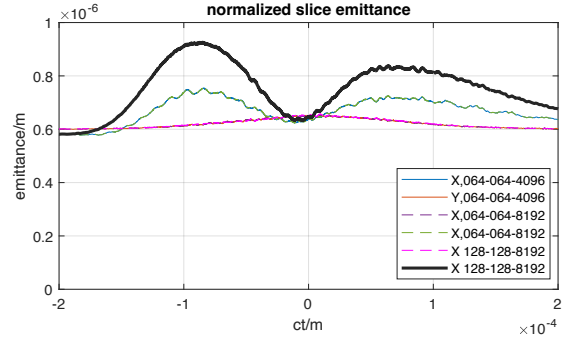

normalized slice emittance
emittance/m
ct/m

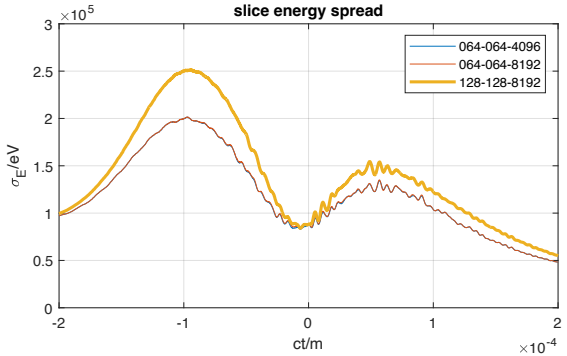

normalized slice emittance
emittance/m
ct/m


slice energy spread
σE/eV
ct/m


slice energy spread
σE/eV
ct/m


current
064-064-4096
064-064-8192
128-128-8192
I/A
ct/m


normalized slice emittance
X,064-064-4096
Y,064-064-4096
X,064-064-8192
X,064-064-8192
X 128-128-8192
X 128-128-8192
emittance/m
ct/m


slice energy spread
064-064-4096
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