Summary of Wed-Afternoon-1 Session

| 13:00	**Extraction bump digital twin for NSRL slow extraction**		Lucy Lin 📎
	Lecture Hall 1		13:00 - 13:30
	Crystal design based on multi-fidelity surrogate models		Francesco Maria Velotti 📎
	Lecture Hall 1		13:30 - 14:00
14:00	**Operational results with new high frequency spill monitor and prospects**		Federico Roncarolo 📎
	Lecture Hall 1		14:00 - 14:30

Extraction Bump Digital Twin for NSRL slow extraction

By Weijian (Lucy) Lin

A **Digital Twin (DT)** system was developed for the extraction bumps in AGS Booster Ring, with bidirectional interaction between physical and virtual machines.
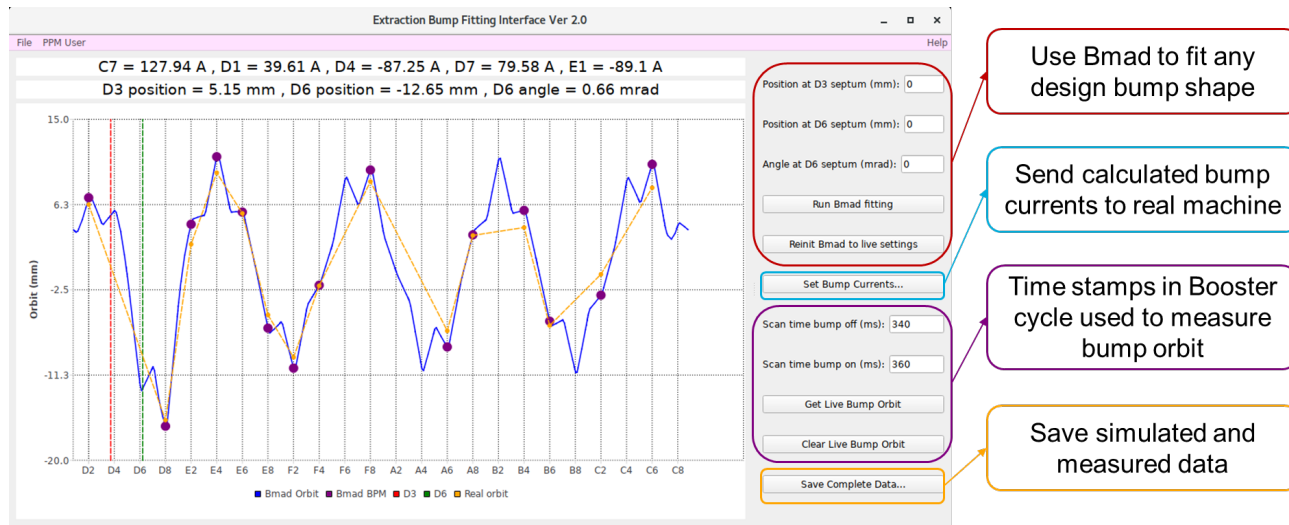
DT for NSRL line also under development, will facilitate beam uniformity optimization
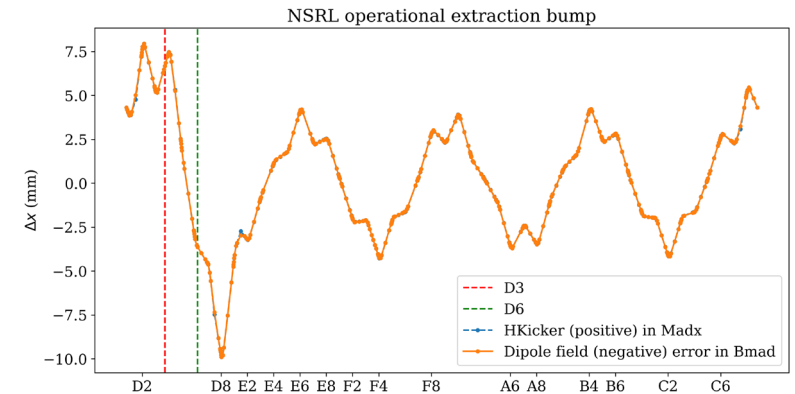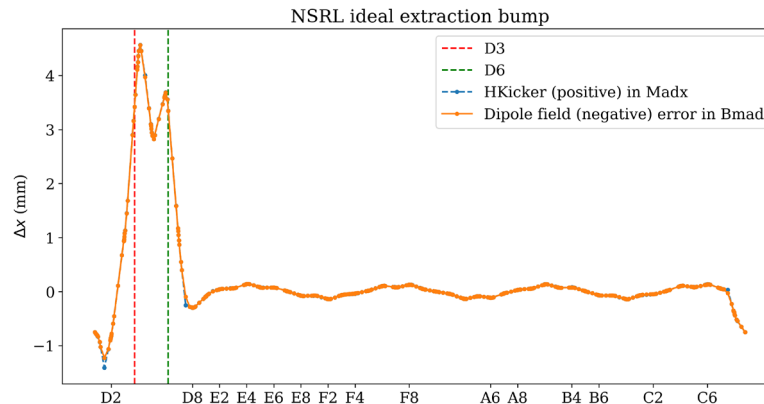
MVRA crystal design via multi fidelity Bayesian optimization

By F. M. Velotti

A highly educational presentation on optimizing the design of MVRA using **multi-fidelity Bayesian optimization**

Multi-Fidelity BO (MF BO):
Learns correlation between LF & HF results — "LF is 10% too optimistic."
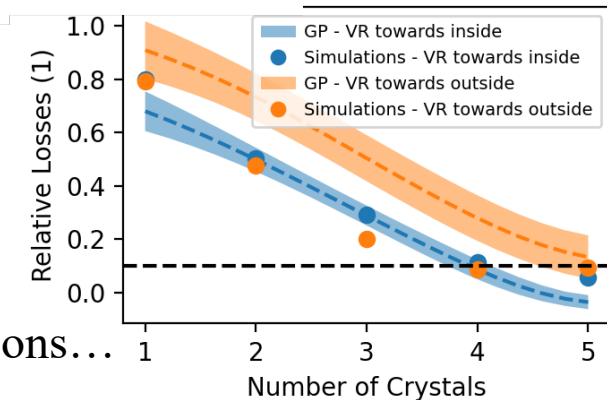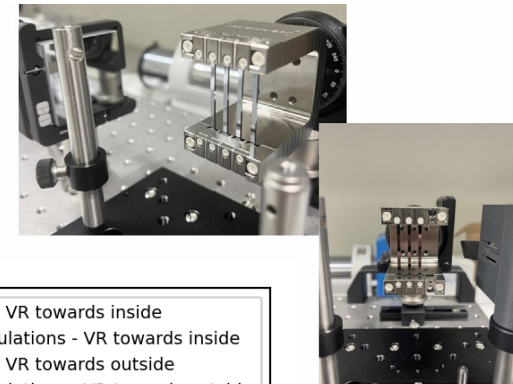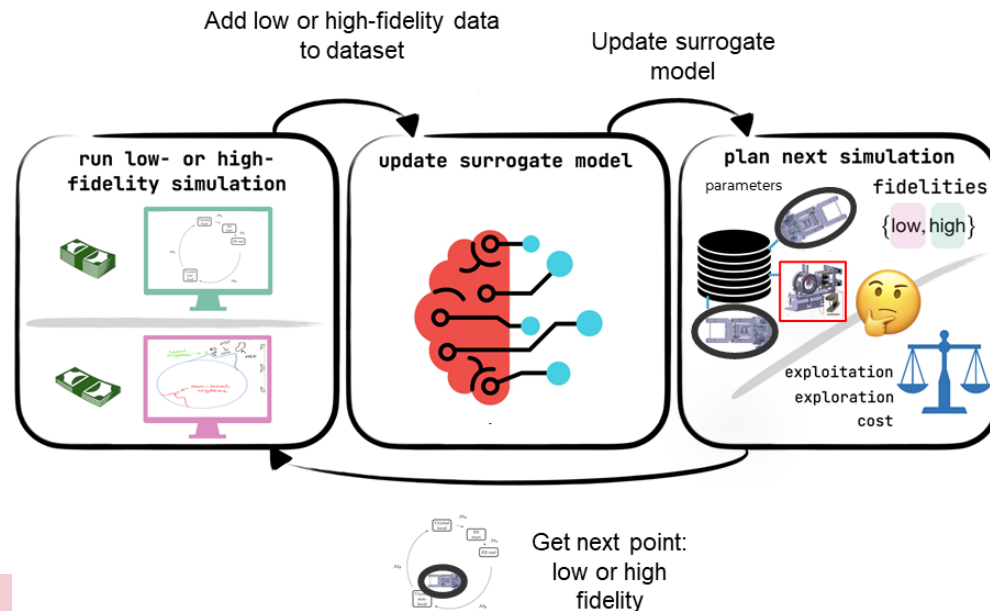Runs many cheap LF tests, only a few HF to anchor reality.

High Fidelity: Full particle tracking in 5D
Low Fidelity: NN trained on 100 tracking simulations

Add low or high-fidelity data to dataset

Update surrogate model

run low- or high-fidelity simulation

update surrogate model

plan next simulation
parameters   fidelities
{low, high}

exploitation
exploration
cost

Get next point: low or high fidelity

Not only can it improve the efficiency of tracking simulations and hardware design, but it can also be used to improve the efficiency of optimization of accelerator parameters?

High Fidelity: Measured Data
Low Fidelity: Tracking Simulation etc…

There may be many other applications…
Are there any examples or ideas?

Relative Losses (1)

- GP - VR towards inside
- Simulations - VR towards inside
- GP - VR towards outside
- Simulations - VR towards outside

Number of Crystals

Slow-Spill-Fast-Monitor at the CERN SPS

By Federico Roncarolo

SPS and SHiP experiment require spill monitors for high frequency more than GHz (!)

Spill Monitoring Requirements - General

Table 1: Key parameters of interest for the SPS spill monitors requirements.

Parameter	Value or Range	Comment
Spill Duration	4.8 [s]	present operation
	1 [s]	future, e.g. PBC
Beam Intensity	1-400 [1e11p]	
Spectrum Harmonics of interest	50 Hz, 100 Hz	e.g. Noise, PC ripples
	43.86 kHz	SPS 1st and 2nd Harmonics*
	476 kHz	PS 1st Harmonic**
	200 MHz	RF capture
	800 MHz	RF long. blow-up
	10 GHz	Future, e.g. PBC

* the SPS circulating beam structure includes $2\times10\,\mu s$ injections, the *abort gap* for the dump kickers rise

** the slow extracted beam can still contain a time structure from the PS (the SPS injector)

From **few nA** to **few uA**

From **few Hz** to
- **800 MHz** (SPS NA CONS, short term)
- **several GHz** (PBC, long term)

Anybody else already with or is developing > 100MHz spill measurements ?