

A New Mode for Operation with Insertion Devices at UVX (LNLS-1)

Liu Lin

Ruy Farias, Ximenes Resende, Pedro Tavares

Brazilian Synchrotron Light Laboratory – LNLS
Campinas – São Paulo – Brazil

WE2PBC02 - PAC 2009 – Vancouver – Canada

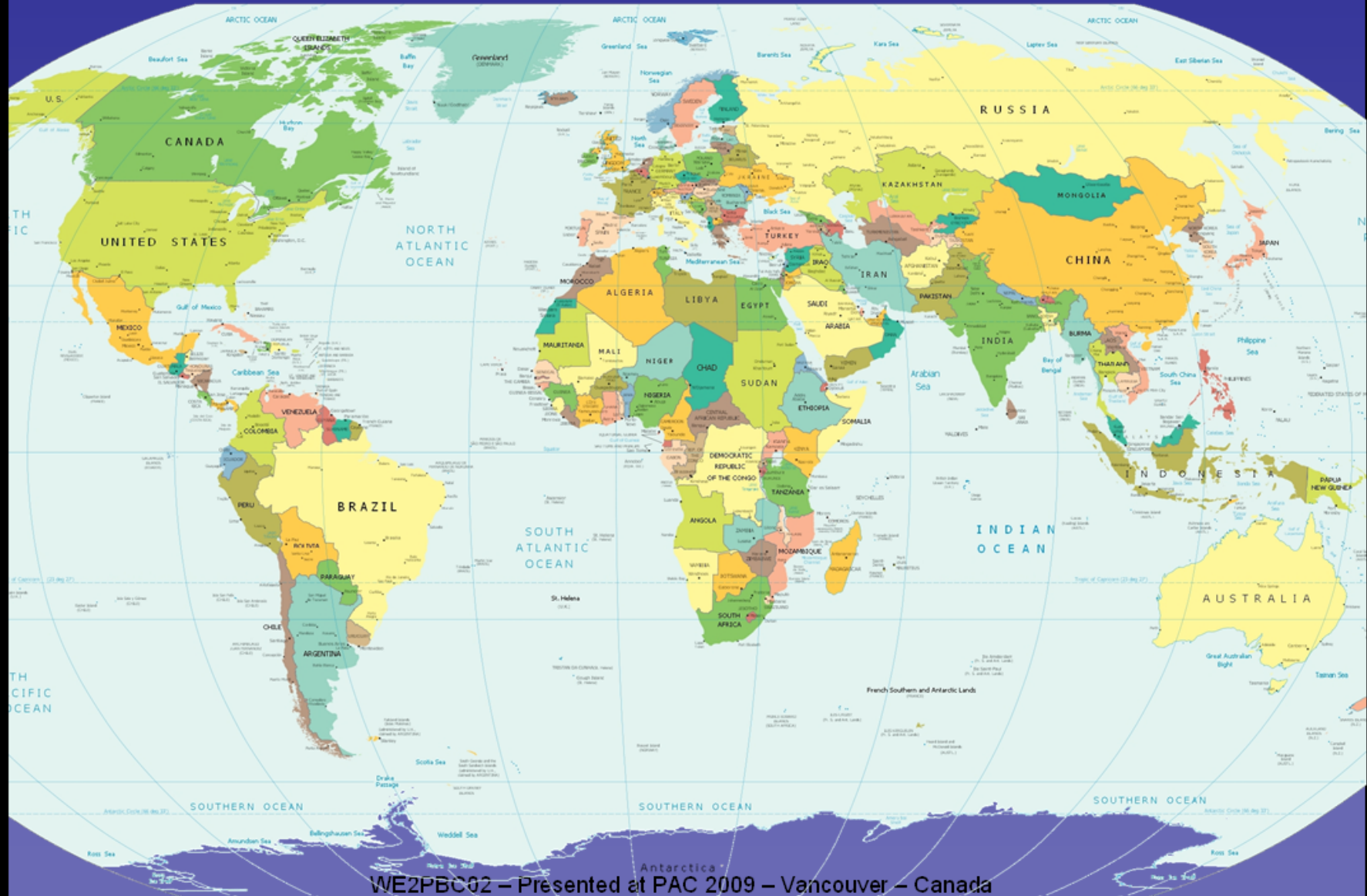
Outline

1. Brief introduction to LNLS
2. The operation modes for UVX: Standard, BBY6T
3. Effects of IDs
4. Commissioning of BBY6T
5. Characterization of BBY6T
6. Conclusions

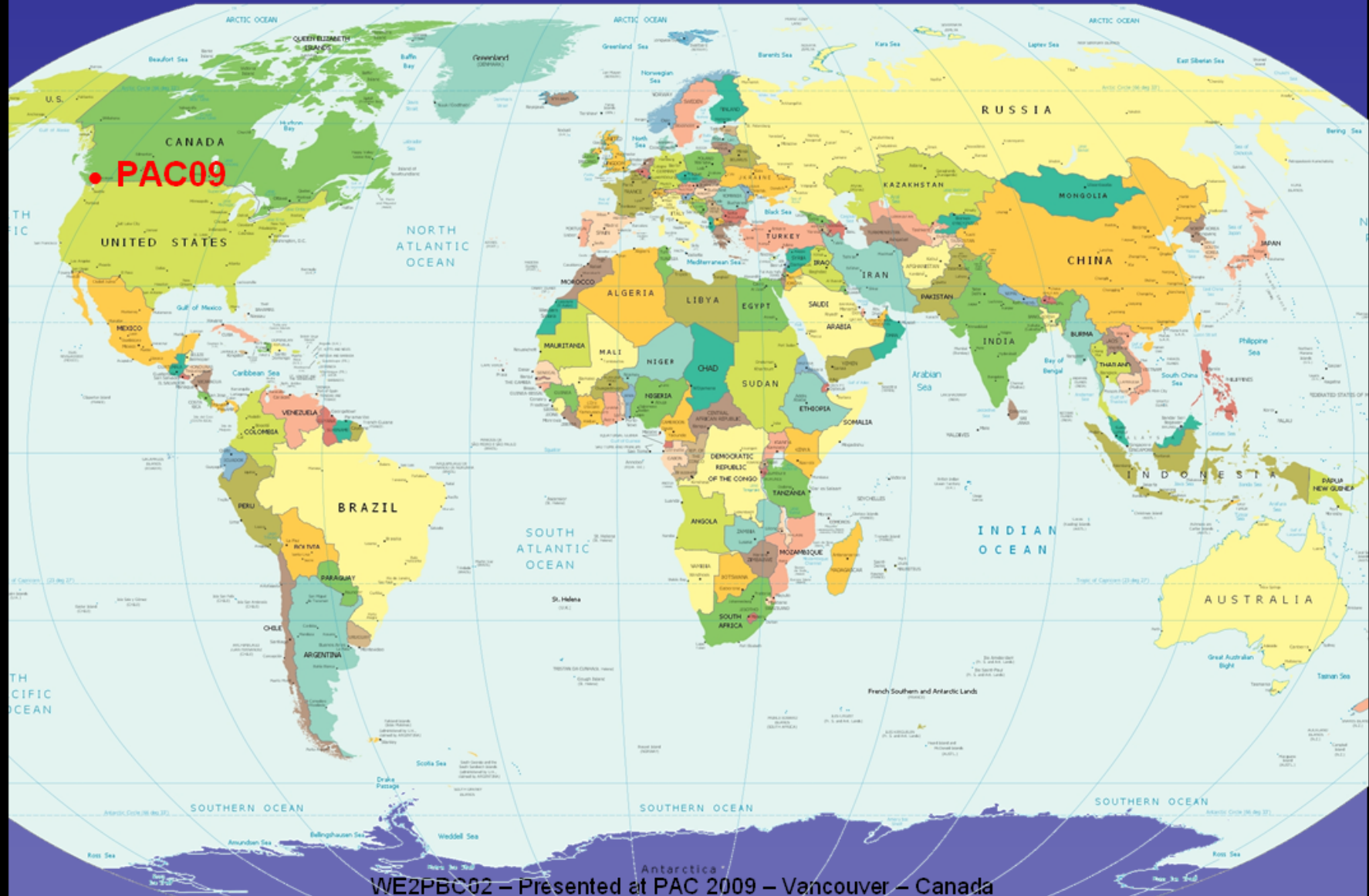
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Where LNLS is located ...



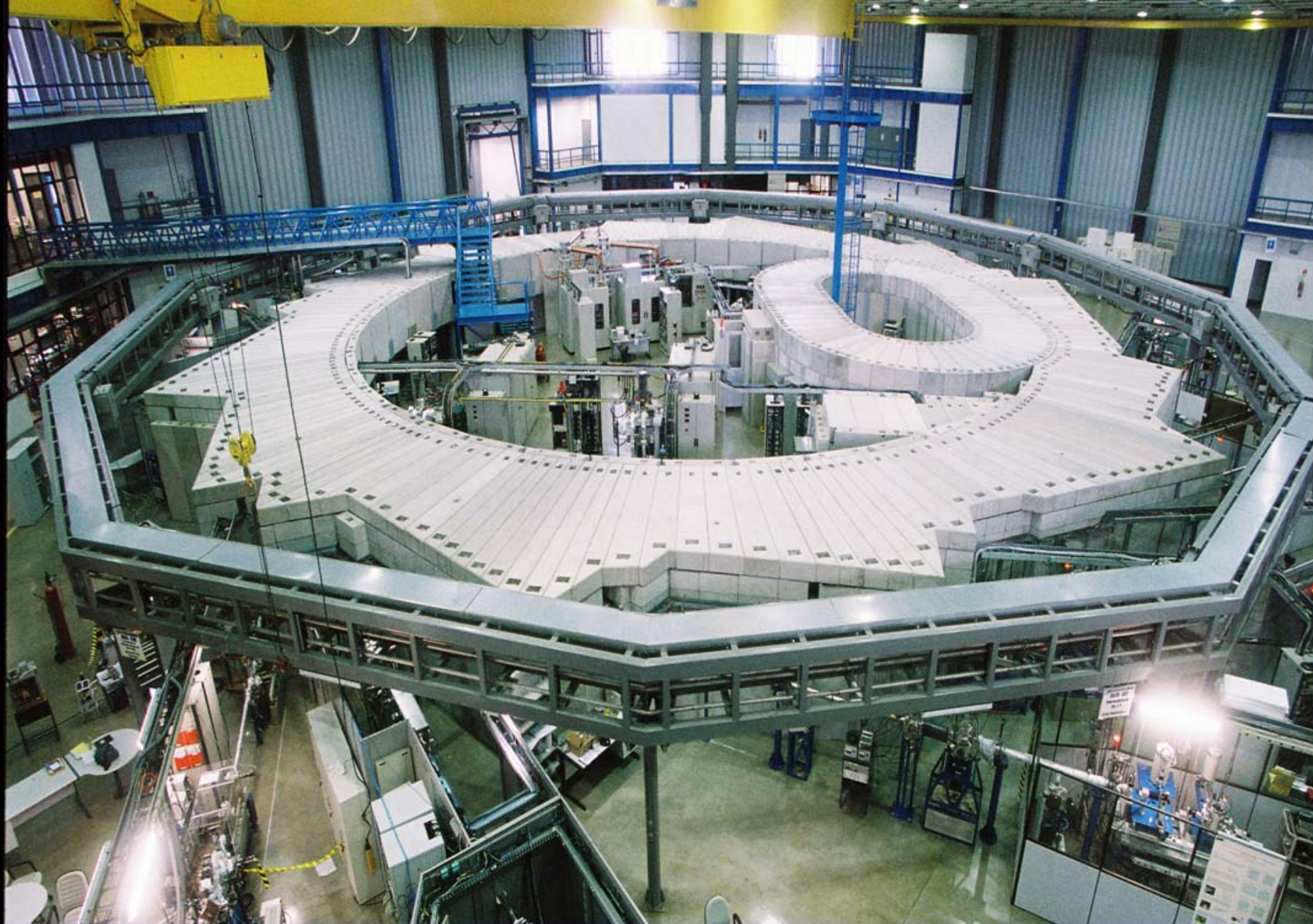
Where LNLs is located ...



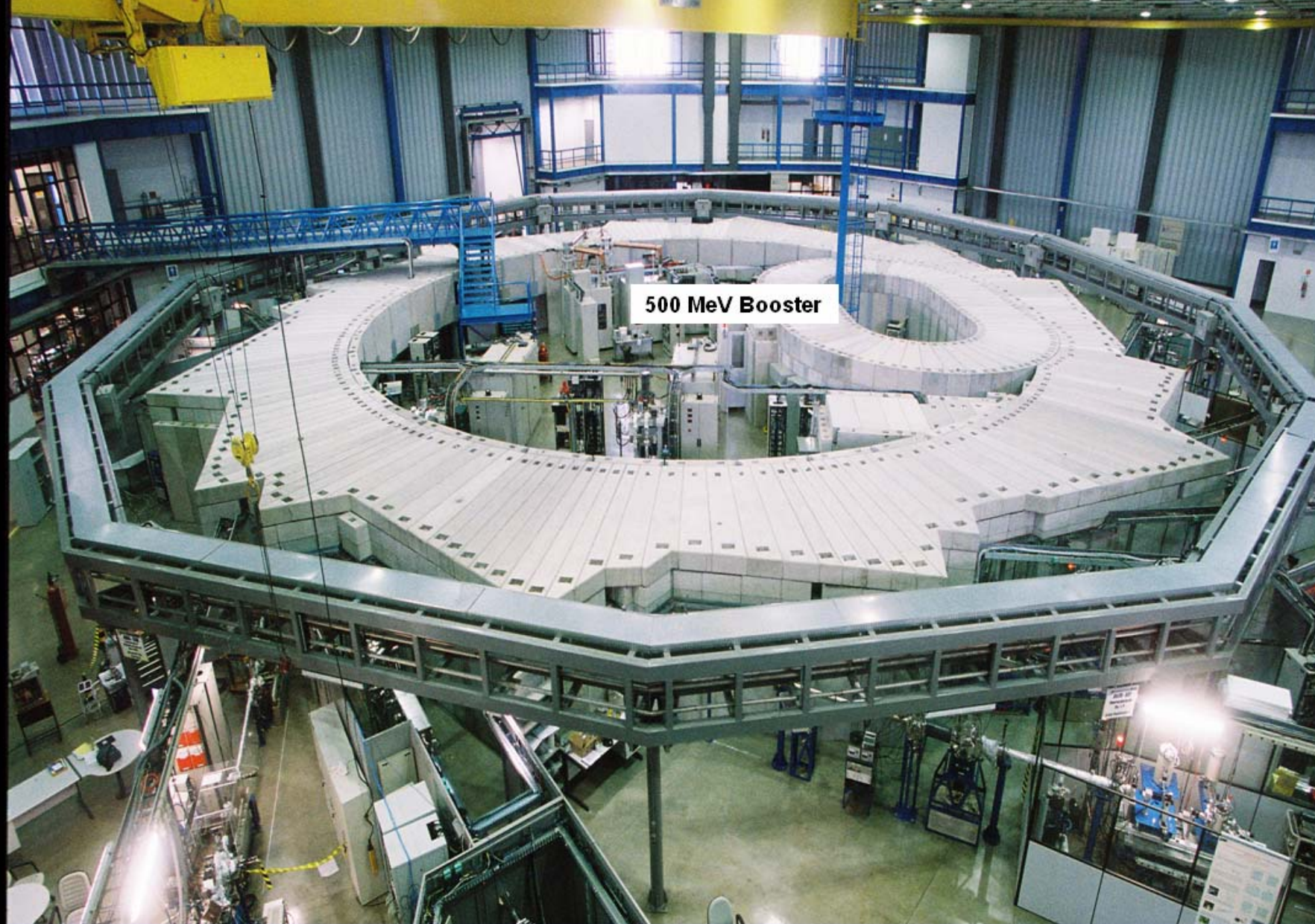
Where LNLS is located ...

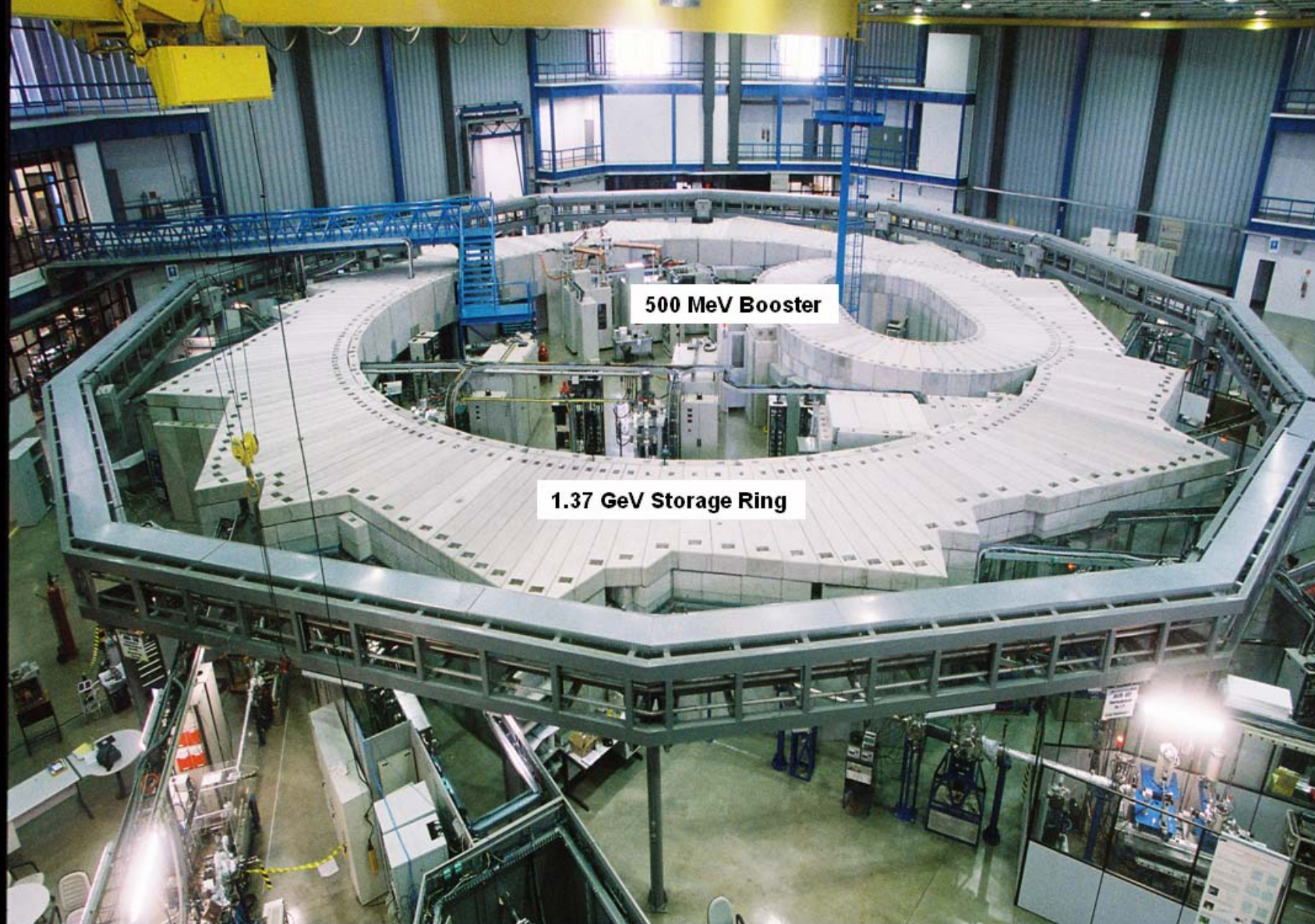






WE2PBC02 – Presented at PAC 2009 – Vancouver – Canada



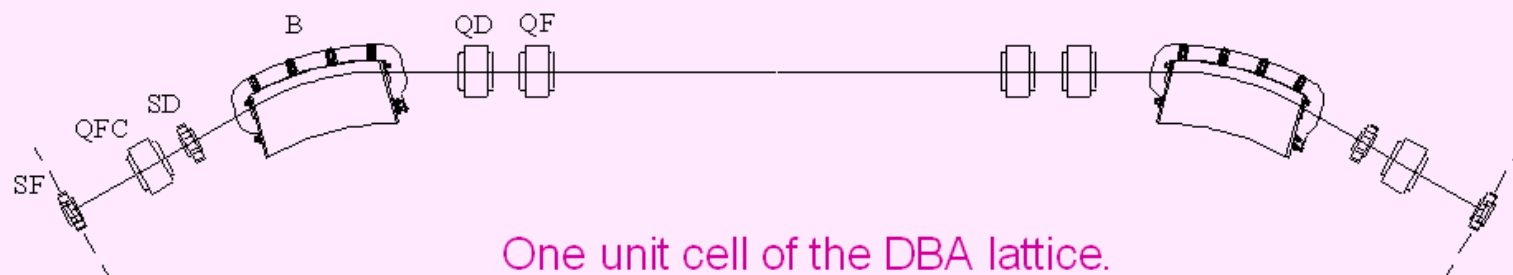


500 MeV Booster

1.37 GeV Storage Ring

Some parameters of the storage ring

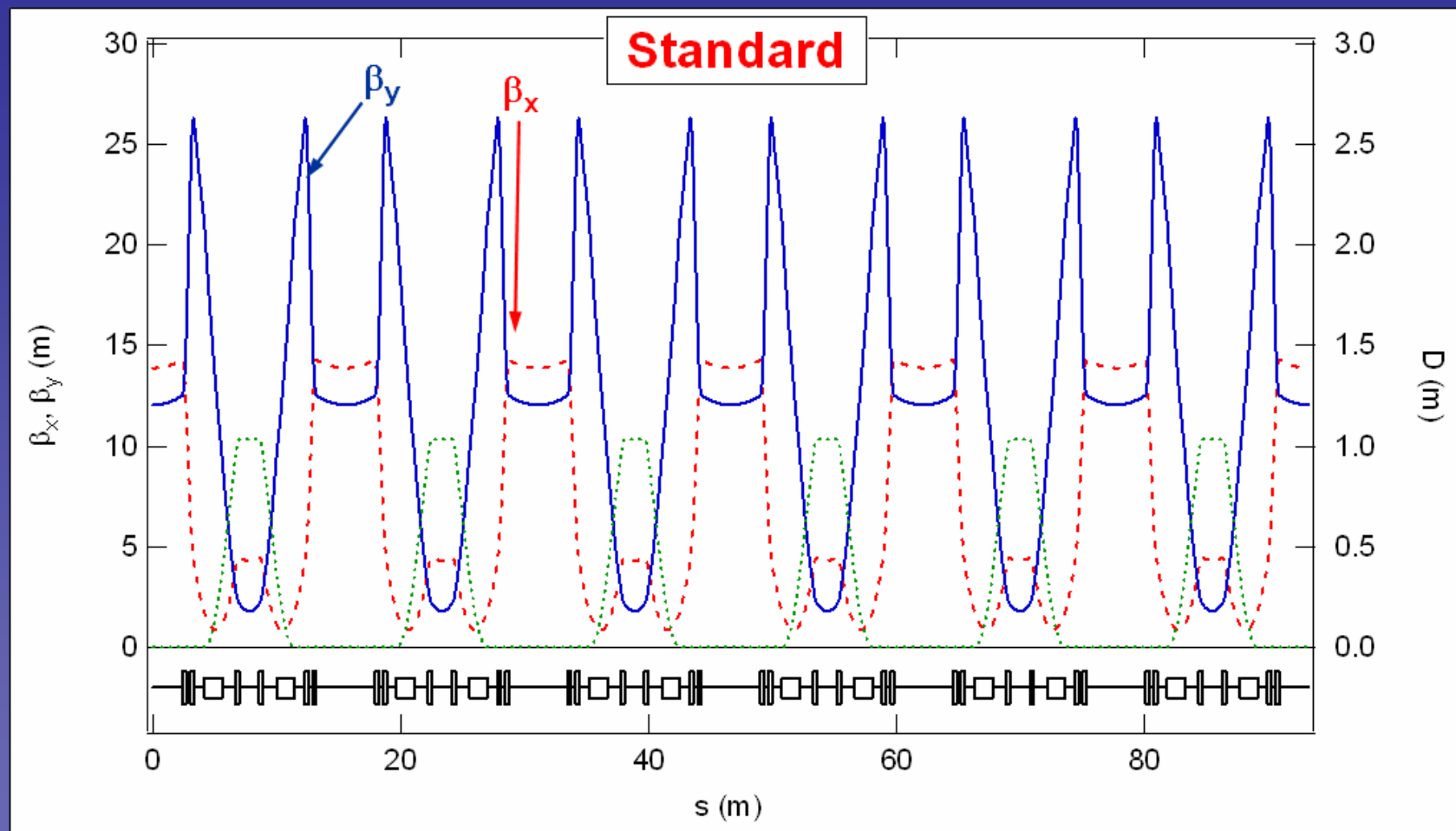
Energy	1.37	GeV
Injection energy	500	MeV
Circumference	93.2	m
Lattice	DBA	
# of long ss	6 (4 for IDs)	
Emittance	100	nm.rad
Initial current	250	mA
ϵ_c from dipoles	2.1	keV



Outline

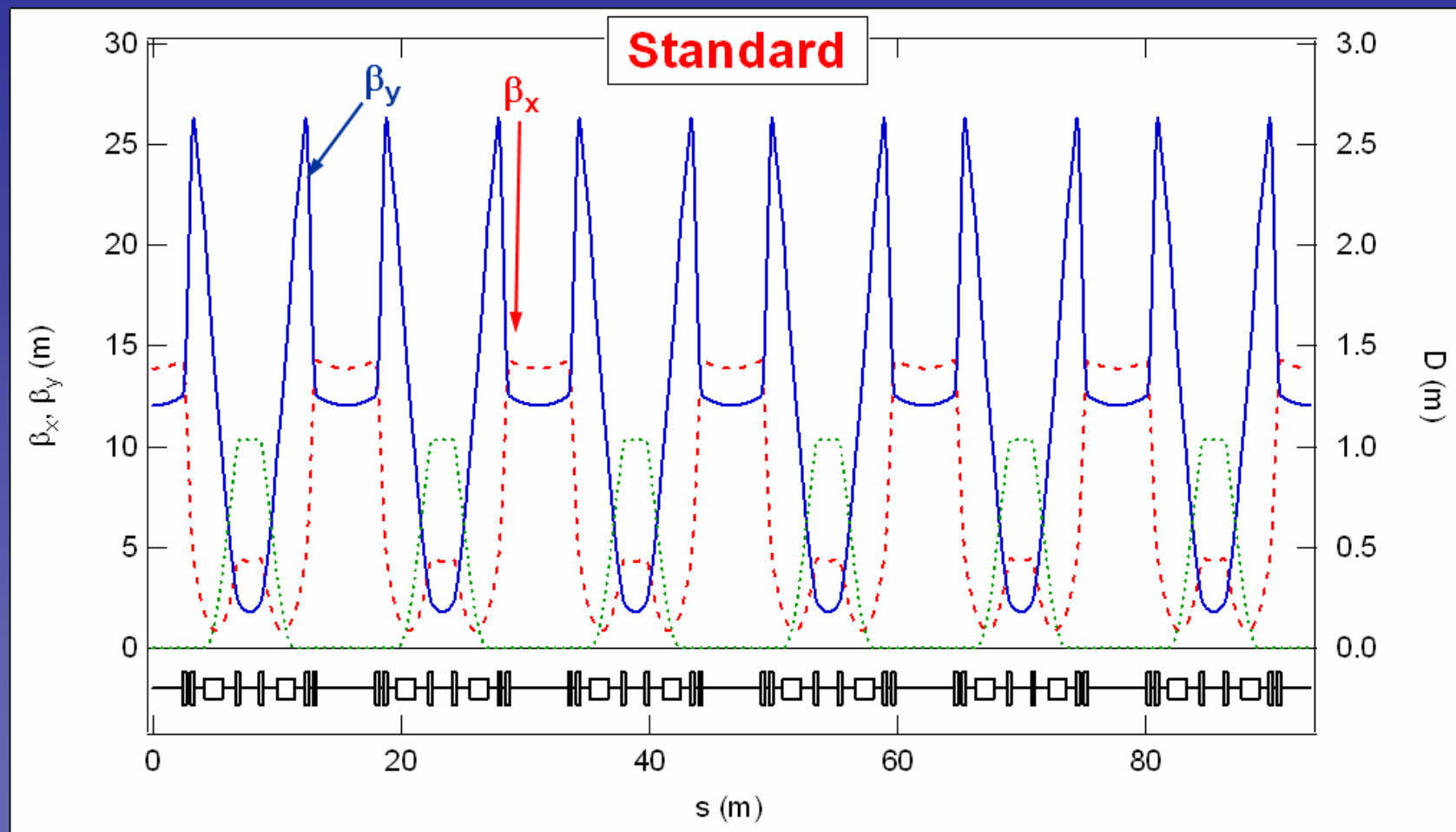
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The Operation Modes for UVX



$$\begin{aligned} v_x &= 5.27 \\ v_y &= 2.17 \end{aligned}$$

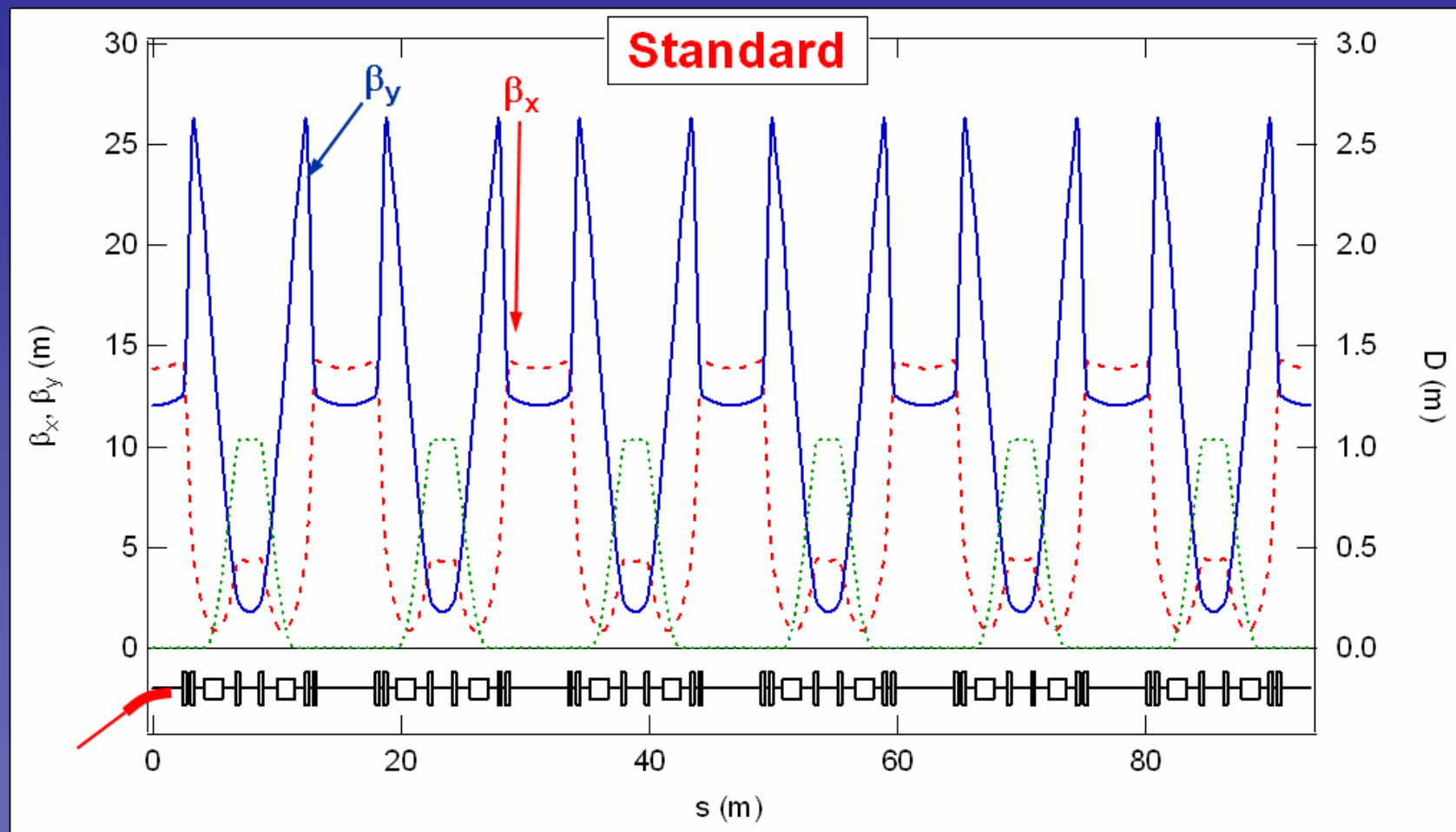
The Operation Modes for UVX



1997
Open for users

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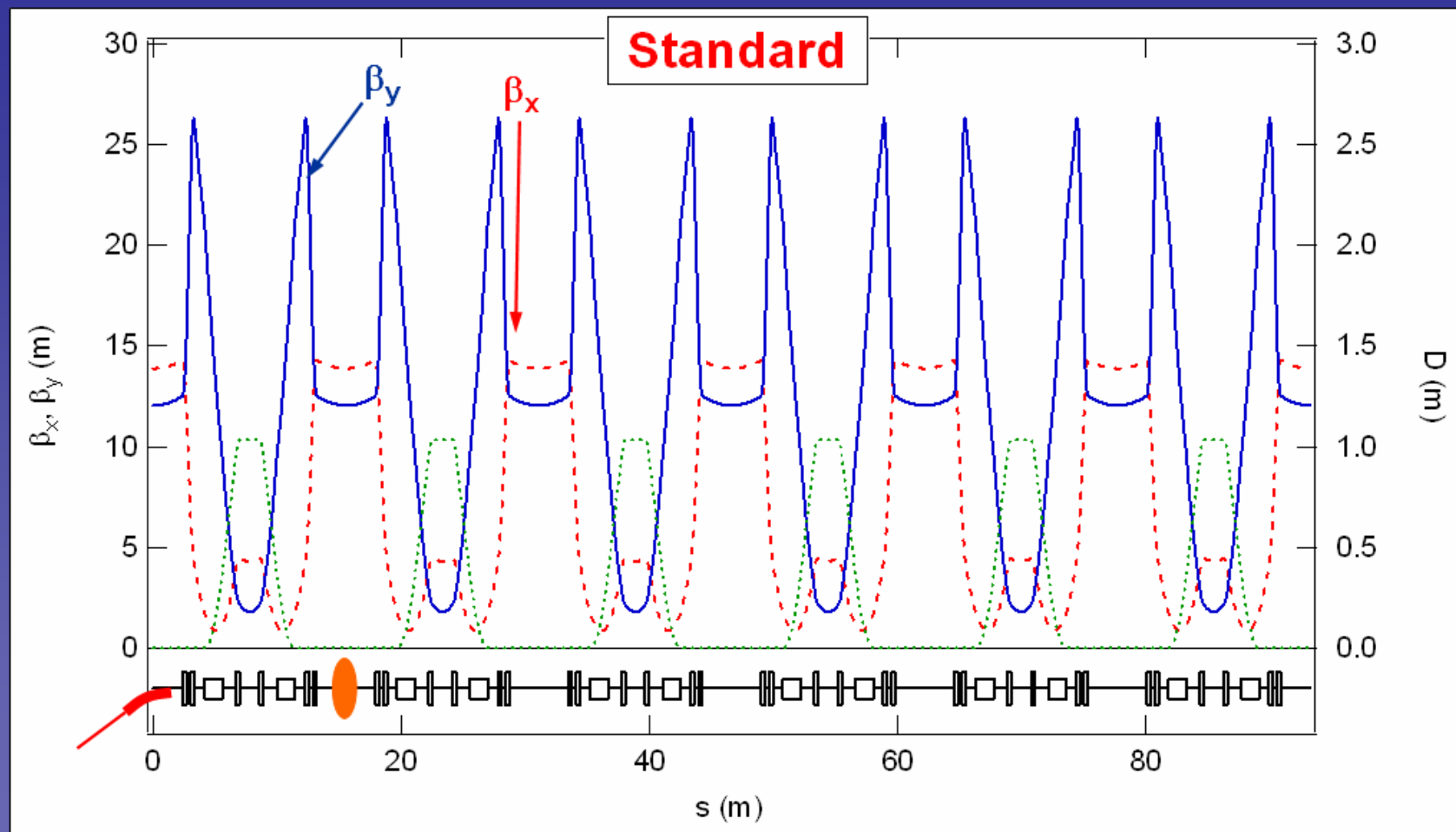
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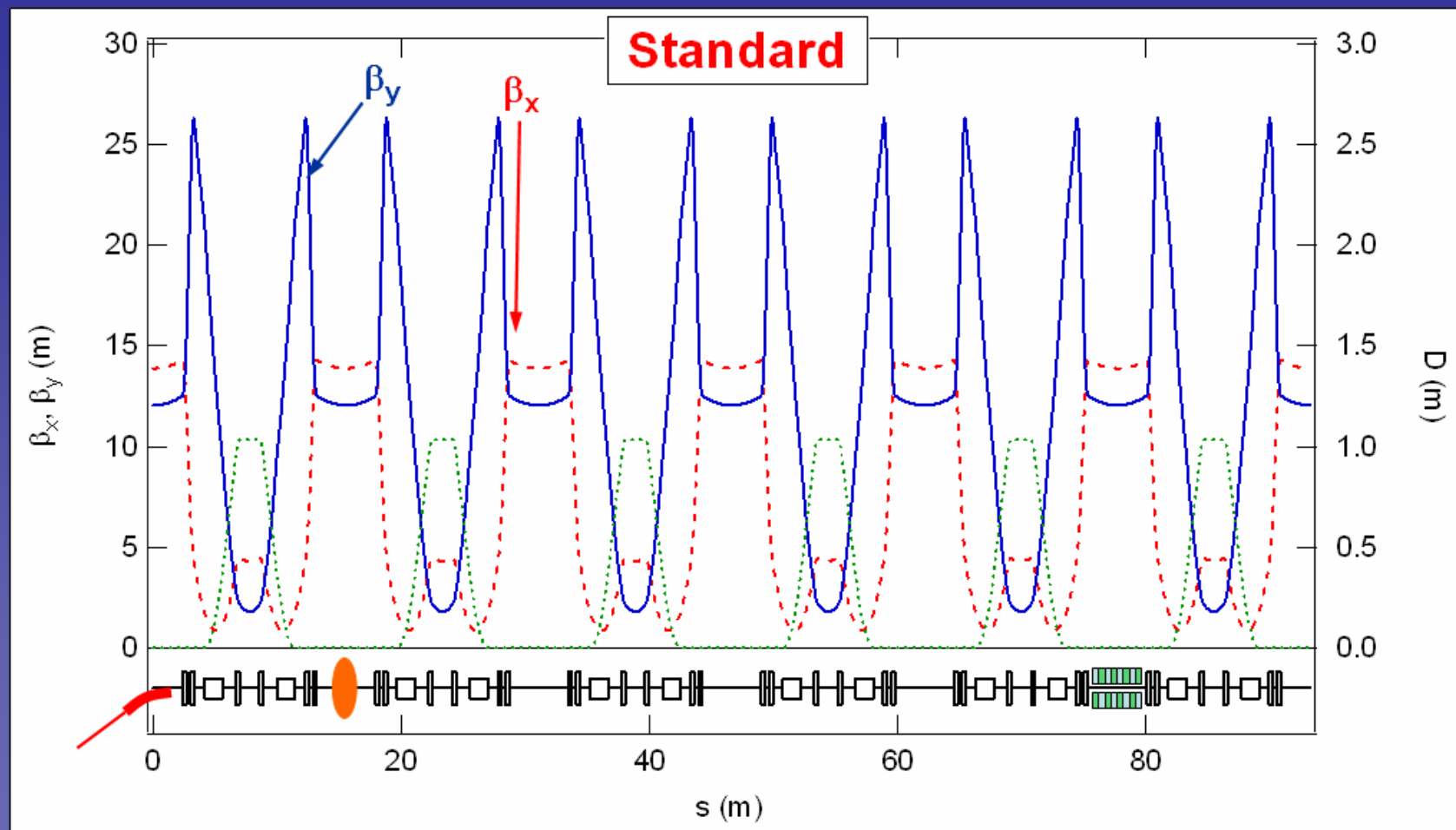
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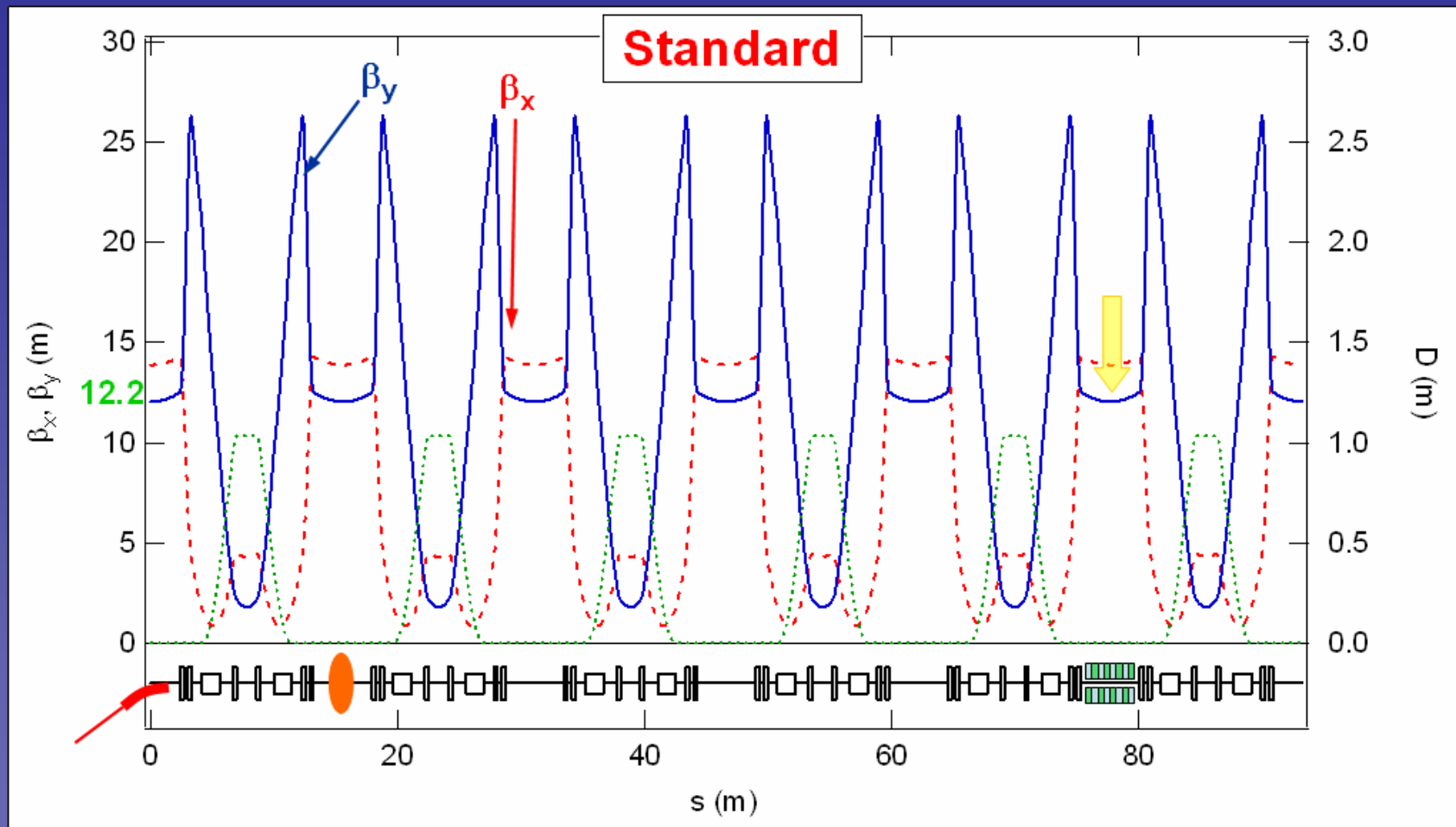


1997
Open for users

2005
2T WIG

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The Operation Modes for UVX

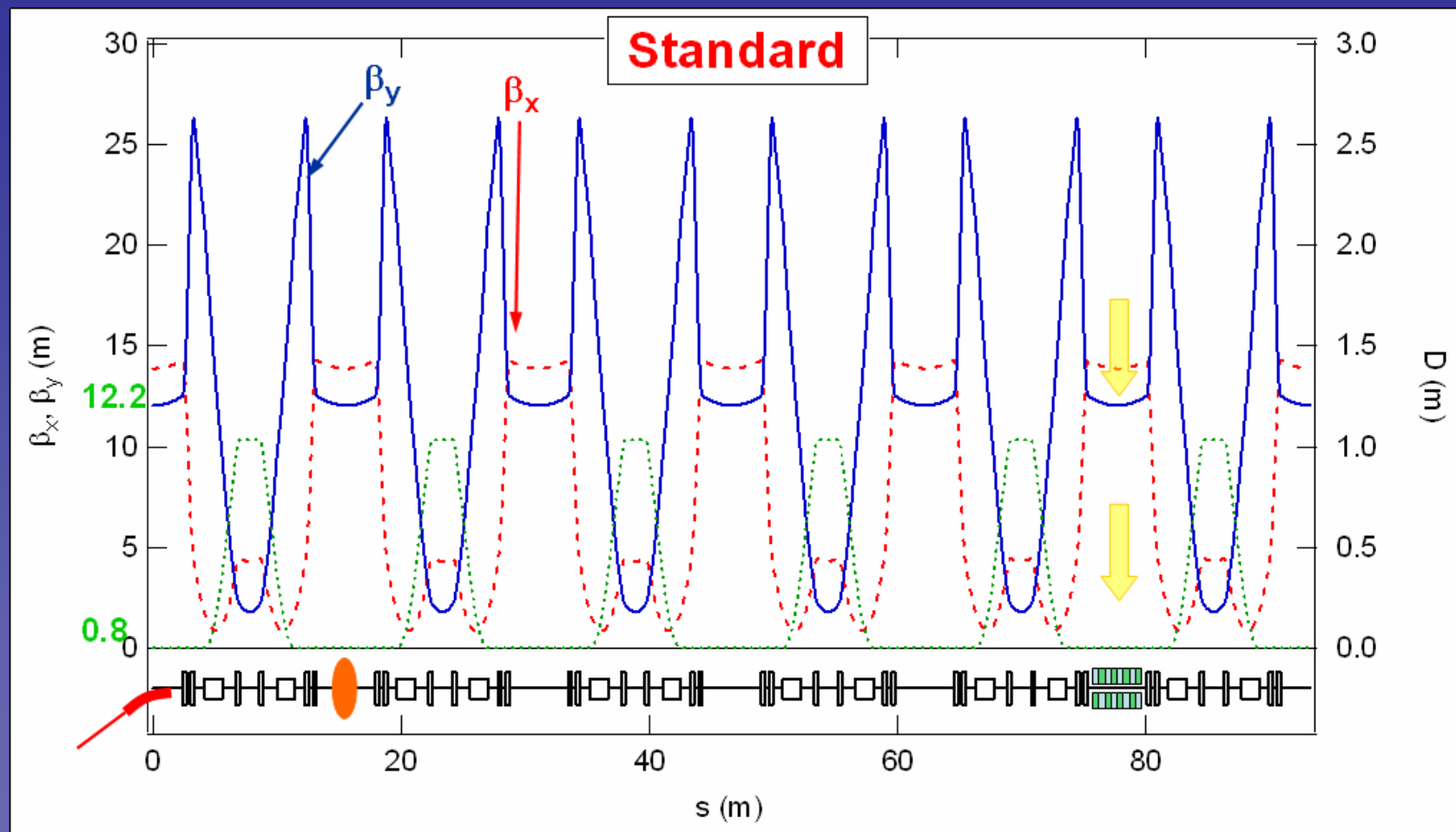


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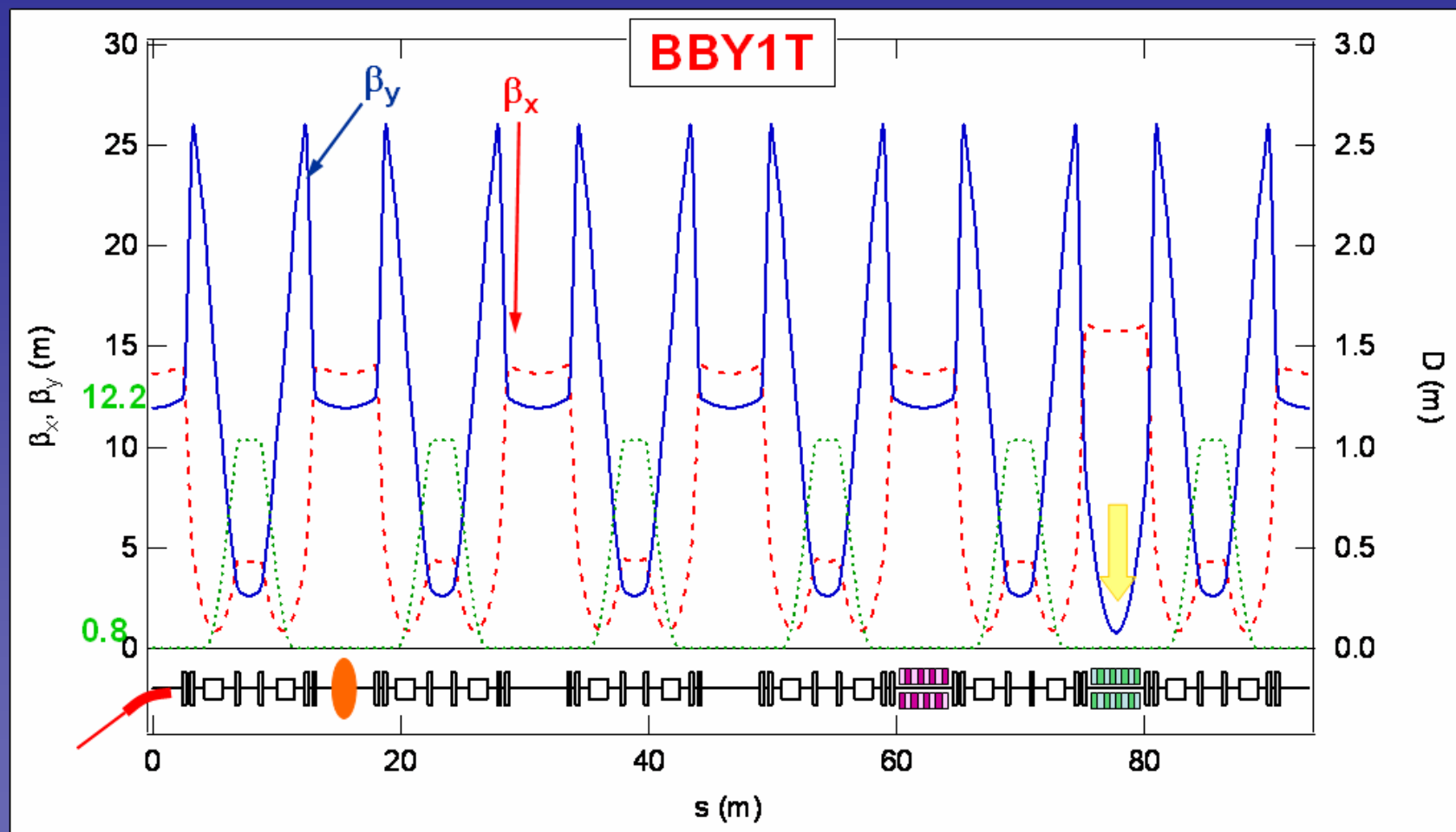


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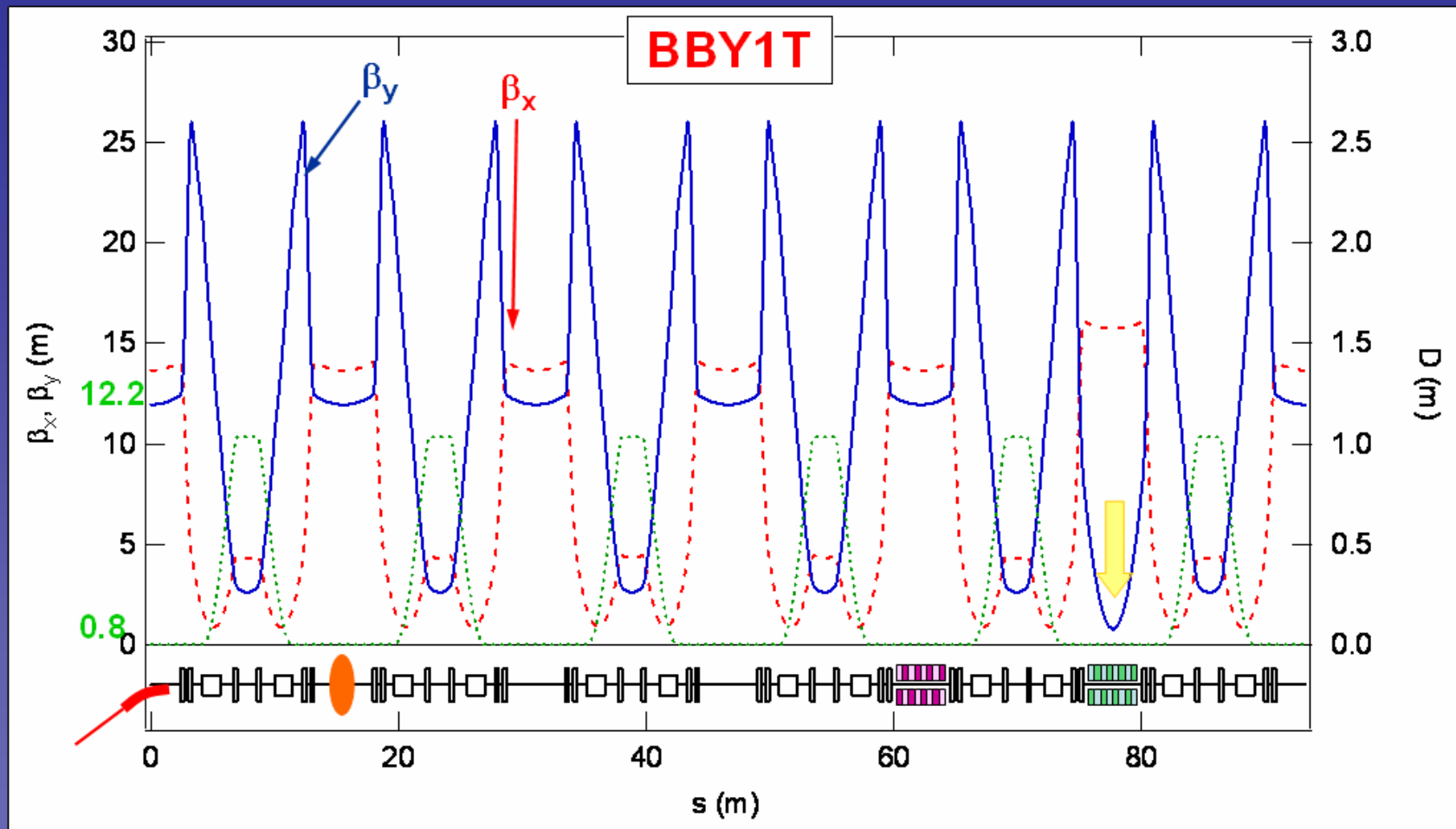
1997
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2007
OND

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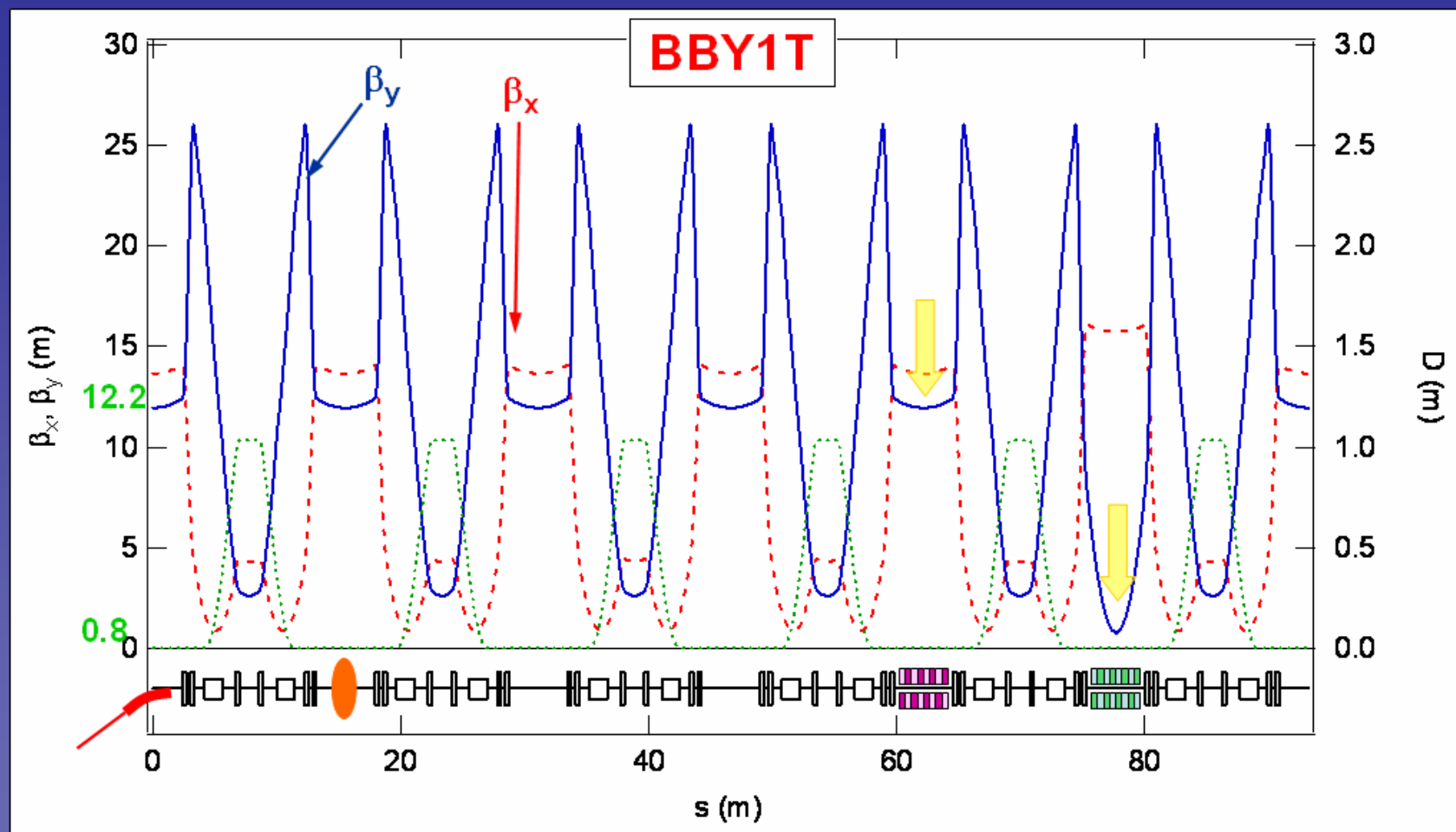
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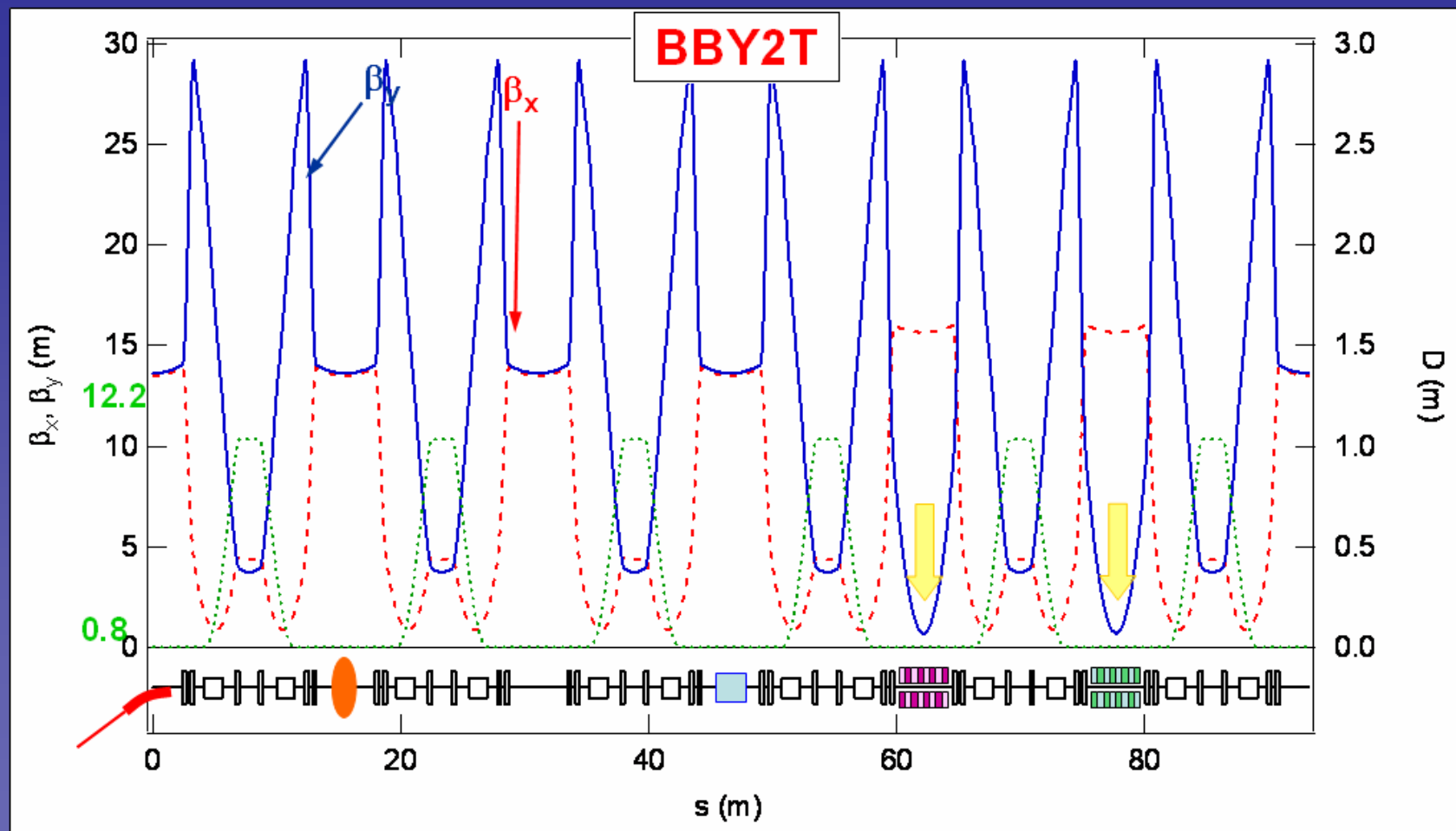
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The Operation Modes for UVX



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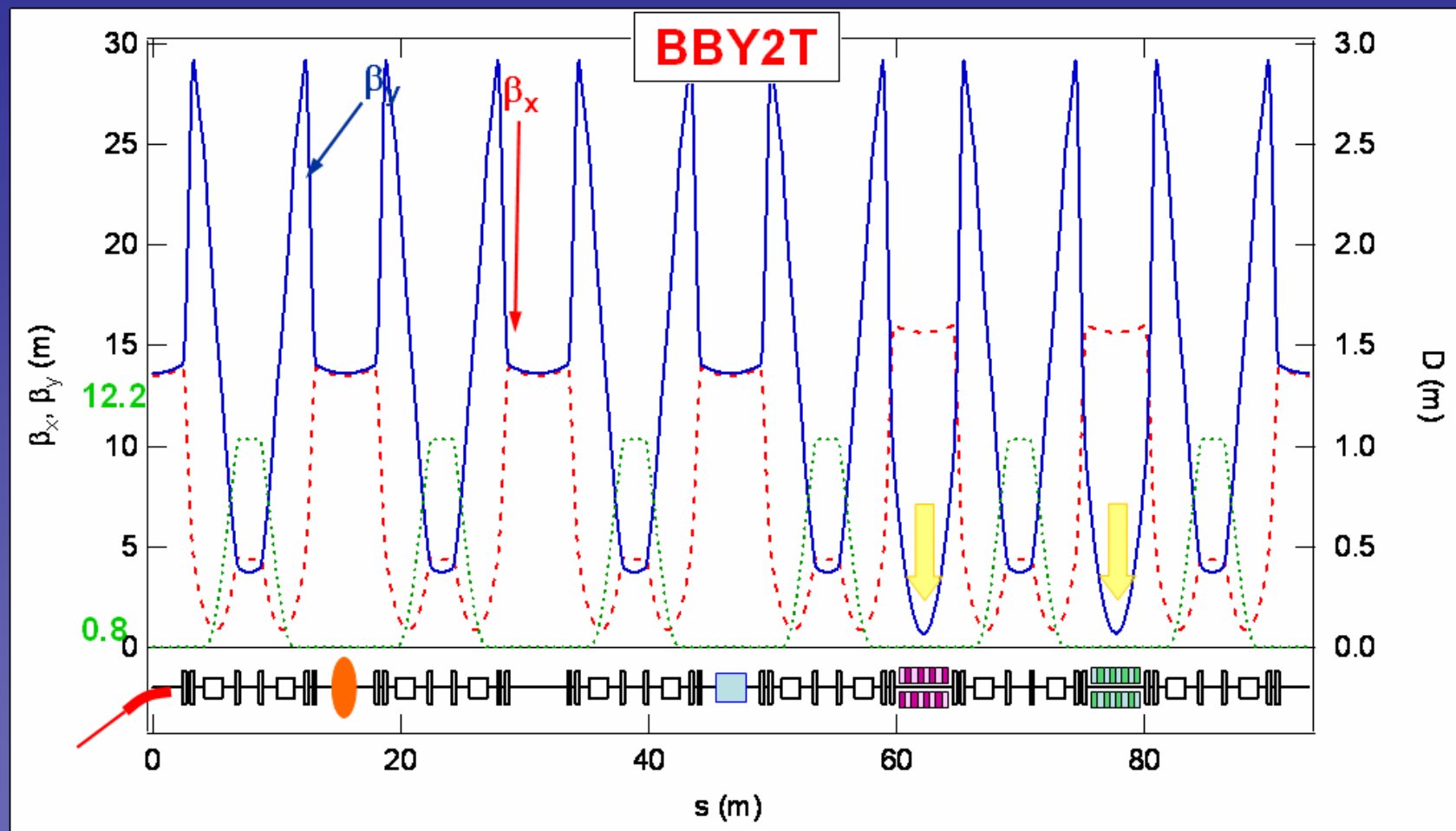
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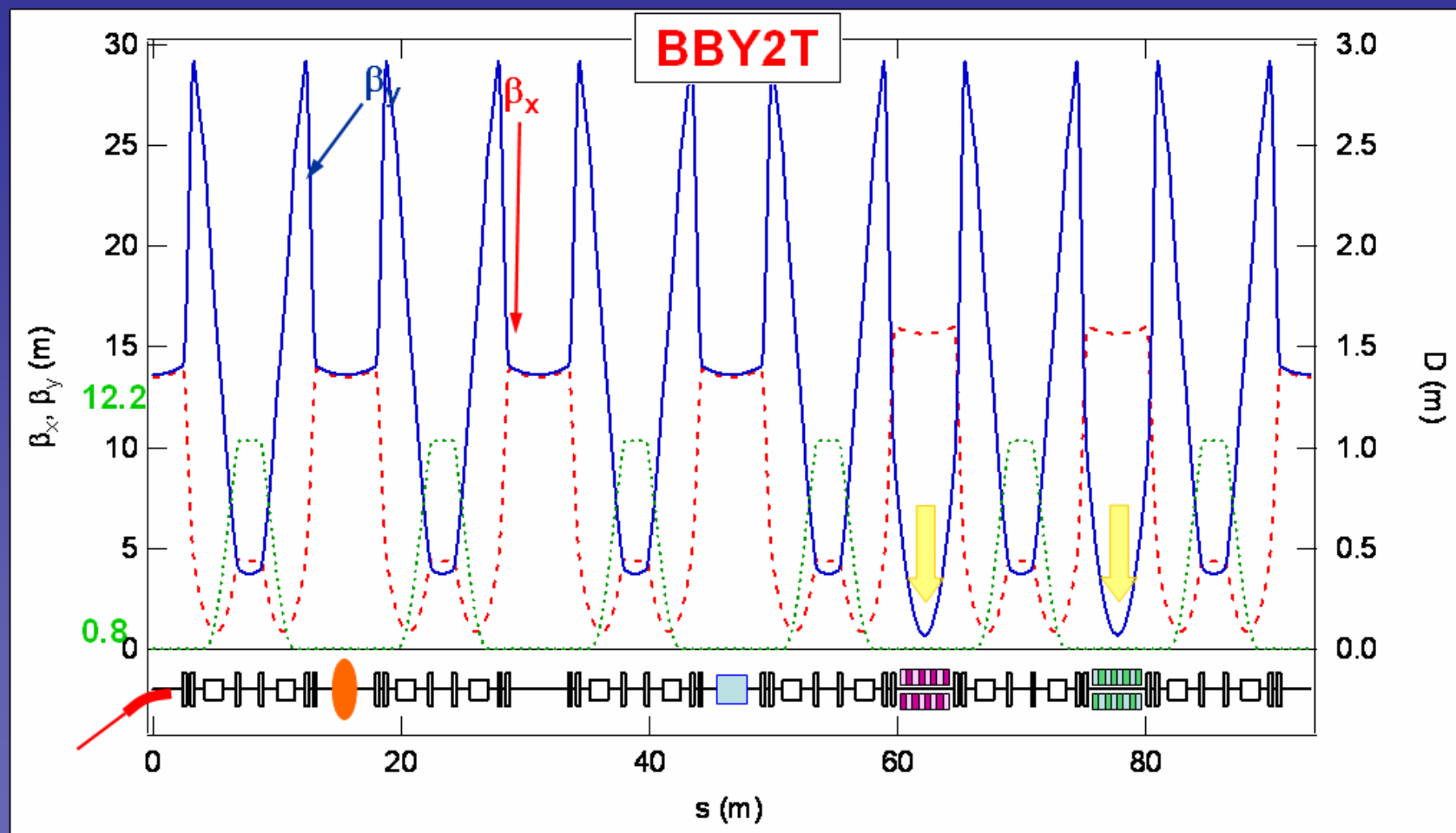
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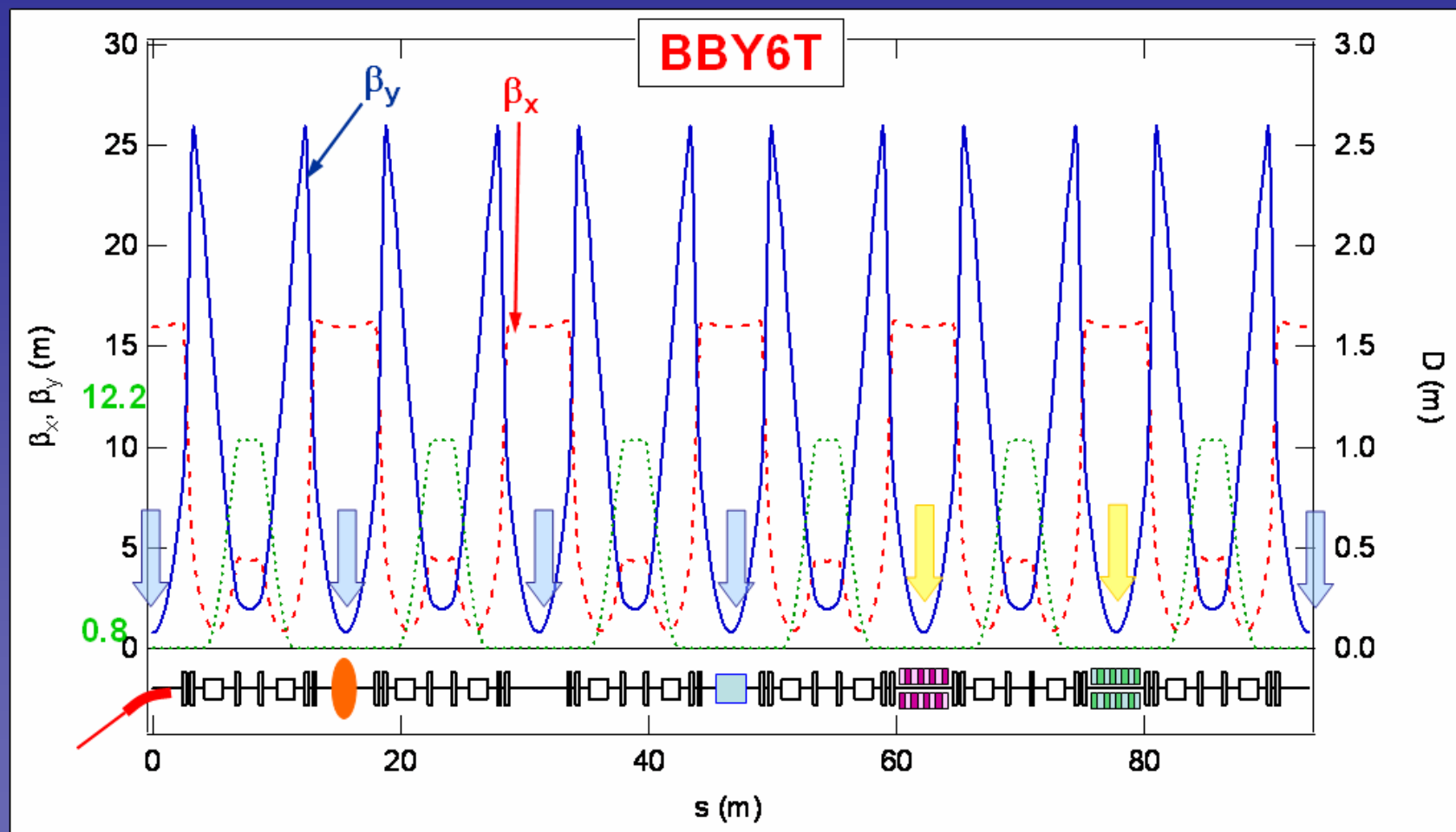
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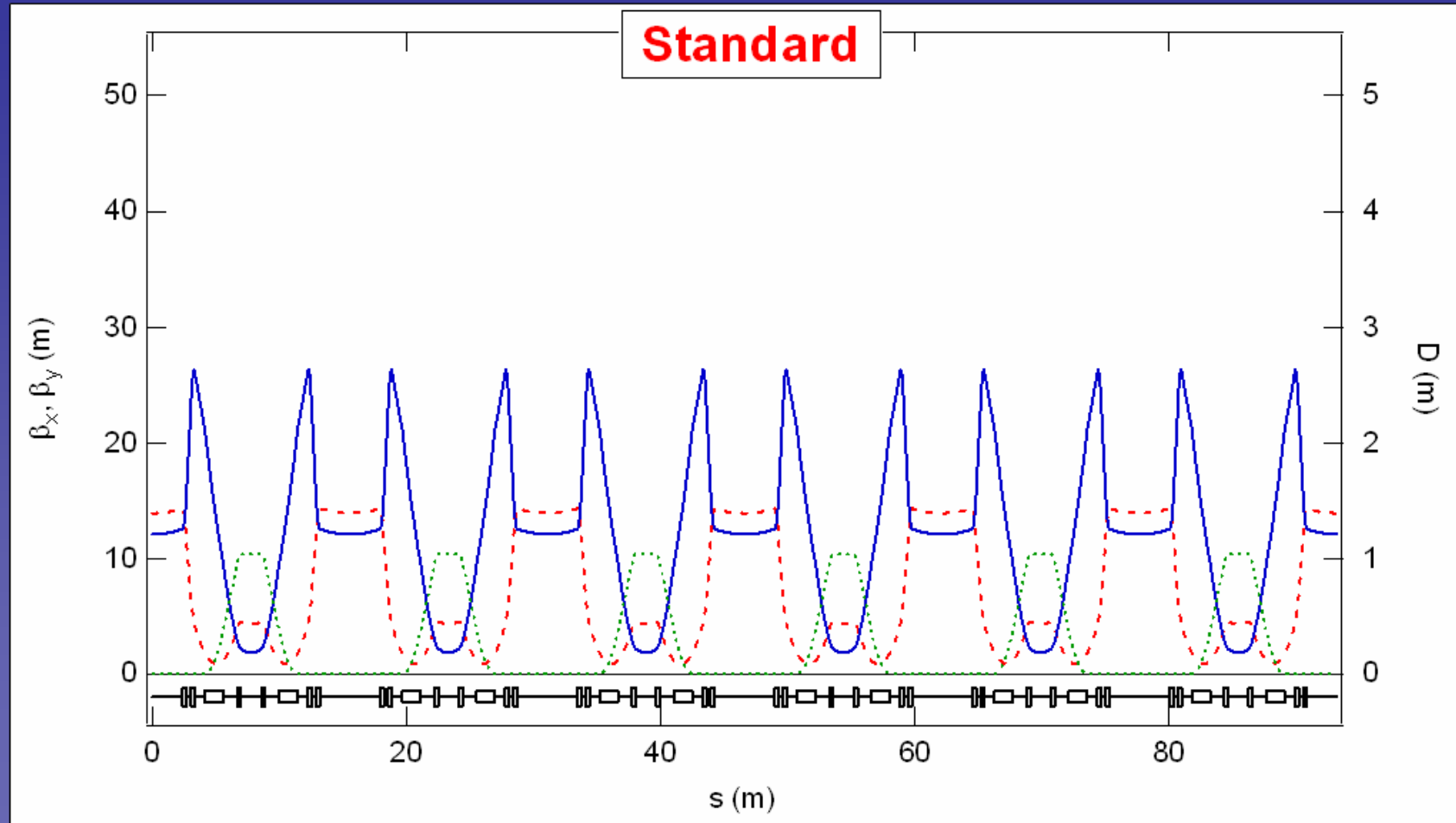
2005
2T WIG

$$\begin{aligned} v_x &= 5.27 \\ v_y &= 4.17 \end{aligned}$$

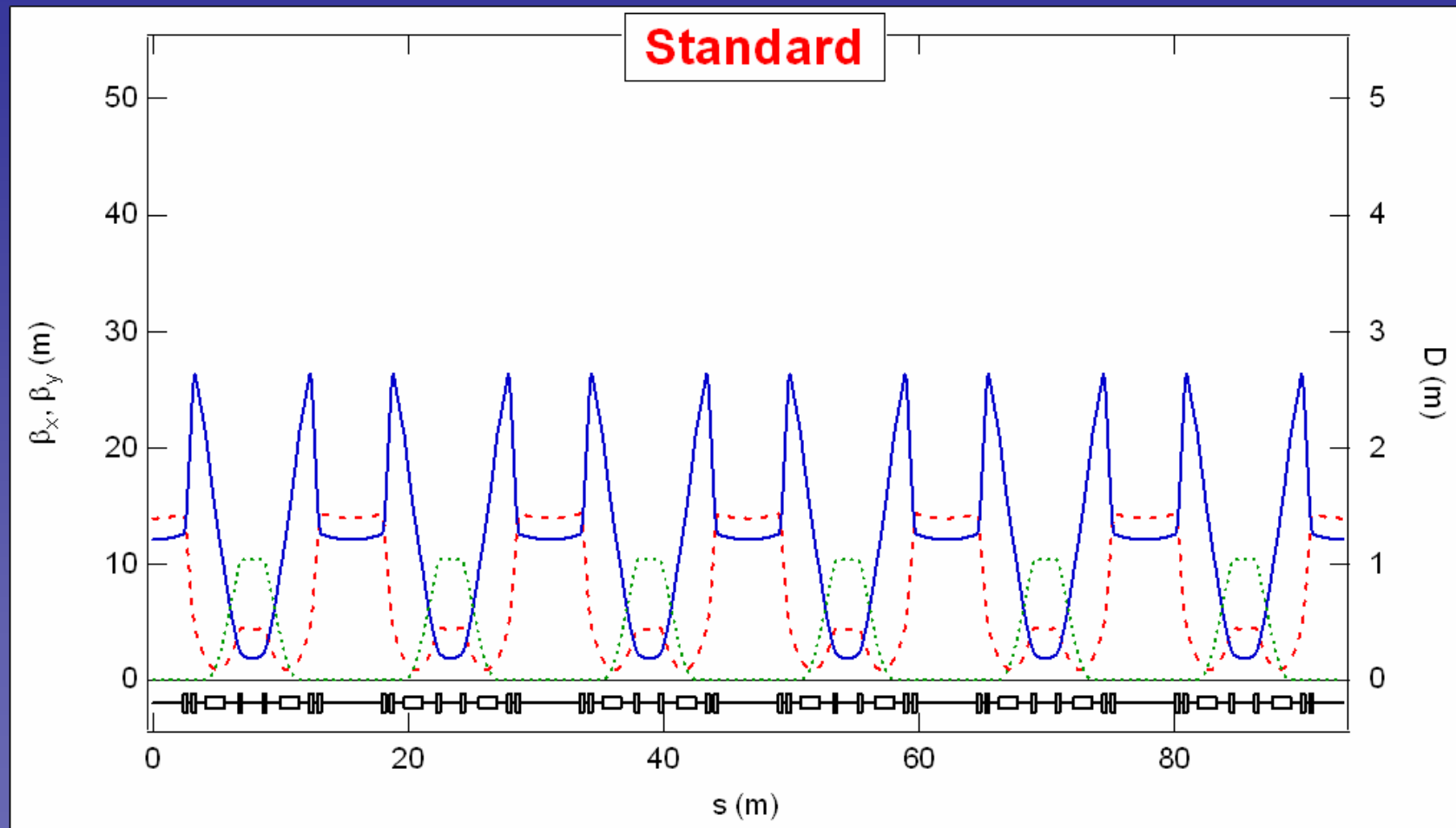
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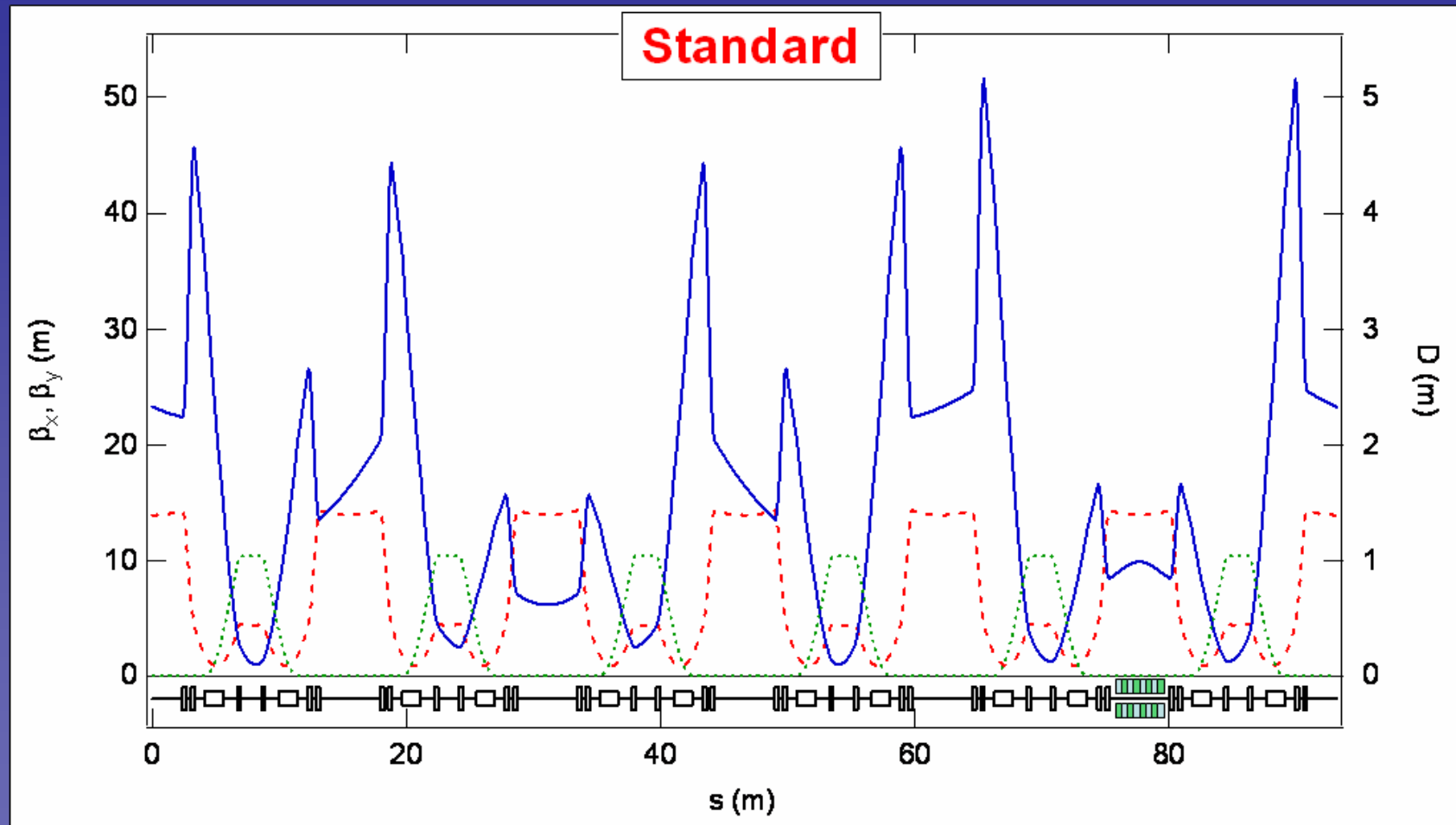
First order focussing effect of 2T WIG



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First order focussing effect of 2T WIG



2T WIG

$B_0 = 2.0$ T

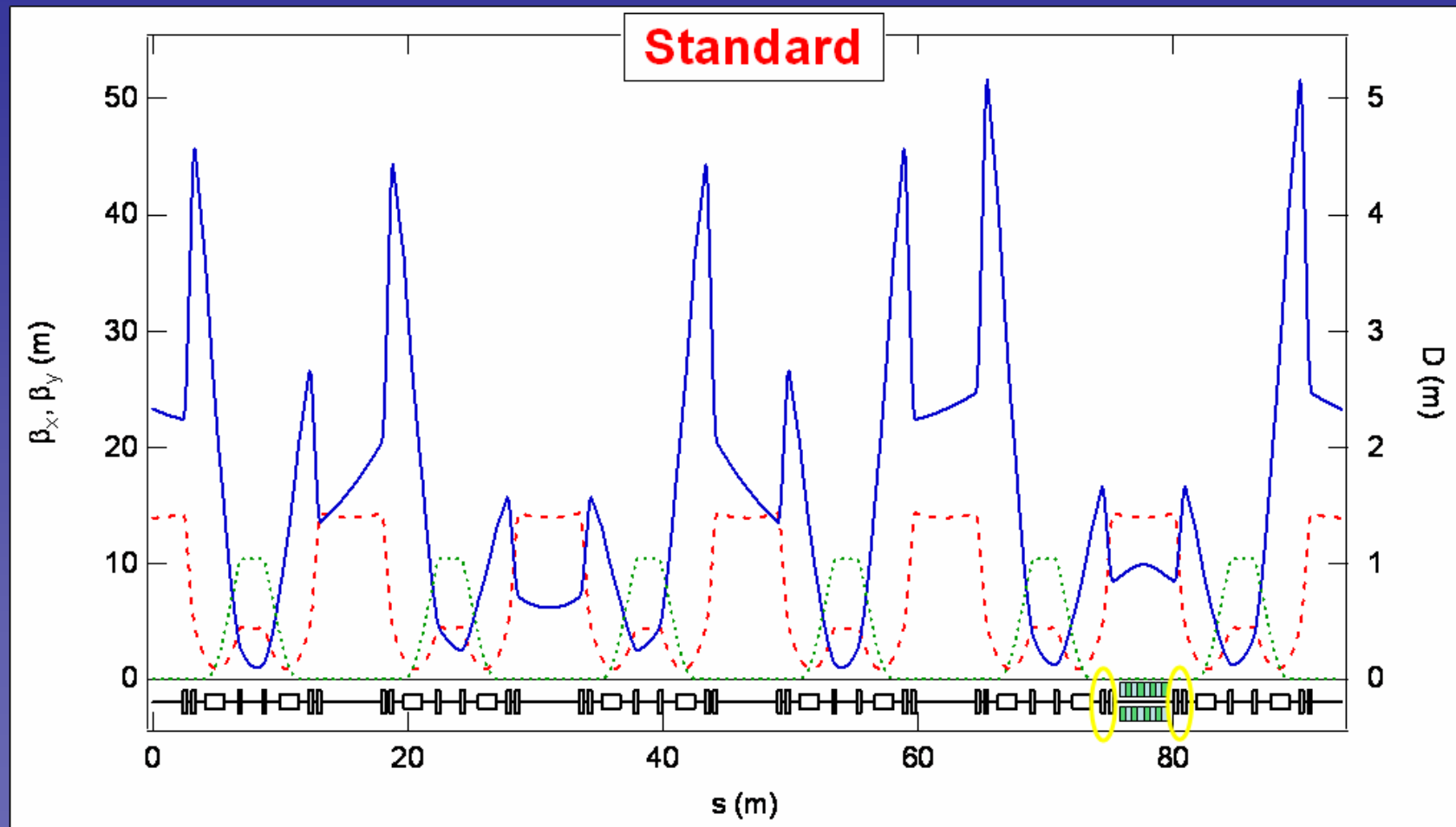
$\lambda = 18.0$ cm

$L = 2.7$ m

$K = 33.6$

BSC = 18 mm

First order focussing effect of 2T WIG



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$B_0 = 2.0$ T

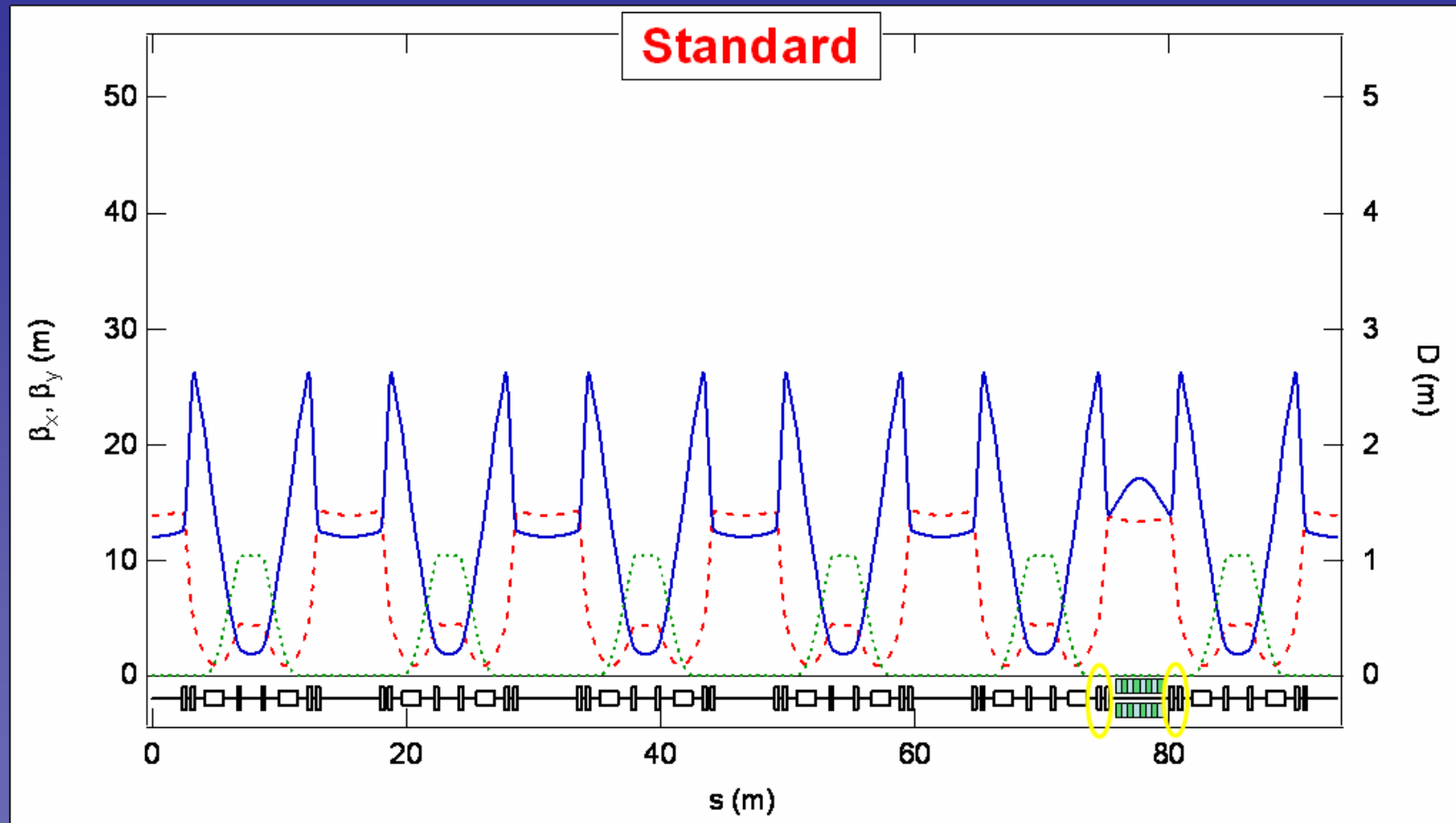
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2T WIG

$B_0 = 2.0 \text{ T}$

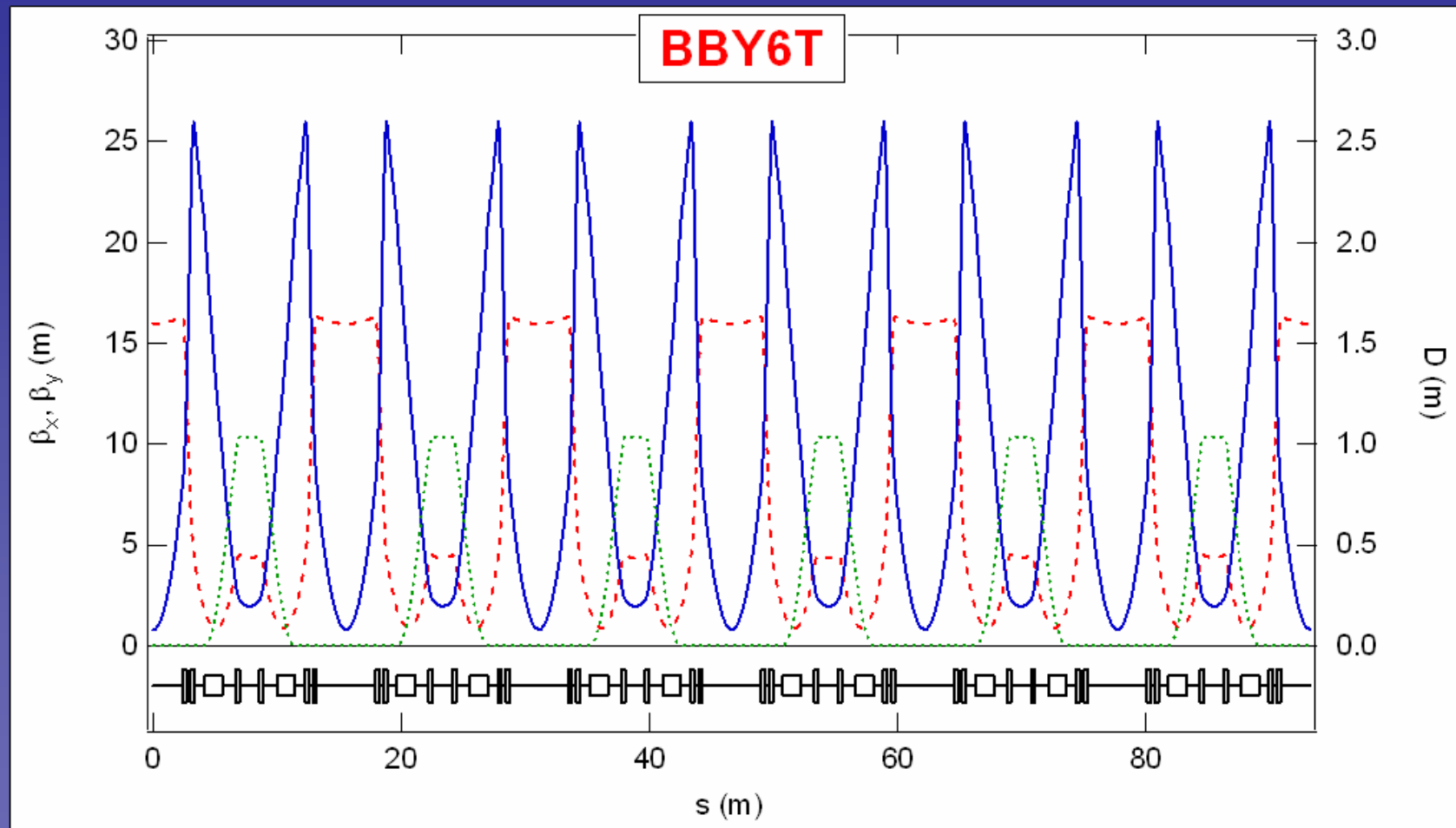
$\lambda = 18.0 \text{ cm}$

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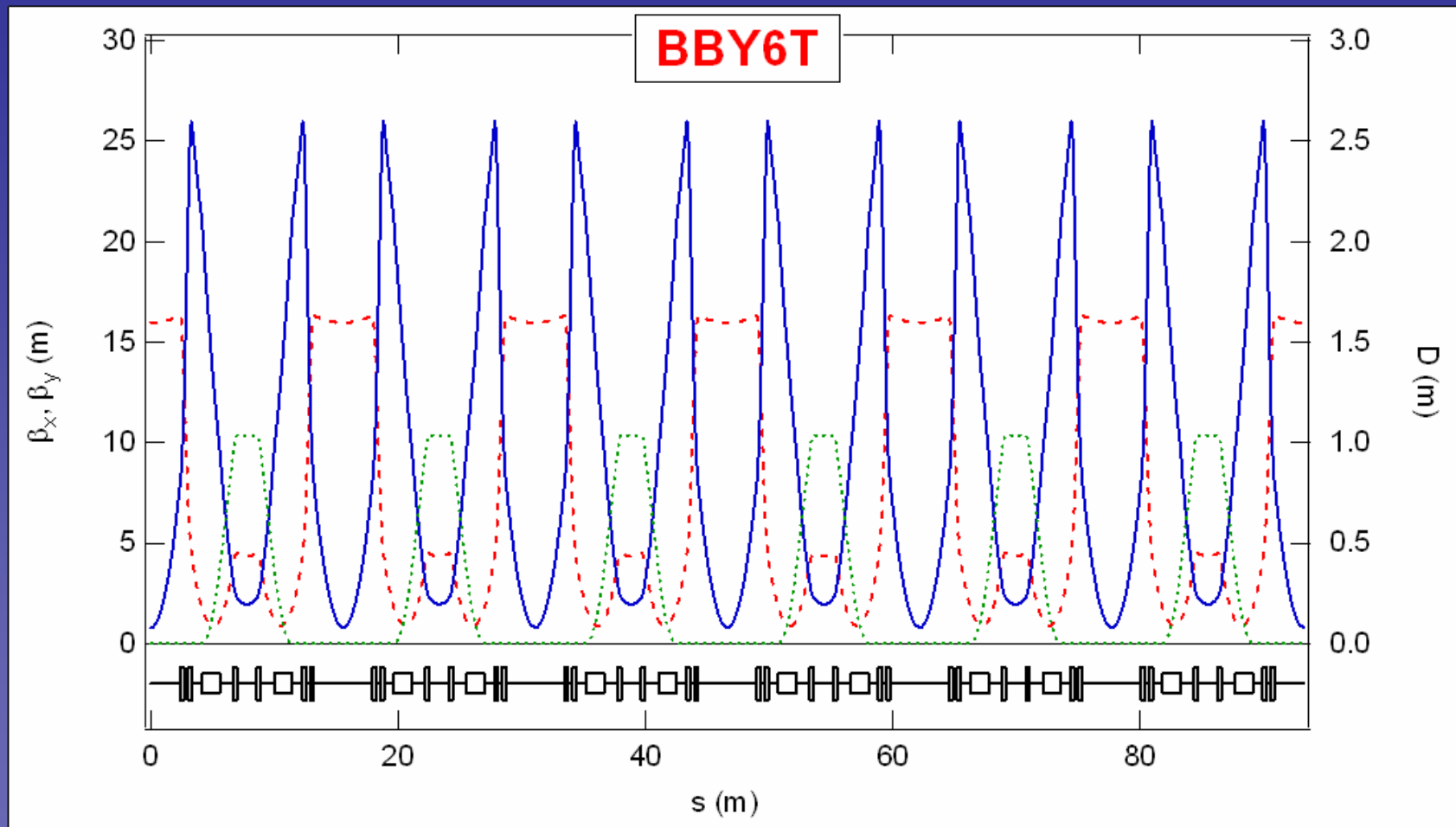
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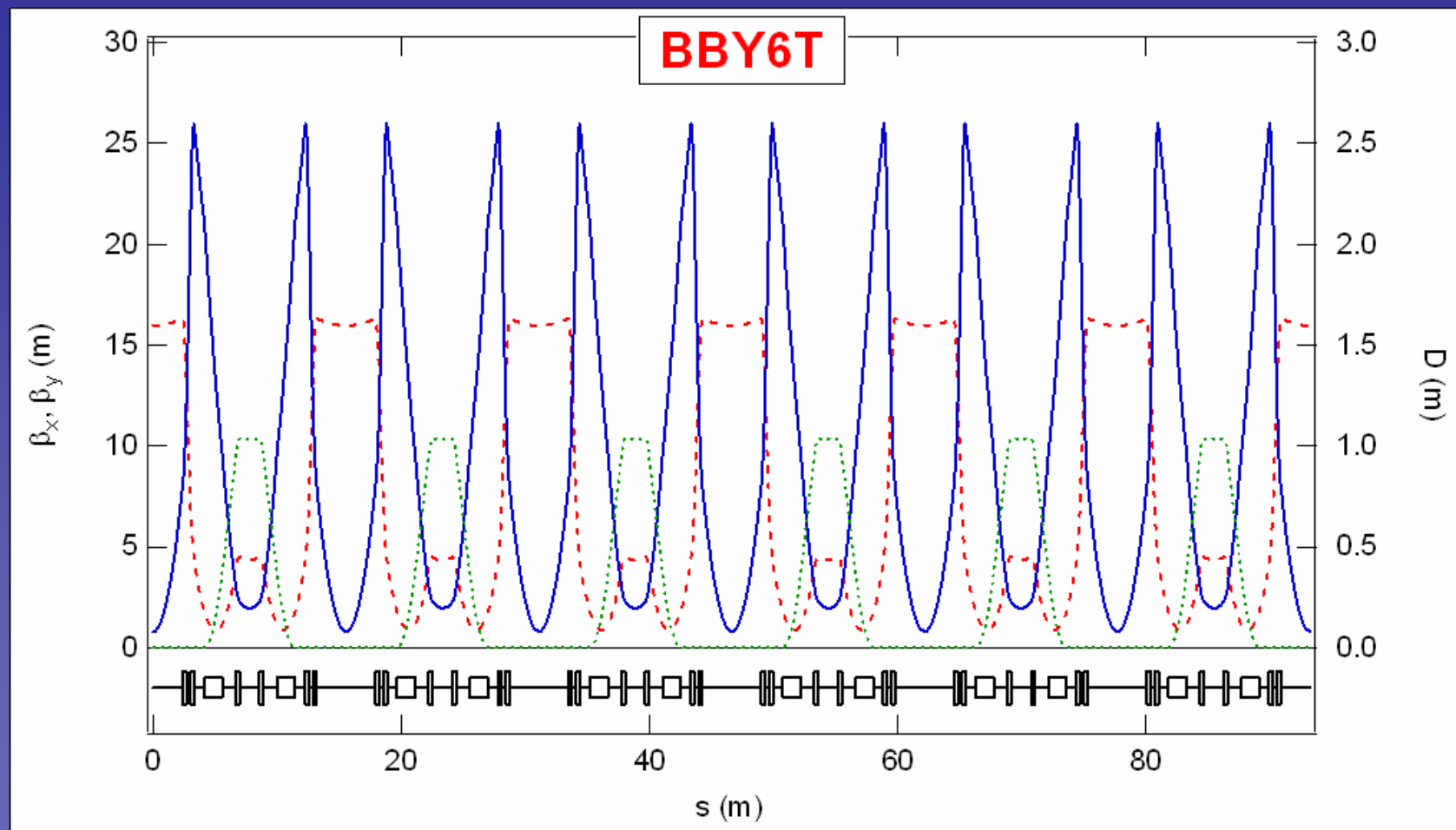
First order focussing effect of 2T WIG



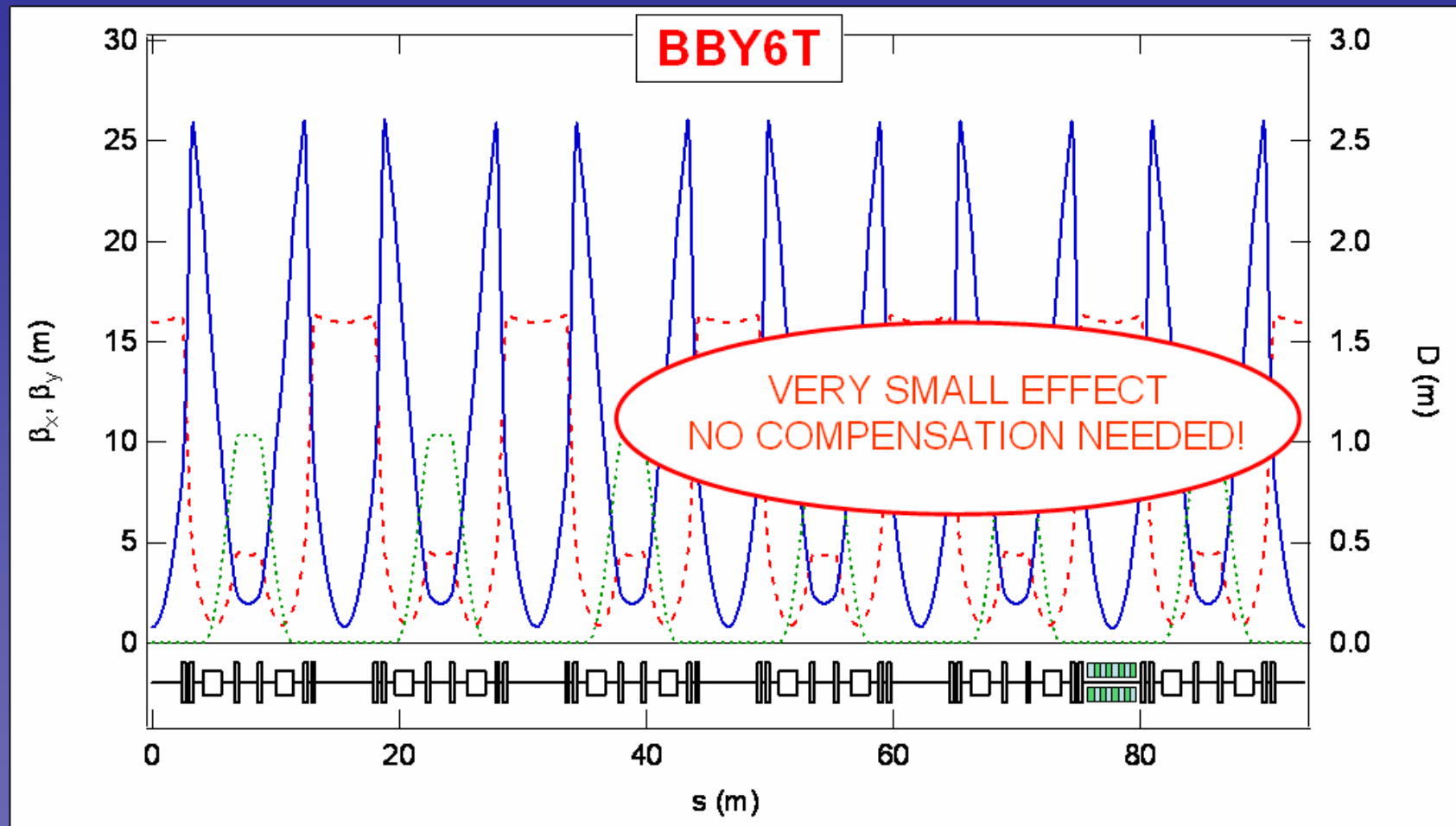
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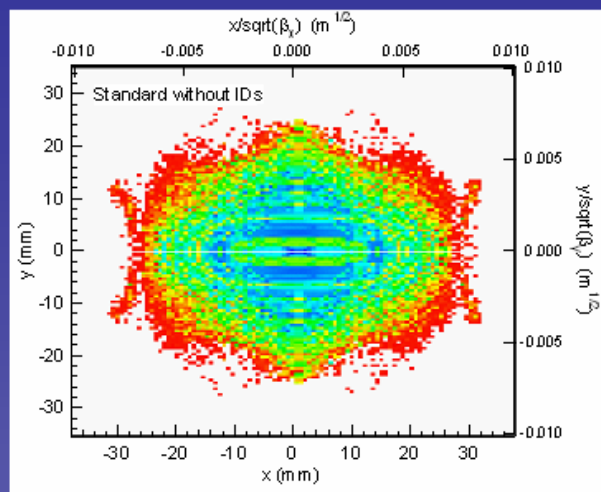


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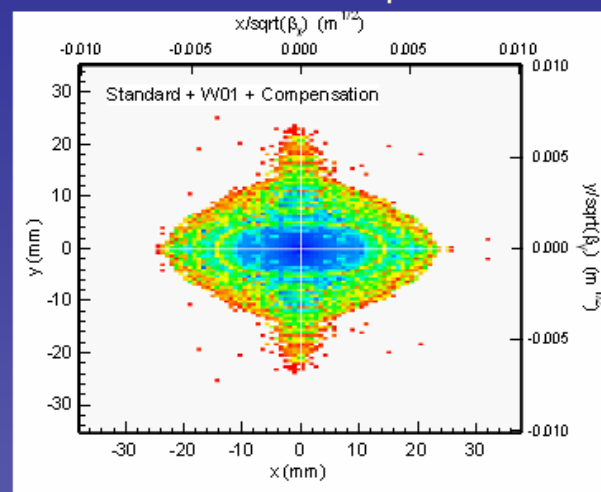
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Higher order effects of 2T WIG – Dynamic aperture

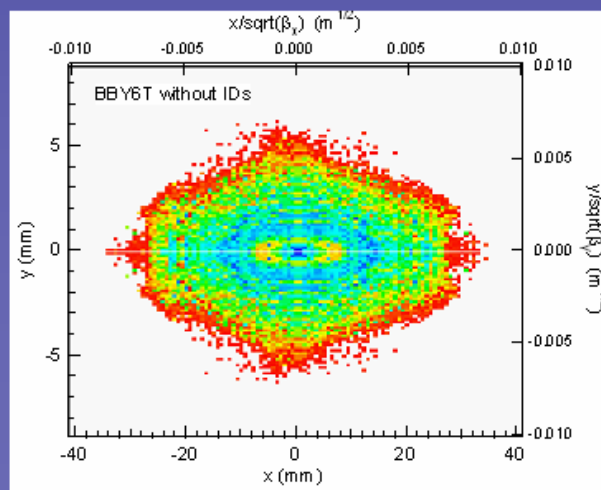
Standard mode without IDs



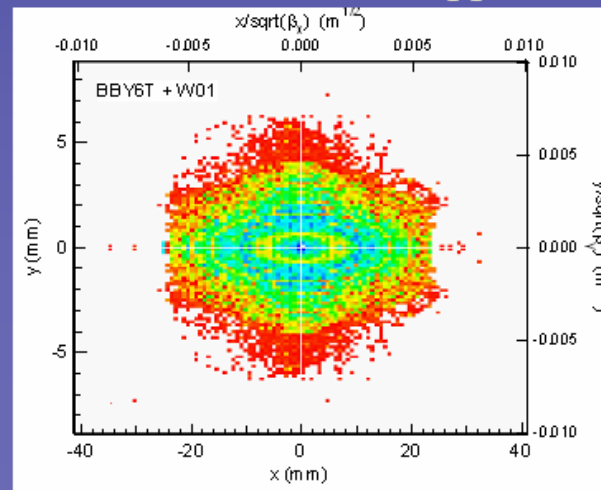
Standard mode + compensation + Wiggler



BBY6T mode without IDs



BBY6T mode + Wiggler



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Commissioning of BBY6T mode

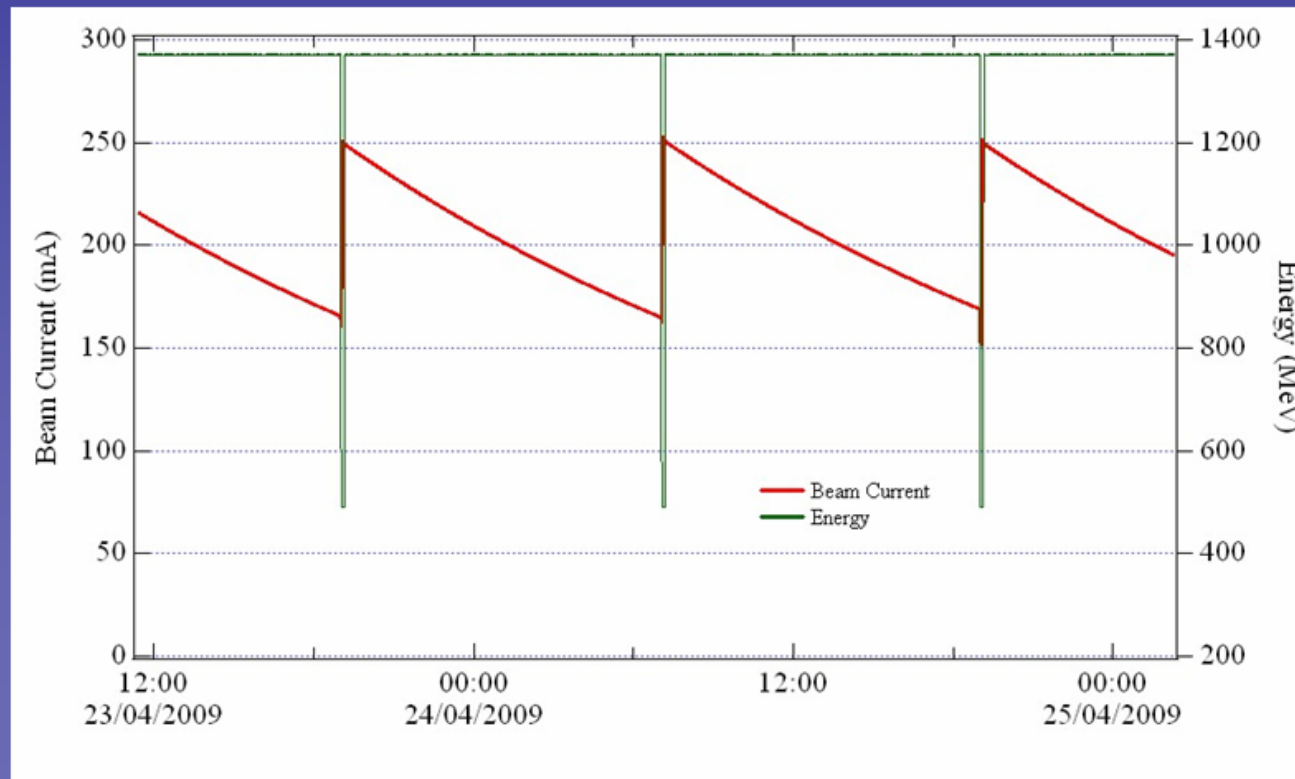
Commissioning in this case involves 3 stages:

- Injection and accumulation of 250 mA @ 500 MeV (injection energy).
- Ramp up to 1.37 GeV (operation energy).
- Ramp down from 1.37 GeV to 500 MeV. → Low energy 'top-up' to reduce injection time.

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Migração de Configurações

Sair Configurações Carregar Config. Correção Órbita

Prepara **Envia** **Habilita** **Dispara** **Pausa** **Continua** **Aborta** **Rec. DPM**

☒ Rec. Aut. Nome da Rampa:

Progresso

MeV NP VRF DT Inter. Registros (s) 1.0 Desliga Relógio

Configurações

Energia Inicial (MeV) **490.2780** Tempo Total = 51.45seg NPassos **128** ☐ RF Habilitada ☒ Abrir Bloqueio Gama ☐ Carregar Configuração

Conjunto: C:\Arq\Controle\BDADOS\CONFIGS\Normal\Run\Down\RampaUPFW.rmw

Config.	E(MeV)	F	Rp.(Hz)	Vi.(MeV/s)	DE(MeV)	Vg(kV)	DT(kHz)	T(s)	Passos	Função Res	Órbita Ref.	Corretoras	#	NOME	FORÇA
AN520BB6T.DB	520.460	1.000		14.946	0.671	2.300	3.500	2.020	46	Injecao	Referencia ACV	ok		A2QD01	-2.966
AN600BB6T.DB	601.820	1.500	79.218	23.694	1.196	2.300	3.500	3.434	69	Injecao	Referencia ACV	ok		A2QD03	-2.979
AN650BB6T.DB	650.550	1.200	69.898	15.769	0.902	2.300	3.500	3.090	55	Injecao	Referencia ACV	ok		A2QD05	-2.968
AN700BB6T.DB	699.590	1.000	20.027	5.456	1.090	2.300	3.500	8.988	46	Injecao	Referencia ACV	ok		A2QD07	-2.964
AN1000BB6T.DB	1001.000	2.000	18.004	14.910	3.313	2.300	3.500	20.218	92	Injecao	Referencia ACV	ok		A2QD09	-2.967
AN1200BB6T.DB	1200.300	2.000	69.898	38.261	2.190	2.300	3.500	5.208	92	Usuario	Referencia ACV	ok		A2QD11	-2.969
AN137BB6TW1.C	1371.300	2.000	74.267	34.894	1.879	2.300	3.500	4.901	92	Usuario	Referencia ACV	ok		A2QF01	2.684
AN137BB6TW1.C	1371.300	0.400	20.027	0.000	0.000	2.300	3.500	3.595	19	Usuario	Referencia ACV+ALV	ok		A2QF03	2.697
														A2QF05	2.696
														A2QF07	2.696
														A2QF09	2.697
														A2QF11	2.698
														A6QF01	1.894
														A6QF02	1.894

Wiggler

☒ Rampa com Wiggler Gap Final (mm) **22.0**

Leitura Gap (mm) **22.001** **21.986**

Resolver Encoder **22.001** **21.986**

Ajuste Gap (mm) **22.000**

Modo Ajuste Gap ☒ Direto ☐ Sincronizado

Status

Wiggler

- 1 - GOODGAPS 8 - ERRPOS
- 2 - GapERR 9 - CMDRCVD
- 3 - GAPMOVST 10 - STRFLAG
- 4 - SYNCHFLG 11 - PWRFLAG
- 5 - LSRECOVR 12 - MVSTATUS
- 6 - ERRLSW 13 - ERRCALIB
- 7 - HomeFlg 14 - ConFlag

Indicação de Fim de Rampa das Fontes.
Confirmado
Terminou rampa fontes 1 - 0
13:47:41 - Timer 3 - desabilitado!! (Timer2)
-> Alterando o modo de AJUSTE
Sincronizado do WIGGLER!!
Movimento Completado.
Ajuste Modo Gap = 0 - Direto

Ondulador

☐ Mover Passo **500**

Gap **22** Fase **0.0**

Gap **22** Fase **0.0**

A **300.0000** S **0.0000**

B **300.0000** I **0.0000**

☐ Sincronismo ☐ Sincronismo

Delta Gap **0.00**

☐ Fase ☒ ContraFase

Relógio

Liga **Desliga**

Taxa(Hz) **20.03**

Contador

Liga **Desliga**

Reset

?? Contador = 0

Taxa Rep : 20.03

☒ Reset Timer

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Characterization of BBY6T

- Series of beam dynamics measurements.
- Program for measurement automatization.

The screenshot shows the 'Medidas Anel' software window. It has a menu bar with 'Matriz', 'Seleciona Corretoras', 'Função Beta', 'Dispersão', 'Perdas', 'Configuração BBA', and 'BBA'. The main area is divided into several sections:

- Shunts:** A list of 24 shunt channels, each with a checked checkbox. The channels are arranged in two columns: AQB01A through AQB09B and AQB10A through AQB11B.
- Clicagem dos Shunts:** A section for shunt triggering with input fields for 'Corrente Shunts Pares[A]' (1.0), 'Corrente Shunts Ímpares[A]' (1.0), '# Ciclos' (5), and 'Pausa [ms]' (1500). A 'Cicla' button is below these fields.
- Medida de Sintonia:** A section for tuning measurement with labels for 'Bétatron X' and 'Bétatron Y'.
- Medidas:** A section for measurements with input fields for 'fx' and 'fy', and 'Inicial' and 'Final' values.
- Delta QF Par:** A section for Delta QF Par with a value of 5.0.
- Delta QF Ímpar:** A section for Delta QF Ímpar with a value of 5.0.
- Delta QD:** A section for Delta QD with a value of 5.0.
- Espera após ajuste Shunt (ms):** A section for waiting time after shunt adjustment with a value of 5000.
- Intervalo Leituras Shunt (ms):** A section for shunt reading interval with a value of 500.
- Nº leituras de Sintonia:** A section for number of tuning readings with a value of 10.
- Número de Medidas:** A section for number of measurements with a value of 1.
- Medir Função:** A button to measure the function.
- Arquivo Registro:** A section for the log file with the path 'c:\arq\medidas\F_Beta.dat'.

Characterization of BBY6T

Series of beam dynamics measurements.
- Program for measurement automatization.

Orbit response matrix

The screenshot shows the 'Medidas Anel' software interface with the following sections:

- Matriz** (selected tab):
 - Shunts**: A list of 24 shunt components, each with a checked checkbox. The components are arranged in two columns: AQF01A through AQF09B and AQF10A through AQD11B.
 - Clicagem dos Shunts**: Fields for 'Corrente Shunts Pares[A]:' (1.0), 'Corrente Shunts Ímpares[A]:' (1.0), '# Ciclos:' (5), and 'Pausa [ms]:' (1500). A 'Cicla' button is below these fields.
 - Medida de Sintonia**: Fields for 'Bétatron X' and 'Bétatron Y'.
 - Medidas**: Fields for 'fx' and 'fy', each with 'Inicial' and 'Final' input boxes.
- Função Beta**: Fields for 'Delta QF Par:' (5.0), 'Delta QF Ímpar:' (5.0), 'Delta QD' (-5.0), 'Espera após ajuste Shunt (ms)' (5000), 'Intervalo Leituras Shunt (ms)' (500), 'Nº leituras de Sintonia' (10), and 'Número de Medidas:' (1). A 'Medir Função' button is below these fields.
- Dispersão**: (Empty)
- Perdas**: (Empty)
- Configuração BBA**: (Empty)
- BBA**: (Empty)
- Arquivo Registro:**: A text box containing 'c:\arq\medidas\F_Beta.dat'.

Characterization of BBY6T

Series of beam dynamics measurements.
- Program for measurement automatization.

Orbit response matrix

Medidas Anel

Matriz | Seleciona Corretoras | Função Beta | Dispersão | Perdas | Configuração BBA | BBA

Shunts

☒ AQF01A	☒ AQF10A
☒ AQF01B	☒ AQF10B
☒ AQF02A	☒ AQF11A
☒ AQF02B	☒ AQF11B
☒ AQF03A	☒ AQF12A
☒ AQF03B	☒ AQF12B
☒ AQF04A	☒ AQD01A
☒ AQF04B	☒ AQD01B
☒ AQF05A	☒ AQD03A
☒ AQF05B	☒ AQD03B
☒ AQF06A	☒ AQD05A
☒ AQF06B	☒ AQD05B
☒ AQF07A	☒ AQD07A
☒ AQF07B	☒ AQD07B
☒ AQF08A	☒ AQD09A
☒ AQF08B	☒ AQD09B
☒ AQF09A	☒ AQD11A
☒ AQF09B	☒ AQD11B

Clicagem dos Shunts

Corrente Shunts Pares[A]: 1.0

Corrente Shunts Ímpares[A]: 1.0

Ciclos: 5

Pausa [ms]: 1500

Cicla

Medida de Sintonia

Bétatron X

Bétatron Y

Medidas

	fx	fy
Inicial		
Final		

Delta QF Par: 5.0

Delta QF Ímpar: 5.0

Delta QD: 5.0

Espera após ajuste Shunt (ms): 5000

Intervalo Leituras Shunt (ms): 500

Nº leituras de Sintonia: 10

Número de Medidas: 1

Medir Função

Arquivo Registro: c:\arq\medidas\F_Beta.dat

Characterization of BBY6T

Series of beam dynamics measurements.
- Program for measurement automatization.

Orbit response matrix

Betatron function

Dispersion function

BBA

The screenshot shows the 'Medidas Anel' software interface. At the top, there is a menu bar with options: Matriz, Seleciona Corretoras, Função Beta, Dispersão, Perdas, Configuração BBA, and BBA. Below the menu bar, the 'Função Beta' tab is selected. The interface is divided into several sections:

- Shunts:** A list of 24 shunts (AQF01A to AQD11B) with checkboxes. All are checked.
- Clicagem dos Shunts:** Fields for 'Corrente Shunts Pares[A]' (1.0), 'Corrente Shunts Ímpares[A]' (1.0), '# Ciclos' (5), and 'Pausa [ms]' (1500). A 'Cicla' button is below.
- Medida de Sintonia:** Fields for 'Bétatron X' and 'Bétatron Y'.
- Medidas:** Fields for 'fx' and 'fy' with 'Inicial' and 'Final' sub-fields.
- Delta QF Par:** 5.0
- Delta QF Ímpar:** 5.0
- Delta QD:** 5.0
- Espera após ajuste Shunt (ms):** 5000
- Intervalo Leituras Shunt (ms):** 500
- Nº leituras de Sintonia:** 10
- Número de Medidas:** 1
- Medir Função:** A button.
- Arquivo Registro:** c:\arq\medidas\F_Beta.dat

Characterization of BBY6T

Series of beam dynamics measurements.
- Program for measurement automatization.

Orbit response matrix

Betatron function

Dispersion function

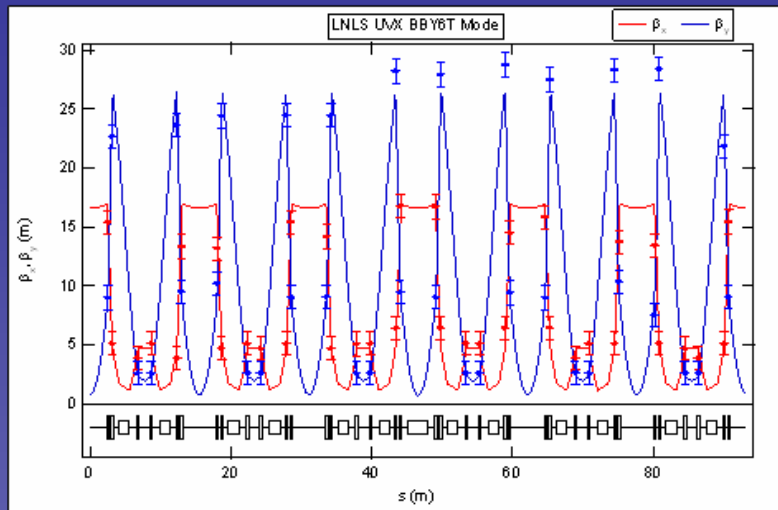
BBA

The screenshot shows the 'Medidas Anel' software interface. At the top, there is a menu bar with options: Matriz, Seleciona Corretoras, Função Beta, Dispersão, Perdas, Configuração BBA, and BBA. Below the menu bar, the 'Função Beta' tab is selected. The interface is divided into several sections:

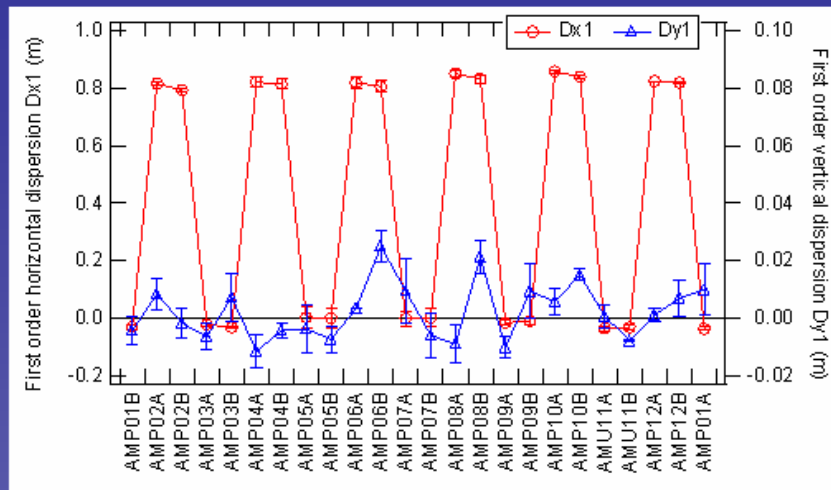
- Shunts:** A list of 24 shunt components, each with a checkbox and a label (e.g., AQF01A, AQF10A, AQD01A, etc.).
- Clicagem dos Shunts:** A section for configuring shunt measurements, including fields for 'Corrente Shunts Pares[A]', 'Corrente Shunts Ímpares[A]', '# Ciclos', and 'Pausa [ms]', along with a 'Cicla' button.
- Medida de Sintonia:** A section for measuring the betatron functions, with labels for 'Bétatron X' and 'Bétatron Y'.
- Medidas:** A section for measuring the dispersion function, with fields for 'fx' and 'fy', and 'Inicial' and 'Final' values.
- Delta QF Par:** A field for the parallel delta QF, set to 5.0.
- Delta QF Ímpar:** A field for the odd delta QF, set to 5.0.
- Delta QD:** A field for the delta QD, set to 5.0.
- Espera após ajuste Shunt (ms):** A field for the wait time after shunt adjustment, set to 5000.
- Intervalo Leituras Shunt (ms):** A field for the shunt reading interval, set to 500.
- Nº leituras de Sintonia:** A field for the number of tuning readings, set to 10.
- Número de Medidas:** A field for the number of measurements, set to 1.
- Medir Função:** A button to measure the function.
- Arquivo Registro:** A field for the log file name, set to 'c:\arq\medidas\F_Beta.dat'.

Characterization of BBY6T

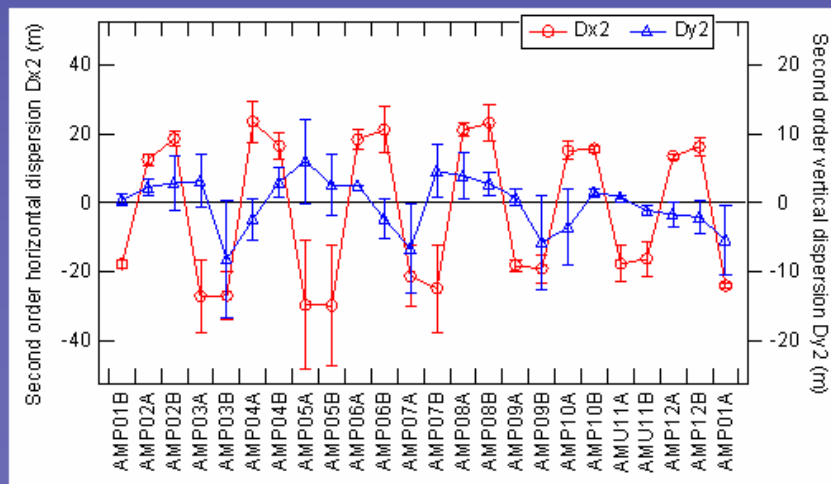
First order dispersion function measurement



Betatron function measurement by changing quadrupole strengths after symmetrization using LOCO.
(Poster on Thursday TH6PFP012).

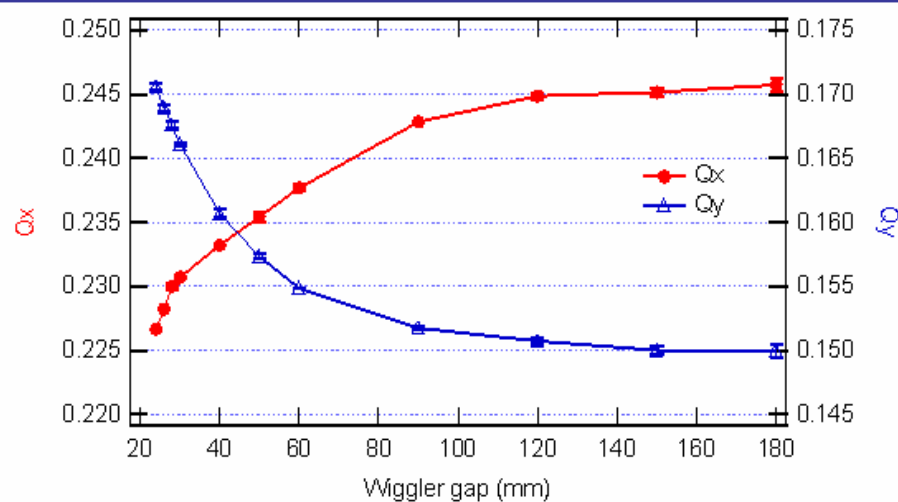


Second order dispersion



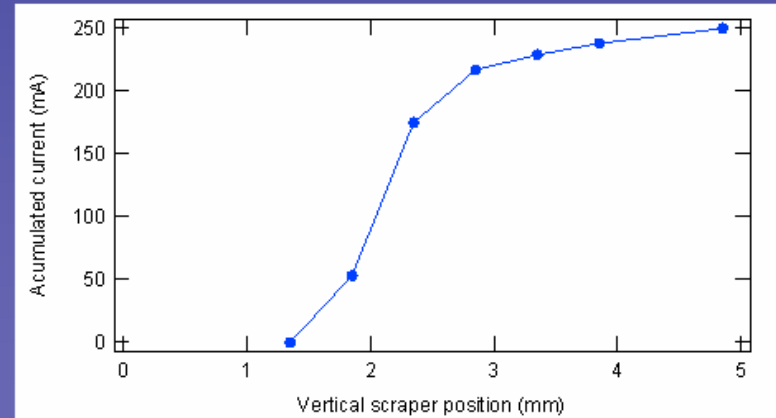
Characterization of BBY6T

Tune shift as a function of wiggler full gap.

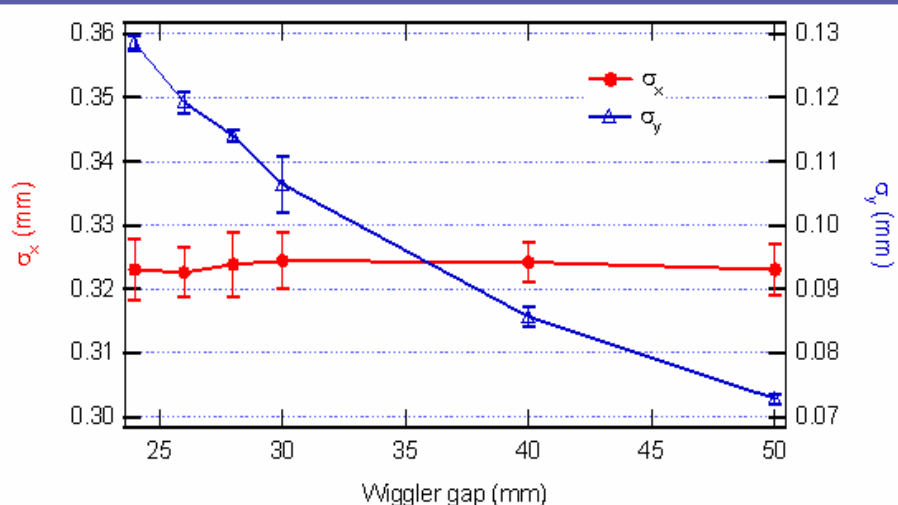


Saturation current at injection as a function of vertical scraper position.

5.0 mm @ scraper scales to
3.5 mm @ ss centre
9.7 mm @ ss extremities



Beam sizes as a function of wiggler full gap.



Outline

1. Brief introduction to LNLS
2. The operation modes for UVX: Standard, BBY6T
3. Effects of IDs
4. Commissioning of BBY6T
5. Characterization of BBY6T
6. Conclusions

Conclusions

- We have changed the nominal operation mode for the LNLS UVX storage ring after 11 years of operation.
- The new mode was successfully commissioned at the end of 2008.
- We can open and close the presently installed IDs without compensation and without losing the beam.
- BBY6T is routinely employed for users runs since the beginning of 2009.

Thank you
for your attention !