PS2 Lattice status

Riccardo de Maria (BNL),
Lattice team: W. Bartmann (CERN), M. Benedikt (CERN), B. Goddard (CERN), Y. Papaphilippou (CERN), S. Peggs (BNL), D. Trbojevic (BNL)

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PS2 in the injector chain

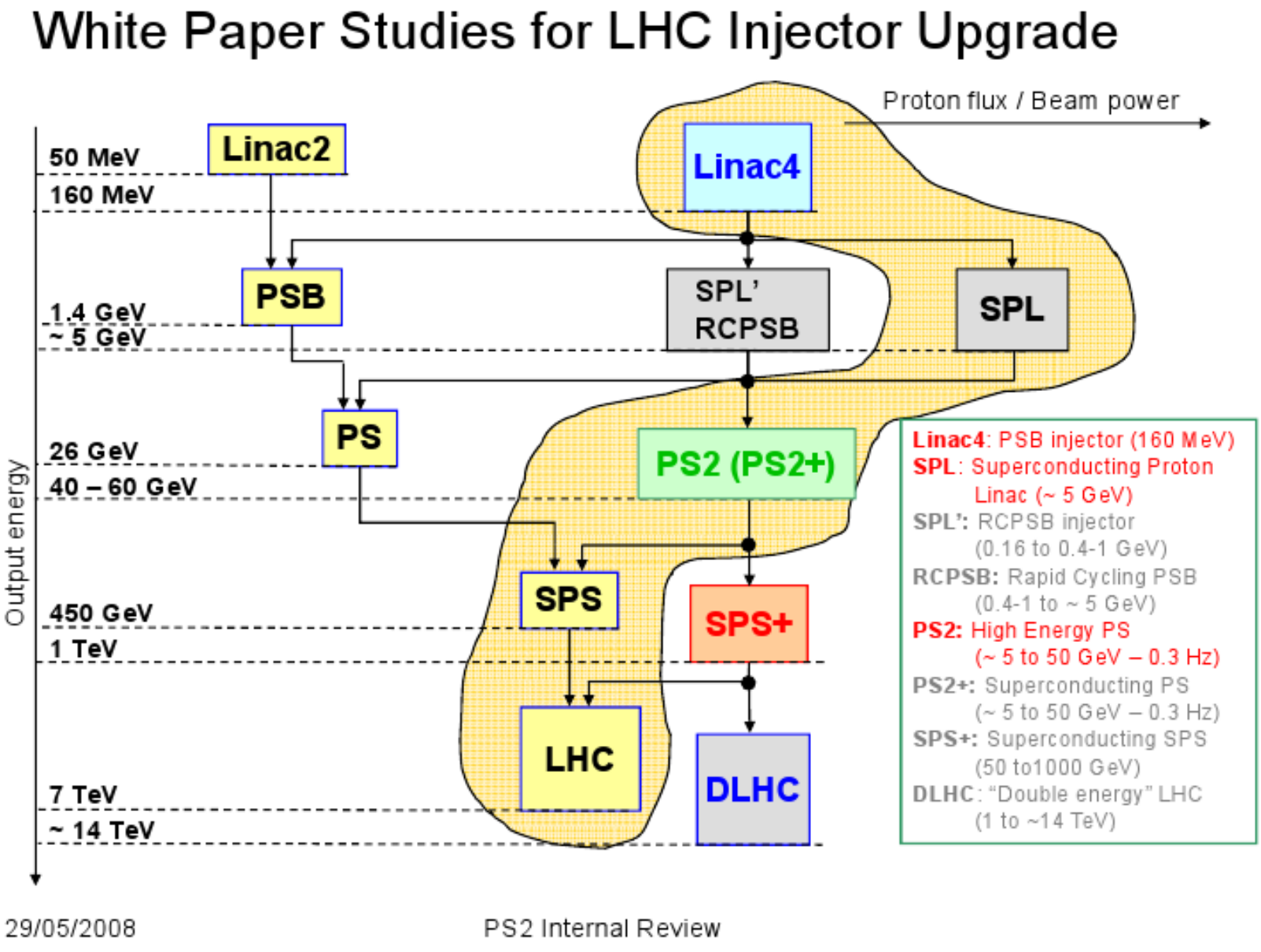
PS2 beams

PS2 main parameters

Lattice

Arc variants

PS2 in the injector chain



(M. Benedikt)

PS2 improvement for the LHC luminosity

The PS2 will contribute to an increase of the LHC luminosity because of:

- increase of beam current;
- reduce turn around time;
- improve the reliability of the injector complex;
- reduce the emittance growth and losses in SPS (reduce space charge, smaller beam size);
- allows a potential energy upgrade of the SPS and the LHC.

PS2 beams

Protons for the LHC:

- $4.2 \cdot 10^{11}$ for 25ns bunches (40Mhz),
- 4GeV - 50GeV (3% RF frequency change),
- H- from LP SPL (commissioning from PS),
- RF structure: chopping at 40MHz or at 10MHz with splitting (implication for the lattice).

Ions for the LHC:

- extracted from LEIR at 6.7Tm,
- 210% RF frequency change.

Protons for fixed target experiment.

- $7 \cdot 10^{11}$ for 25ns bunches (40Mhz),
- SPS filling for CNGS using multi turn extraction (MTE)
- slow resonant and fast extraction and to target area

PS2 main parameters

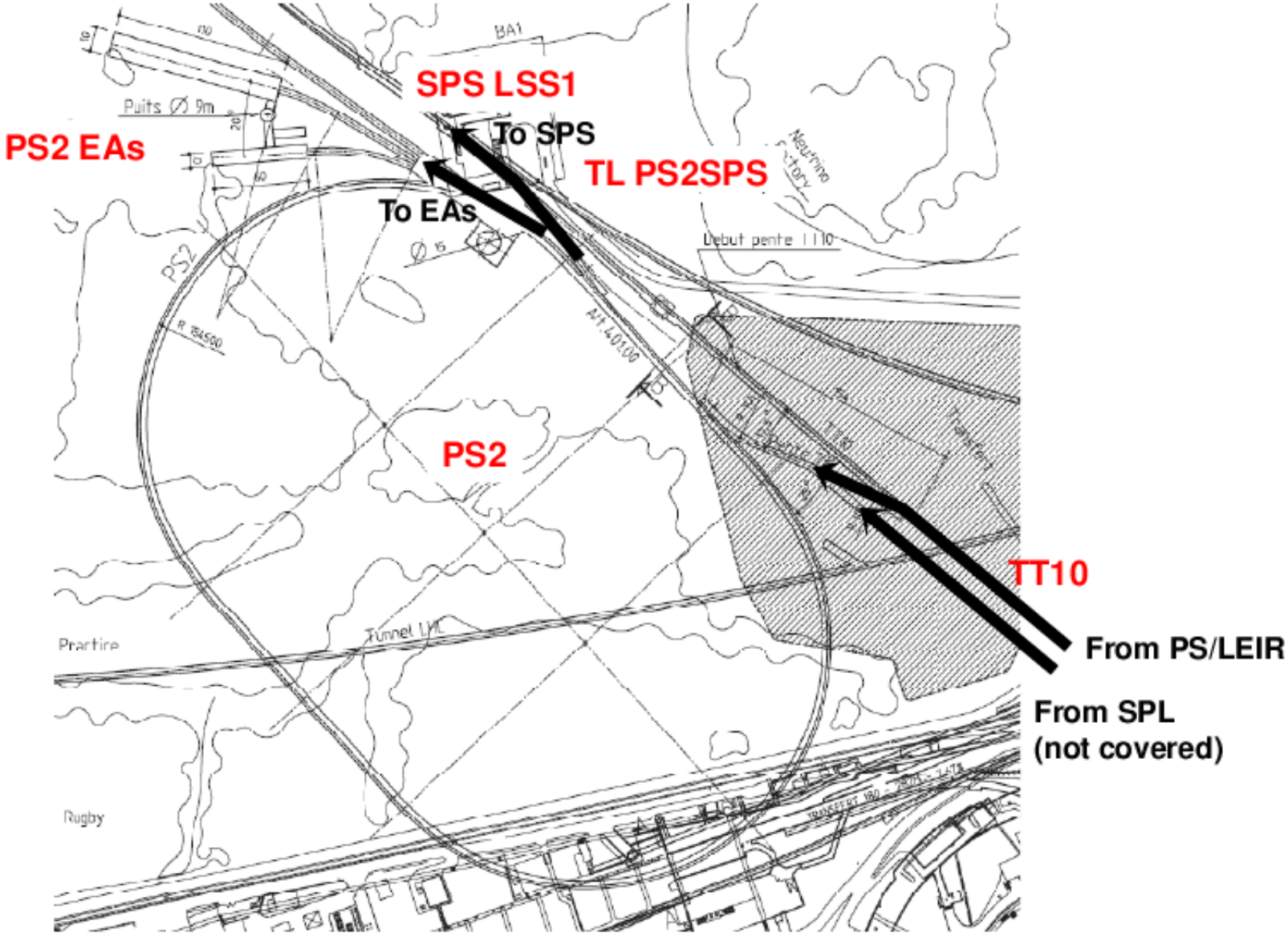
The PS2 main parameters are:

- length: PS2 = 15/77 SPS = 15/7 PS = 1346.4m,
- h (at 40Mhz) = 180,
- normal conducting magnets, separate functions,
- max bending field 1.8T,
- max gradient 17T/m,
- pole tip radius 65mm,
- cycle time 2.4s. (1.2s ramp).

Layout


Linac 4
SPL
96.7
(460)
PROFIL EN LONG – H=1/2000 L=1/1000
COUPE AMOREE SPL – 1/200e
Fourreau circulaire realise par carottage
Puis tubage 1100x150mm
PS2
TI2
Coupe A-A – 1/100e
PS2
TT10
Coupe B-B – 1/100e
Practice
Foot
Rugby
GOLF
BAT
Neutrino factory
Début pente TT9

Layout


SPS LSS1
To SPS
TL PS2SPS
PS2 EAs
To EAs
PS2
TT10
From PS/LEIR
From SPL
(not covered)
Puits Ø 9m
Début pente 1 1 10
Prairie
Rugby

Lattice

After exploring a FODO lattice with gamma transition jump, negative momentum compaction (NMC) lattices have given higher priority.

The absolute value of gamma transition set the adiabatic time for RF manipulation (not a big issue if a 40Mhz system is used).

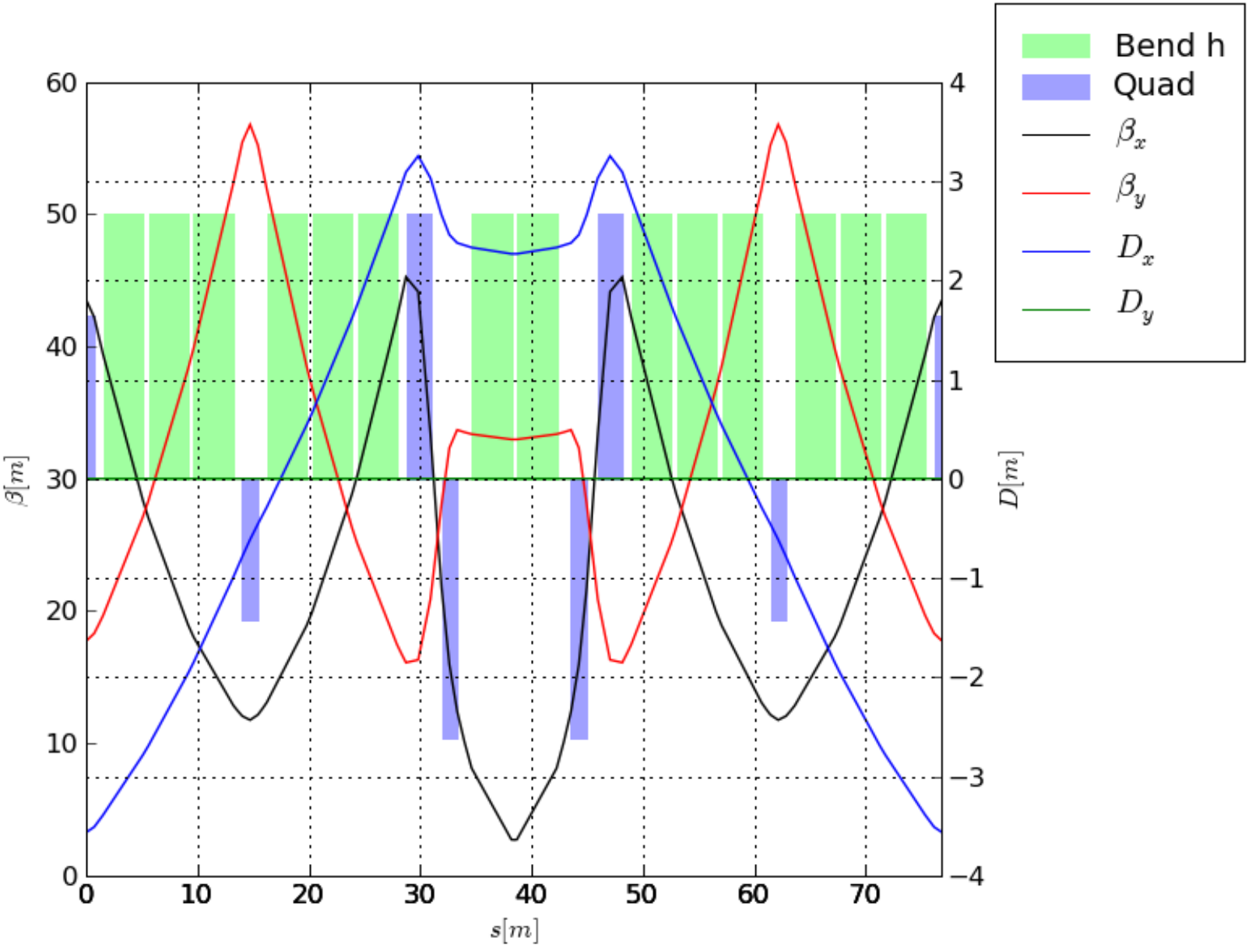
$$\alpha_c = \frac{1}{L}\int D_x k_0 ds$$

$$\ddot{\phi} + \Omega^2(\sin\phi - \sin\phi_s) = 0$$

$$\Omega^2 = \frac{eV h \alpha_c \omega_x \cos\phi_s}{2\pi R_s p_s}$$

$$\gamma_{tr} = \sqrt{1/\alpha_c}$$

Arc cell prototype



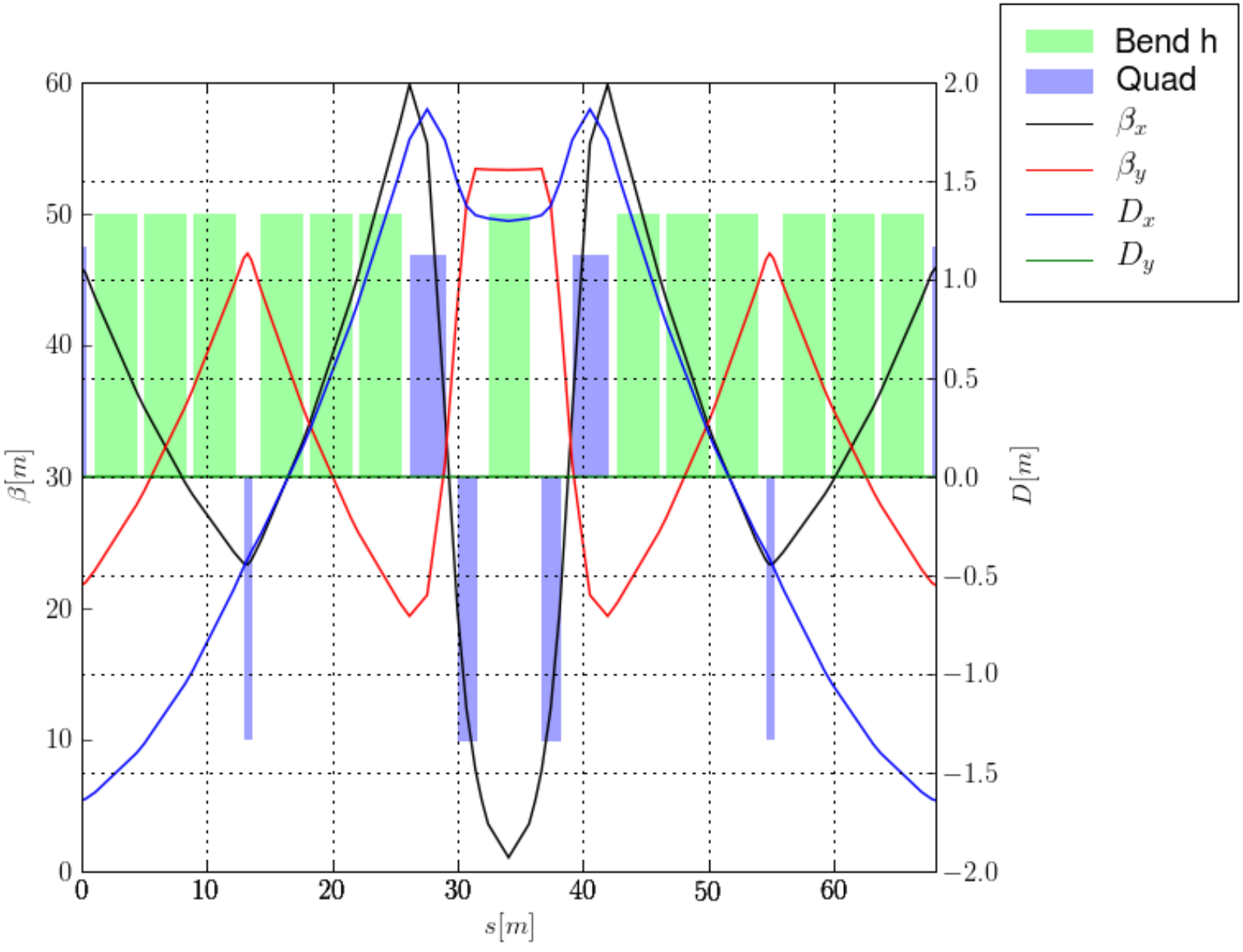
Arc variants

There are several variants under study. They differ from

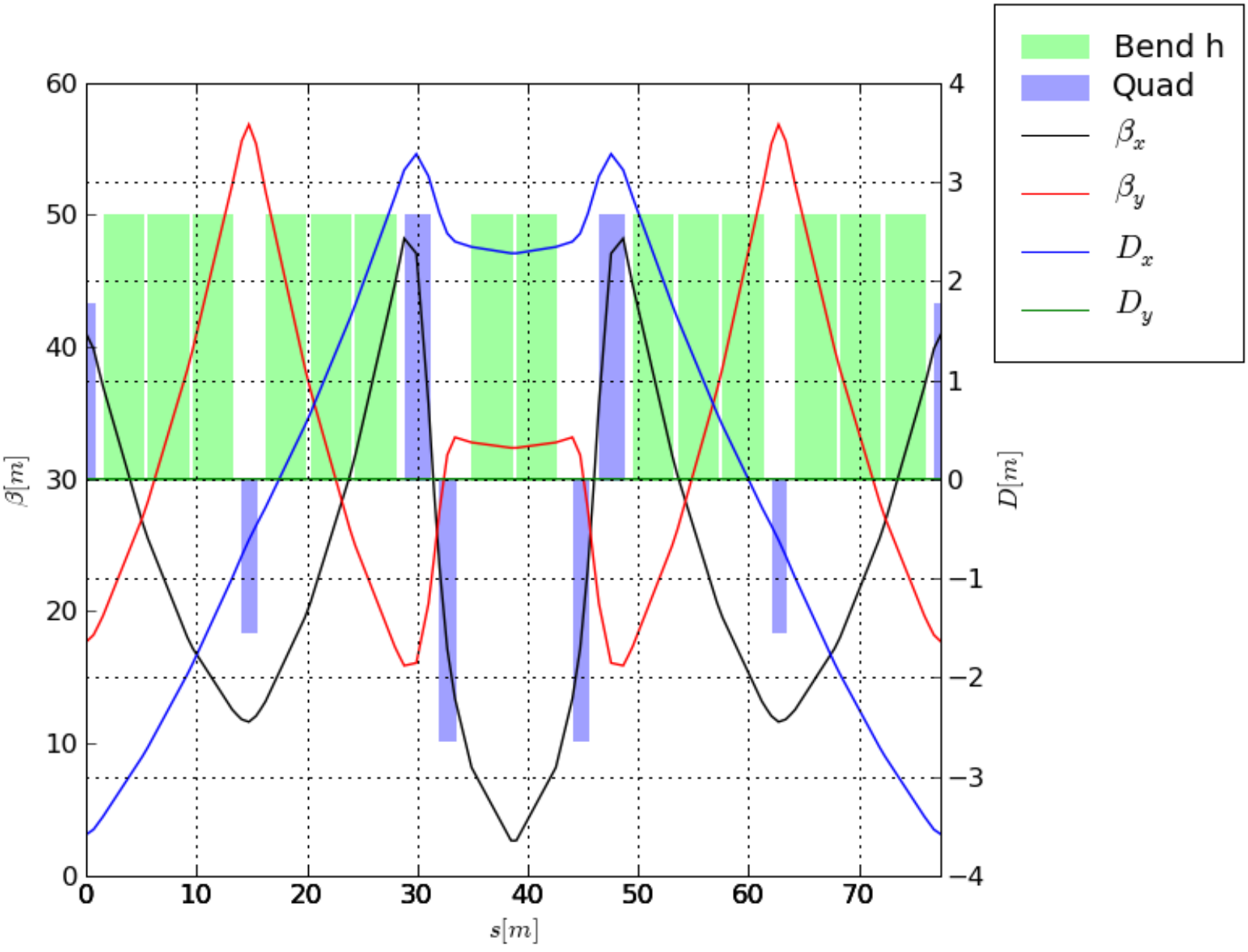
- the number of modules in the arc (6,5,4?),
- the number of dipoles in the pseudo fodo (3,2?),
- the number of dipoles between the doublet (2,1).

Options: 631, 532, 531, 521, 431, ...
Difference are in the bends lengths, maximum dispersion, minimum γ_{tr}, minimum β_{x}, additional available drifts.

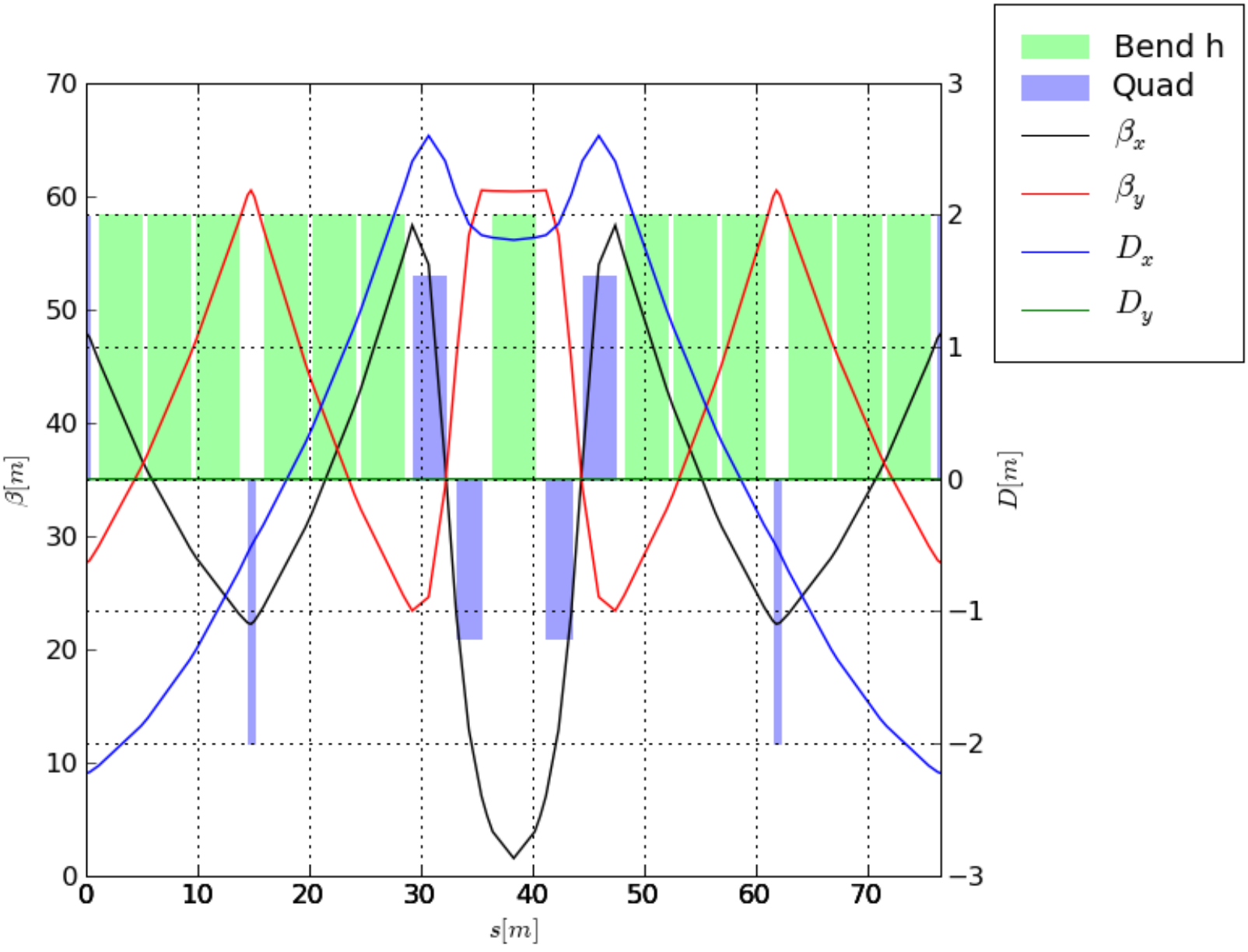
Arc 631


Bend h
Quad
β_x
β_y
D_x
D_y
$\beta[m]$
$D[m]$
$s[m]$
0
10
20
30
40
50
60
−2.0
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
2.0

Arc 532

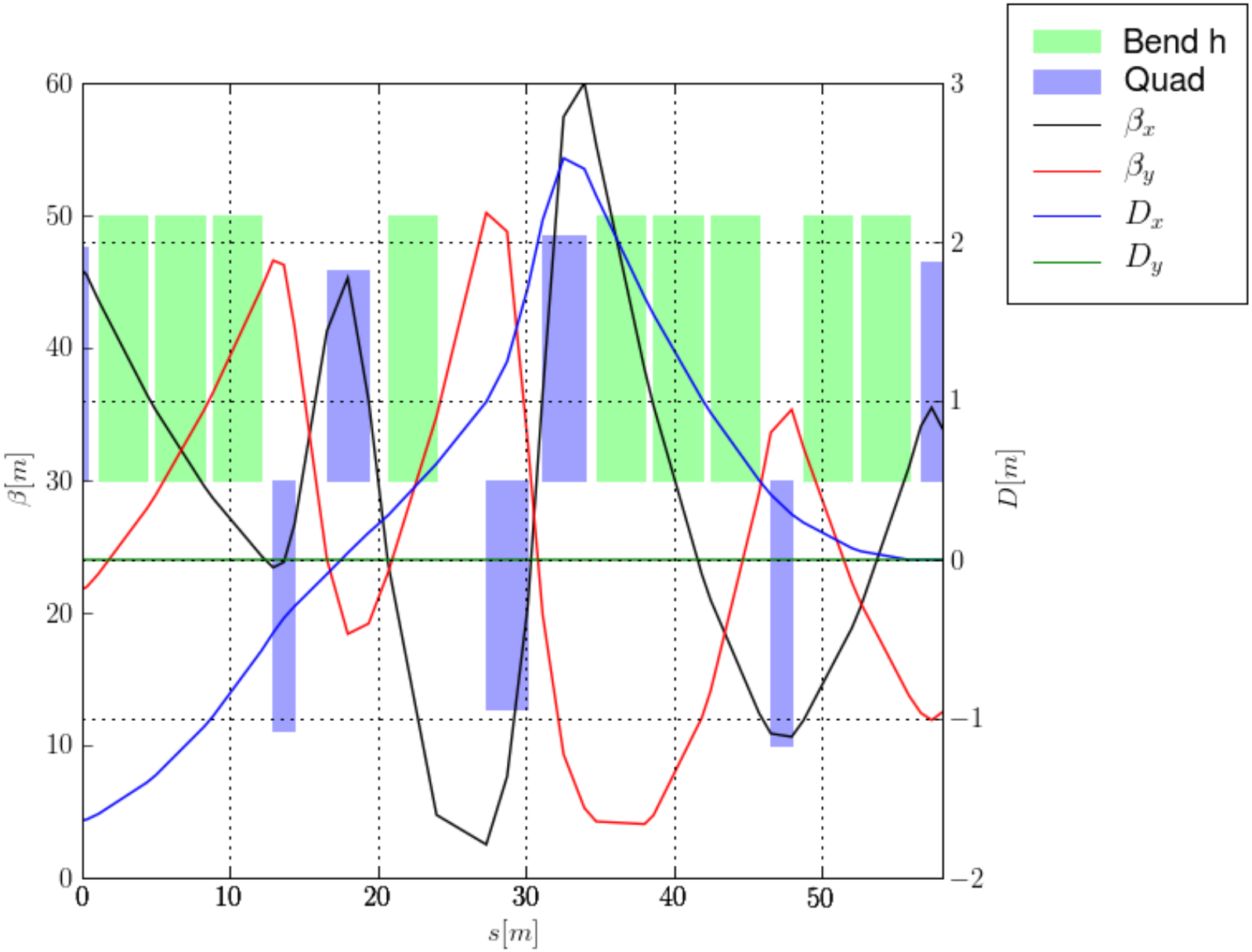

Bend h
Quad
β_x
β_y
D_x
D_y
$\beta[m]$
$D[m]$
$s[m]$
0
10
20
30
40
50
60
70
−4
−3
−2
−1
1
2
3
4

Arc 531


Bend h
Quad
β_x
β_y
D_x
D_y
$\beta[m]$
$D[m]$
$s[m]$
0
10
20
30
40
50
60
70
−3
−2
−1
0
1
2
3

Dispersion Supressor

There are two variants for the dispersion suppressor:



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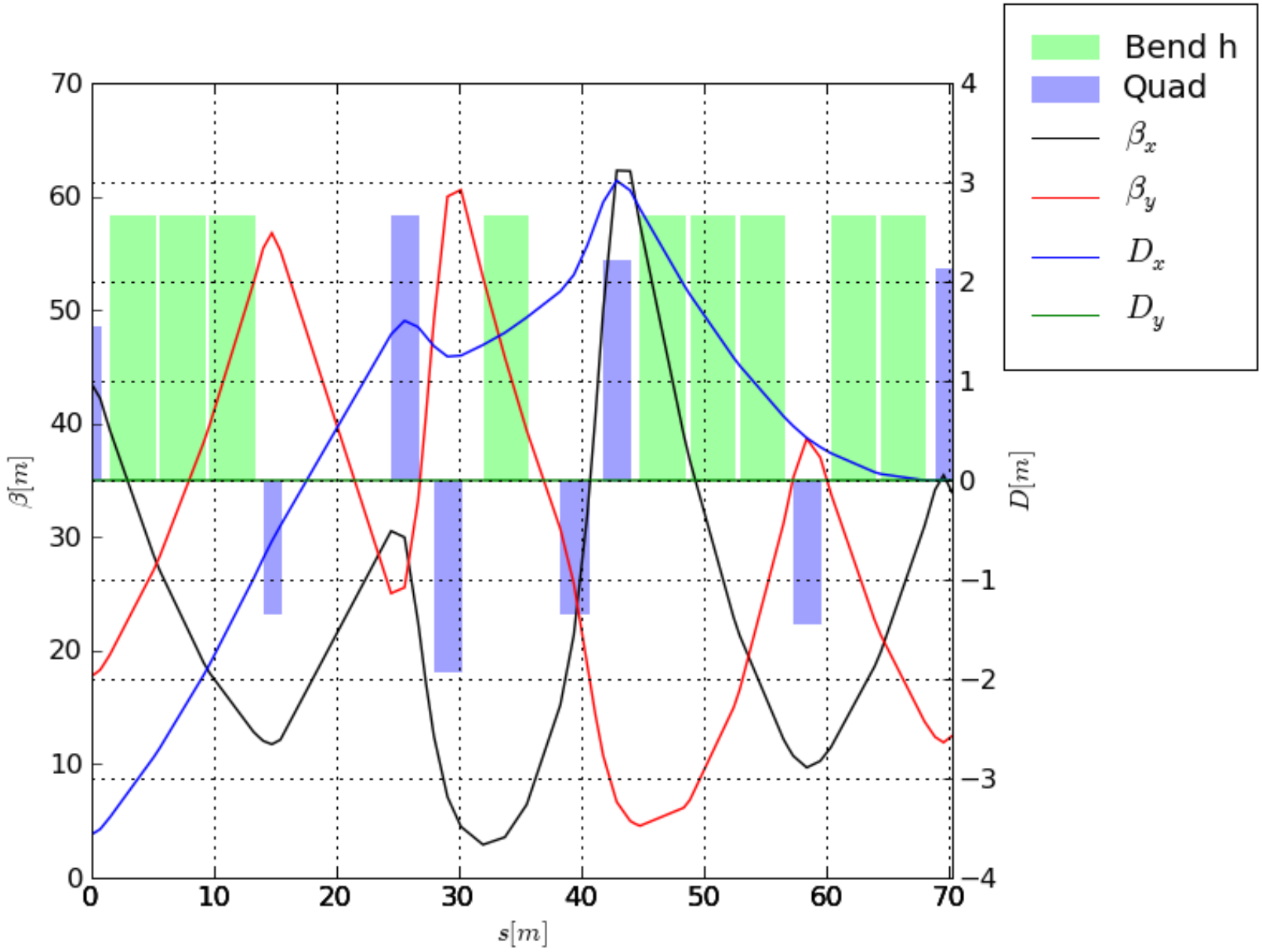
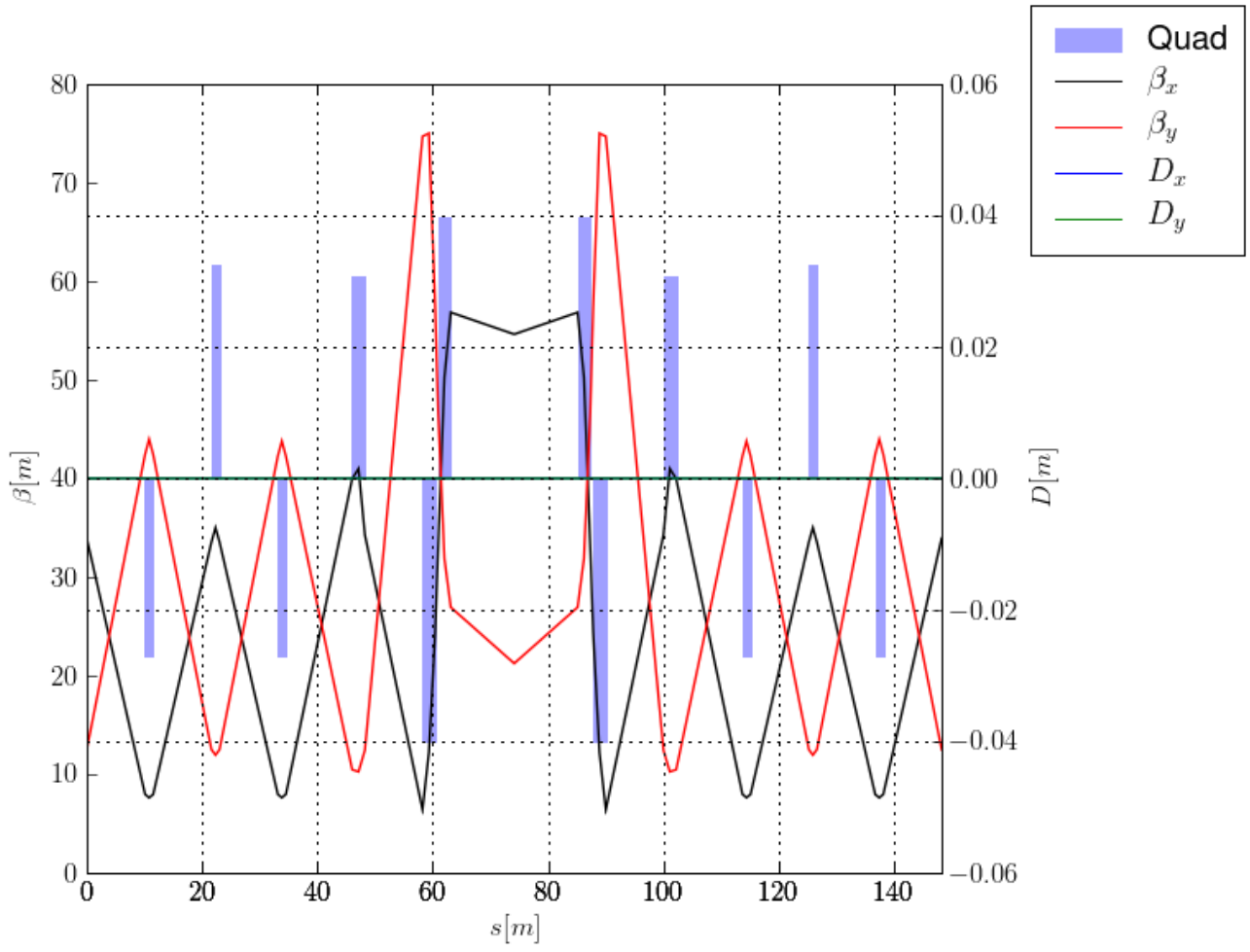


Straight section



Must accommodate H- injection, fast injection, fast extraction, MTE, slow extraction.

Conclusion: lattice status

The lattice structure is being finalized.
There are several arc variants under study.
The lattice studies will focus on:

- evaluate the overall performance,
- implement and test correction schemes,
- address integration issues,
- iterate with hardware constraints.