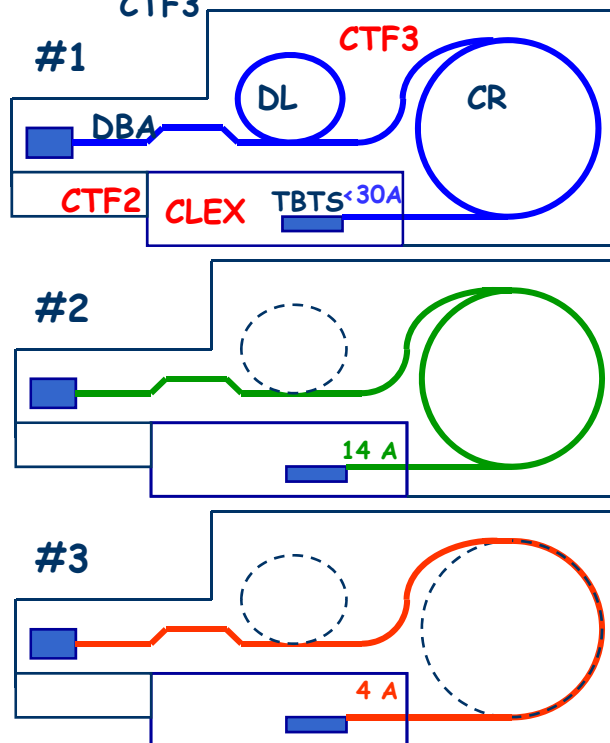# Two-beam Test Stand Status and Results

Roger Ruber & Igor Syratchev

for the

TBTS team

- Different scenarios of the drive beam generation in the CTF3
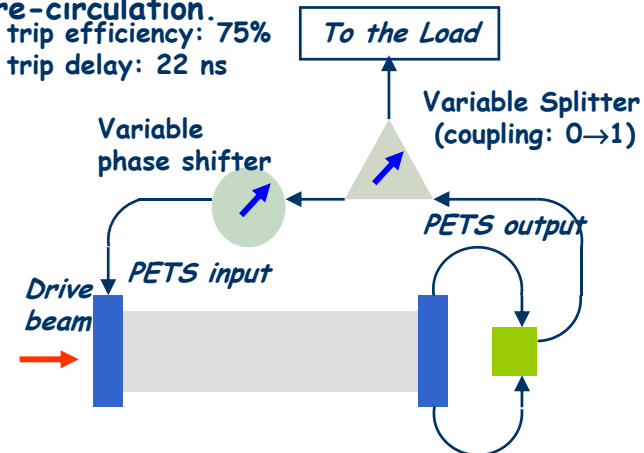
#1

CTF3

DL   CR

DBA

CTF2   CLEX   TBTS <30A

#2

14 A

#3

4 A

- To compensate for the lack of current, the active TBTS PETS length was significantly increased: from the original 0.215 m to 1 m.

| Operation mode	#1	#2	#3	CLIC
Current, A	<30	14	4	101
Pulse length, ns	140	<240	<1200	240
Bunch Frequency, GHz	12	12	3	12
PETS power (12 GHz), MW	<280	61	5	135

- In order to demonstrate the nominal CLIC power level and pulse length, it was decided to implement a different PETS configuration – PETS with external re-circulation.

Round trip efficiency: 75%
Round trip delay: 22 ns

To the Load

Variable Splitter (coupling: 0→1)

Variable phase shifter

PETS output

Drive beam   PETS input

Expected PETS power production with re-circulation. The calculation followed the measured performance of all the components

Power, MW

Tc   Tp

Pn — CLIC nominal

Pn·0.9

6.0 A
5.0 A
4.0 A
3.5 A

240 ns

CLIC nominal

Time, ns

2
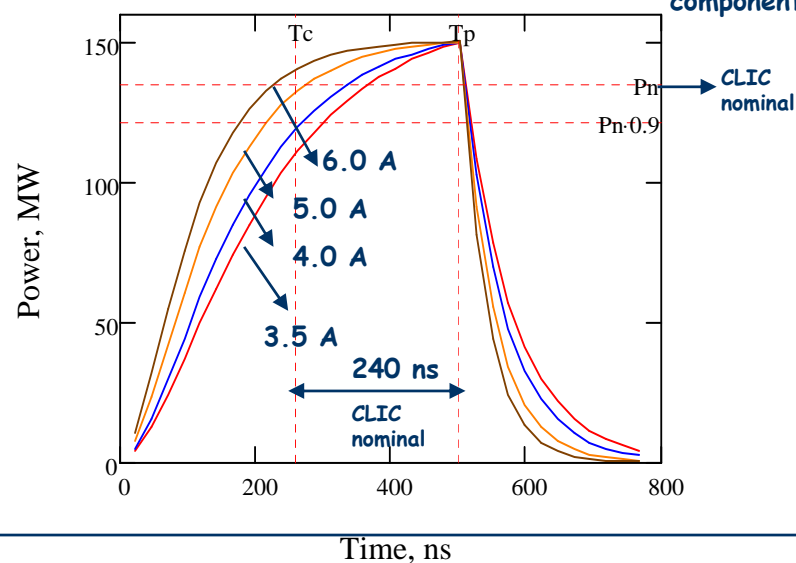
PETS high power tests at CERN (TBTS)

The first RF 12 GHz power generation from the PETS in re-circulation regime 15.11.008

BPM signals

RF signals

Power gain = 6
No re-circulation

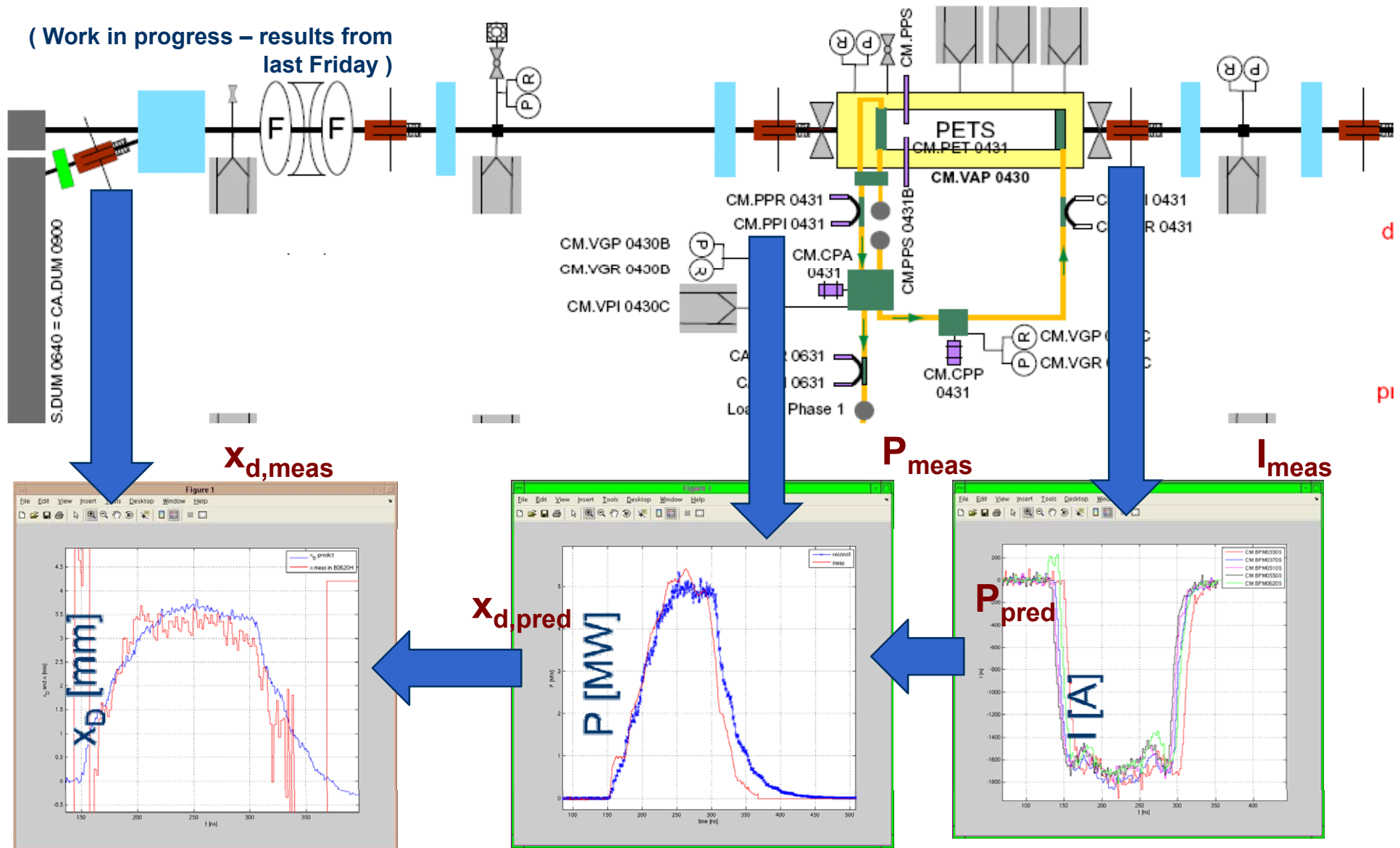Power, MW (y-axis)
Time, ns (x-axis)
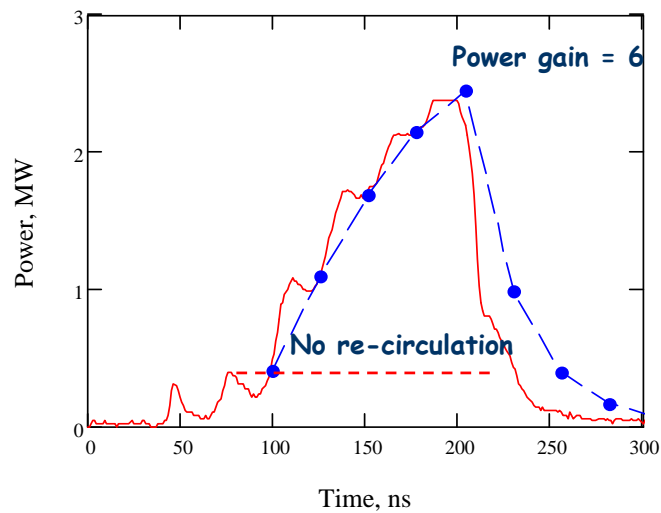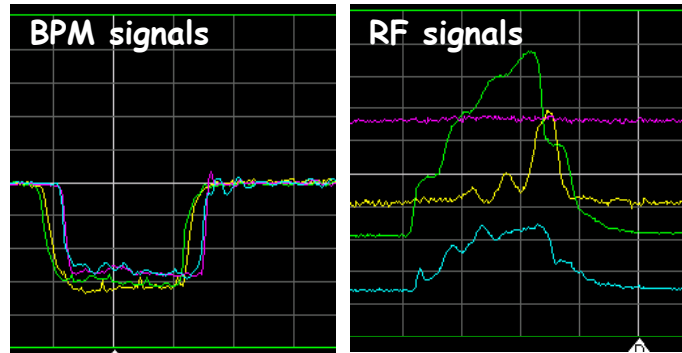
Input for calculations:

~Measured: **I = 1.18 A**
Coupling = 0.82

Similar to SLAC, the conditioning of the system is accomplished with heavy out gassing.

PETS tank installed in CLEX 15.10.08

3

Two-Beam Test Stand

NorduCLIC

(Work in progress – results from last Friday)

Relevance for the Decelerator BD studies : the effect *of* the PETS *on* the Drive Beam
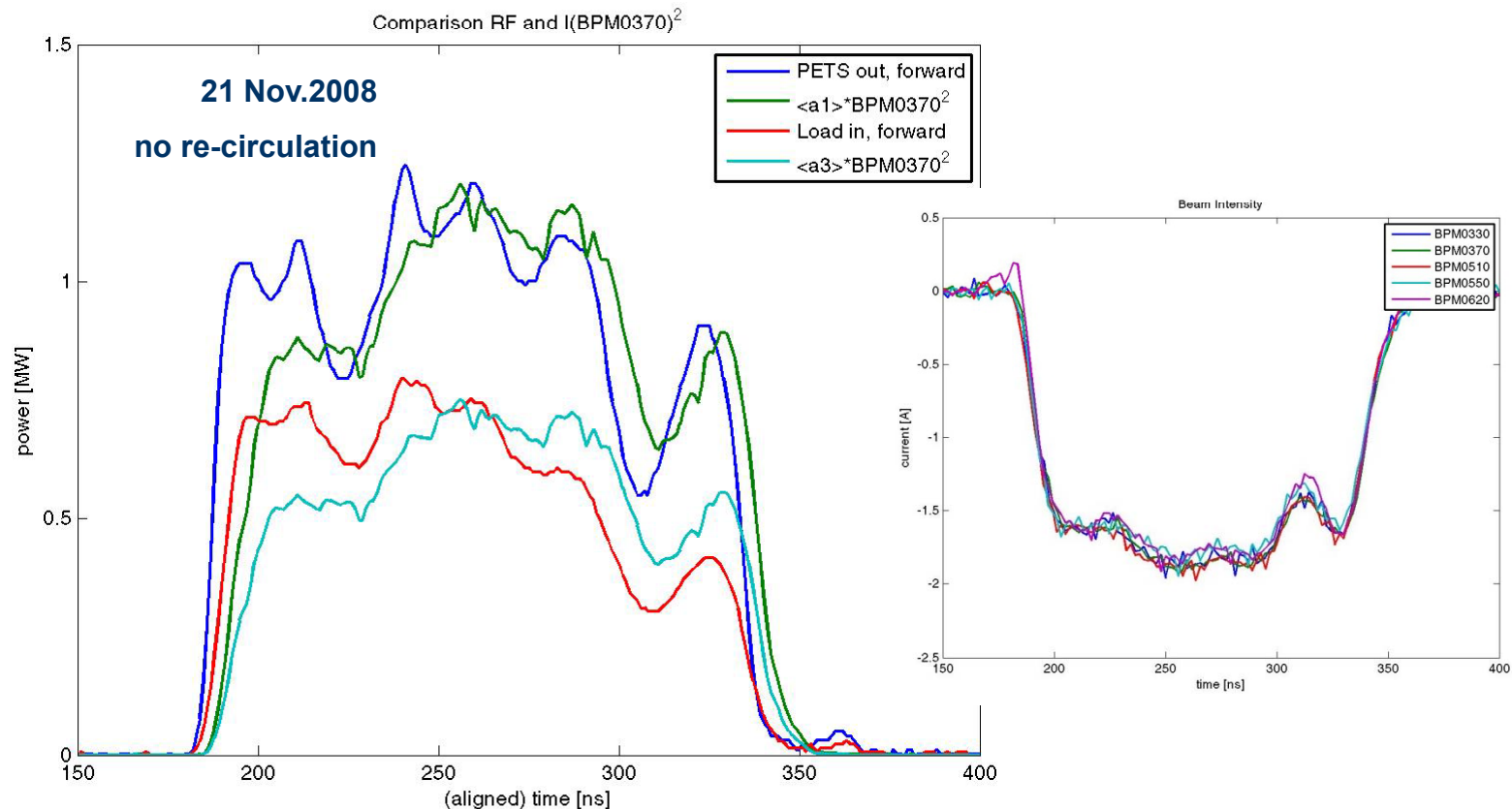
RF Power Generation (150ns pulse)

- 1.25 MW max. at 1.93 A, no significant beam loss
- comparison RF power to beam current:
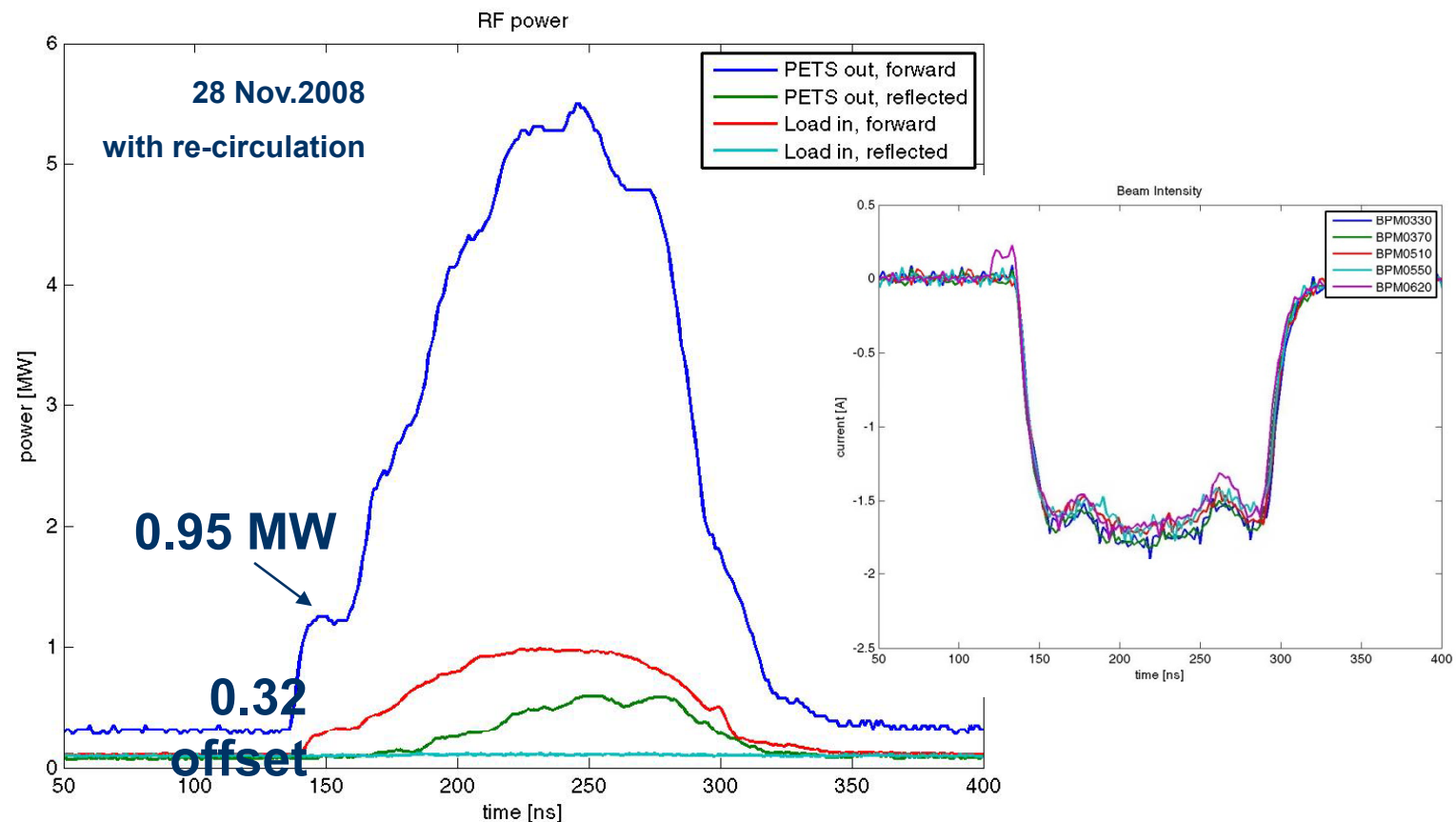 → assume $\mathrm{RF} \propto \langle a \rangle \mathrm{I}^2$

$$\langle a \rangle = \frac{\sum_i (\mathrm{RF}_i \times \mathrm{I}_i^2)}{\sum_i (\mathrm{I}_i^2 \times \mathrm{I}_i^2)}$$

Power Generation with Re-circulation

- max. 5.2 MW power at 1.8A
  factor 4.4 compared to 1.25 MW at 1.9 A w/o circ.

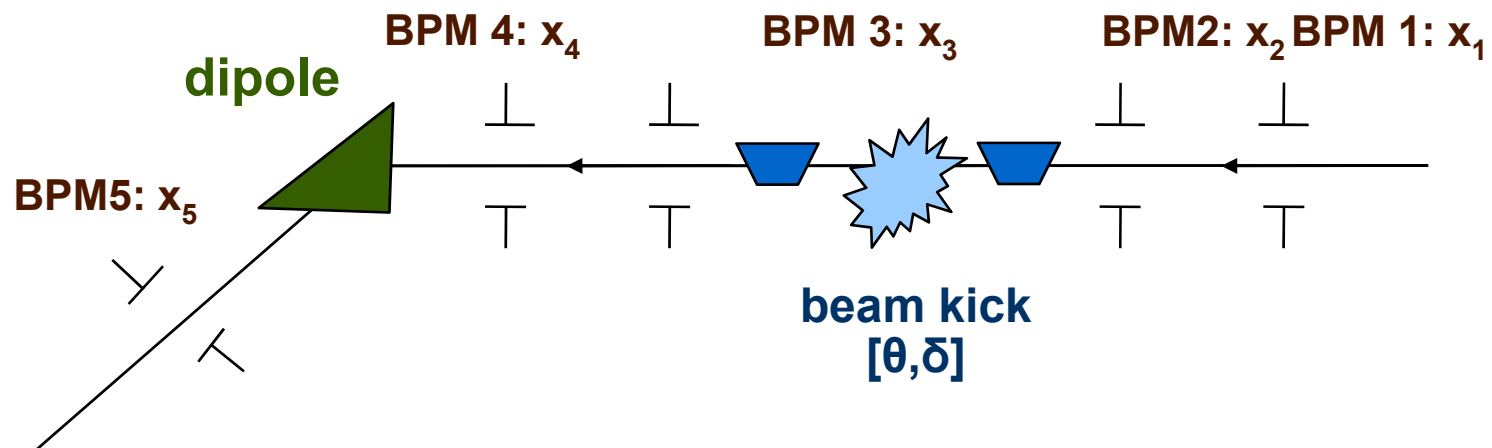- not sure about phase-shift & variable splitter

Beam Kick Measurements

- 5 BPMs in each beam line
  - 2 before: incoming angle & offset
  - 2 after: kick angle
- dipole + BPM5 for energy measurement

$$\vec{x} = A\vec{\theta}$$

$$\theta = (A^t A)^{-1} A^t \vec{x}$$

$$\begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 & 0 \\ R_{11}^{12} & R_{12}^{12} & 0 & 0 \\ R_{11}^{13} & R_{12}^{13} & R_{12}^{c3} & 0 \\ R_{11}^{14} & R_{12}^{14} & R_{12}^{c4} & 0 \\ R_{11}^{15} & R_{12}^{15} & R_{12}^{c5} & D^5 \end{pmatrix} \begin{pmatrix} x_1 \\ x_1' \\ \theta \\ dp/p \end{pmatrix}$$

BPM 4: x₄   **BPM 3: x₃**   **BPM2: x₂ BPM 1: x₁**

dipole

BPM5: x₅

beam kick
[θ,δ]

Estimation of Beam Bending in PETS

bend: $$\theta = \vec{g} \cdot \vec{x}$$

- *g* for bend in centre of PETS
- incoming beam not on PETS axis
- gradual change along pulse