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(54) BEAM ENERGY MEASUREMENT SYSTEM

(57) A time-of-flight (TOF) measurement system for measuring energy of a pulsed hadron beam, wherein each pulse of the beam is structured into a series of bunches (B) of charged particles, said bunches being repeated according to a repetition rate of the order of magnitude of radiofrequency. The system comprises
a first detector (1), a second detector (2) and a third detector (3) arranged along a beam path (10), each of the detectors being configured to detect the passage of a bunch (B) of charged particles and provide an output signal ($v_{PP,1}$, $v_{PP,2}$, $v_{PP,3}$) dependent on phase of the detected bunch (B), wherein the second detector (2) is spaced apart from the first detector (1) by a first distance (L_{12}) and wherein the third detector (3) is spaced apart from the second detector (2) by a second distance (L_{23}), wherein the first distance is set out in such a way as that time of flight (t_{12}) of the bunch (B) from the first detector (1) to the second detector (2) is approximately equal to, or lower than a repetition period (T_{RFQ}) of the bunches (B), and wherein the second distance is set out in such a way as that time of flight (T_{23}) of the bunch (B) from the second detector (2) to the third detector (3) is greater than a multiple of the repetition period (T_{RFQ}) of the bunches (B), and
a processing unit (7) configured to
a) calculate phase shifts ($\Delta_{\varphi 12}$, $\Delta_{\varphi 13}$, $\Delta_{\varphi 23}$) between the output signals ($v_{PP,1}$, $v_{PP,2}$, $v_{PP,3}$) of the detectors (1, 2, 3), and
b) calculate energy (E) of the pulse based on the calculated phase shifts.

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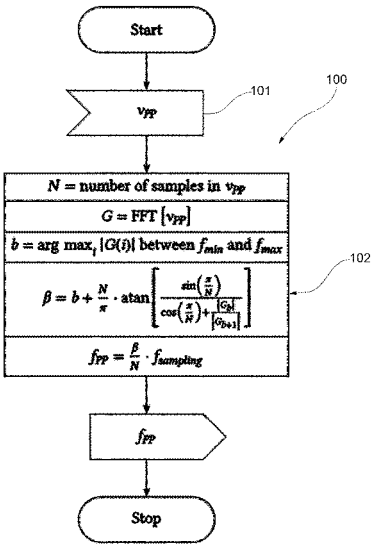
Start
v_{FP}
101
100
N = number of samples in v_{FP}
G = FFT $[v_{FP}]$
b = arg max$_i$ $|G(i)|$ between f_{min} and f_{max}
$\beta = b + \frac{N}{\pi} \cdot \text{atan}\left[\frac{\sin\left(\frac{\pi}{N}\right)}{\cos\left(\frac{\pi}{N}\right) + \frac{|G_b|}{|G_{b+1}|}}\right]$
102
$f_{FP} = \frac{\beta}{N} \cdot f_{sampling}$
f_{FP}
Stop

FIG. 6