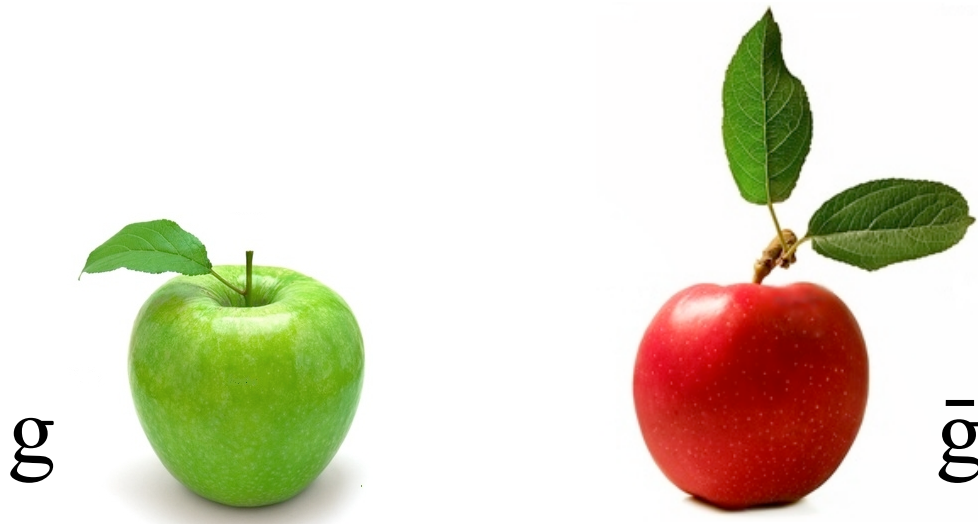


# GBAR (Gravitational Behaviour of Antihydrogen at Rest)

Proposal to SPSC in preparation



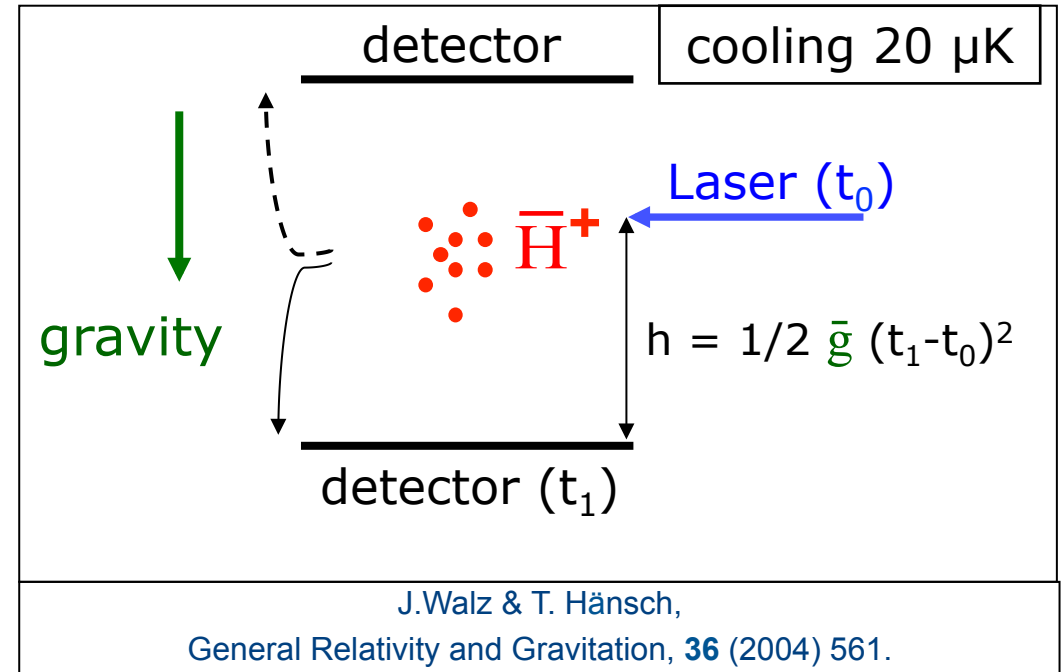
# using $\bar{H}^+$ to get $\bar{H}$ atoms

- Produce ion  $\bar{H}^+$
- Sympathetic cooling  $20 \mu\text{K}$
- Photodetachment of  $e^+$
- Time of flight

*Error dominated by temperature of  $\bar{H}^+$*

Relative Precision on  $\bar{g}$ :

| $\bar{H}^+$ in ion trap | $\Delta g/g$ |
|-------------------------|--------------|
| $5 \cdot 10^5$          | 0.001        |
| $10^4$                  | 0.006        |
| $10^3$                  | 0.02         |

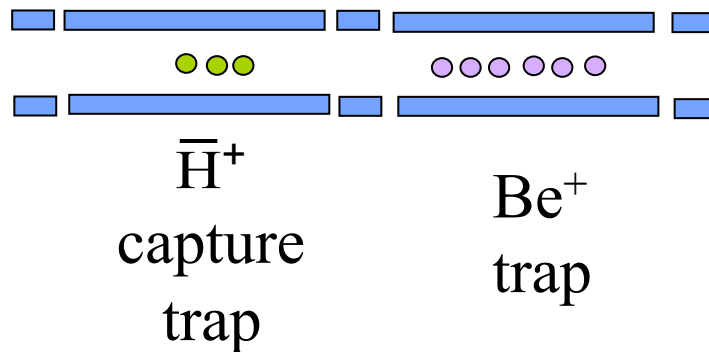


$$h = 10 \text{ cm} \rightarrow \Delta t = 143 \text{ ms}$$

$$h = 1 \text{ mm} \rightarrow \Delta t = 14 \text{ ms}$$

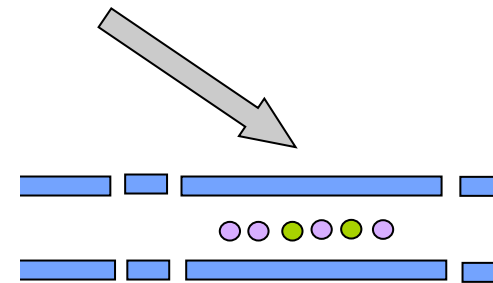
# $\bar{H}^+$ cooling

Segmented RF Paul Trap  
Well depth  $\sim 1$  eV



Sympathetic cooling by  
laser cooled  $Be^+$  ions

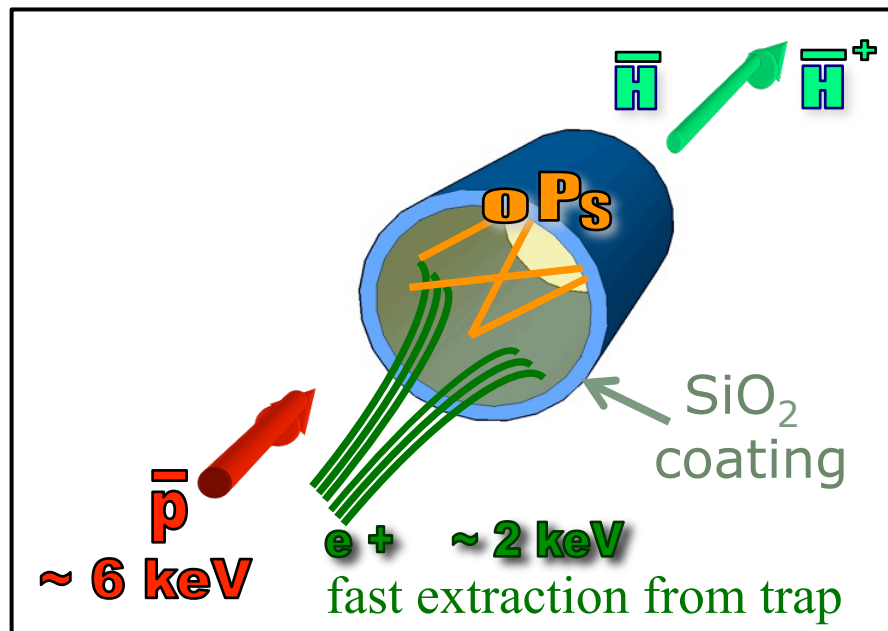
$T \sim 4.5$  or  $9$   $\mu K$  for  $Be^+$  ions



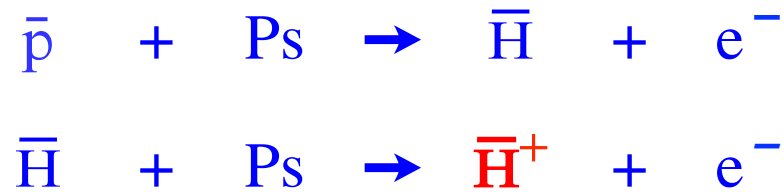
spot size  $\sim 100$   $\mu m^2$

# $\bar{H}$ Production via $\bar{H}^+$

Standard production

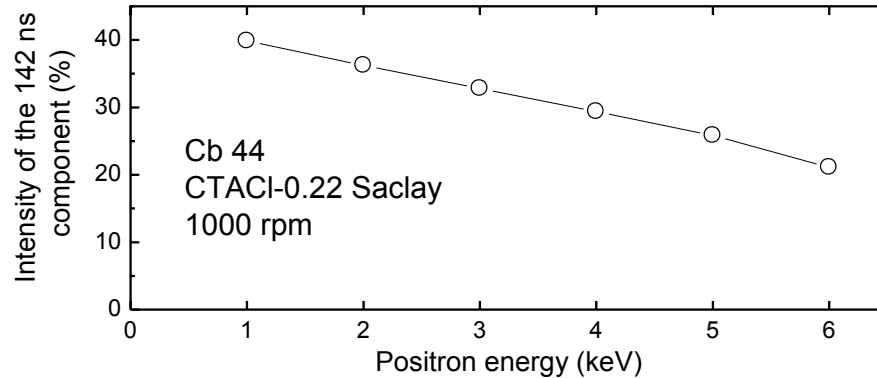


$\bar{H}^+$  Formation



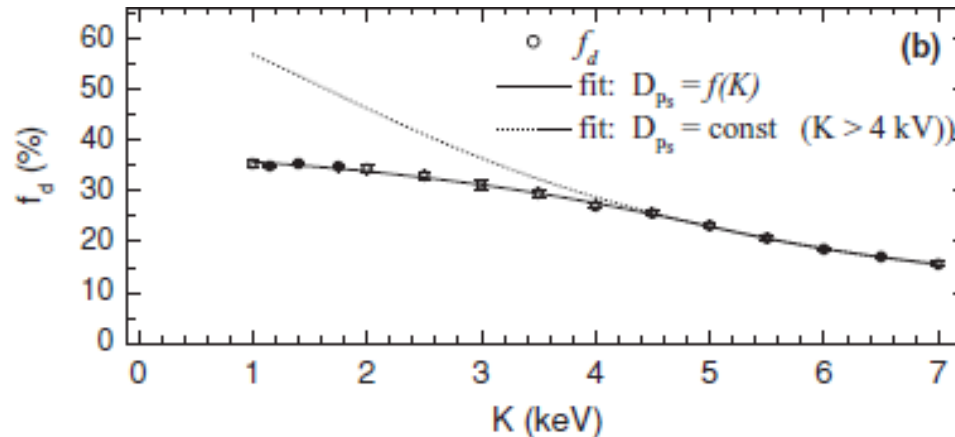
# Yield of o-Ps : comparison ETHZ / UCR

Measurement  
with ETHZ  
beam



$$\sim 3.5 \times 10^5 \text{ e}^+ \text{ cm}^{-2}\text{s}^{-1}$$

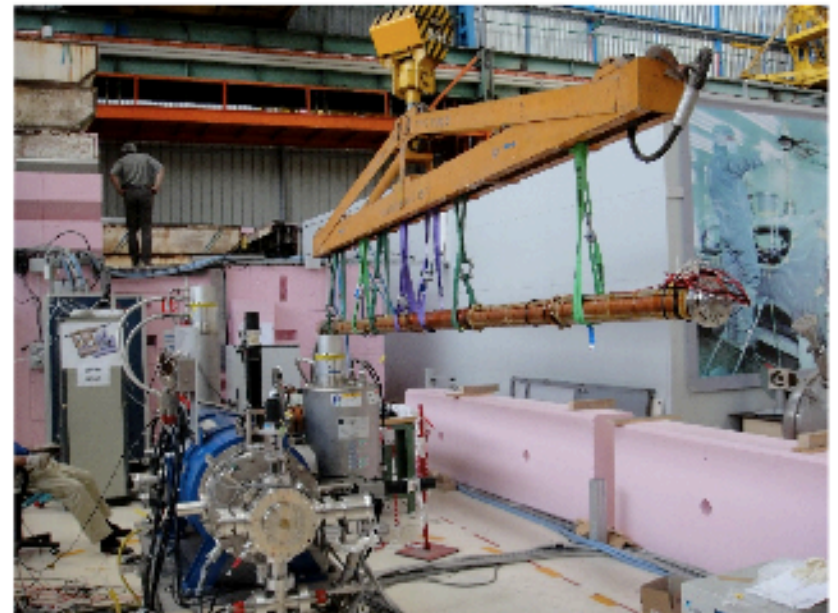
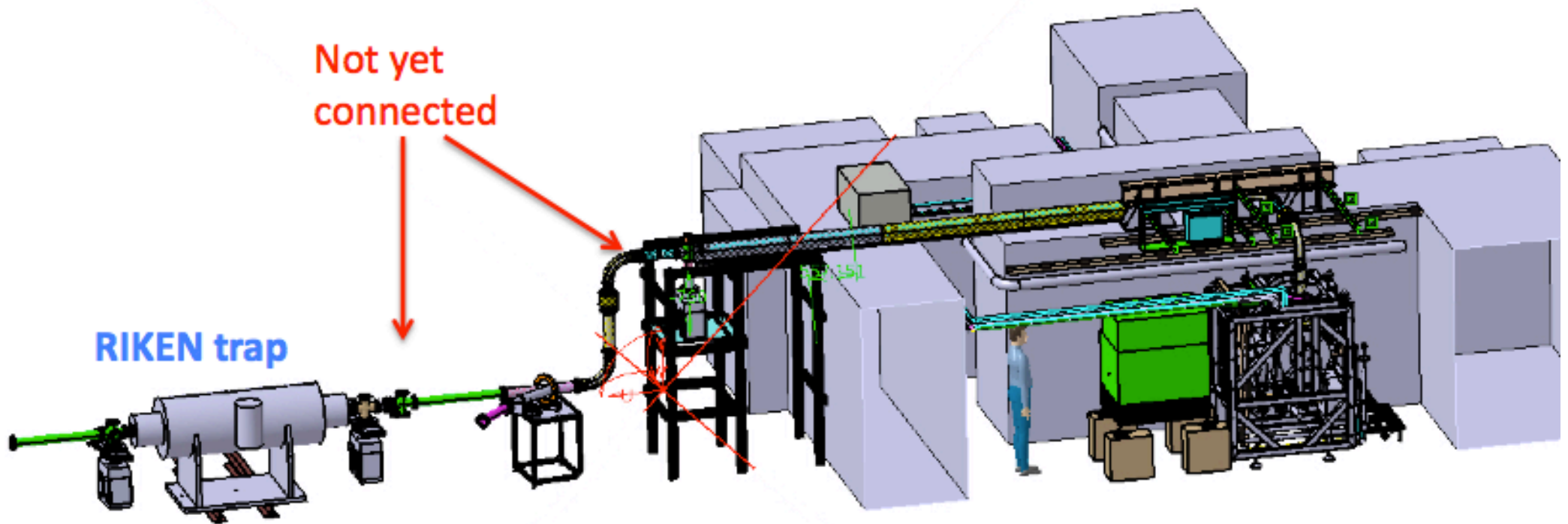
Measurement  
at  
U.C.Riverside



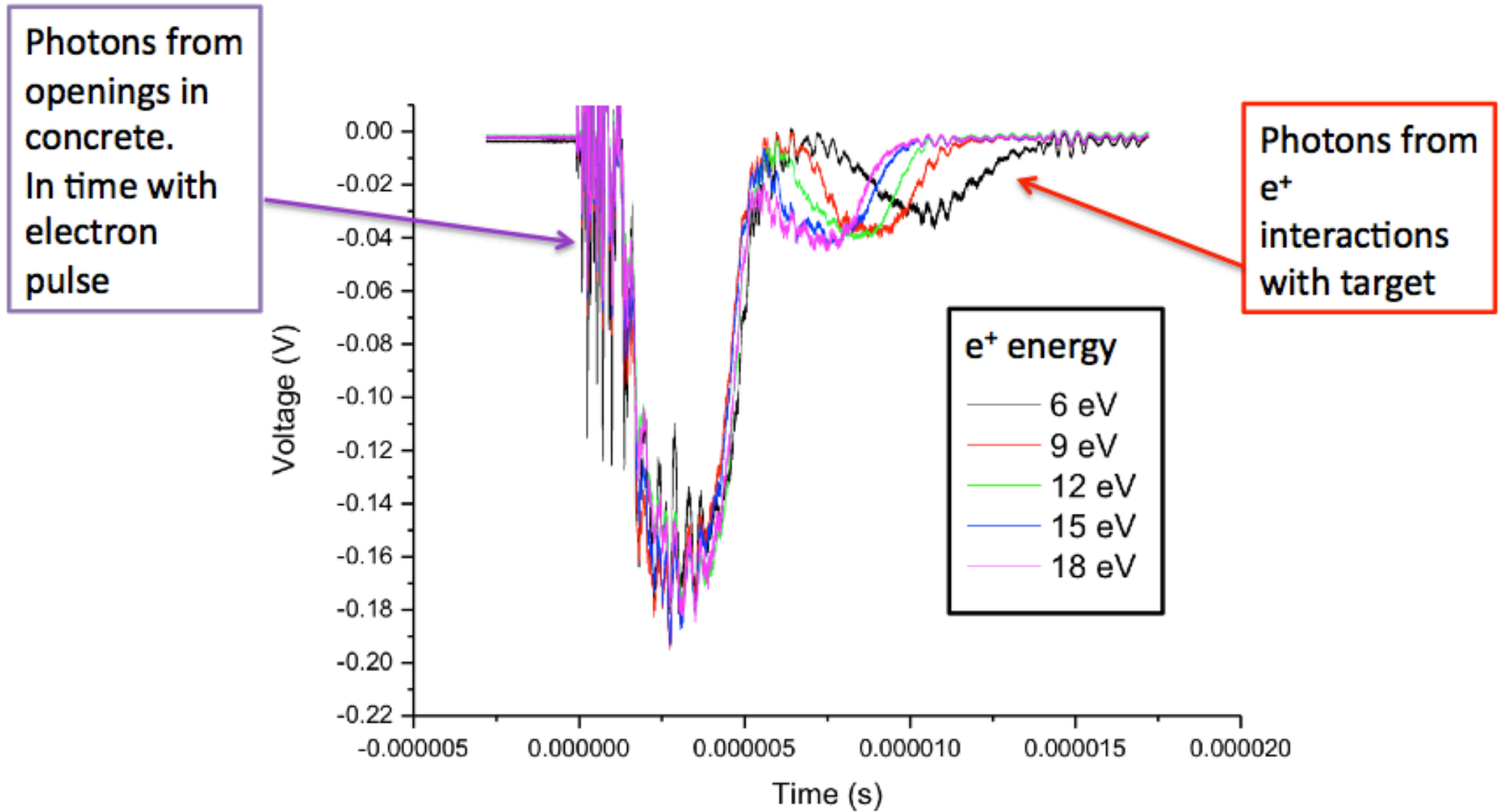
$\text{e}^+$  flux  
x  
 $\sim 10^{11}$

$$\sim 5.6 \times 10^{16} \text{ e}^+ \text{ cm}^{-2}\text{s}^{-1}$$

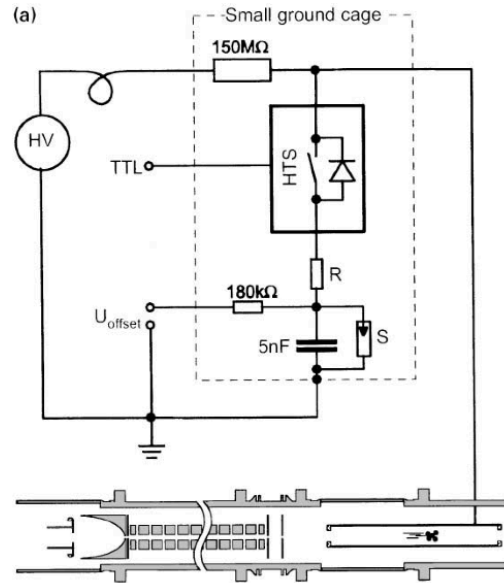
**No loss in conversion efficiency in spite of the  $10^{11}$  intensity factor**



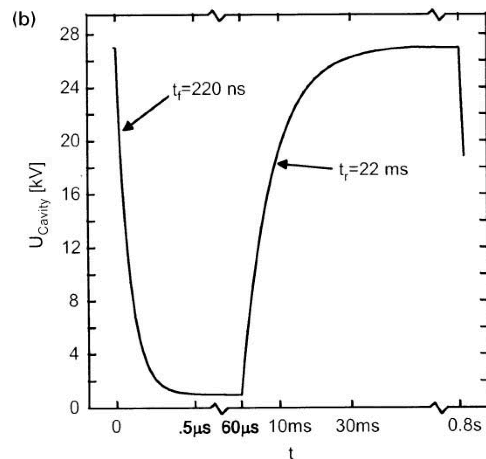
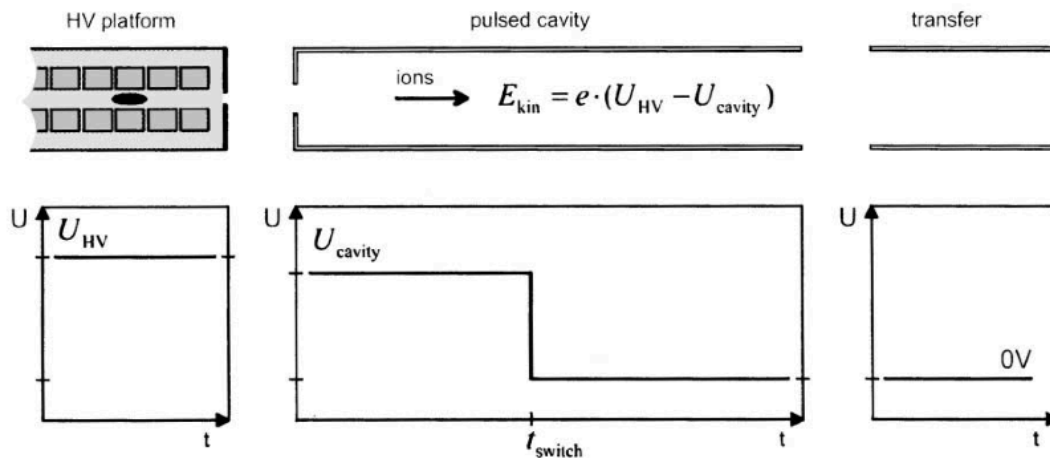
# Detection of slow positrons from Linac



# $\bar{p}$ deceleration



Scheme adapted from ISOLTRAP  
 F. Herfurth et al., NIMA 469 (2001) 254.



$\bar{p}$  accumulation trap can be added



# Workshop advertisement

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## Antimatter and Gravitation

10-11 October 2011

Europe/Paris timezone

### Overview

Speakers

Scientific program

Timetable

The **first international workshop on "Antimatter and Gravitation"** at Institut **Henri Poincaré** in Paris on **October 10-11 2011**.

Its main objectives will be to review indirect experimental tests and possible different behaviour of matter and antimatter with respect to gravity. The workshop will include experiments on the production and study of antihydrogen at CERN.

<http://indico.in2p3.fr//event/gbar2011.fr>