

a linac based positron source

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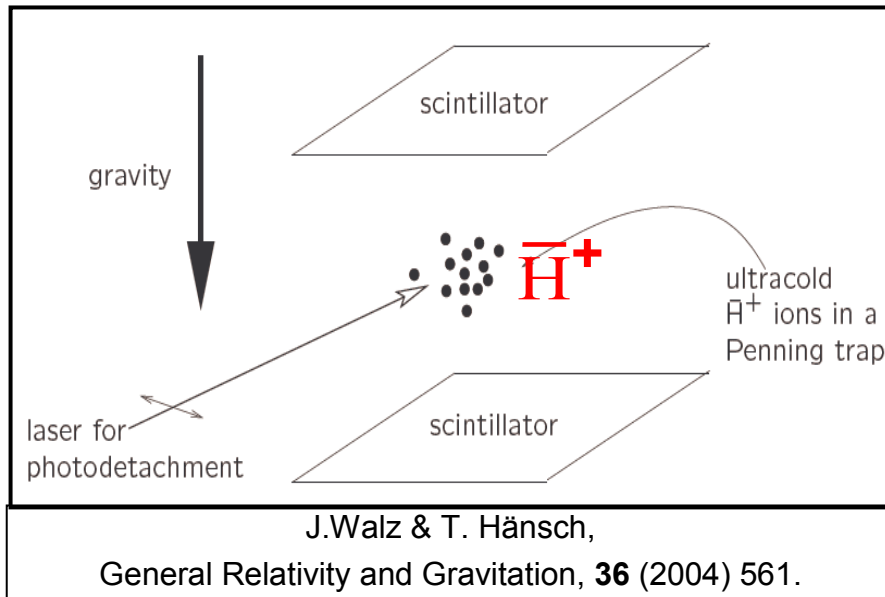
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Outline:

- Motivation : antimatter gravity
- e^+ energy spectrum & rate @ low E high I
- The linac and electron beam
- e^+ selector (SOPHI)
- Saclay installation
- Outlook

Motivation : \bar{g} experiment

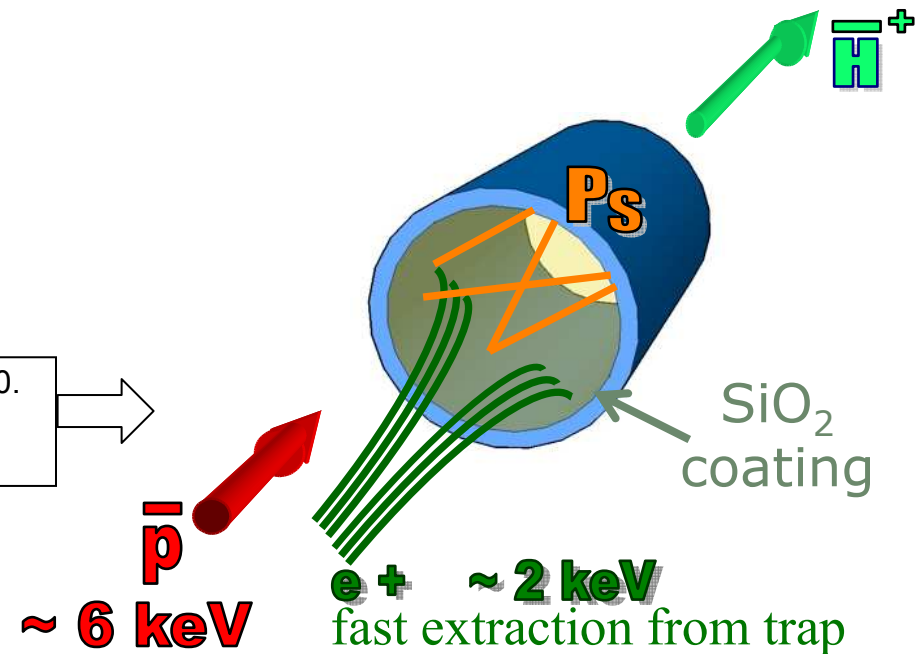
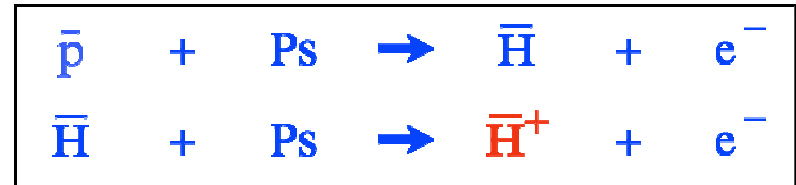
use \bar{H}^+ cooled to few μ K



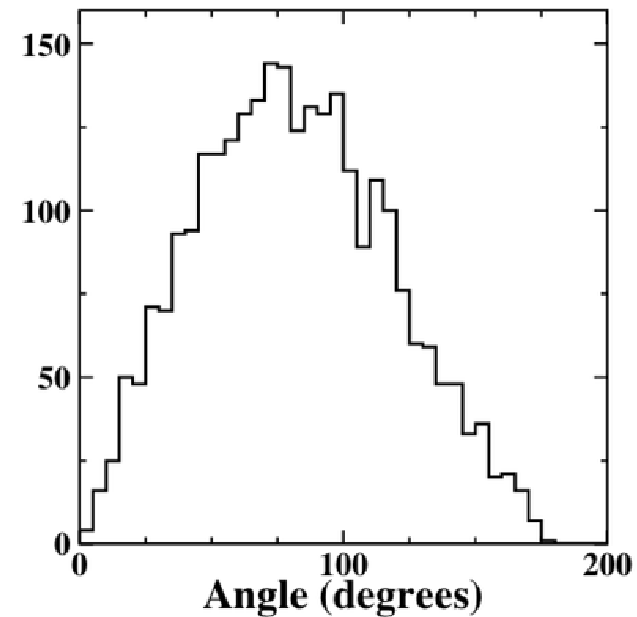
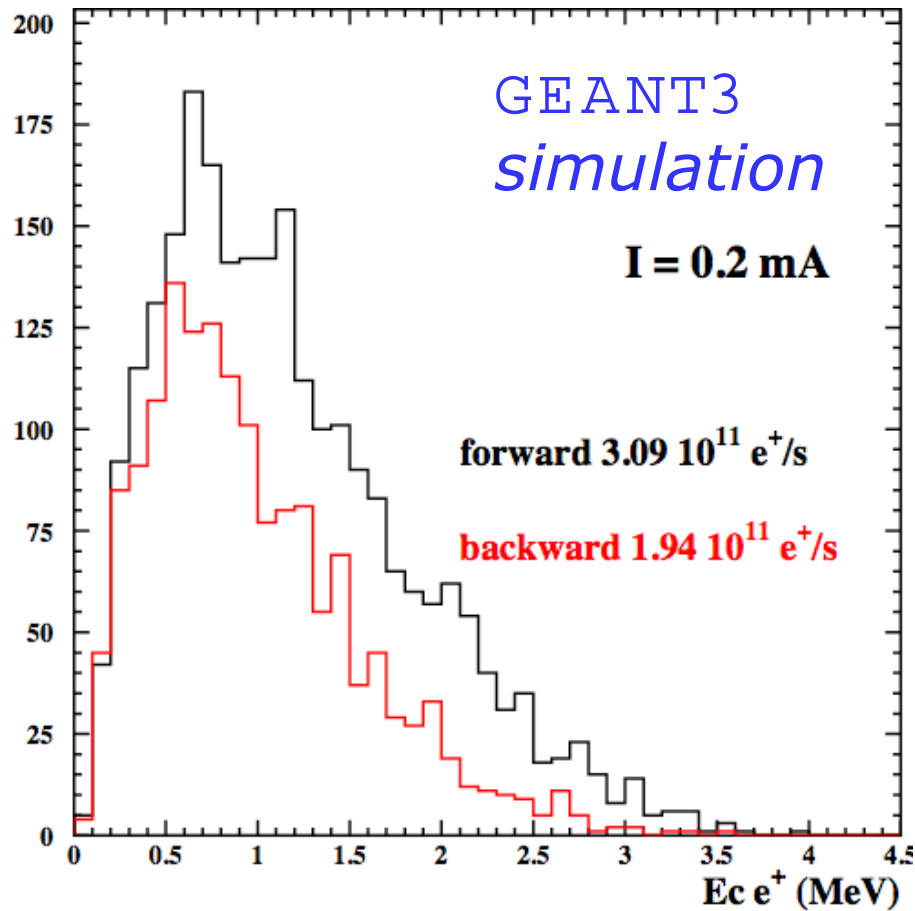
P. Pérez and A. Rosowsky, Nucl. Inst. Meth. A 545 (2005) 20-30.
P. Pérez et al., CERN-SPSC-2007-038, December 2007.
 P. Perez, SLOPOS-11 communication

Needs high intensity slow positron beam!

\bar{H}^+ formation



e^+ production with 5.5 MeV electron Linac



- W moderator $\varepsilon = 10^{-4}$
> 10^7 slow e^+/s
- Ne moderator
> 10^8 slow e^+

Fast e^+ transport efficiency and beam size

Commercial Linac (1)

$E_c (e^-) = 5.5 \text{ MeV}$ (< neutron activation threshold)

$v_{\text{max}} = 200 \text{ Hz}$

$I_{\text{max}} = 0.2 \text{ mA}$

Bunch length $4 \mu\text{s}$

Magnetron 1.9 MW peak

Total electric power 35 kVA

RF frequency 3 GHz

Installed November 2008

Acceleration length 21 cm

Beam diameter 1 mm , 6 mm at target

Overall dimensions $1 \text{ m} \times 1 \text{ m} \times 0.8 \text{ m}$



Commercial Linac (2)

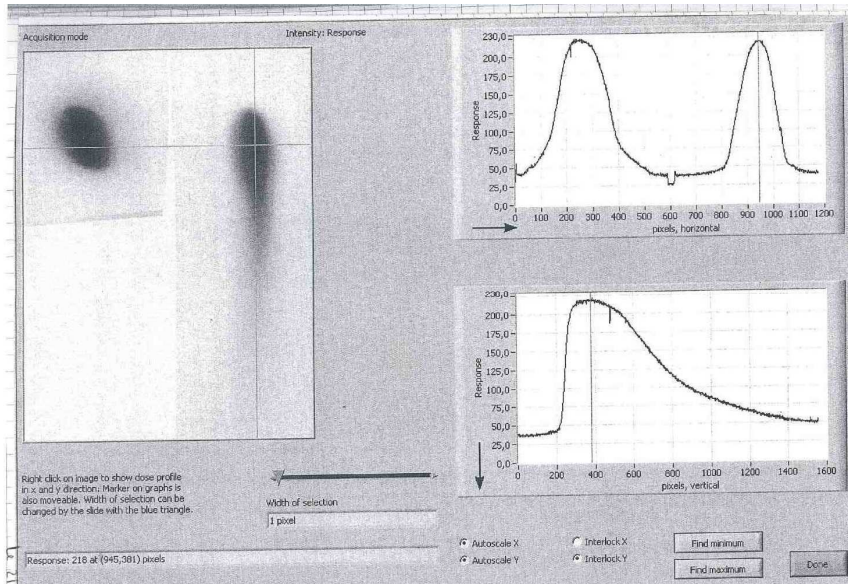


21 cm

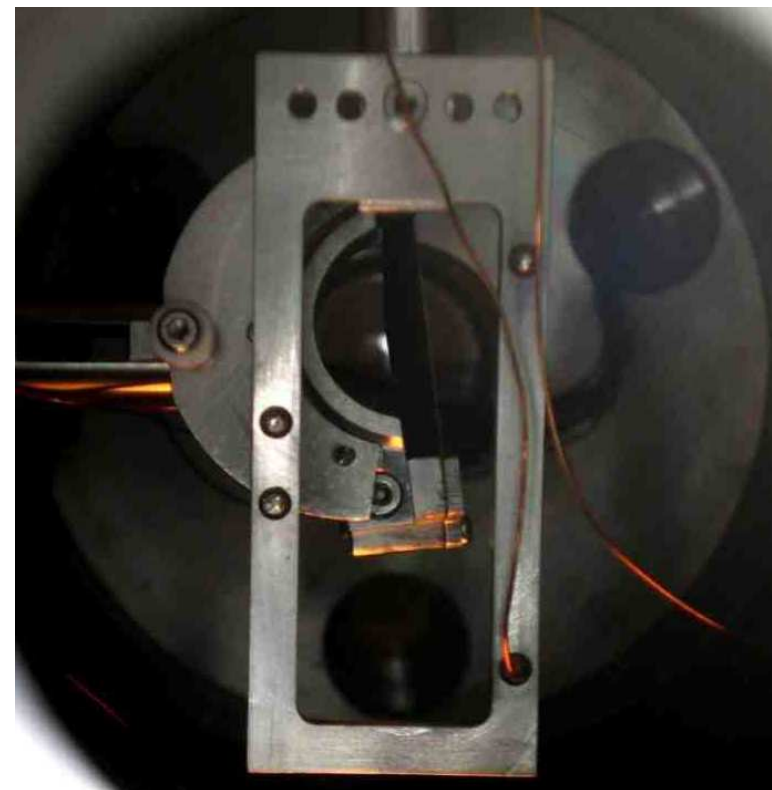


e^- beam:
 $E_c = 5.5 \text{ MeV}$
 $I_{\text{max}} = 0.2 \text{ mA}$

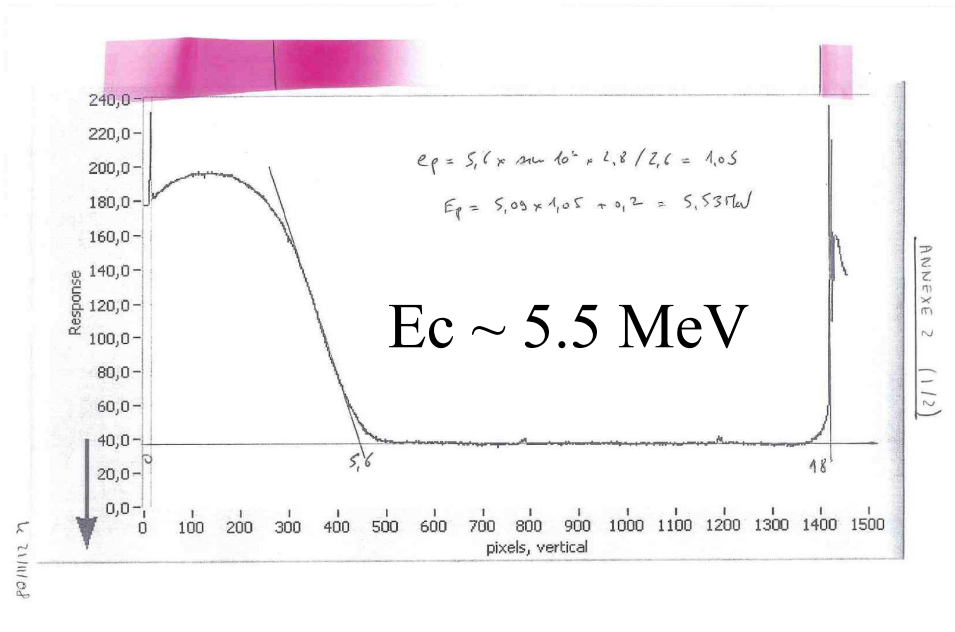
Linac commissioning (Dec '08)



Beam spot $\varnothing \sim 1 \text{ cm}$ @ 80 cm
 from end of acceleration section
 ↘ 1 mm @ 10 cm

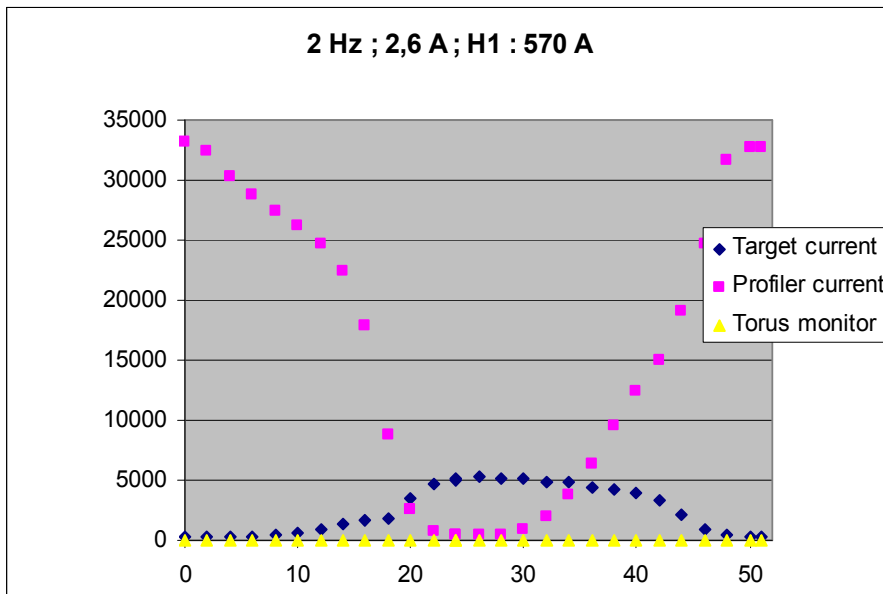


Target
 +
 profiler



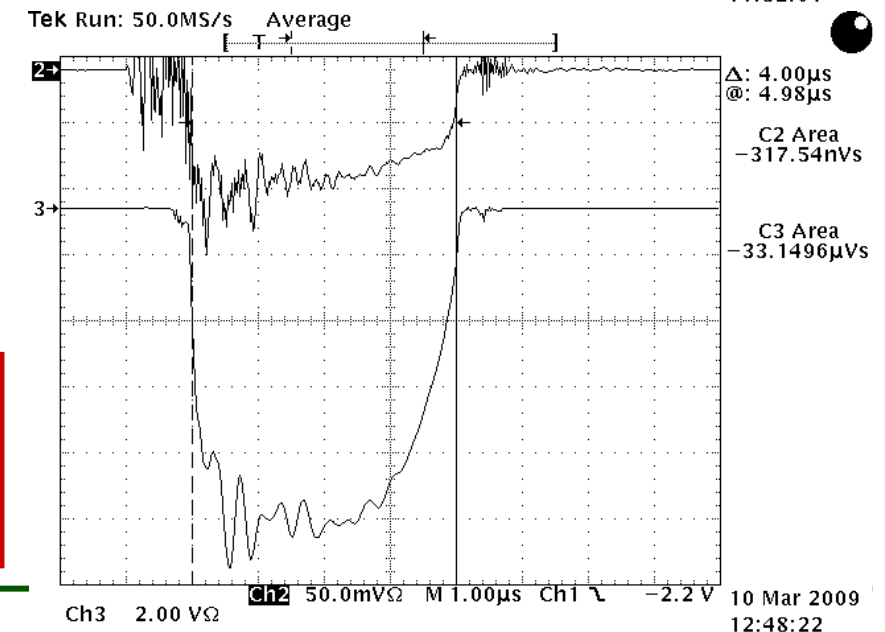
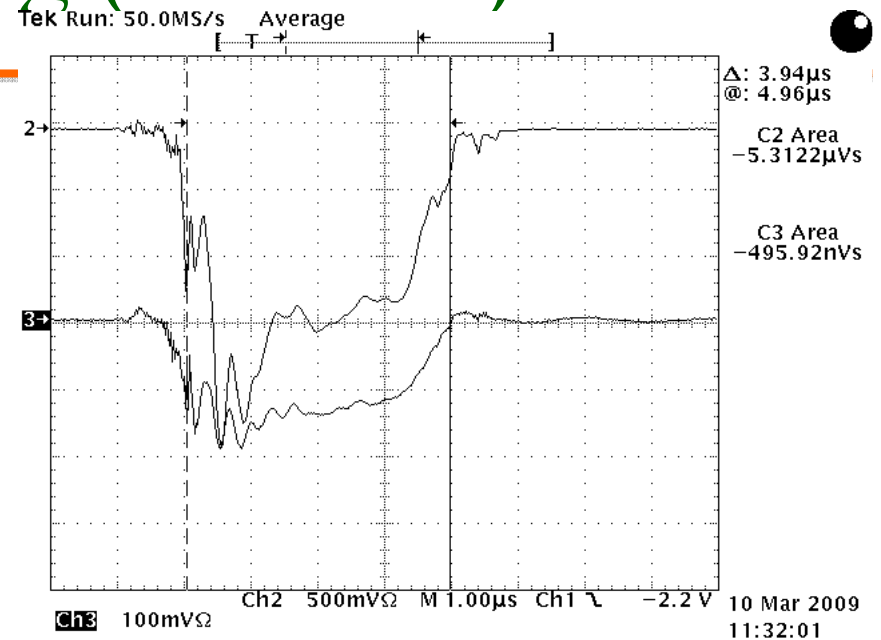
Linac commissioning (Mar.'09)

Jan'09 : new impregnated cathode , new profiler
Measured intensity : from 8 \rightarrow 140 μ A

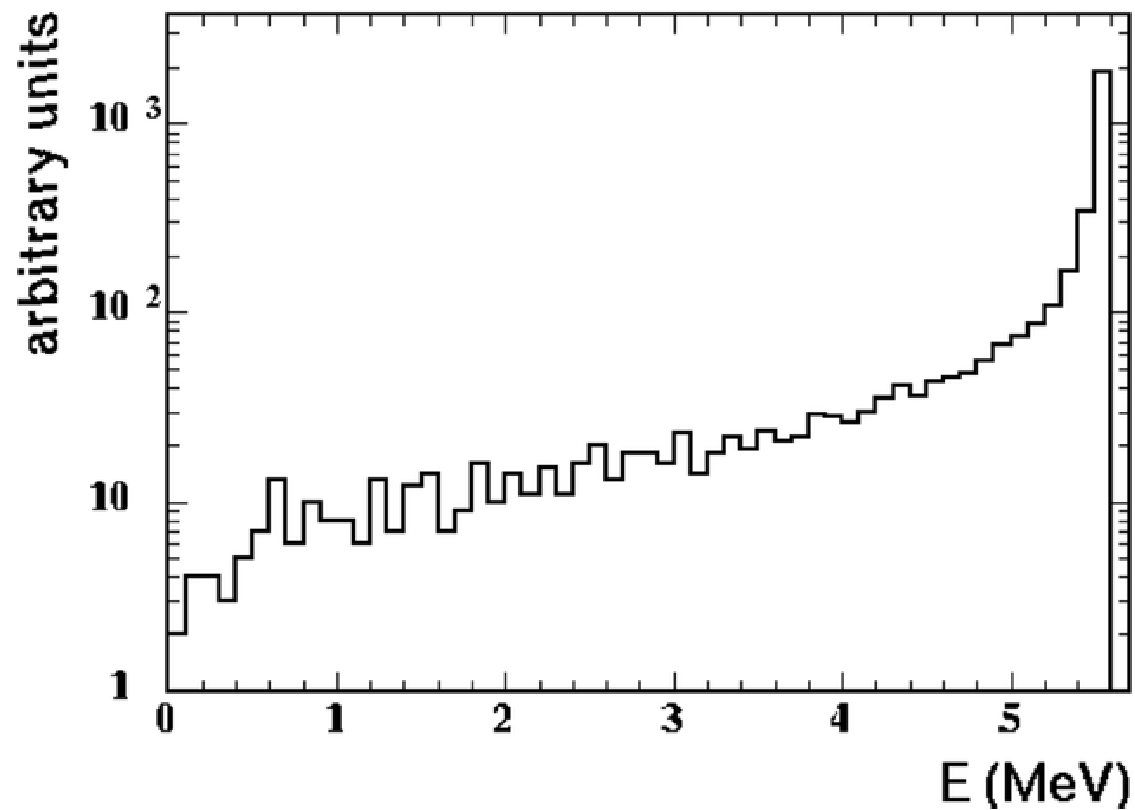


Beam position scan with new Cu profiler:
Beam size $\sigma = 5$ mm at target

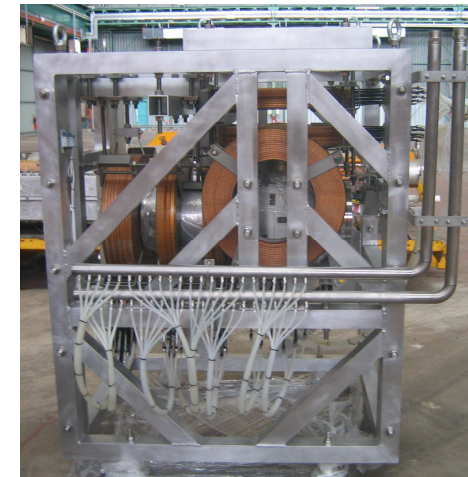
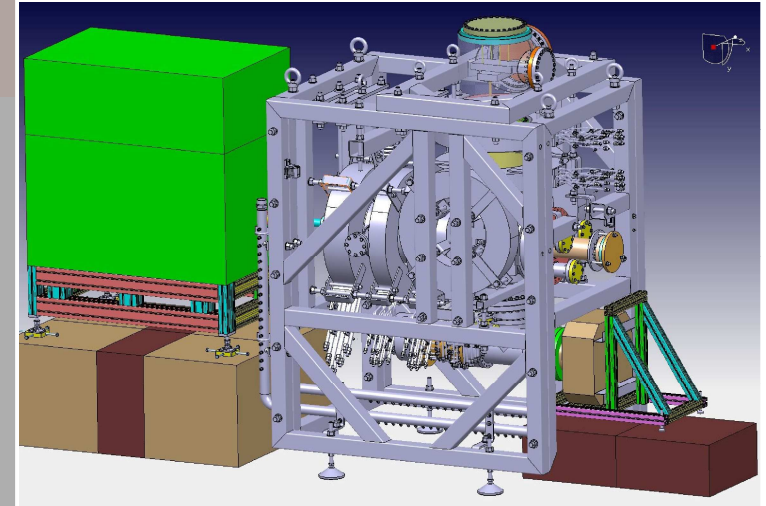
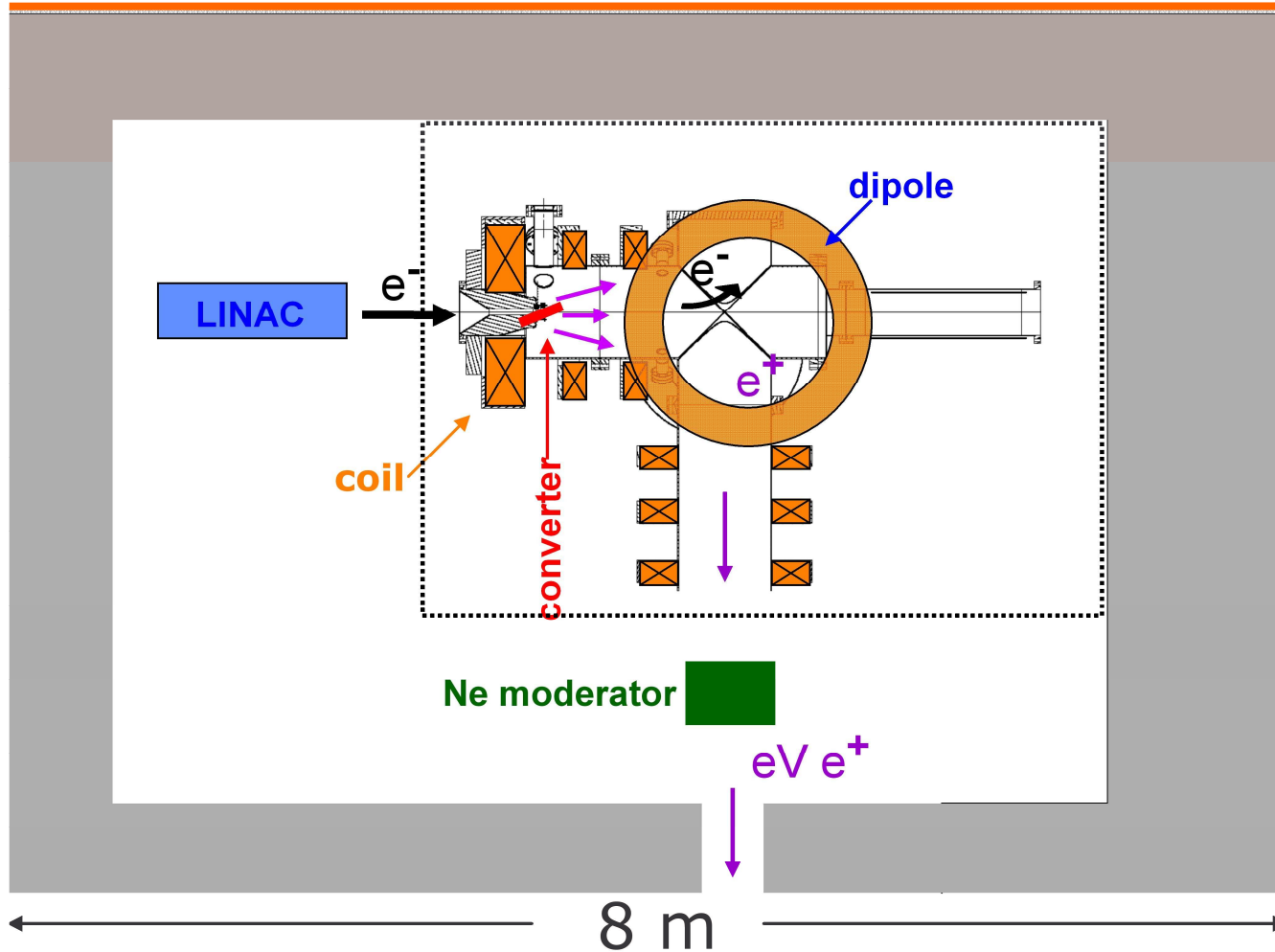
Next steps: stability test (8h running at 200 Hz) ;
better positioning of positron detector (noise due to
backscattering and HF)



Simulated energy spectrum of e^-



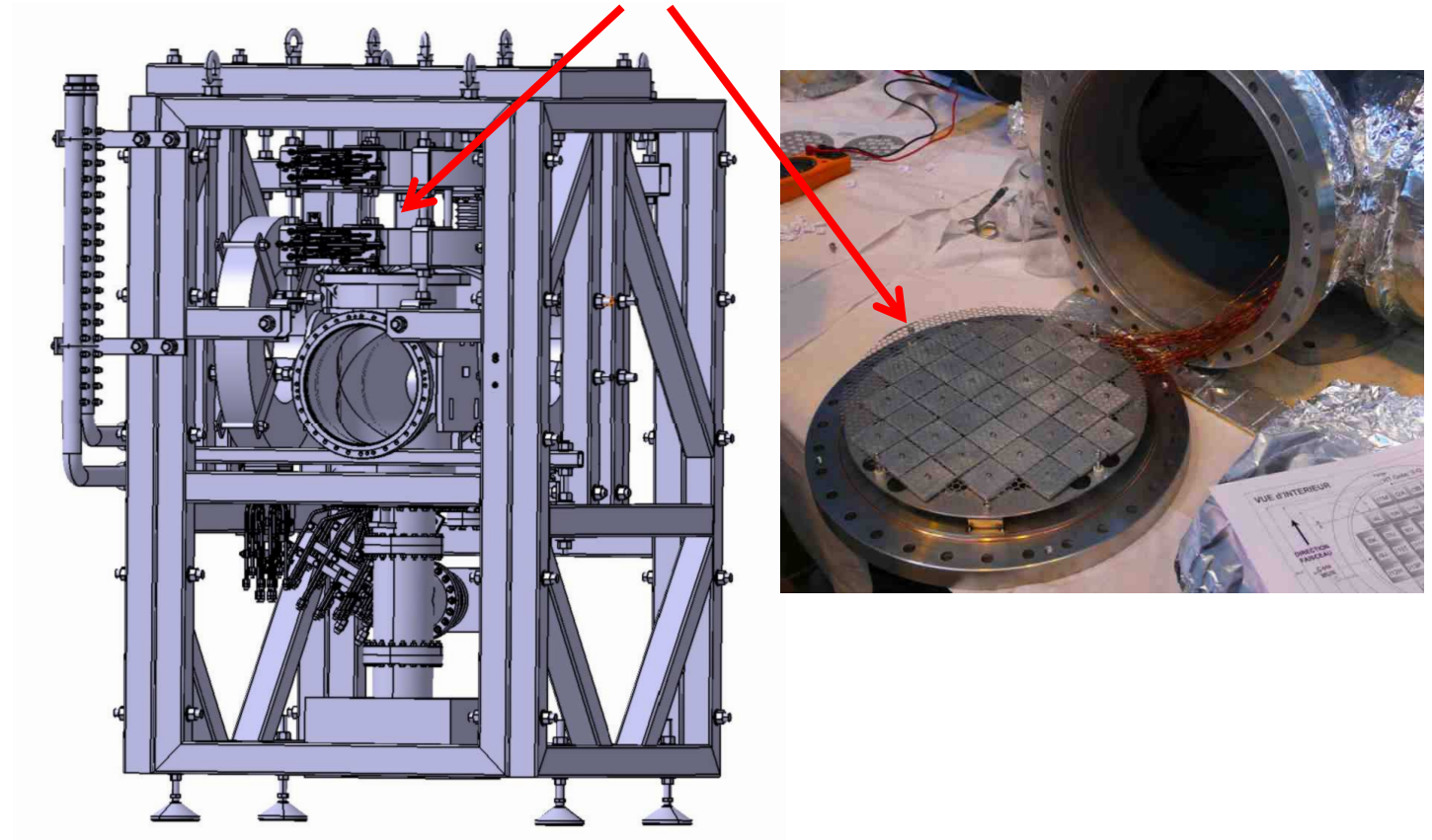
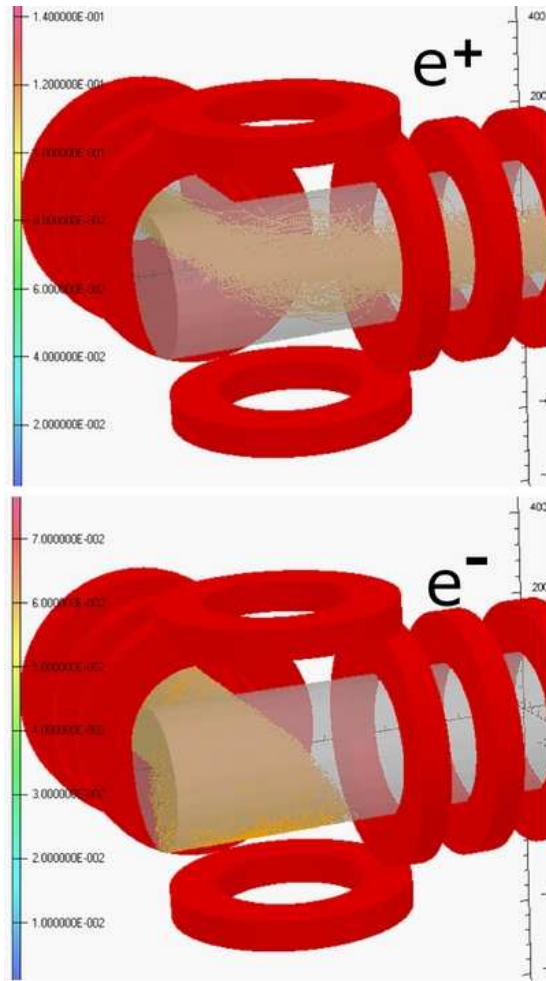
Fast e^+ selector for cryo-moderation



http://www-dapnia.cea.fr/Phocea/Vie_des_labos/Ast/ast_technique.php?id_ast=784

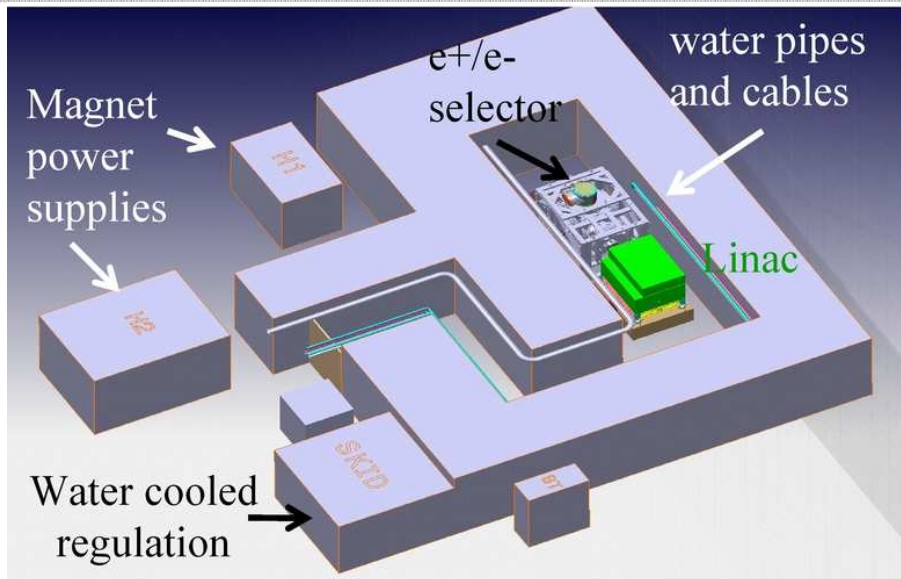
e^+/e^- selector

Temporary e^+ detector

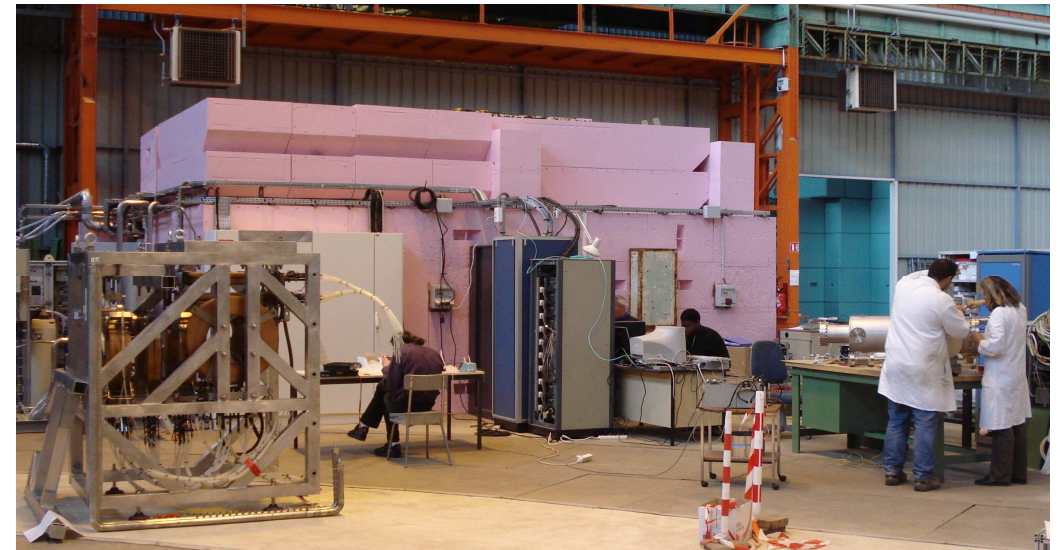
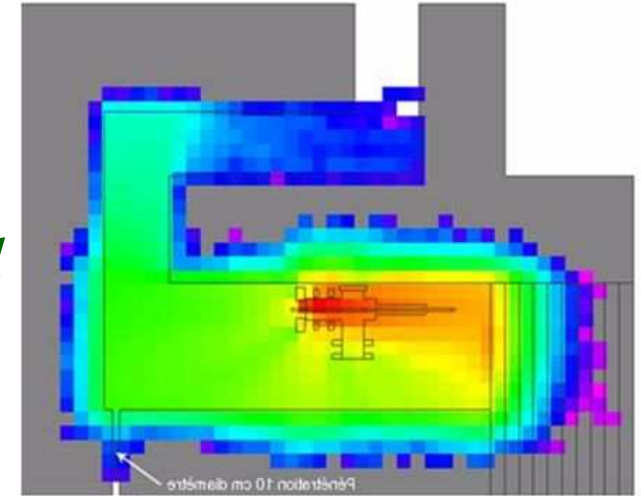


For cryogenic moderation in a later step

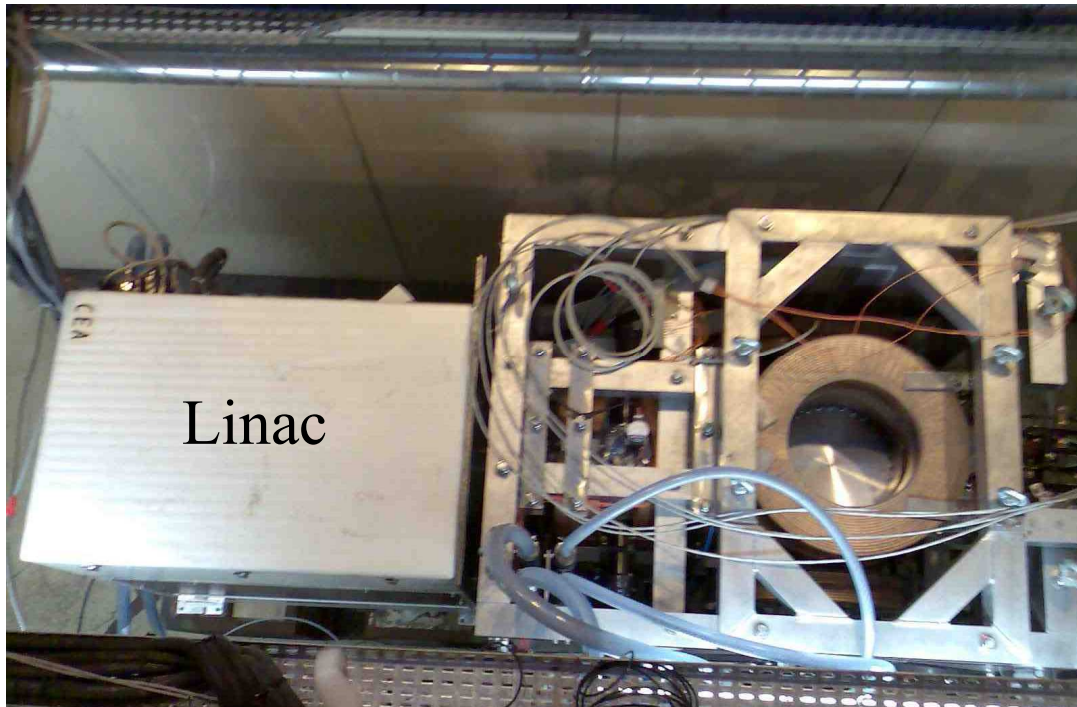
Installation at Saclay



*Simulation
for
radiological
safety*



Installation (nov'08)



e⁺/e⁻ selector



Dedicated water temperature regulation for magnets and linac

Outlook

2009 milestones : Linac final commissioning and W Moderation

Starting or continuing in 2009 :

- Systematic studies of mesoporous SiO_2 for P_s production (at Cern)
- Cryogenic moderation
- Design and building of a high field Penning trap adapted to linac for \bar{H} physics
- Low field trapping for material science (needs a more extended time structure)