RFD simulations

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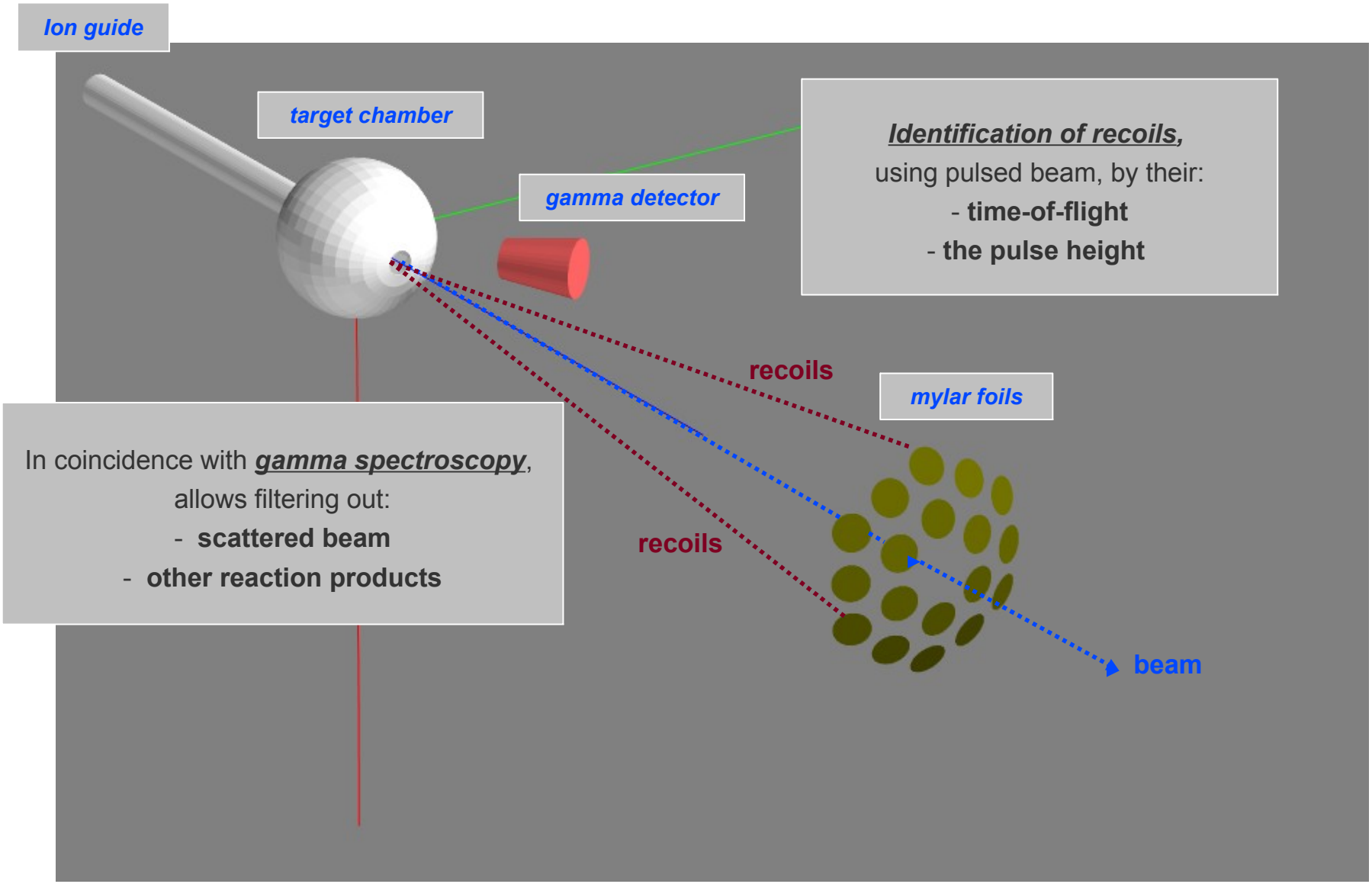
Introduction to RFD

construction and performance



Introduction to simulations

„some history”

Simulations started by G. Jaworski in GEANT4 and COMPA:

Simulation of a beam

Simulation of desired recoil

Continued with application of CASCADE:

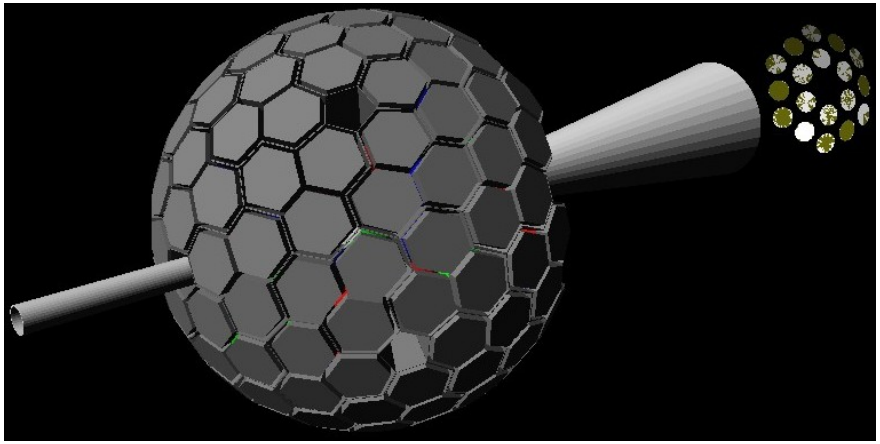
Simulation of all types of recoils for given reaction

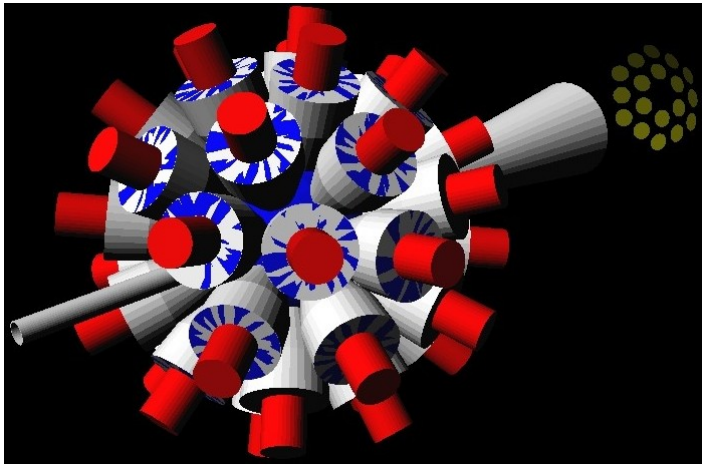
Inclusion of fission products (pre-phase)

Application of GEMINI++

Inclusion of symmetric and asymmetric fission products

Simulations of lifetime measurements with RFD, AGATA and GASP

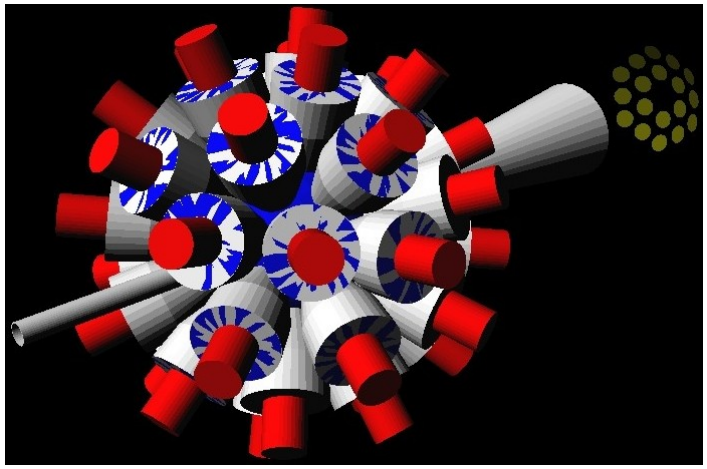


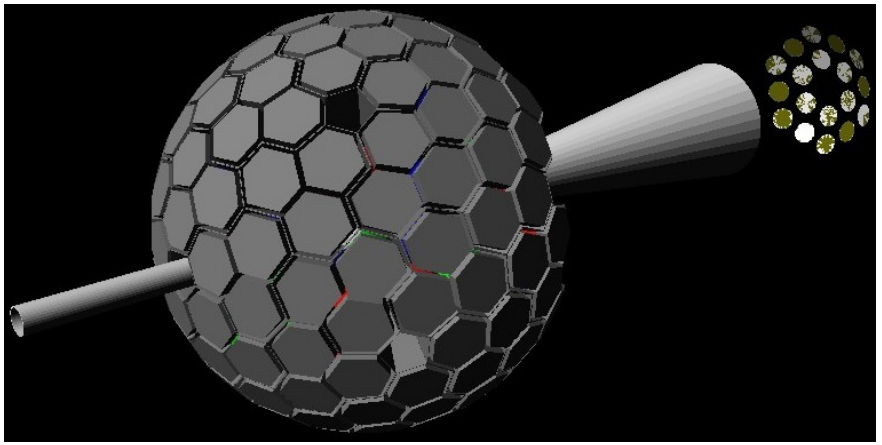


shown during AW in Uppsala, July 2008

$^{40}Ca(^{32}S,2\alpha)^{64}Ge$

$\varepsilon_{RFD}=24\%$





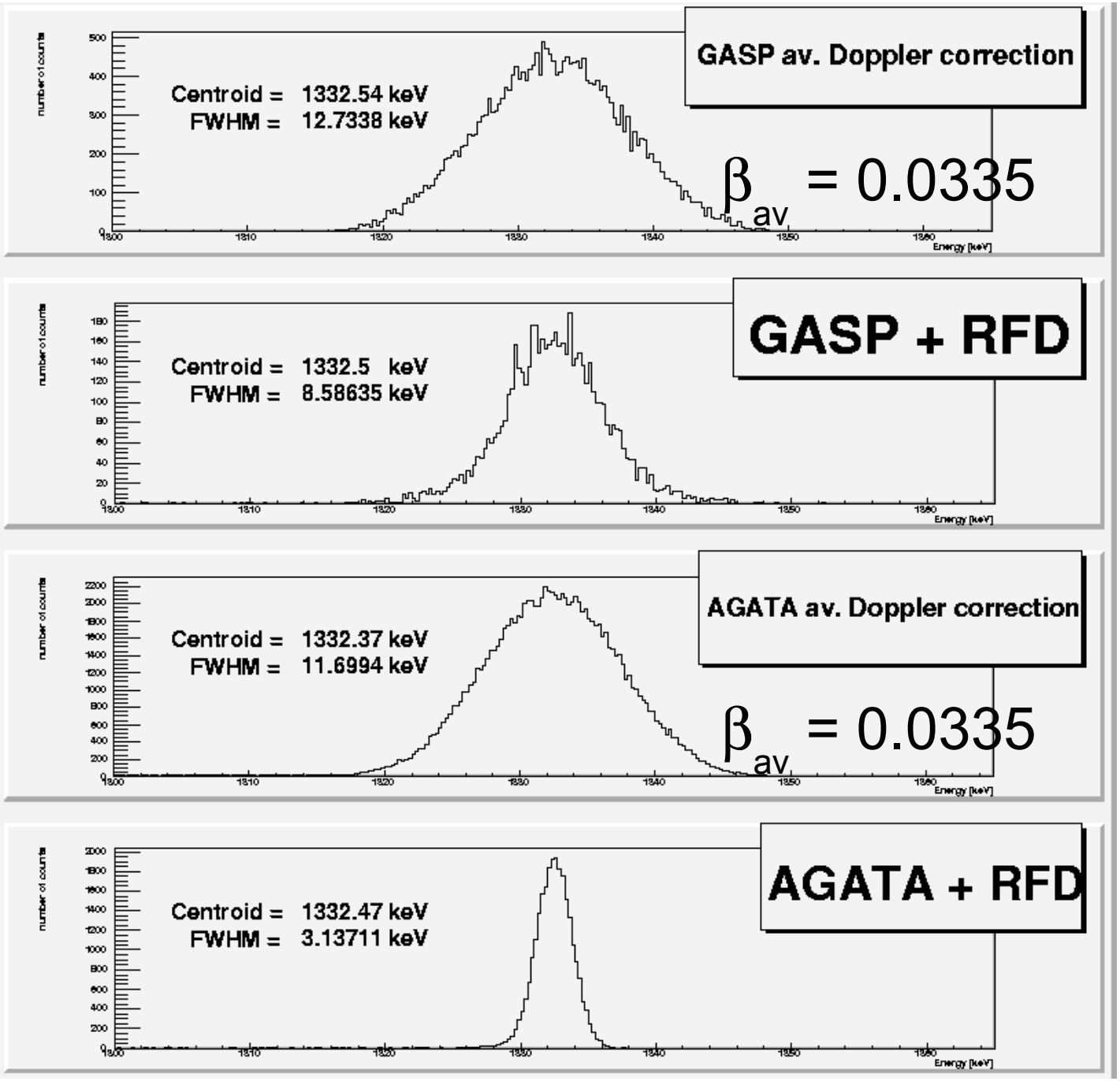
$\varepsilon_{GASP}=5.0\%$

P/T = 0.71

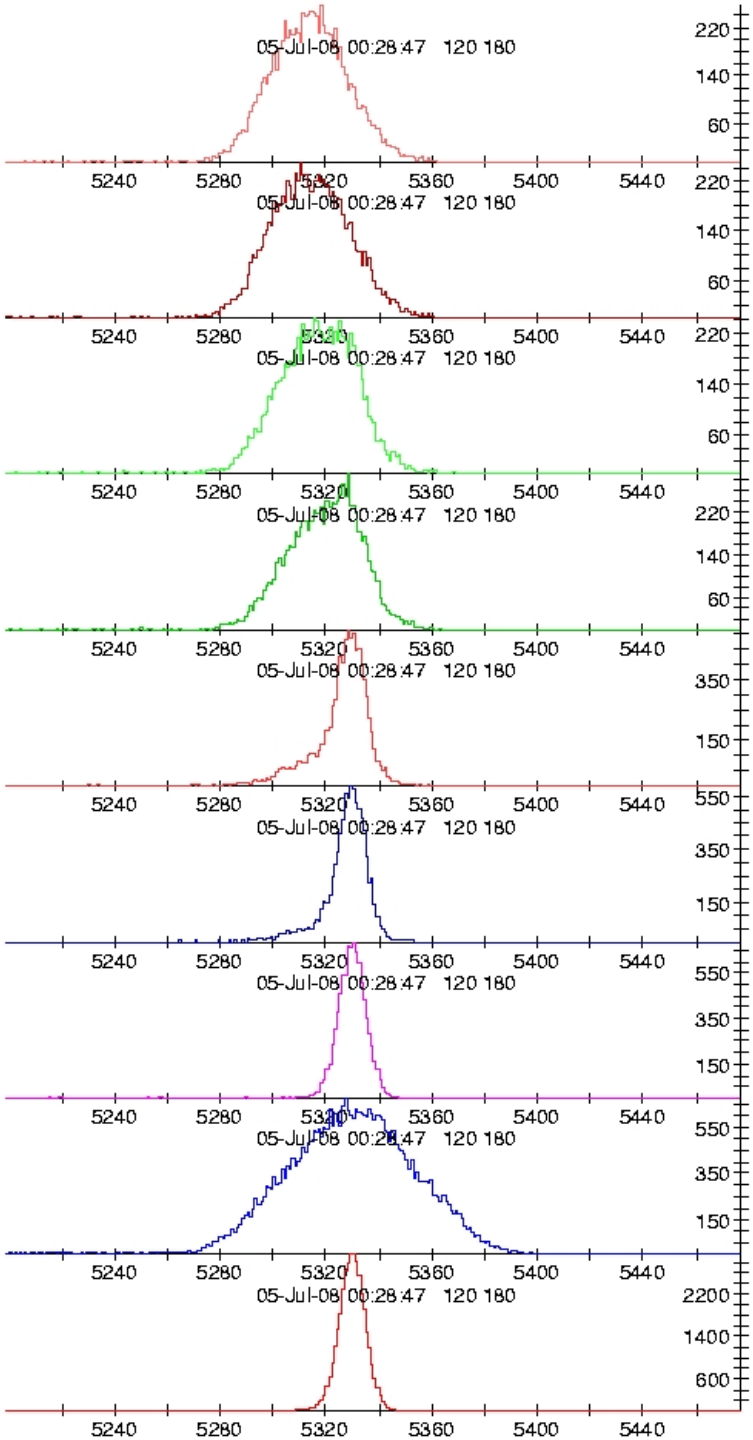
$\varepsilon_{3\Pi}=22\%$

P/T=0.67

FWHM = 2.4 keV @ 1.3 MeV



γ emission after passing through the target



prompt γ emission

τ = 0.01 ps

τ = 0.05 ps

τ = 0.1 ps

τ = 0.5 ps

τ = 1.0 ps

γ emission outside the target

average Doppler correction

stopped source

AGATA

120-180°

lifetime determination:
P.Bednarczyk et al.
EPJA 20(2004)45

Aim of simulations

radioactive beams, inverse kinematics

„Study of collective modes of excitations in the neutron-rich Ba region via fusion-evaporation reactions”

Spiral2 Day1 – Phase2 LoI

Adam Maj (Kraków), Silvia Leoni (Milano) – spokespersons
Christell Schmitt – GANIL Liaison et al

Proposed reaction:

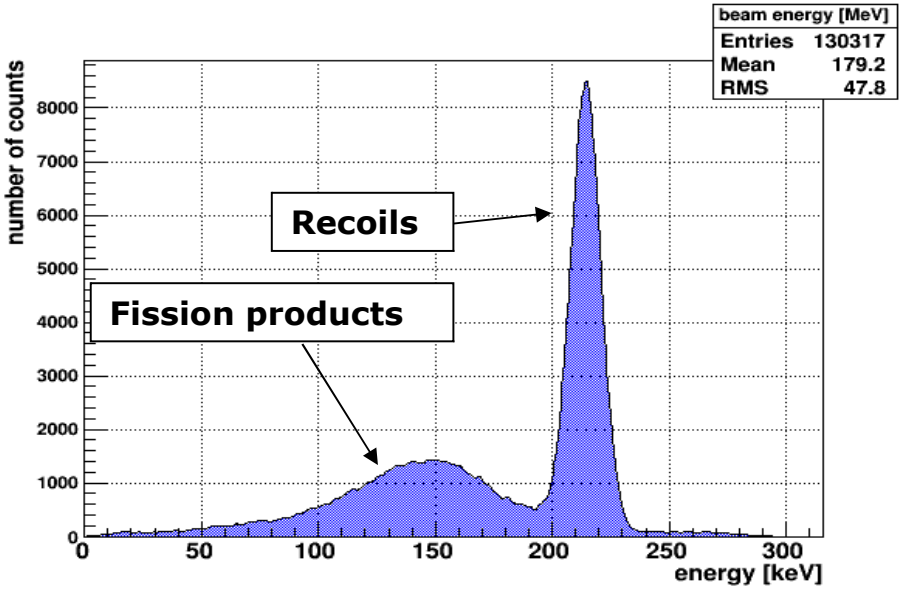
- Radioactive beam: ^{90}**Kr**, E = 388 MeV
- Target: ^{48}**Ca**, 1mg/cm^2

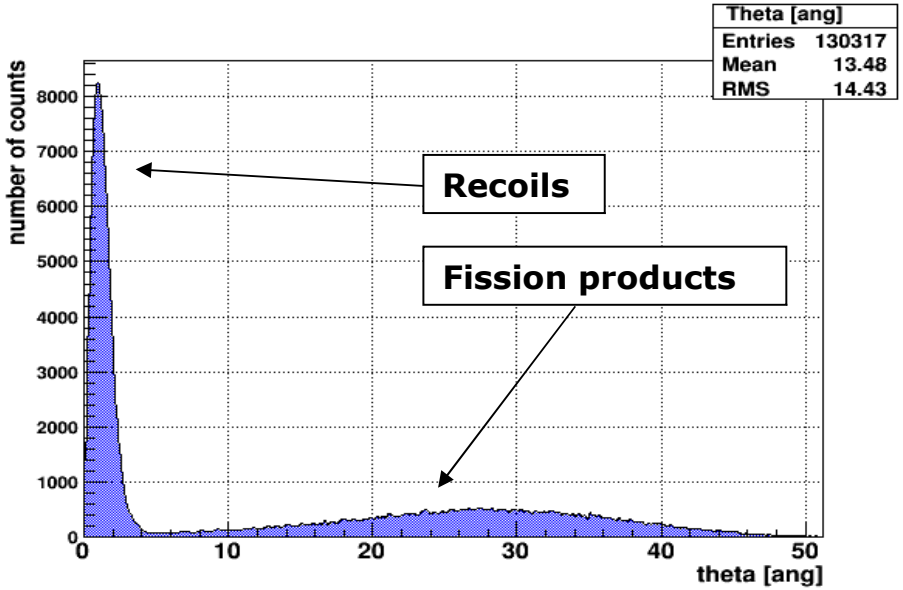
Possible application of RFD

- Doppler shift correction
- elimination of fission products – *essential in this kind of reaction*

Results

reaction products





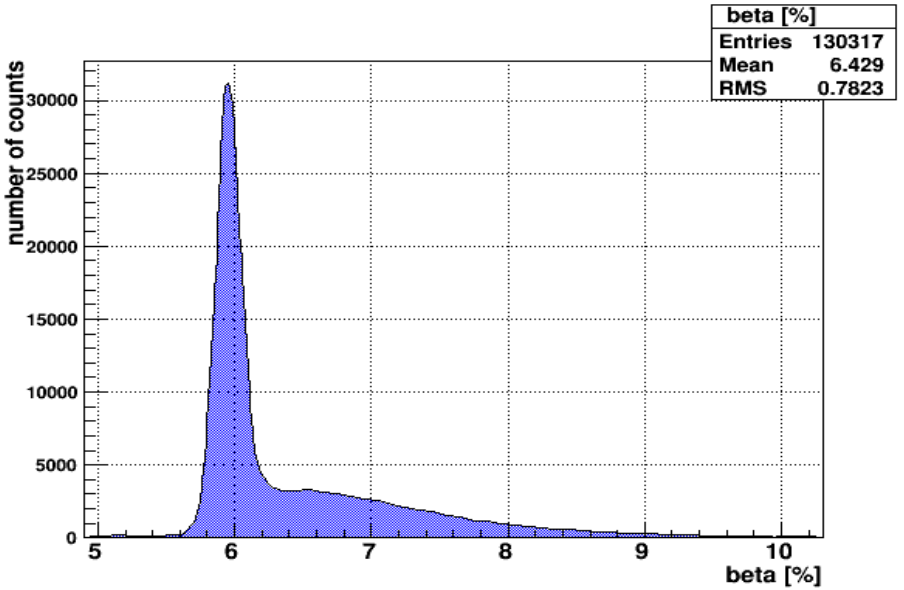
388 Mev ^{90}Kr beam passing 1mg/cm^2 ^{48}Ca target

calculated with Geant4.9.2 + Gemini+

Energy, angular and beta distributions

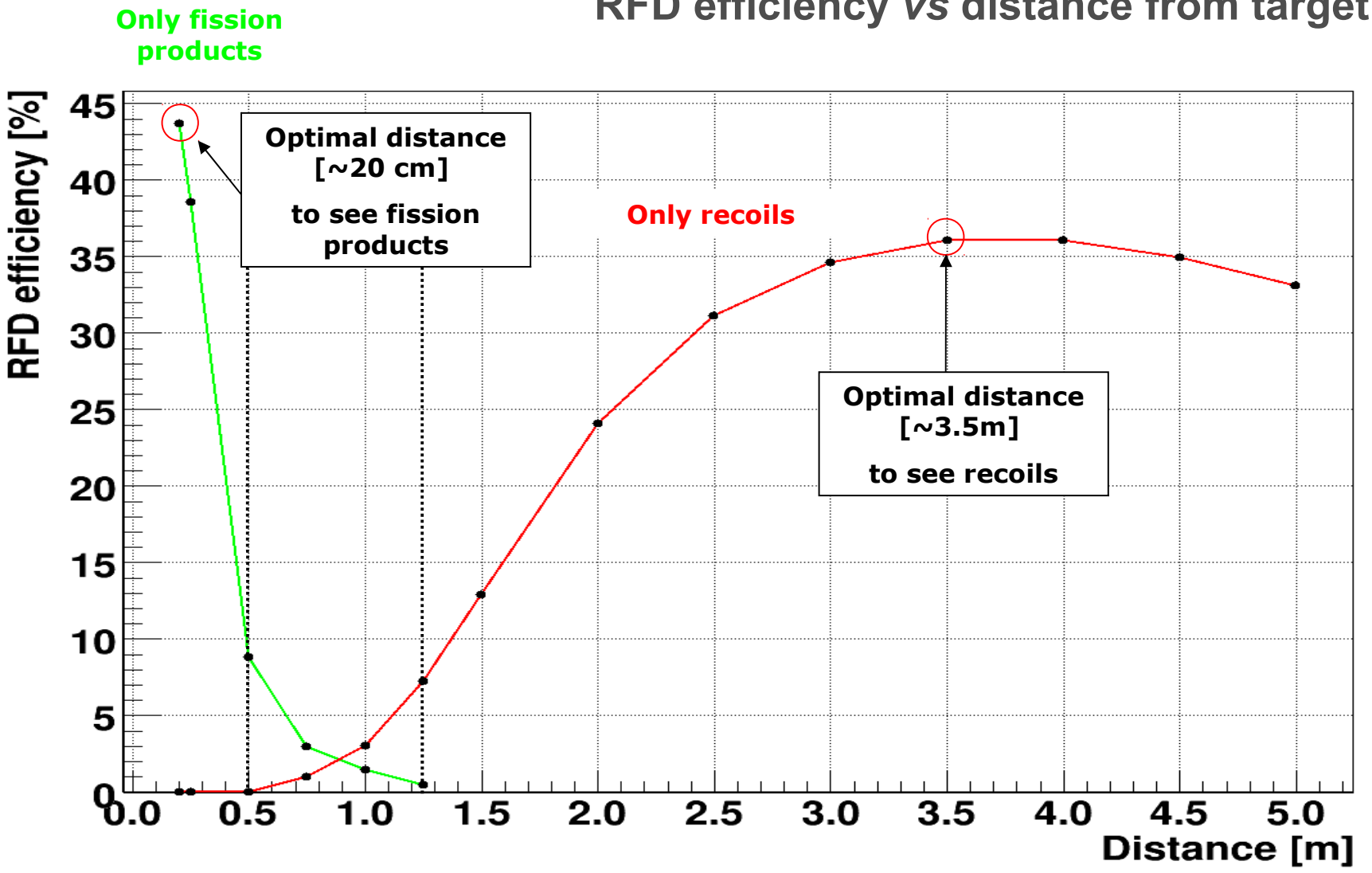
of

reaction products that leave target



Results

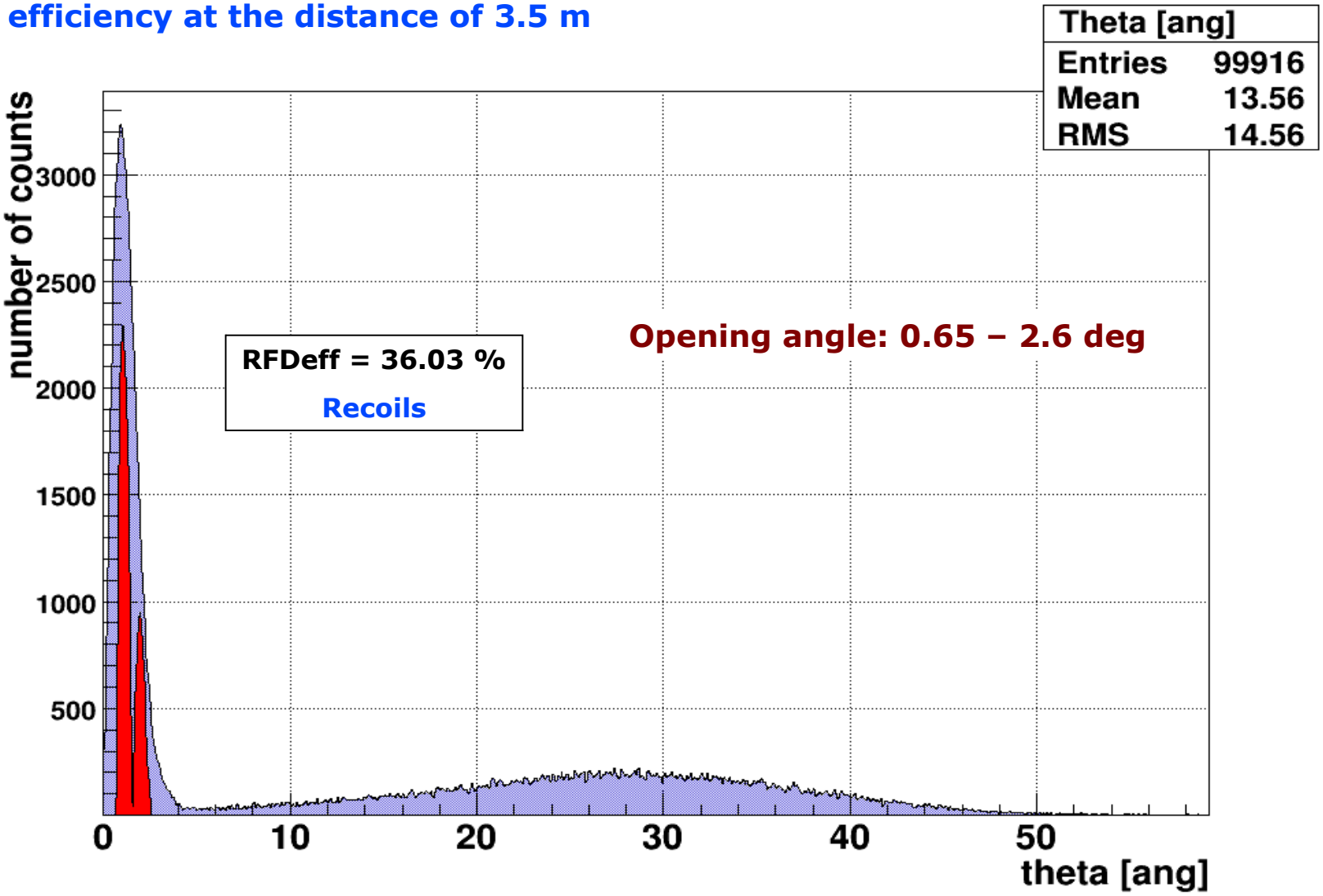
RFD efficiency *vs* distance from target



Results

RFD efficiency *vs* distance

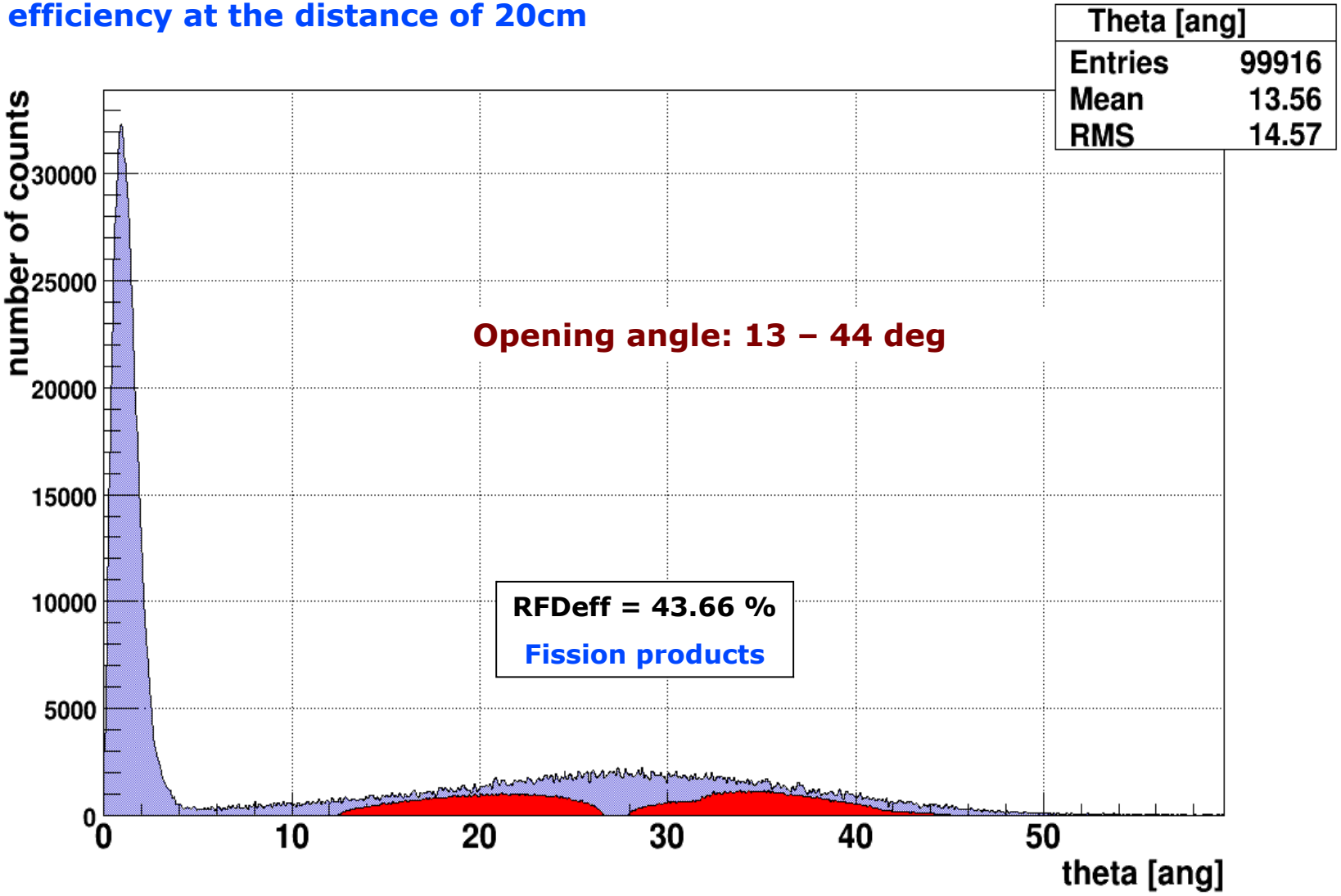
RFD efficiency at the distance of 3.5 m



Results

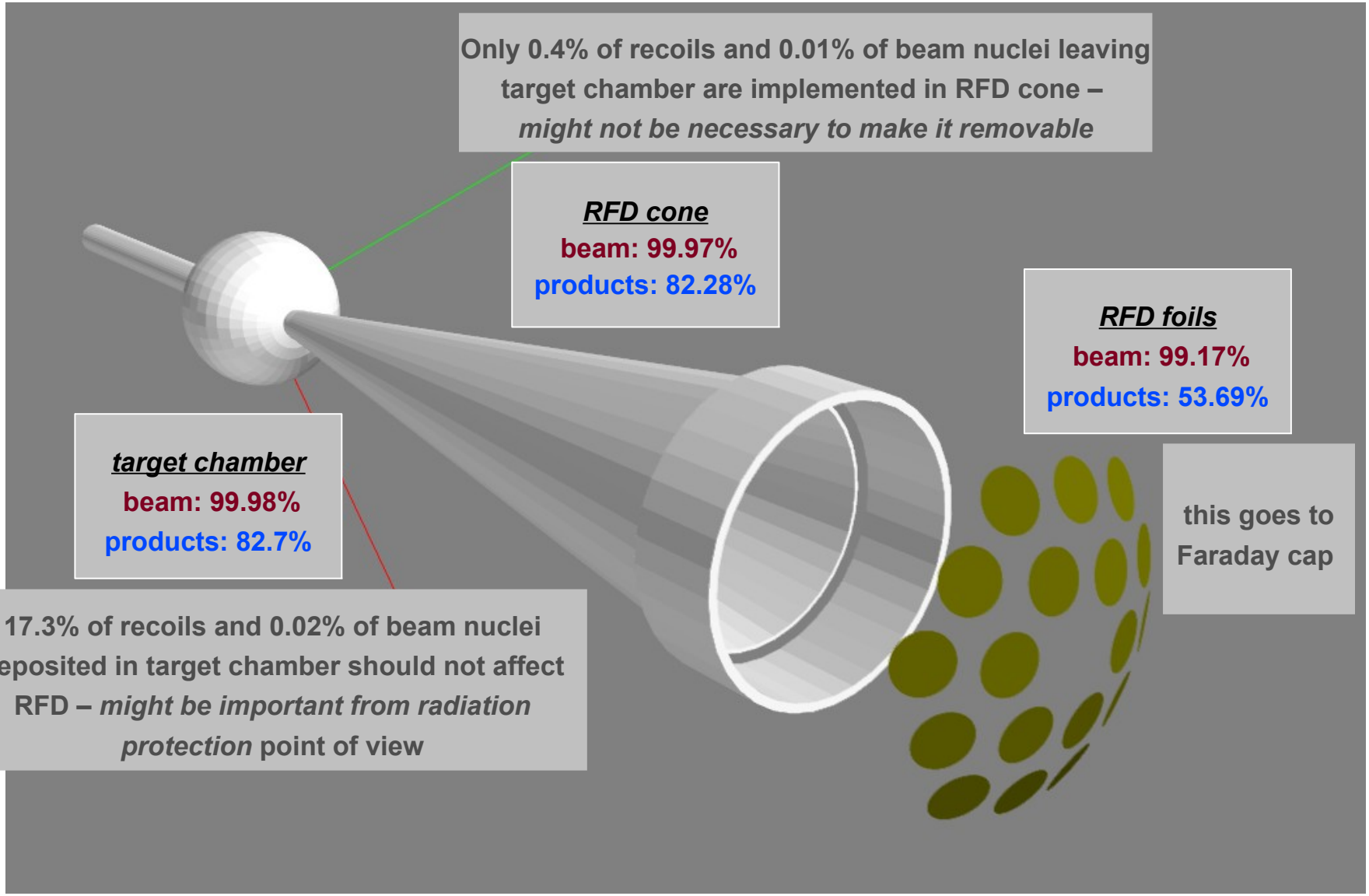
RFD efficiency *vs* distance

RFD efficiency at the distance of 20cm



Results

deposition of nuclei in RFD elements



Summary

→ experiments with RFD: widths of the γ lines just due to Ge det. opening angle;
→ complete simulations of GASP+RFD and AGATA+RFD performed (with COMPA);
→ AGATA+RFD setup sensitive to lifetimes in the range 0.01-1.00 ps;
→ new design of RFD for RIB ongoing;
→ CASCADE and GEMINI employed

Simulations

„to do list"

General „improvements":

Point vs non point-like (finite size of the spot) beam

Broadening of initial beam energy

Further study on possible application to detect fission products:

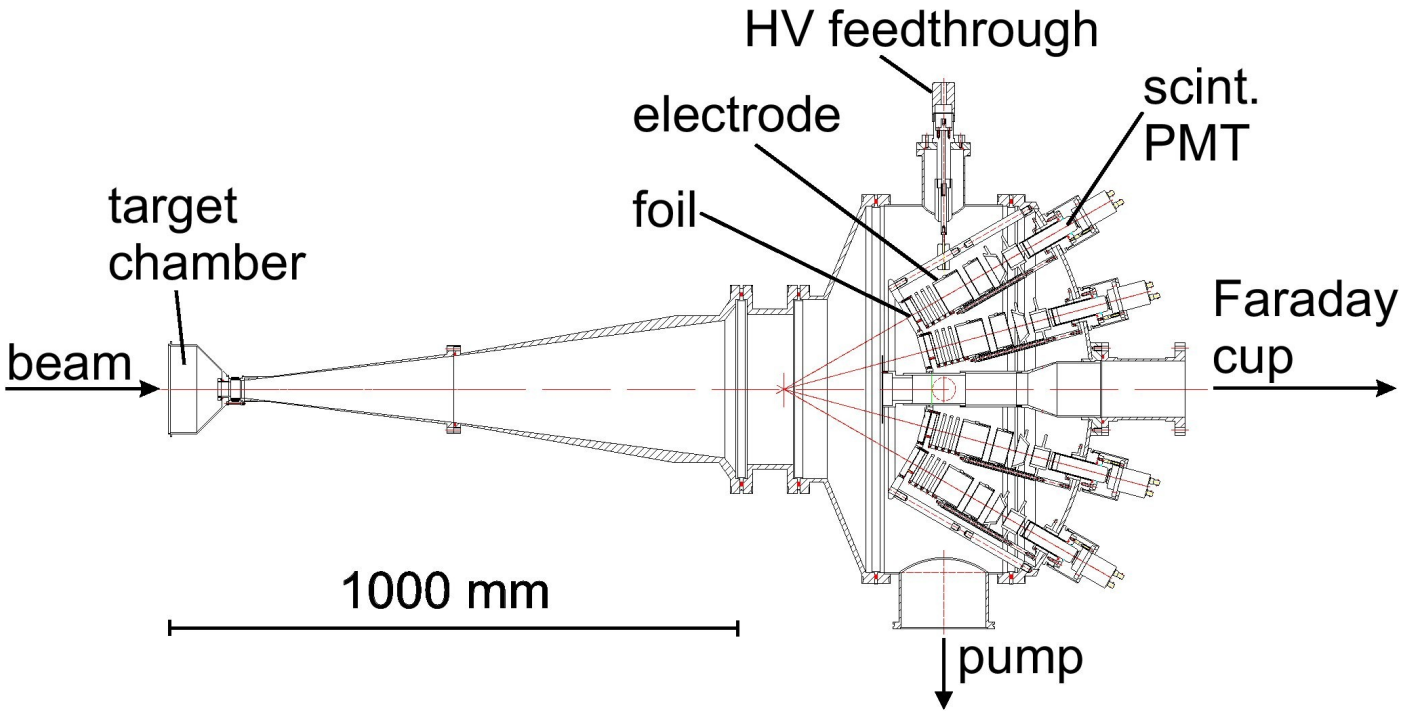
Angular resolution

Doppler shift correction

Further study on nuclei deposition in RFD construction:

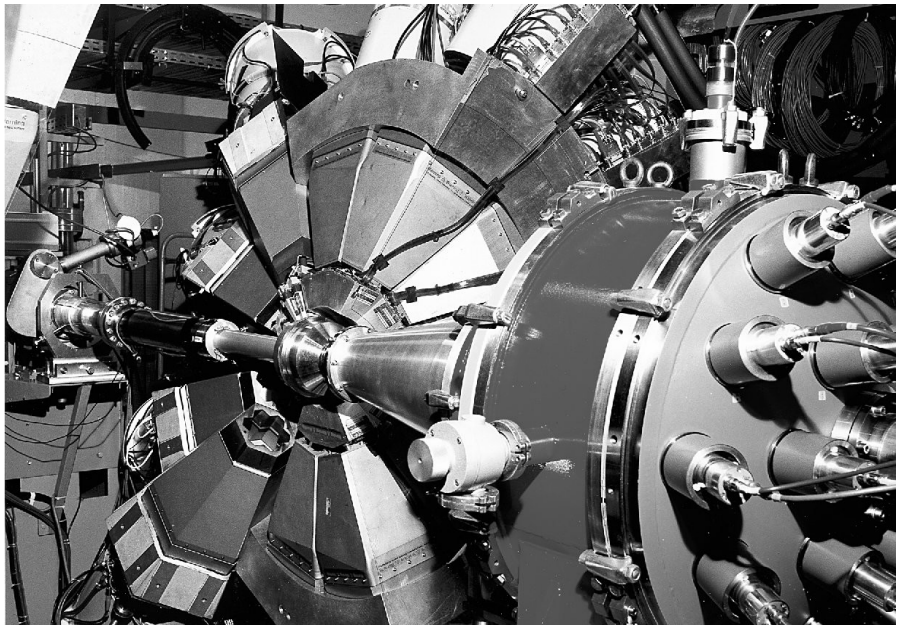
Detailed identification of nuclei and its quantity – estimation of dose deposition

The RFD detector



W.Męczyński et al. - NIM A580, 1310(2007)

The RFD detector



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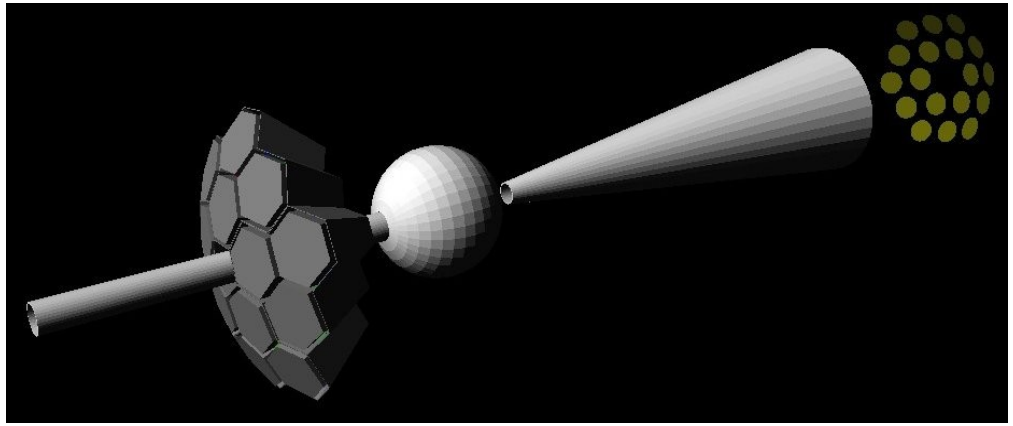

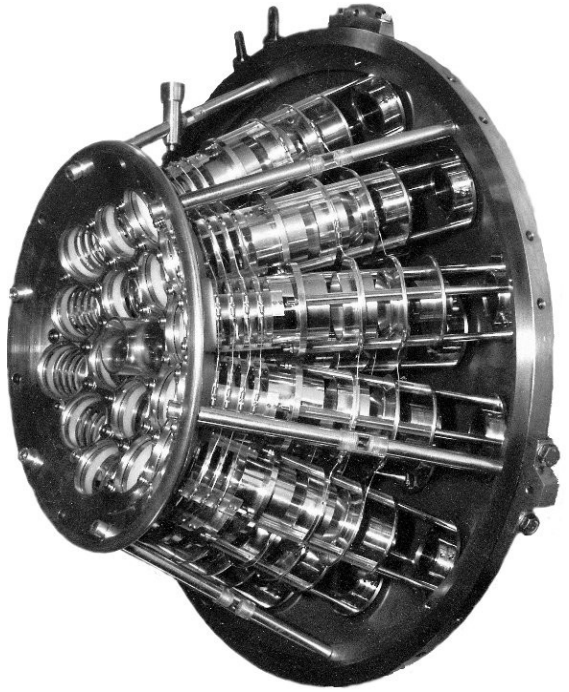

W.Męczyński et al.
NIM A580, 1310(2007)