Simulations of Possible Application of Recoil Filter Detector in Nuclear Structure's Studies with Radioactive Beams

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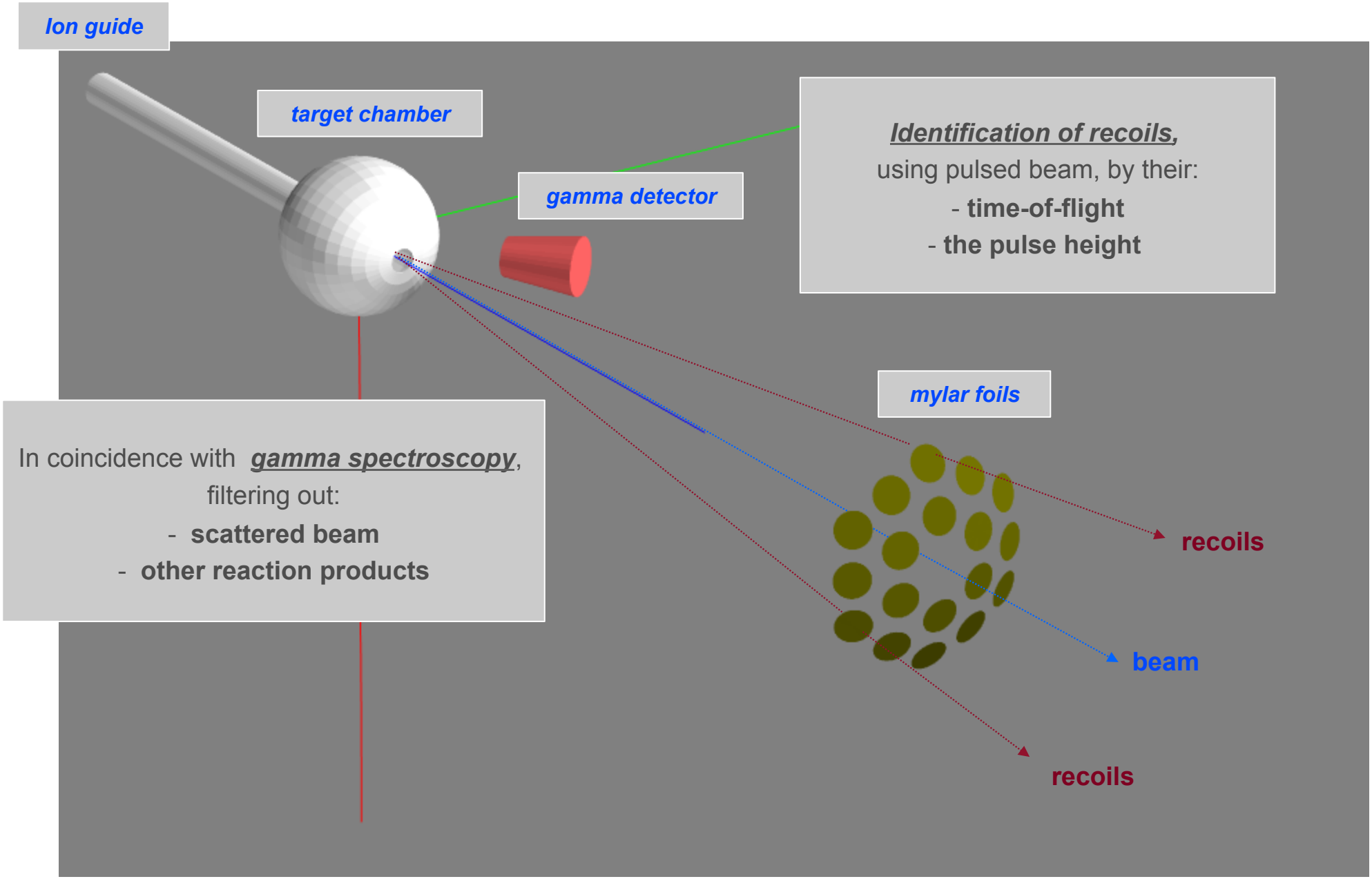
Introduction to RFD

construction and performance



Introduction
aim of simulations

„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

Application of RFD

* Doppler shift correction

* elimination of fission products – *essential in this kind of reaction*

Results

RFD efficiency as a function of distance from target

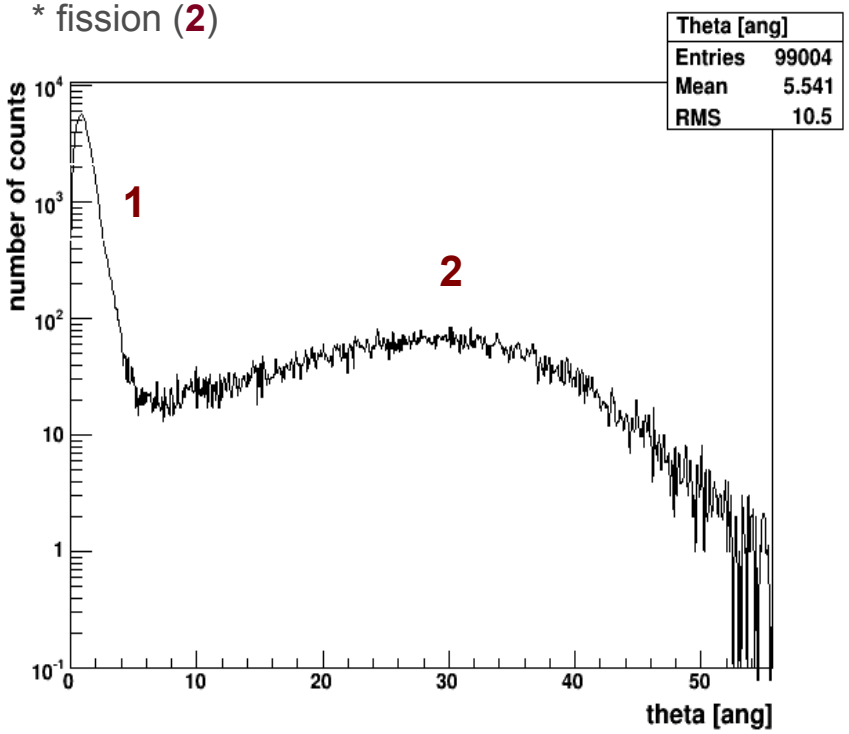
General remarks on simulations

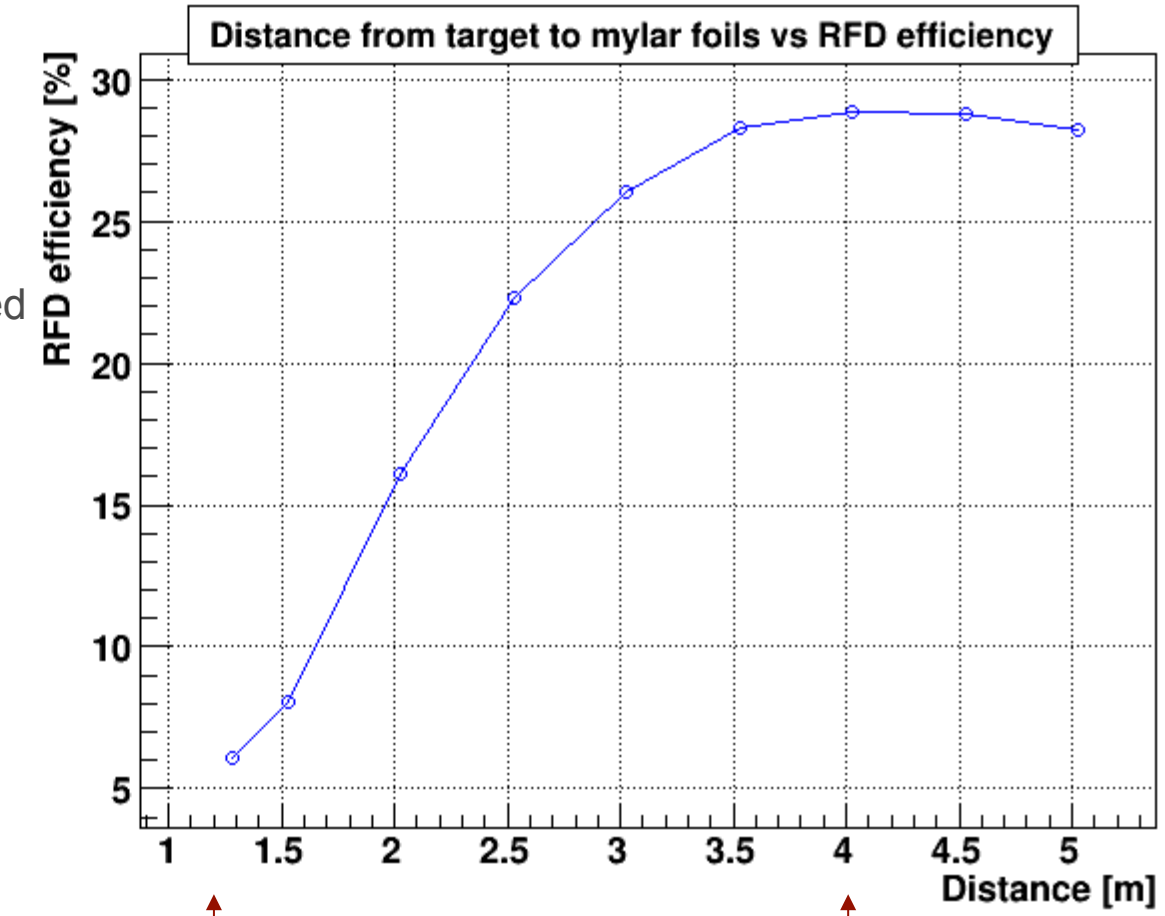
Simulations **started** by *G.Jaworski* using Geant4:

* one reaction channel: ^{90}**Kr**(^{48}**Ca, 8n**)^{130}**Ba**

Then, **products of reactions** were simulated with ***Cascade*** (*M. Ciemała*) including:

* fusion-evaporation (**1**)
* fission (**2**)



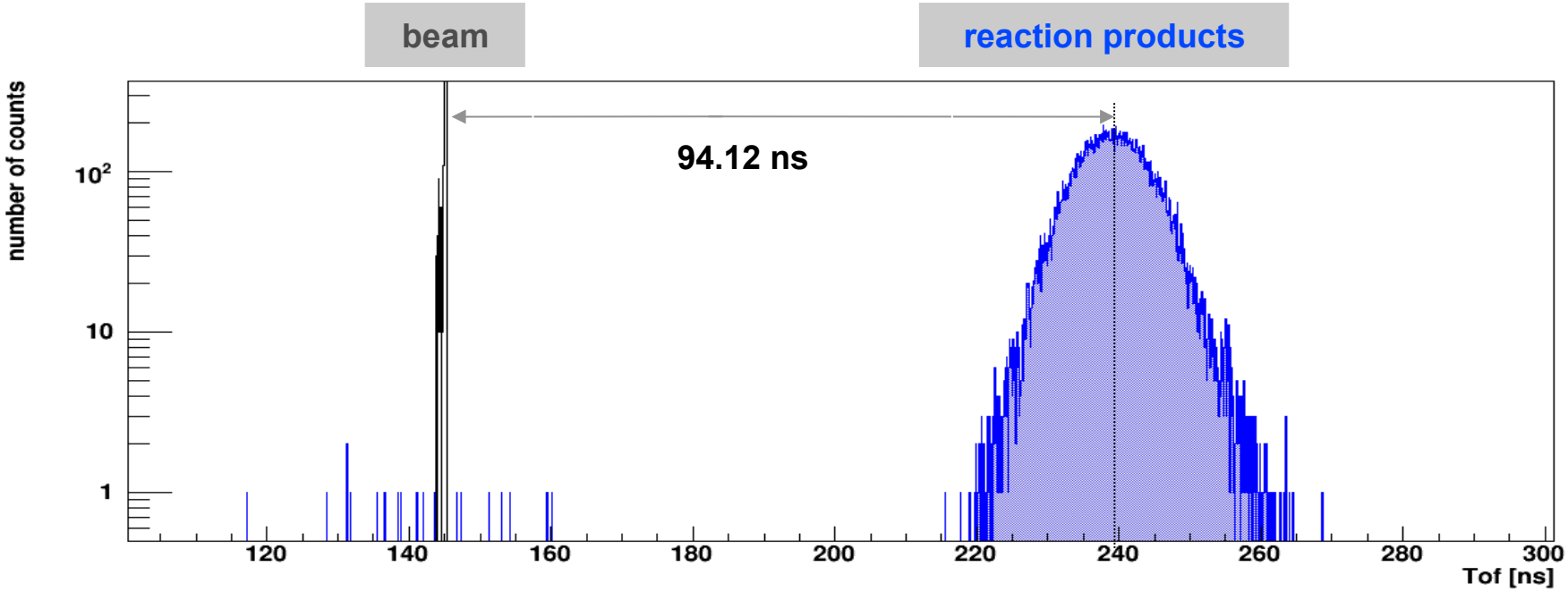


original distance [1.25m]

optimal distance

Results

Time-of-flight separation



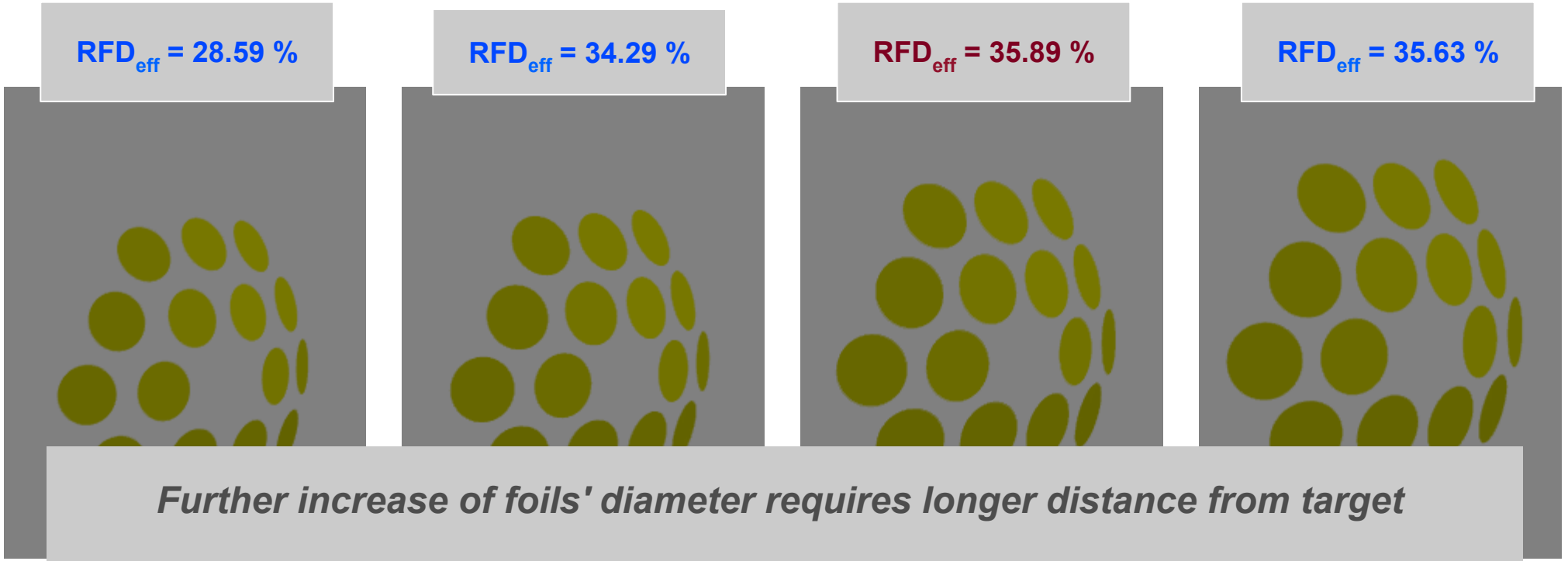
Tof_{av} = 145.11 ns
σ = 0.28 ns

Tof_{av} = 239.23 ns
σ = 5.42 ns

Possible separation of beam and reaction products with this setup

Results

different foils' geometry



Further increase of foils' diameter requires longer distance from target

to maximize the positive effect - we can not afford it ! 4 m is already long

foil

inner ring theta = 2.9 deg
middle ring theta = 5.1 deg
outer ring theta = 5.69 deg
distance from target = 4 m

inner ring theta = 2.9 deg
middle ring theta = 5.1 deg
outer ring theta = 5.9 deg
distance from target = 4 m

inner ring theta = 3.2 deg
middle ring theta = 5.65 deg
outer ring theta = 6.55 deg
distance from target = 4 m

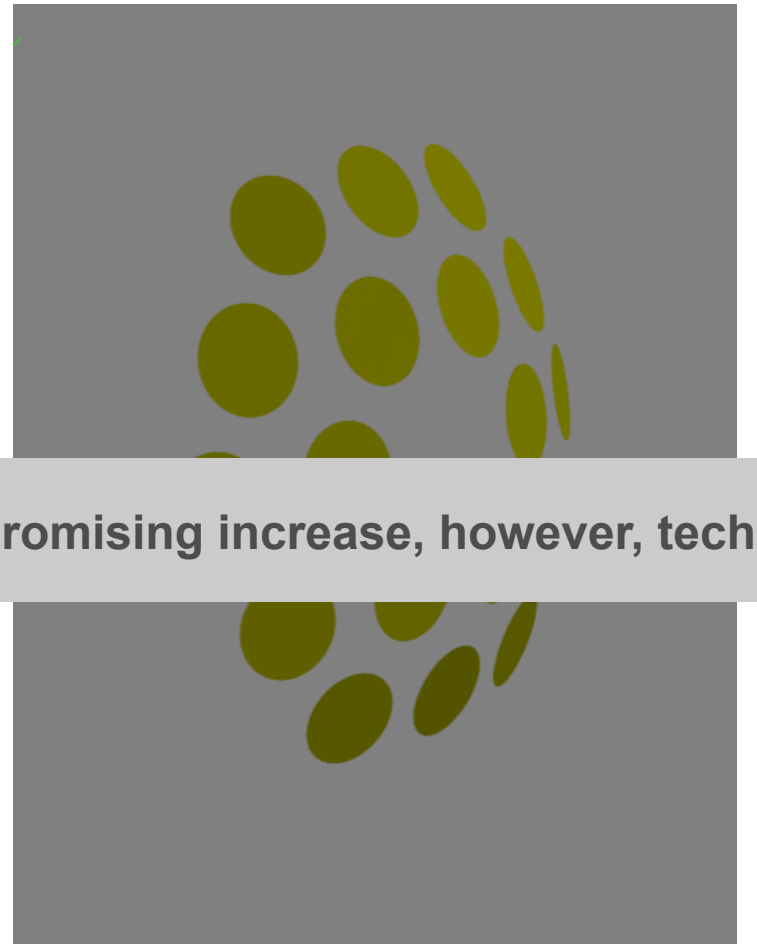
inner ring theta = 3.45 deg
middle ring theta = 6.0 deg
outer ring theta = 7.0 deg
distance from target = 4 m

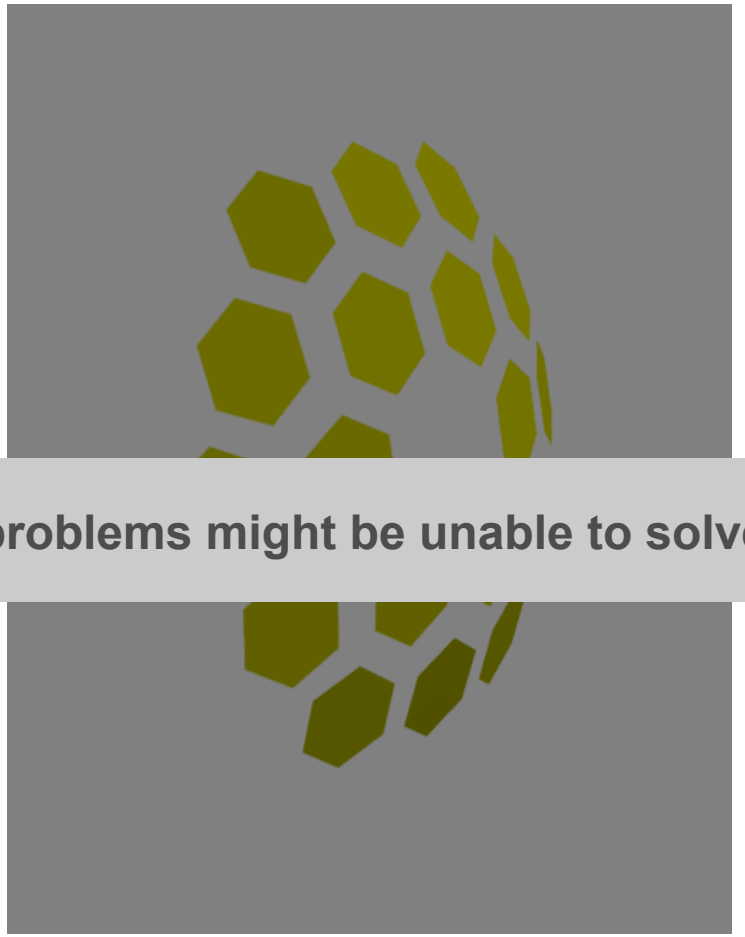
Results

different foils' shape

spherical vs ***hexagonal***

RFD_{eff} = 28.59 % RFD_{eff} = 31.75%



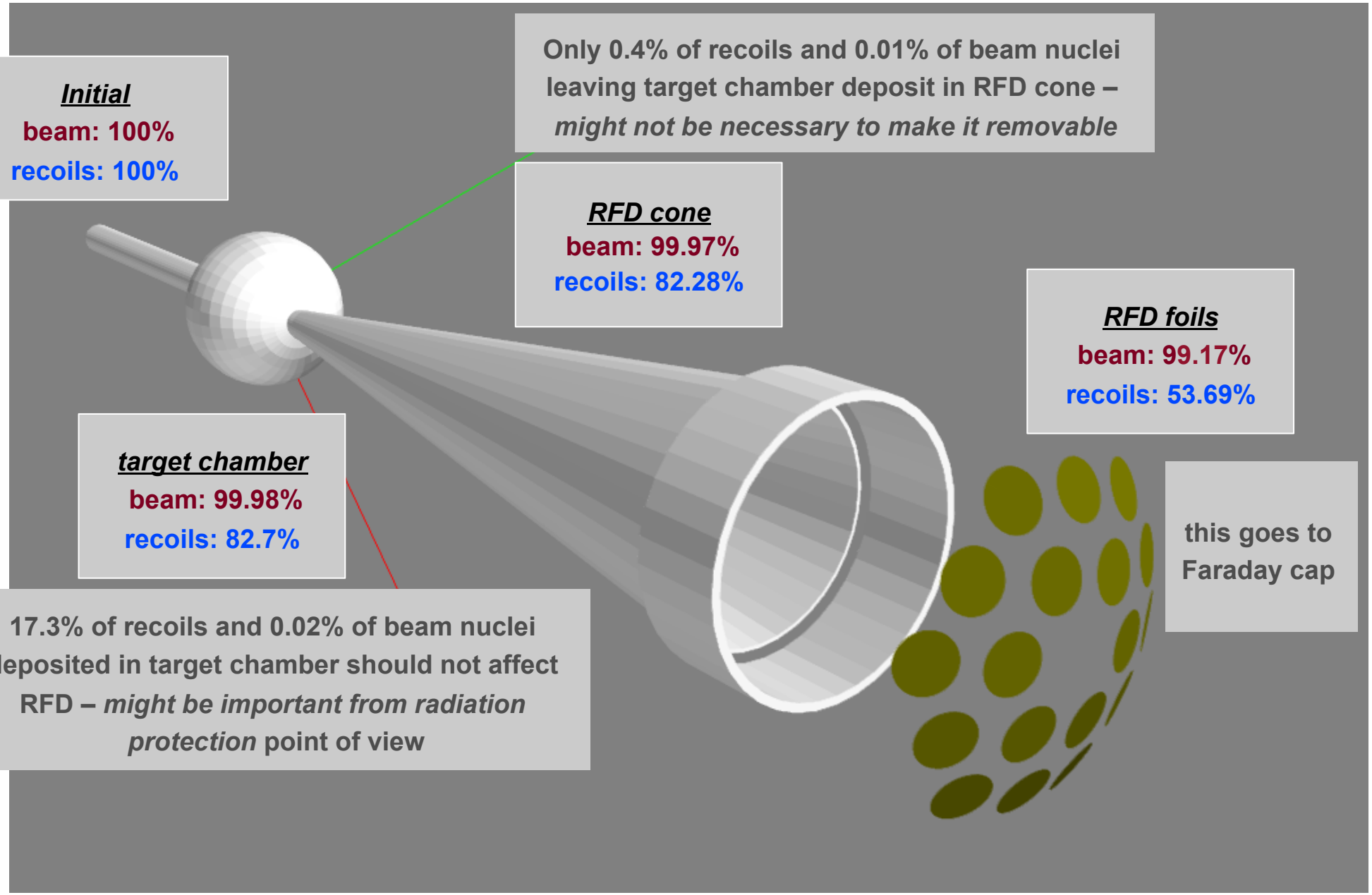


Promising increase, however, technical problems might be unable to solve

present configuration

Results

deposition of nuclei in RFD elements



Summary

„to do" list:

* **simulation of realistic reaction products** – *done with Cascade* ☺

* **beam separation** – *theoretically possible !* ☺

* **searching for optimal foils configuration** – *in progress, with some promising results*

* **simulation of nuclei deposition in RFD elements** – in progress*, first step has been done*

* *….*

… any suggestions are very welcome !