Production cross-section and reaction yield of ^{82}Sr for $^{82}Sr/^{82}Rb$ generator

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INTRODUCTION

- There are many radioisotopes used for diagnostic and therapeutic purposes in nuclear medicine. One of the radioisotopes used for diagnostic purposes is ^{82}Sr.

- It is used in positron emission tomography (PET) as to be positron emitter and commonly obtained from $^{82}Sr/^{82}Rb$ generator.

- In this study, we have investigated some possible production mechanisms of ^{82}Sr by regarding $^{82}Sr/^{82}Rb$ generator.
- $^{85,87}Rb(p,xn)^{82}Sr$ and $^{80,82,83,84,86}Kr(^{3}He,xn)^{82}Sr$ reaction channels have been investigated using the CTFGM, BSFGM, and GSM models within the framework of TALYS nuclear reaction code.

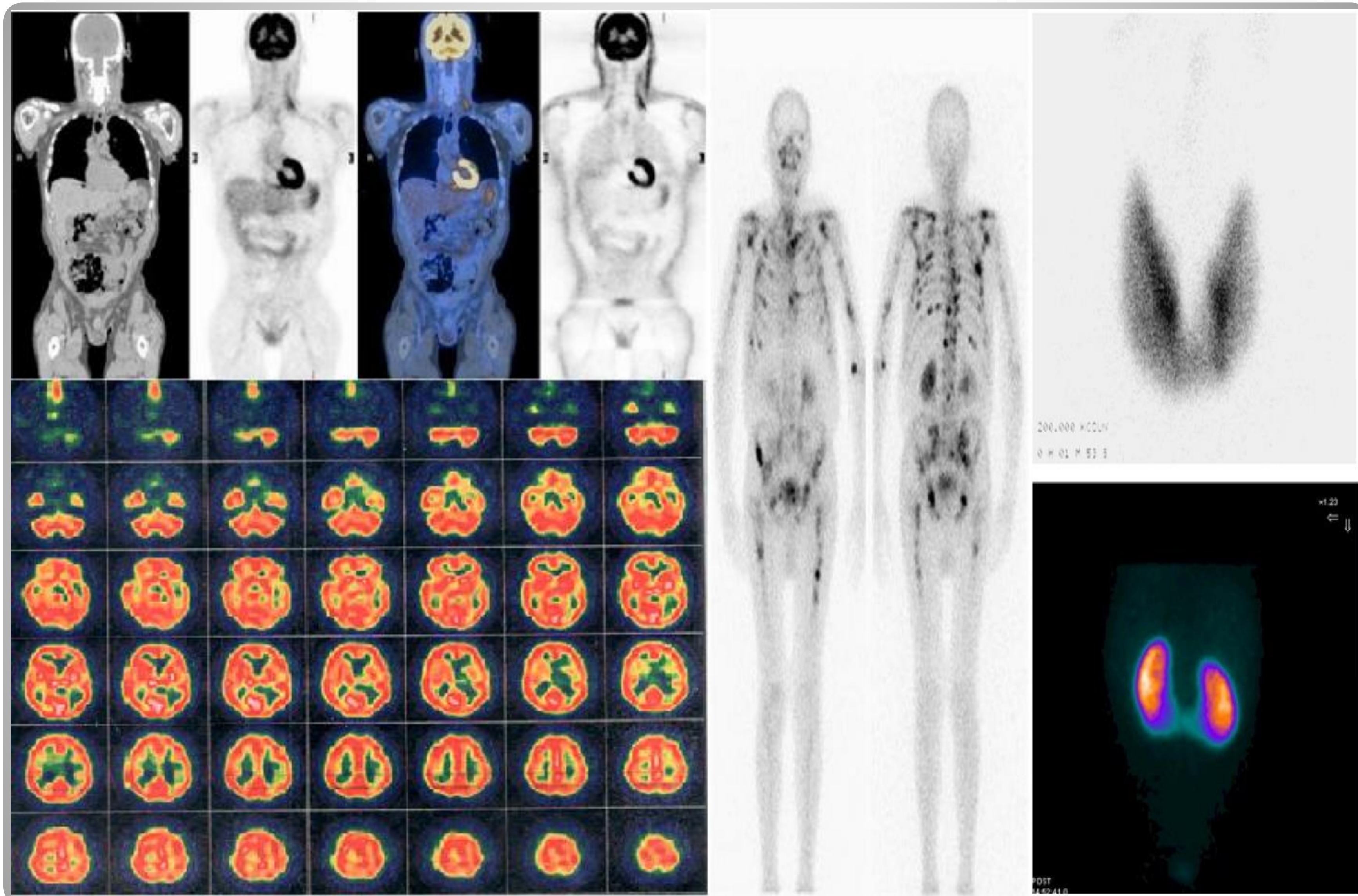
- We have been calculated that the production cross-sections, reaction yields and total activation values up to 60 MeV beam energy value.

Use of Radioisotopes in Medicine

- Radioisotopes are used for scintigraphy (imaging) in medicine.

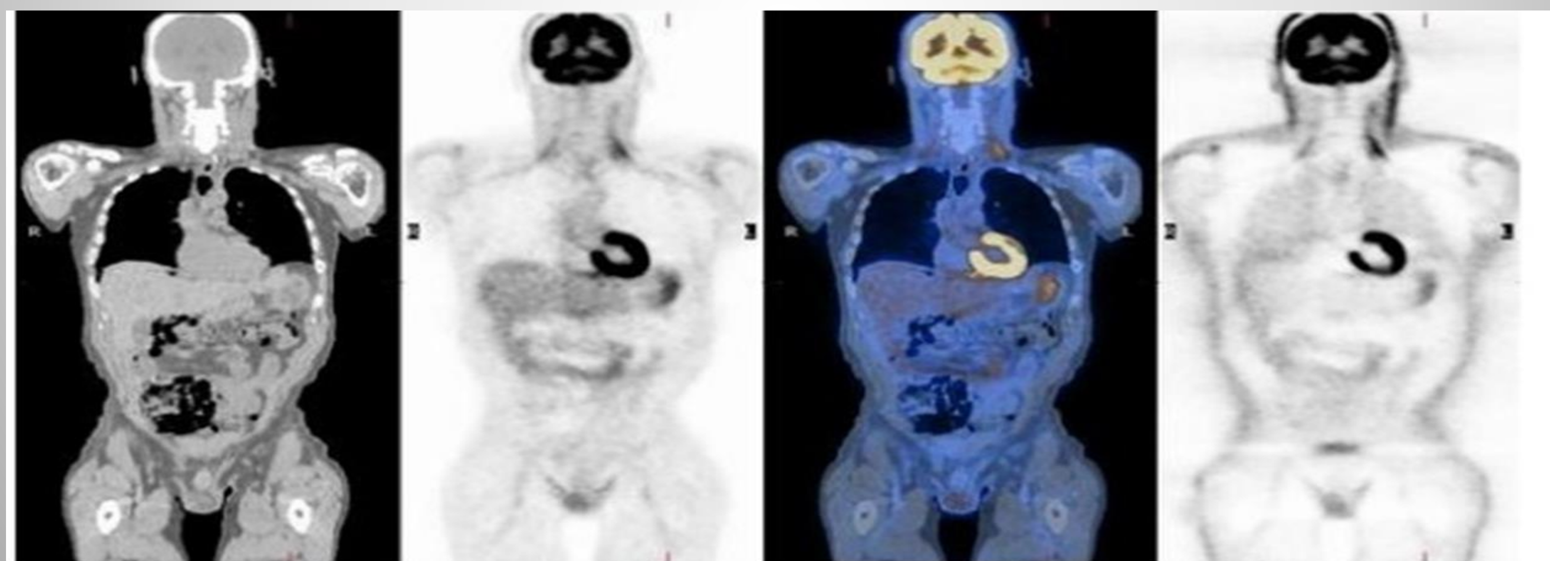
- Imaging applications used in nuclear medicine are used effectively in the diagnosis and treatment of diseases by providing information about the physiological movements of the tissue or organ to be imaged, thanks to the radioisotopes given to the patient.

- In these applications; Various imaging devices such as gamma cameras (SPECT, SPECT/CT) and positron emission tomography (PET, PET/CT) are used.

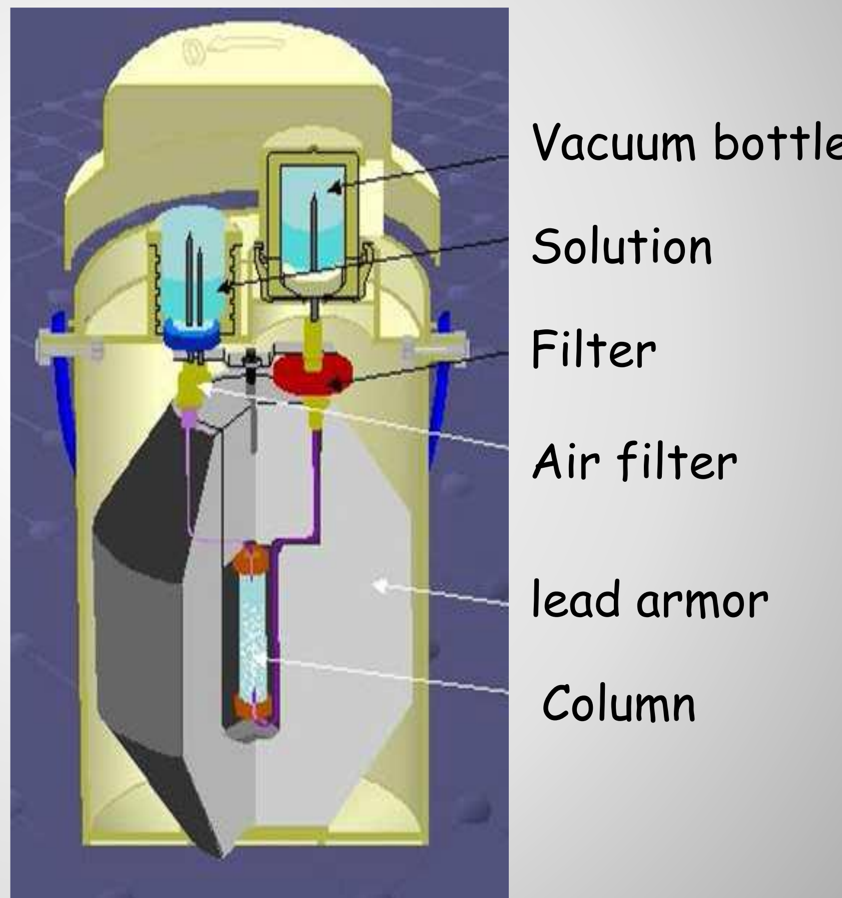


Pozitron Emisyon Tomografi(PET)

- short half life radioisotopes that emit positrons are used (^{18}F, ^{11}C, ^{13}N, ^{82}Rb, ^{68}Ga).



Radioisotope Generator



- Generators are a convenient method for on site radioisotope production.
- They provide an alternative to cyclotrons for the production of short half-life radionuclides for rapid and regular clinical use.
- The generators allow the separation of the short half-life daughter nucleus from the long half-life parent nucleus for immediate clinical use.

Some Radioisotopes Produced in the Generator

Parent Half life	Decay	Dougther Half life	Decay
^{99}Mo (67 h)	β^-	^{99m}Tc (6 h)	γ
^{68}Ge (271 d)	EC	^{68}Ga (68 m)	β^+, EC
^{90}Sr (28.8 y)	β^-	^{90}Y (2.7 d)	β^-
^{82}Sr (25.5 d)	EC	^{82}Rb (75 s)	β^+

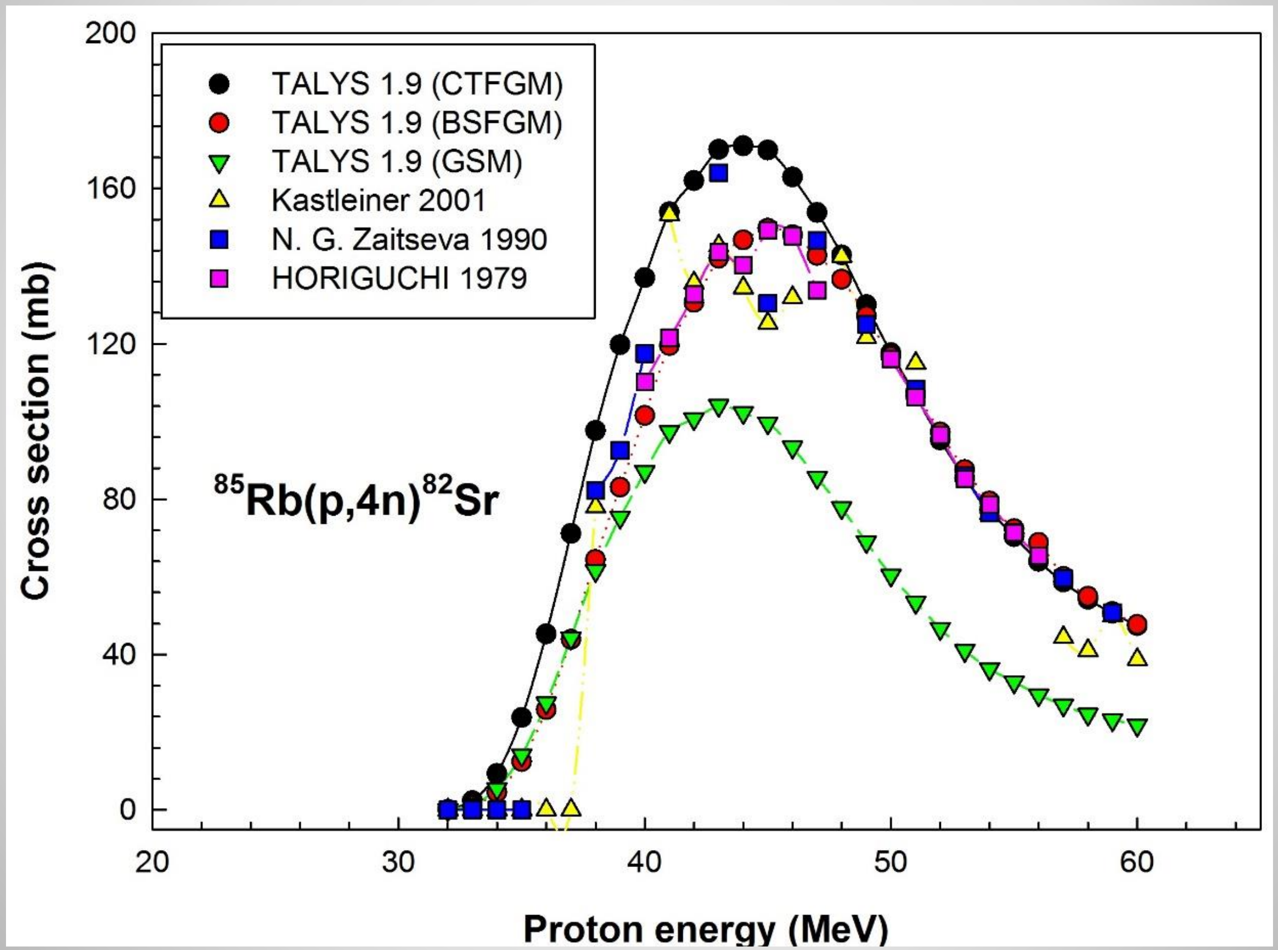
Calculation Methods

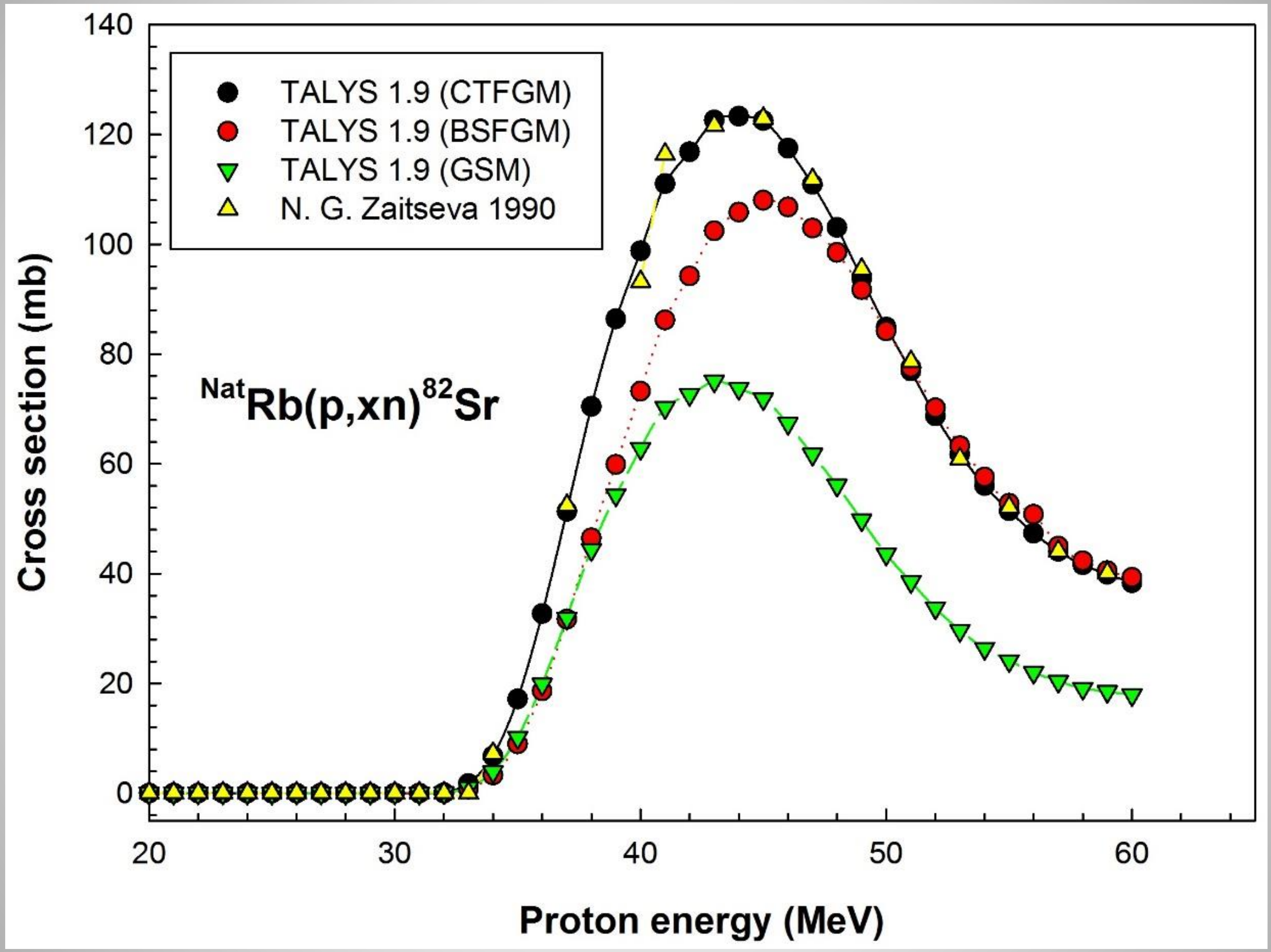
- In this study, $^{85,87}Rb(p,xn)^{82}Sr$ and $^{80,82,83,84,86}Kr(^{3}He,xn)^{82}Sr$ reaction channels have been investigated using the CTFGM, BSFGM, and GSM models within the framework of TALYS 1.9 nuclear reaction code.

- The basic level density model could be pointed as fermi gas model which was also used to derive other phenomenological models.
- In the assumption of this model,protons and neutrons occupies the lowest energy states and in the case of excitation they fill higher ones.
- This assumption provides successful results to FGM for low energies but fails with the increase of energy.

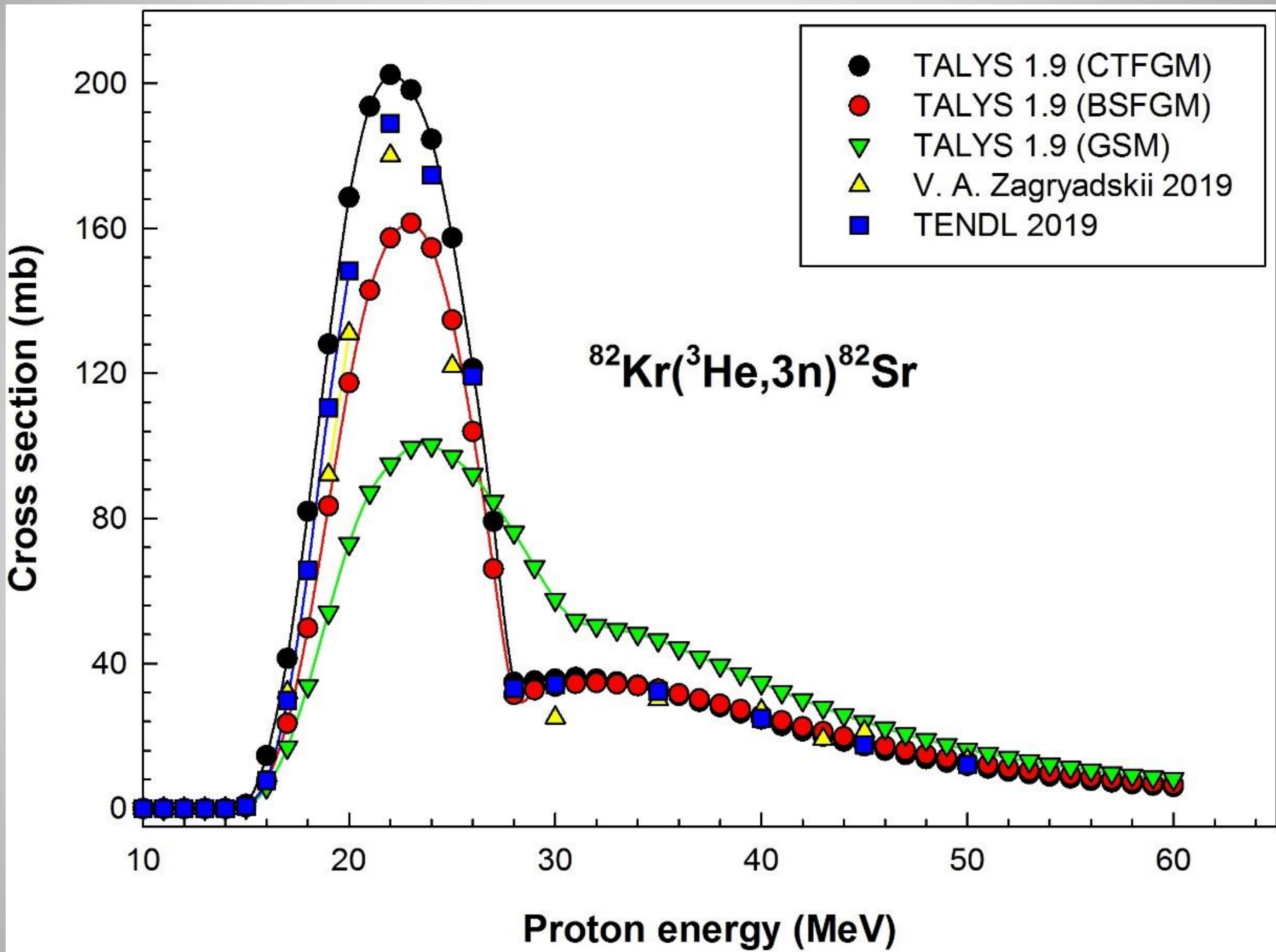
- Constant Temperature Fermi Gas Model (CTFGM) was developed for calculations in the high energy region.
- Back Shifted Fermi Gas Model (BSFGM), has been developed to allow coupling energy to be considered as a modifiable parameter at low energies.

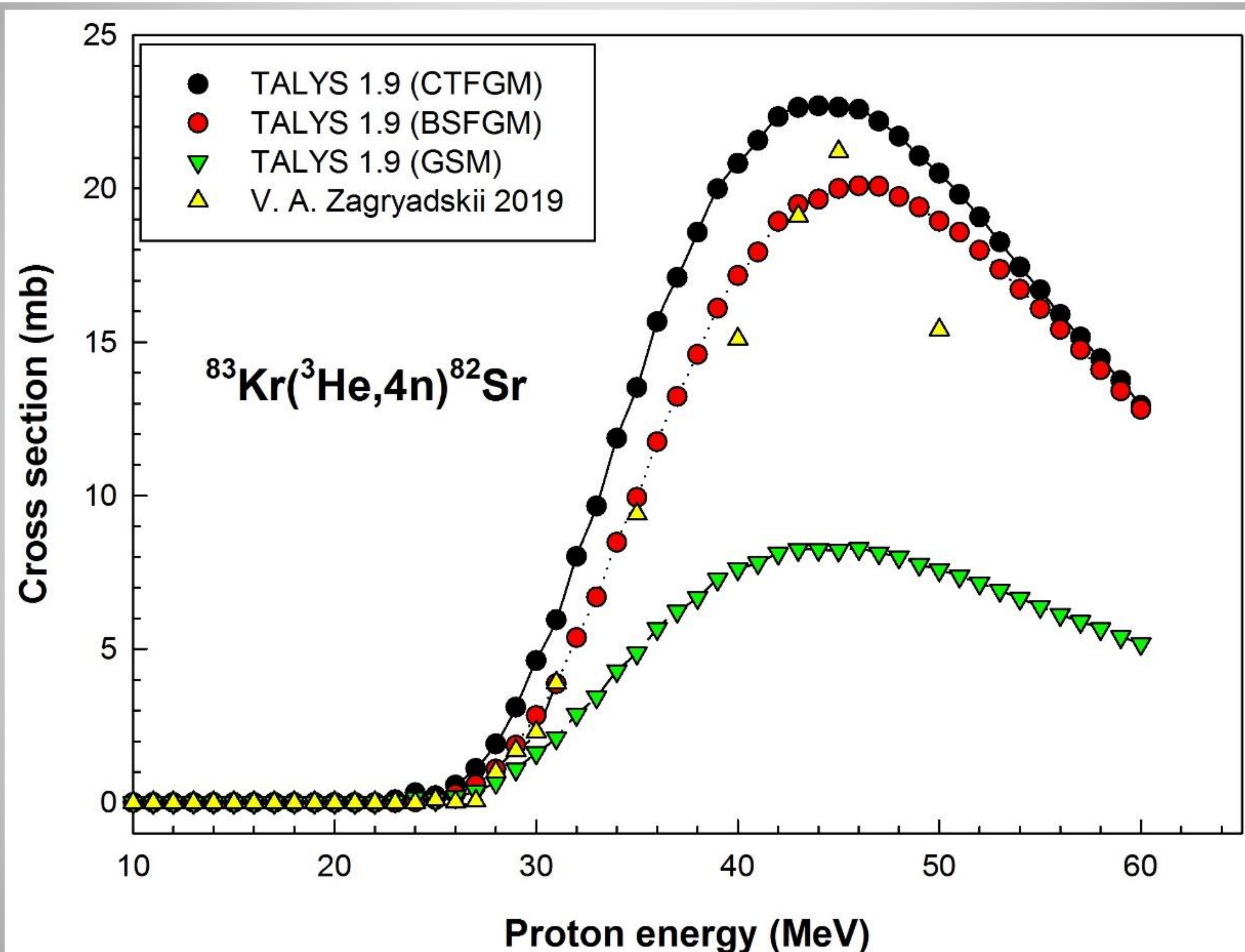
RESULTS and Discussion



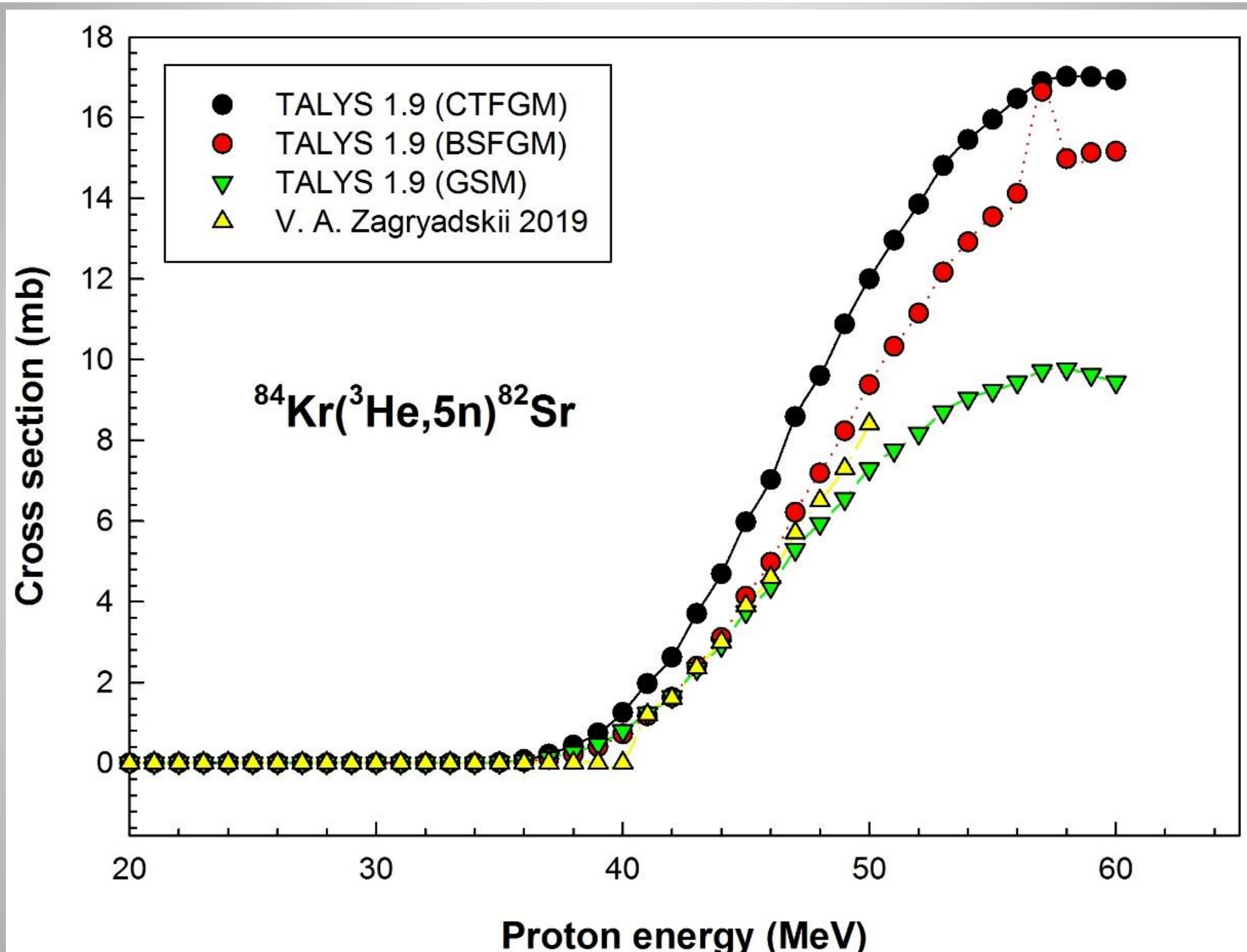


TALYS 1.9 (CTFGM)
TALYS 1.9 (BSFGM)
TALYS 1.9 (GSM)
N. G. Zaitseva 1990
$^{Nat}Rb(p,xn)^{82}Sr$
Cross section (mb)
Proton energy (MeV)
0
20
40
60
80
100
120
140
20
30
40
50
60

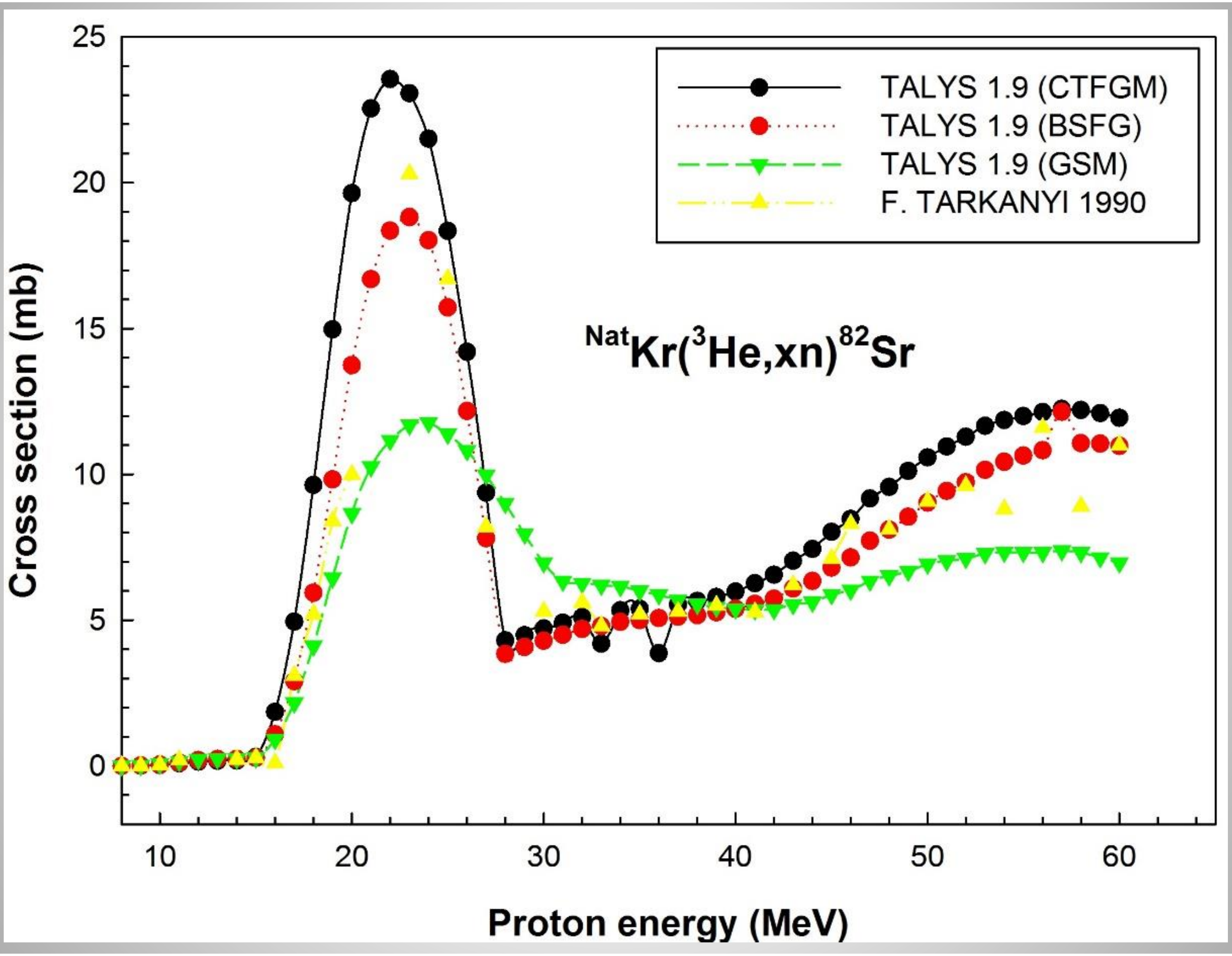

TALYS 1.9 (CTFGM)
TALYS 1.9 (BSFGM)
TALYS 1.9 (GSM)
V. A. Zagryadskii 2019
TENDL 2019
$^{82}Kr(^{3}He,3n)^{82}Sr$
Cross section (mb)
Proton energy (MeV)
0
40
80
120
160
200
10
20
30
40
50
60



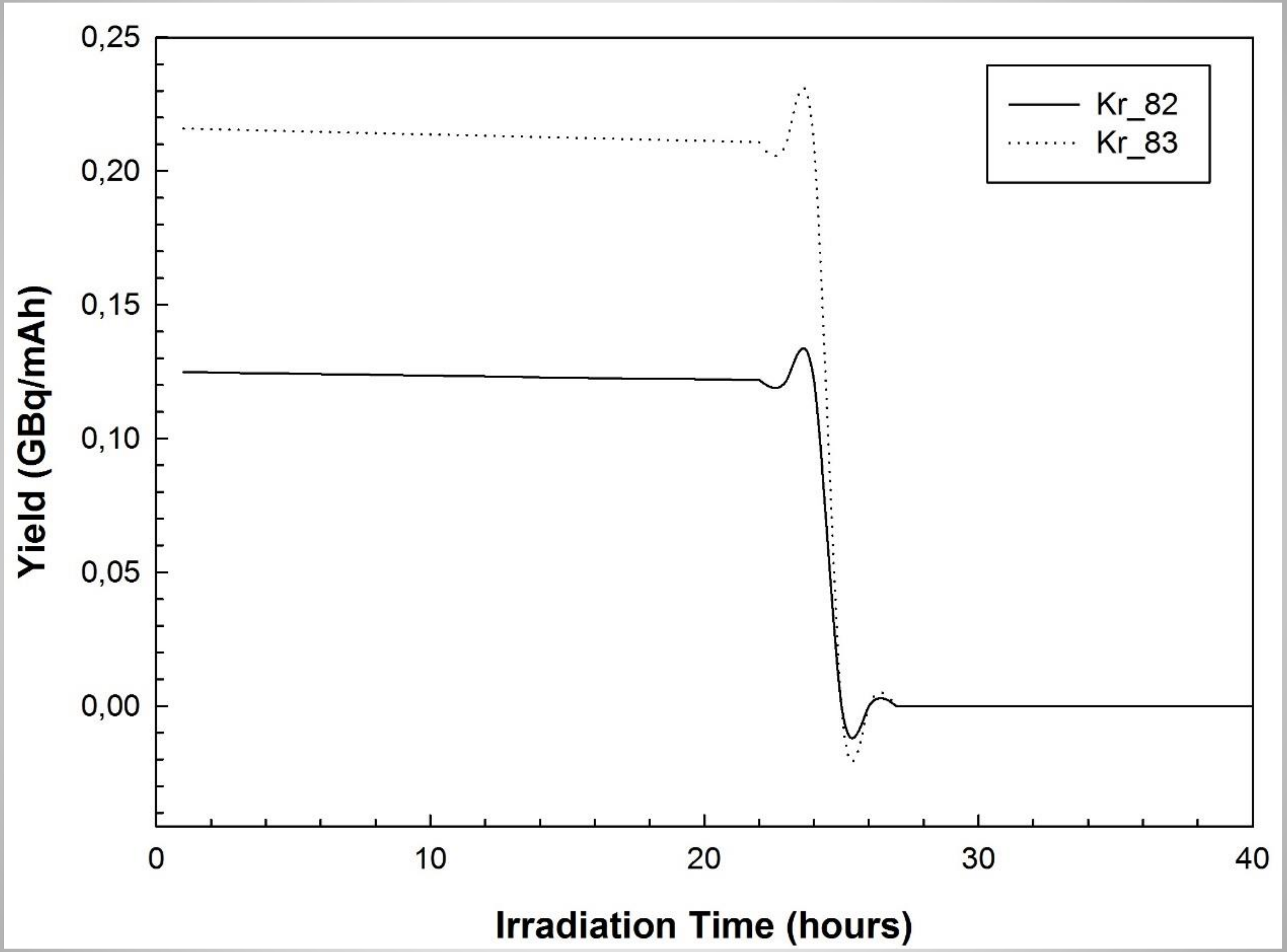
TALYS 1.9 (CTFGM)
TALYS 1.9 (BSFGM)
TALYS 1.9 (GSM)
V. A. Zagryadskii 2019
$^{83}Kr(^{3}He,4n)^{82}Sr$
Cross section (mb)
Proton energy (MeV)
0
5
10
15
20
25
10
20
30
40
50
60



TALYS 1.9 (CTFGM)
TALYS 1.9 (BSFGM)
TALYS 1.9 (GSM)
V. A. Zagryadskii 2019
$^{84}Kr(^{3}He,5n)^{82}Sr$
Cross section (mb)
Proton energy (MeV)
0
2
4
6
8
10
12
14
16
18
20
30
40
50
60



TALYS 1.9 (CTFGM)
TALYS 1.9 (BSFG)
TALYS 1.9 (GSM)
F. TARKANYI 1990
$^{Nat}Kr(^{3}He,xn)^{82}Sr$
Cross section (mb)
Proton energy (MeV)
0
5
10
15
20
25
10
20
30
40
50
60



0,25
0,20
0,15
0,10
0,05
0,00
Yield (GBq/mAh)
0
10
20
30
40
Irradiation Time (hours)
Kr_82
Kr_83

- Maximum cross-section for $^{85}Rb(p,4n)^{82}Sr$ and $^{Nat}Rb(p,xn)^{82}Sr$ reactions has been calculated as 170.982 mb at 44 MeV and 123 mb at 42 MeV, respectively.

- Also,for $^{82,83,84}Kr(p,xn)^{82}Sr$ and $^{Nat}Kr(p,xn)^{82}Sr$ has been calculated as 202.393 mb, 22.637 mb, 17.019 mb and 23.546 mb at 22 MeV, 44 MeV, 58 MeV, 22 MeV, respectively.

- $^{82,83}Kr(p,xn)^{82}Sr$ reaction yields are 0.2159 and 0.1248 GBq/mAh, respectively.

THANK YOU FOR YOUR LISTENING