

# In memory of Prof. Yongseok Oh With the collaboration work:

*A dynamical model of  $\phi$  meson photoproduction on the nucleon and He-4*

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In collaboration with

Sang-Ho Kim (Soongsil), T.-S. H. Lee (Argonne), the late Y. Oh (KNU).

Contents based on  
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## Organizing the World

The late Prof. Oh energetically organized ideas, research, workshops, conferences, etc for decades Worldwide (Scientific coordinator of APCTP).

Especially, his efforts in the Korean Physics Society of Nuclear Physics were enormous: EIC, RAON, APCTP, etc.



## An example

Dr. Sang-Ho Kim was once hired by APCTP via Prof. Oh and Dr. Kim became my PD fortunately. Also, I had good humane and scientific relations with Prof. Oh.

Prof. Oh has many collaborations in the USA as well.

He organized a collaboration with T.-S. H. Lee (Argonne).

## A strategy

I and Dr. Kim works on  $\phi$ -meson EM-production off the proton and neutron targets intensively with various contributions



T. -S. H. Lee is an expert in the nucleus wave functions via Argonne potential model for He-4 etc.

Prof. Oh has an idea to combine these researches into  $\phi$ -meson EM-production off the nuclei targets







## A result

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### Dynamical model of $\phi$ meson photoproduction on the nucleon and ${}^4\text{He}$

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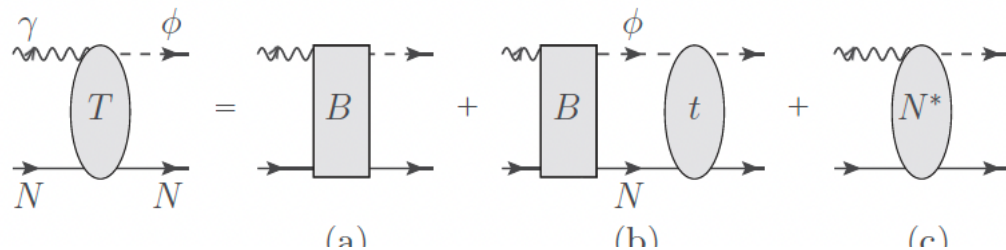


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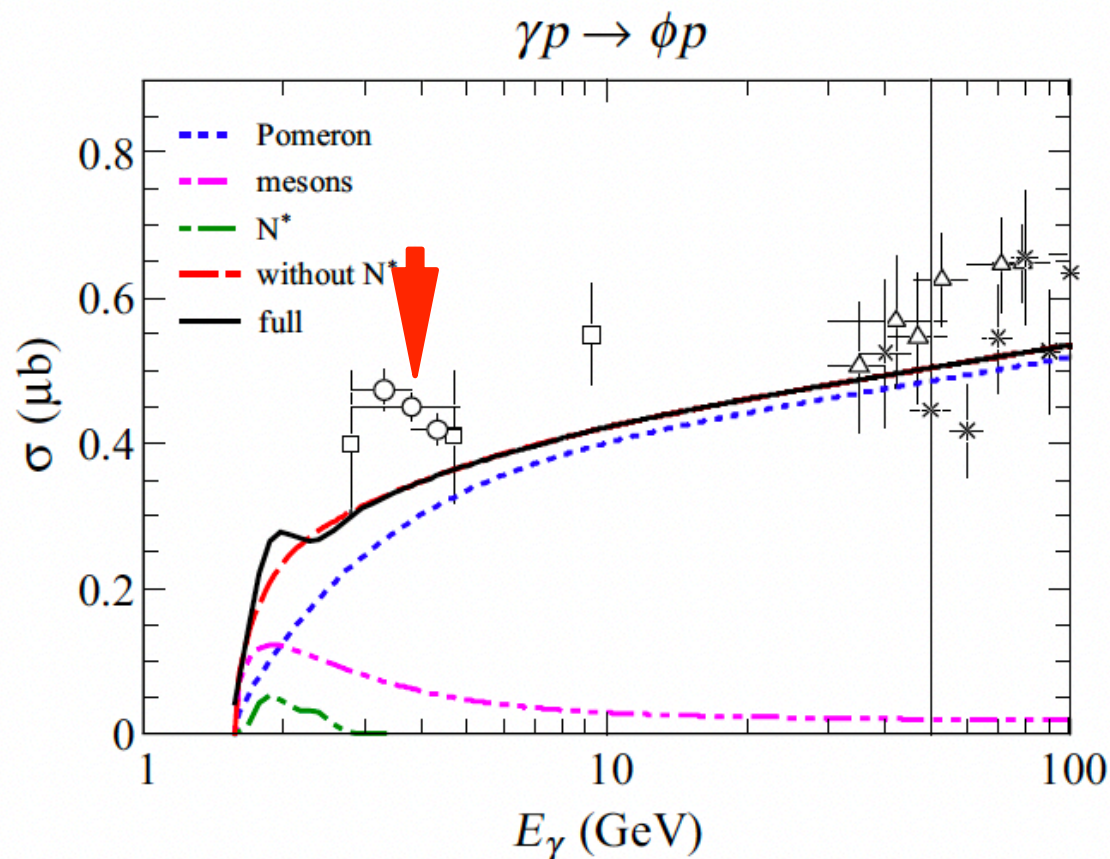
We investigate  $\phi$  meson photoproduction on the nucleon and  ${}^4\text{He}$  targets within a dynamical model approach based on a Hamiltonian which describes the production mechanisms by the Pomeron exchange, meson exchange,  $\phi$  radiation, and nucleon resonance excitation mechanisms. The final  $\phi N$  interactions are included and described by the gluon-exchange, direct  $\phi N$  couplings, and the box diagrams arising from the couplings with  $\pi N$ ,  $\rho N$ ,  $K\Lambda$ , and  $K\Sigma$  channels. The parameters of the Hamiltonian are determined by the experimental data of  $\gamma p \rightarrow \phi p$  from the CLAS Collaboration. The resulting Hamiltonian is then used to predict the coherent  $\phi$ -meson production on the  ${}^4\text{He}$  targets by using the distorted-wave impulse approximation. For the proton target, the final  $\phi N$  rescattering effects, as required by the unitarity condition, are found to be very weak, which supports the earlier calculations in the literature. For the  ${}^4\text{He}$  targets, the predicted differential cross sections are in good agreement with the data obtained by the LEPS Collaboration. The role of each mechanism in this reaction is discussed and predictions for a wide range of scattering angles are presented, which can be tested in future experiments.

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The idea was materialized in 2021 finally!

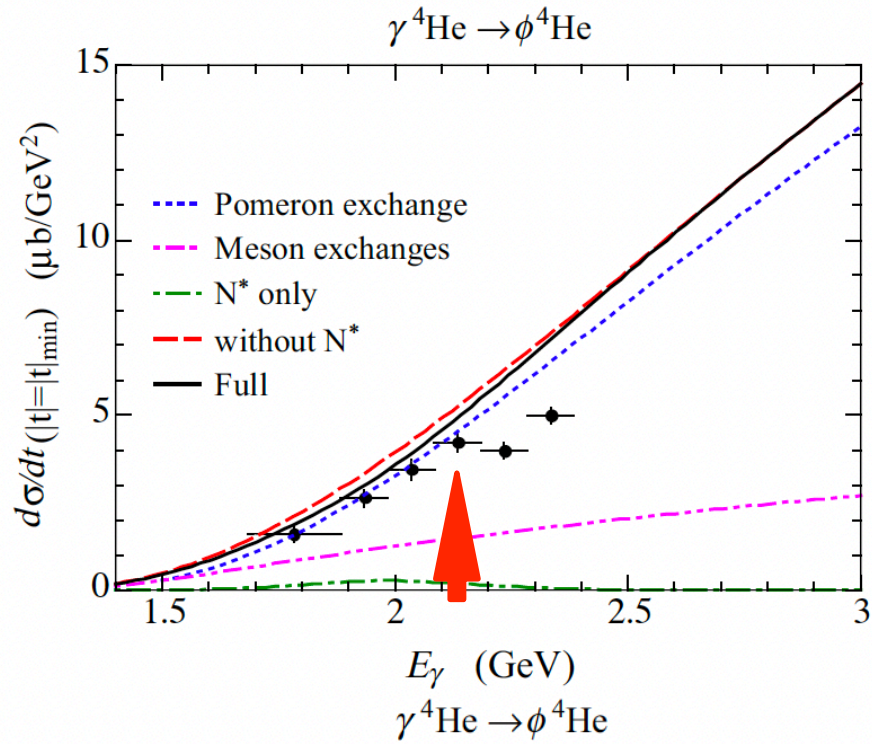


Final state interactions  
for elementary process



Pomeron + various mesons  
+ s- and u- channel contributions

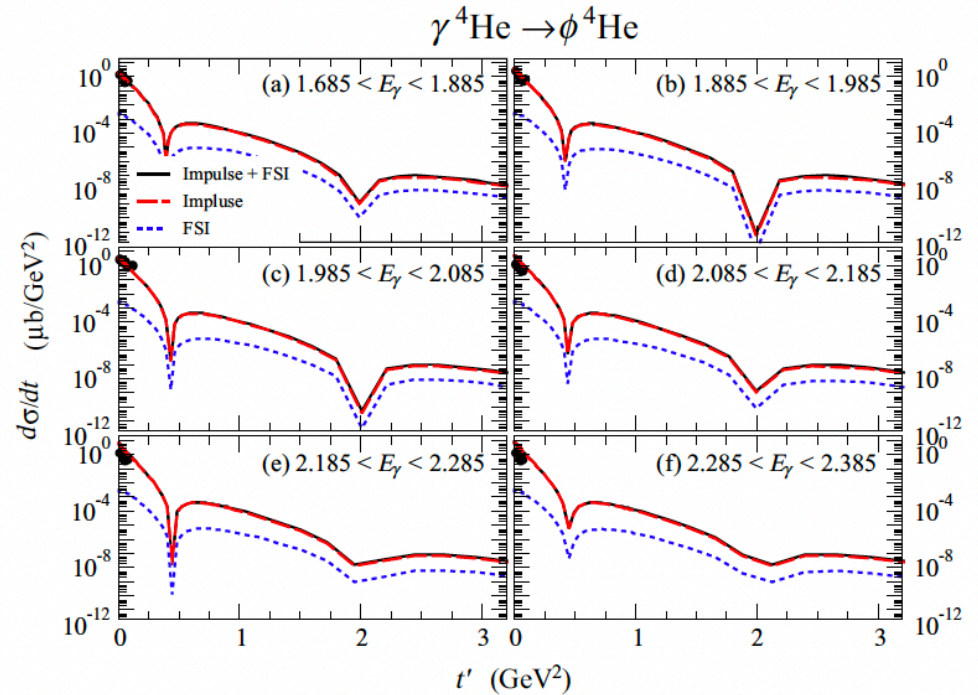
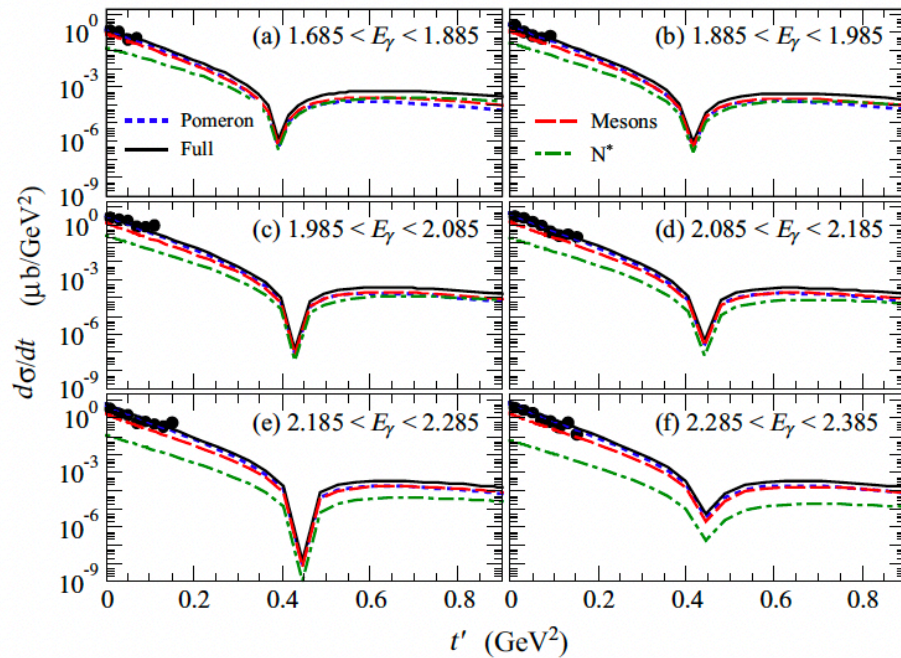
Data qualitatively well reproduced  
But still can not explain the "Bump"



With the Argonne WF, data described well

Bump seems there?

More related researches will come soon!



## My memories of the late Prof. Oh

He is a stoic in life but a generous person to others

Most of all, he is serious about Physics with a pure mind with great ideas

I believe he led the Korean Nuclear Physical Society in good directions

Great ability to organize research, administration, and friendship as well.

The Oh's children from KNU, APCTP, Yonsei U., etc all over the World will be following his will for the next decades:

*Dr. Kisang Jung, Dr. Yongwoo Choi, Dr. Dr. Hana Gil, Dr. Sang-Ho Kim, and so on*



With the late Prof. Oh at JINR/Dubna with his all-time friends (APCTP-BLTP)

His legacy for nuclear physics remains all the same among us.

Rest in peace, Prof. Oh.