

CERN'S NA61 WIKIPEDIA ARTICLE

CERN Summer Student Report.

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Duration: 14/06/2021 - 06/08/2021

This report gives a description of the work done during my CERN summer student program for the year 2021. I was appointed with the NA61/SHINE experiment which is a fixed-target experiment that uses a large acceptance hadron spectrometer and is located in the CERN Super Proton Synchrotron (SPS).

Introduction:

The project consisted of being familiar with the NA61/ SHINE experiment and adding new information to the articles online concerning this experiment, more specifically Wikipedia.

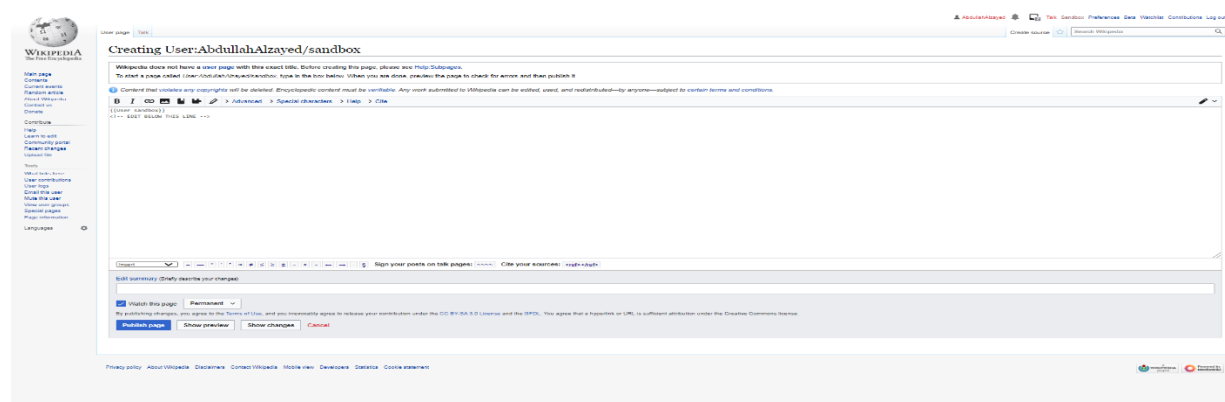
NA61/SHINE (standing for "SPS Heavy Ion and Neutrino Experiment") is a particle physics experiment at the Super Proton Synchrotron (SPS) at the European Organization for Nuclear Research (CERN). The SPS Heavy Ion and Neutrino Experiment (NA61/SHINE) studies the properties of the production of hadrons in collisions of beam particles (hadrons and ions) with a variety of fixed nuclear targets.

The main physics goals of NA61/SHINE are:

- (i) The measurements for physics of strong interactions, in particular, study the properties of the onset of deconfinement and search for the critical point of strongly interacting matter which is pursued by investigating p+p (proton to proton), p+Pb (proton to lead) and nucleus-nucleus collisions.
- (ii) The measurements for improving calculations of the initial neutrino beam flux in the long-baseline neutrino oscillation experiments as well as for more reliable simulations of cosmic-ray air showers.
- (iii) Study how cosmic rays interact with the interstellar media, what type of particle (and especially antiparticles p+p (interstellar H gas) $\rightarrow$ anti-p + X) are being produced and how medium size nuclei fragments into lighter ones (C + p (interstellar H gas) $\rightarrow$ B or Be + X).

The work on Wikipedia included the editing of the NA61/SHINE Wikipedia page. Several trails and drafts were done and discussed on weekly meetings, until the final result was met.

It was challenging to be accustomed with the rules, templates, and themes of Wikipedia. Articles about how to write a Wikipedia article and to stay within the regulation of the website were read. In order to be accustomed, simple work was done on the Sandbox in Wikipedia. The Sandbox is simply a space to experiment with the process of editing in Wikipedia. The picture below is a representation of the Sandbox.



The work done involved the reformulation of a segment from the NA61/SHINE Wikipedia article from “free text” into a table and adding references. The citations and references are obtained from <https://inspirehep.net>, which is a trusted community hub that helps researchers to share and find accurate scholarly information in high energy physics. References were obtained by simply searching for the key interaction, and plenty of articles belonging to the NA61/SHINE experiment and other experiments would be provided.

The work done pertaining to the NA61/SHINE Wikipedia article involved many drafts. Attached below are pictures of some of the former drafts.

The first draft:

Type of interaction	Beam momentum $\left(\frac{GeV}{c}\right)$	Year	Citation
$\pi + Be$	120	2016	[1]
$\pi + C$	30, 60, 158, and 350	2009, 2012, 2016, and 2017	[2][3]
$\pi + Al$	60	2017	[4]
Kaon + C	158	2012	[5]
$p^+ + p^+$	13, 20, 31, 40, 80, 158, and 400	2009, 2010, 2011, and 2016	[6] [7] [8]
$p^+ + Be$	60, and 120	2016 and 2017	[9]
$p^+ + C$ $p^+ + (T2K \text{ replica target})$ $p^+ + (NOvA \text{ replica target})$	31, 60, 90, and 120	2007, 2009, 2010, 2012, 2016, 2017, and 2018	[10] [11]
$p^+ + Al$	60	2016	[12]
$p^+ + Pb$	30, 40, 80 and 158	2012, 2014, 2016, and 2017	[13]
$Be + Be$	13A, 19A, 30A, 40A, 75A, and 150A	2011, 2012, and 2013	[14] [15]
$C + C$ and $C + CH_2$	13A	2018	
$Ar + Sc$	13A, 19A, 30A, 40A, 75A and 150A	2015	[16] [17][18] [19]
$Xe + La$	13A, 19A, 30A, 40A, 75A, and 150A	2017	[20] [21]
$Pb + Pb$	13A, 30A, and 150A	2016 and 2018	[22] [23] [24] [25]

This was the first attempt. The font used to type the types of interactions was not appropriate. The citation column was left empty for now.

The second draft:

Type of interaction	Beam momentum $\left(\frac{GeV}{c}\right)$	Year	Citation
$\pi + Be$	120	2016	PR D100 112001 ^[1]
$\pi + C$	30, 60, 158, and 350	2009, 2012, 2016, and 2017	PR D100 112004 ^[2] PR D100 112001 ^[3]
$\pi + Al$	60	2017	PR D98 052001 ^[4]
Kaon + C	158	2012	MPLA34 1950078 ^[5]
$p + p$	13, 20, 31, 40, 80, 158, and 400	2009, 2010, 2011, and 2016	EPJ C80 460 ^[6] NONE ^[7] NONE ^[8]
$p + Be$	60, and 120	2016 and 2017	PR D100 112001 ^[9]
$p + C$ $p + (T2K \text{ replica target})$ $p + (NOvA \text{ replica target})$	31, 60, 90, and 120	2007, 2009, 2010, 2012, 2016, 2017, and 2018	PR D100 112001 ^[10] EPJ C76 617 ^[11]
$p + Al$	60	2016	NONE ^[12]
$p + Pb$	30, 40, 80 and 158	2012, 2014, 2016, and 2017	Universe 5 126 ^[13]
$Be + Be$	13A, 19A, 30A, 40A, 75A, and 150A	2011, 2012, and 2013	NONE ^[14] EPJ C80 961 ^[15]
$C + C$ and $C + CH_2$	13A	2018	
$Ar + Sc$	13A, 19A, 30A, 40A, 75A and 150A	2015	NONE ^[16] Universe 5 126 ^[17] Acta Phys. Pol. B Proc. Suppl. 10 645 ^[18] EPJ C81 397 ^[19]
$Xe + La$	13A, 19A, 30A, 40A, 75A, and 150A	2017	Universe 5 126 ^[20] NONE ^[21]
$Pb + Pb$	13A, 30A, and 150A	2016 and 2018	J. Phys. Conf. Ser. 1690 012127 ^[22] PR C77 064908 ^[23] PR C77 024903 ^[24] PR C66 054902 ^[25]

The font used for the type of interactions was correct and is put into the appropriate form. The citation column was filled with the citation used in the Review of particle physics, e.g.

AGUILAR-AR...	20A	PR D102 012001	A. Aguilar-Arevalo <i>et al.</i>	(PIENU Collab.)
COLANGELO	19	JHEP 1902 006	G. Colangelo, M. Hoferichter, P. Stoffer	(BERN+)
DAUM	19	PL B796 11	M. Daum, R. Frosch, P.-R. Kettle	(PSI)
PDG	19	RPP 2019 at pdg.lbl.gov	M. Tanabashi <i>et al.</i>	(PDG Collab.)
ANANTHANA...	17	PRL 119 132002	B. Ananthanarayan, I. Caprini, D. Das	
HANHART	17	EPJ C77 98	C. Hanhart <i>et al.</i>	
ANANTHANA...	16A	PR D93 116007	B. Ananthanarayan <i>et al.</i>	
TRASSINELLI	16	PL B759 583	M. Trassinelli <i>et al.</i>	
ADOLPH	15A	PRL 114 062002	C. Adolph <i>et al.</i>	(COMPASS Collab.)
AGUILAR-AR...	15	PRL 115 071801	A. Aguilar-Arevalo <i>et al.</i>	(PIENU Collab.)
HOLSTEIN	14	ARNPS 64 51	B. Holstein, S. Scherer	(MASA, MAINZ)
AUBERT	09	PR D79 011102	B. Aubert <i>et al.</i>	(BABAR Collab.)
BYCHKOV	09	PRL 103 051802	M. Bychkov <i>et al.</i>	(PSI PIBETA Collab.)
FRLEZ	04	PRL 93 181804	E. Frlez <i>et al.</i>	(PSI PIBETA Collab.)
POCANIC	04	PRL 93 181803	D. Pocanic <i>et al.</i>	(PSI PIBETA Collab.)
ESCHRICH	01	PL B522 233	I. Eschrich <i>et al.</i>	(FNAL SELEX Collab.)
LIESENFELD	99	PL B468 20	A. Liesenfeld <i>et al.</i>	

The “NONE”-s in the draft is simply to point out the references that I had a difficulty with finding the appropriate way to present them in the above form.

The third draft:

Type of interaction	Beam momentum $\left(\frac{GeV}{c}\right)$	Year	Citation
$\pi + \text{Be}$	120	2016	PR D100 112001 ^[1]
$\pi + \text{C}$	30, 60, 158, and 350	2009, 2012, 2016, and 2017	PR D100 112004 ^[2] PR D100 112001 ^[1]
$\pi + \text{Al}$	60	2017	PR D98 052001 ^[3]
$\text{Kaon} + \text{C}$	158	2012	MPLA34 1950078 ^[4]
$p + p$	13, 20, 31, 40, 80, 158, and 400	2009, 2010, 2011, and 2016	EPJ C80 460 ^[5] NONE ^[6] NONE ^[7]
$p + \text{Be}$	60, and 120	2016 and 2017	PR D100 112001 ^[1]
$p + \text{C}$ $p + (\text{T2K replica target})$ $p + (\text{NOvA replica target})$	31, 60, 90, and 120	2007, 2009, 2010, 2012, 2016, 2017, and 2018	PR D100 112001 ^[1] EPJ C76 617 ^[8]
$p + \text{Al}$	60	2016	NONE ^[9]
$p + \text{Pb}$	30, 40, 80 and 158	2012, 2014, 2016, and 2017	Universe 5 126 ^[10]
$\text{Be} + \text{Be}$	13A, 19A, 30A, 40A, 75A, and 150A	2011, 2012, and 2013	NONE ^[11] EPJ C80 961 ^[12]
$\text{C} + \text{C}$ and $\text{C} + \text{CH}_2$	13A	2018	
$\text{Ar} + \text{Sc}$	13A, 19A, 30A, 40A, 75A and 150A	2015	NONE ^[13] Universe 5 126 ^[10] Acta Phys. Pol. B Proc. Suppl. 10 645 ^[14] EPJ C81 397 ^[15]
$\text{Xe} + \text{La}$	13A, 19A, 30A, 40A, 75A, and 150A	2017	Universe 5 126 ^[10] NONE ^[16]
$\text{Pb} + \text{Pb}$	13A, 30A, and 150A	2016 and 2018	J. Phys. Conf. Ser. 1690 012127 ^[17] PR C77 064908 ^[18] PR C77 024903 ^[19] PR C66 054902 ^[20]

In here, instead of a particular citation be mentioned twice by different numbers, it was adjusted such that if one citation was mentioned more than once, it will still have the same numerical superscript.

The fourth draft:

Type of interaction	Beam momentum $\left(\frac{GeV}{c}\right)$	Year	Citation
$\pi + \text{Be}$	120	2016	Cite the 1st status report
$\pi + \text{C}$	30, 60, 158, and 350	2009, 2012, 2016, and 2017	Cite the 4th status report PR D100 112004 ^[1] PR D100 112001 ^[2]
$\pi + \text{Al}$	60	2017	Cite the 4th status report PR D98 052001 ^[3]
$\text{Kaon} + \text{C}$	158	2012	Cite the 4th status report MPL A34 1950078 ^[4]
$p + p$	13, 20, 31, 40, 80, 158, and 400	2009, 2010, 2011, and 2016	EPJ C80 460 ^[5] NONE ^[6] NONE ^[7]
$p + \text{Be}$	60, and 120	2016 and 2017	Cite the 1st status report PR D100 112001 ^[2]
$p + \text{C}$ $p + (\text{T2K replica target})$ $p + (\text{NOvA replica target})$	31, 60, 90, and 120	2007, 2009, 2010, 2012, 2016, 2017, and 2018	Cite the 1st and 4th status reports PR D100 112001 ^[2] EPJ C76 617 ^[8]
$p + \text{Al}$	60	2016	Cite the 1st status report NONE ^[9]
$p + \text{Pb}$	30, 40, 80 and 158	2012, 2014, 2016, and 2017	Cite the 3rd status report
$\text{Be} + \text{Be}$	13A, 19A, 30A, 40A, 75A, and 150A	2011, 2012, and 2013	Cite the 2nd status report NONE ^[10] EPJ C80 961 ^[11]
$\text{C} + \text{C}$ and $\text{C} + \text{CH}_2$	13A	2018	
$\text{Ar} + \text{Sc}$	13A, 19A, 30A, 40A, 75A and 150A	2015	Cite the 3rd status report NONE ^[12] Universe 5 126 ^[13] Acta Phys. Pol. B Proc. Suppl. 10 645 ^[14] EPJ C81 397 ^[15]
$\text{Xe} + \text{La}$	13A, 19A, 30A, 40A, 75A, and 150A	2017	NONE ^[16]
$\text{Pb} + \text{Pb}$	13A, 30A, and 150A	2016 and 2018	Cite the 4th status report J. Phys. Conf. Ser. 1690 012127 ^[17] PR C77 064908 ^[18]

To make up for the lack of citations, the CERN status reports were used which were obtained from <https://cds.cern.ch/>.

The fifth draft:

Type of interaction	Beam momentum $\left(\frac{GeV}{c}\right)$	Year	Citation
$\pi + \text{Be}$	120	2016	CERN-SPSC-2017-038 ^[1]
$\pi + \text{C}$	30, 60, 158, and 350	2009, 2012, 2016, and 2017	CERN-SPSC-2016-038 ^[2] PR D100 112004 ^[3] PR D100 112001 ^[4]
$\pi + \text{Al}$	60	2017	CERN-SPSC-2016-038 ^[5] PR D98 052001 ^[6]
$\text{Kaon} + \text{C}$	158	2012	CERN-SPSC-2016-038 ^[7] MPL A34 1950078 ^[8]
$p + p$	13, 20, 31, 40, 80, 158, and 400	2009, 2010, 2011, and 2016	EPJ C80 460 ^[9] SQM 2019 315 ^[10] EPJ C74 2794 ^[11]
$p + \text{Be}$	60, and 120	2016 and 2017	CERN-SPSC-2017-038 ^[12] PR D100 112001 ^[4]
$p + \text{C}$ $p + (\text{T2K replica target})$ $p + (\text{NOvA replica target})$	31, 60, 90, and 120	2007, 2009, 2010, 2012, 2016, 2017, and 2018	CERN-SPSC-2017-038 ^[13] CERN-SPSC-2016-038 ^[14] CERN-SPSC-2019-041 ^[15] PR D100 112001 ^[4] EPJ C76 617 ^[16]
$p + \text{Al}$	60	2016	CERN-SPSC-2017-038 ^[17] NP B732 1 ^[18]
$p + \text{Pb}$	30, 40, 80 and 158	2012, 2014, 2016, and 2017	CERN-SPSC-2015-036 ^[19]
$\text{Be} + \text{Be}$	13A, 19A, 30A, 40A, 75A, and 150A	2011, 2012, and 2013	CERN-SPSC-2013-028 ^[20] PoS 364 305 ^[21] EPJ C80 961 ^[22]
$\text{C} + \text{C}$ and $\text{C} + \text{CH}_2$	13A	2018	CERN-SPSC-2019-041 ^[15]
$\text{Ar} + \text{Sc}$	13A, 19A, 30A, 40A, 75A and 150A	2015	CERN-SPSC-2015-036 ^[23] PoS 364 305 ^[21] Acta Phys. Pol. B Proc. Suppl. 10 645 ^[24] EPJ C81 397 ^[25]
$\text{Xe} + \text{La}$	13A, 19A, 30A, 40A, 75A, and 150A	2017	CERN-SPSC-2018-029 ^[26] PoS 364 305 ^[21]
$\text{Pb} + \text{Pb}$	13A, 30A, and 150A	2016 and 2018	CERN-SPSC-2016-038 ^[27] J. Phys. Conf. Ser. 1690 012127 ^[28] PR C77 064908 ^[29]

The appropriate way to cite the CERN status reports were used, and more citations were added.

The final product:

Collected data [\[edit source \]](#)

Type of interaction	Beam momentum $\left(\frac{GeV}{c}\right)$	Year	Citation
$\pi + \text{Be}$	120	2016	CERN-SPSC-2017-036 ^[4]
$\pi + \text{C}$	30, 60, 158, and 350	2009, 2012, 2016, and 2017	CERN-SPSC-2016-036 ^[5] PR D100 112004 ^[6] and PR D100 112001 ^[7]
$\pi + \text{Al}$	60	2017	CERN-SPSC-2016-036 ^[5] and PR D98 052001 ^[8]
Kaon + C	158	2012	CERN-SPSC-2016-036 ^[5] and MPL A34 1950078 ^[9]
p + p	13, 20, 31, 40, 80, 158, and 400	2009, 2010, 2011, and 2016	EPJ C80 460 ^[10] SQM 2019 315 ^[11] and EPJ C74 2794 ^[12]
p + Be	60, and 120	2016 and 2017	CERN-SPSC-2017-036 ^[4] and PR D100 112001 ^[7]
p + C p + (T2K replica target) p + (NOvA replica target)	31, 60, 90, and 120	2007, 2009, 2010, 2012, 2016, 2017, and 2018	CERN-SPSC-2017-036 ^[4] CERN-SPSC-2016-036 ^[5] CERN-SPSC-2019-041 ^[13] PR D100 112001 ^[7] and EPJ C76 617 ^[14]
p + Al	60	2016	CERN-SPSC-2017-036 ^[4] and NP B732 1 ^[15]
p + Pb	30, 40, 80 and 158	2012, 2014, 2016, and 2017	CERN-SPSC-2015-036 ^[16]
Be + Be	13A, 19A, 30A, 40A, 75A, and 150A	2011, 2012, and 2013	CERN-SPSC-2013-026 ^[17] PoS 364 305 ^[18] and EPJ C80 961 ^[19]
C + C and C + CH ₂	13A	2018	CERN-SPSC-2019-041 ^[13]
Ar + Sc	13A, 19A, 30A, 40A, 75A and 150A	2015	CERN-SPSC-2015-036 ^[16] PoS 364 305 ^[18] Acta Phys. Pol. B Proc. Suppl. 10 645 ^[20] and EPJ C81 397 ^[21]
Xe + La	13A, 19A, 30A, 40A, 75A, and 150A	2017	CERN-SPSC-2018-029 ^[22] and PoS 364 305 ^[18]
Pb + Pb	13A, 30A, and 150A	2016 and 2018	CERN-SPSC-2016-036 ^[5] J. Phys. Conf. Ser. 1690 012127 ^[23] and PR C77 064908 ^[24]

The repeated citations were made such that they have the same numerical superscript. This was the product published in NA61/SHINE Wikipedia article.

Conclusion:

Throughout these months I have gained important experience with and information about the NA61/SHINE experiment and experimental physics in general. Being oblivious about the experiment and its intricacies has made this program a very valuable one.

Acknowledgments:

A lot has been learnt whilst working on the project. I would like to thank my supervisor Andrey Seryakov and Jens Vigen for aiding and supporting me during this program. I would also like to thank my colleagues Vaibhavi Gawas, and Louis Camille Marinho Fernandes, that made this program joyous. I would also like to thank Dr. Mohammed Yousif and Maryam Shorooqi that supported me in my decision to register to the CERN Sumer Student program. Finally, I would like to thank the CERN summer student team for providing me with the opportunity to be a member in this summer program.

References:

- <https://cds.cern.ch/>
- <https://inspirehep.net/>
- https://en.wikipedia.org/wiki/NA61_experiment
- <https://shine.web.cern.ch/>
- <https://home.cern/science/experiments/na61shine>
- <https://cernbox.cern.ch/>
- <https://en.wikipedia.org/wiki/Wikipedia:Sandbox>