

Closing Session

5th Graduate School on Astro-Particle Physics
Unifying view on cosmic interacting matter

Unifying view on cosmic interacting matter

SFB1491 - CIM

Cosmic Interacting Matters - From Source to Signal

- Plasma Physics, Neutrinos, Cosmic Rays, Magnetic Fields, Gravitational Waves, Multi-Messenger Astronomy, ...
- Deep Learning (*the new core competency for physicists*)
- **Many thanks to all lecturers!**

Slides Available on Indico

Timetable

[!\[\]\(0a85d2f447280dbcc0b4b89e01ea54cd_img.jpg\) Sun 18/01](#) **Mon 19/01** [Tue 20/01](#) [Wed 21/01](#) [Thu 22/01](#) [Fri 23/01](#) [All days](#) [!\[\]\(c0663aaea62e650f83b1fcef5230a1df_img.jpg\)](#)

[!\[\]\(a336134f887e530008d9607a53a223b6_img.jpg\) Print](#) [!\[\]\(f3ce5336da5a384067b3036f0e1403be_img.jpg\) PDF](#) [!\[\]\(63640bd3c5dbc67c145299f83d8ba815_img.jpg\) Full screen](#) [!\[\]\(38aa2c6a8eaa118b8f3ac0308865f8cf_img.jpg\) Detailed view](#) [!\[\]\(4de99ad682f0f9ff257c693ddc684ee5_img.jpg\) Filter](#)

09:00	Astrophysical Plasmas and Cosmic Ray Propagation (1/2)	<i>Daniel Verscharen</i>	
10:00	<i>Physikzentrum Bad Honnef</i>	09:00 - 10:30	
	Coffee		
	<i>Physikzentrum Bad Honnef</i>	10:30 - 11:00	
11:00	Astrophysical Plasmas and Cosmic Ray Propagation (2/2)	<i>Daniel Verscharen</i>	

Photo collection

We collect photos at:

<https://tu-dortmund.sciebo.de/s/geQoxqYys8z4SnX>

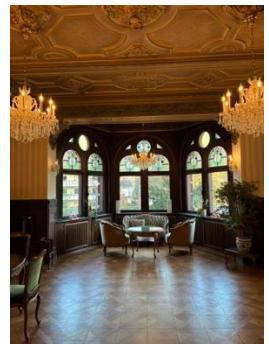
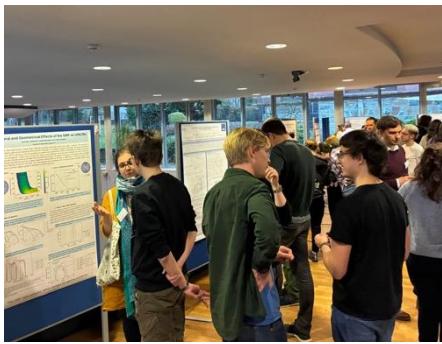
You can upload your own photos (if we are allowed to potentially post them on social media)

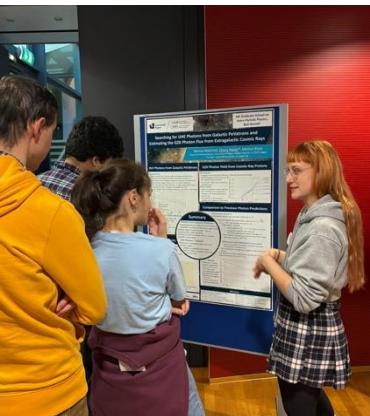
and

- Pay your drinks by 13:00

$$\begin{aligned}
\mathcal{L}_{SM} = & -\frac{1}{2}\partial_\nu g_\mu^a \partial_\nu g_\mu^a - g_s f^{abc} \partial_\mu g_\mu^a g_\mu^b g_\mu^c - \frac{1}{4}g_s^2 f^{abc} g_\mu^b g_\nu^c g_\mu^d g_\nu^c - \partial_\mu W_\mu^+ \partial_\nu W_\mu^- - \\
& M^2 W_\mu^+ W_\mu^- - \frac{1}{2}\partial_\mu Z_\mu^0 \partial_\nu Z_\mu^0 - \frac{1}{2c_w} M^2 Z_\mu^0 Z_\nu^0 - \frac{1}{2}\partial_\mu A_\mu \partial_\nu A_\nu - ig_{cw} (\partial_\nu Z_\mu^0 (W_\mu^+ W_\nu^- - \\
& W_\nu^+ W_\mu^-) - Z_\mu^0 (W_\mu^+ \partial_\nu W_\mu^- - W_\nu^- \partial_\mu W_\mu^+) + Z_\mu^0 (W_\nu^+ \partial_\nu W_\mu^- - W_\nu^- \partial_\mu W_\mu^+)) - \\
& ig s_w (\partial_\mu A_\mu (W_\mu^+ W_\nu^- - W_\nu^+ W_\mu^-) - A_\nu (W_\mu^+ \partial_\nu W_\mu^- - W_\nu^- \partial_\mu W_\mu^+) + A_\mu (W_\nu^+ \partial_\nu W_\mu^- - \\
& W_\nu^- \partial_\mu W_\mu^+)) - \frac{1}{2}g^2 W_\mu^+ W_\mu^- W_\nu^+ W_\nu^- + \frac{1}{2}g^2 W_\nu^+ W_\mu^- W_\mu^+ W_\nu^- + g^2 c_w^2 (Z_\mu^0 W_\mu^+ Z_\nu^0 W_\nu^- - \\
& Z_\mu^0 Z_\nu^0 W_\mu^- W_\nu^-) + g^2 s_w^2 (A_\mu W_\mu^+ A_\nu W_\nu^- - A_\mu A_\mu W_\nu^+ W_\nu^-) + g^2 s_w c_w (A_\mu Z_\mu^0 (W_\mu^+ W_\nu^- - \\
& W_\nu^+ W_\mu^-) - 2 A_\mu Z_\mu^0 W_\nu^+ W_\nu^-) - \frac{1}{2}\partial_\mu H \partial_\mu H - 2M^2 \alpha_h H^2 - \partial_\mu \phi^+ \partial_\mu \phi^- - \frac{1}{2}\partial_\mu \phi^0 \partial_\mu \phi^0 - \\
& \beta_h \left(\frac{2M^2}{g^2} + \frac{2M}{g} H + \frac{1}{2}(H^2 + \phi^0 \phi^0 + 2\phi^+ \phi^-) \right) + \frac{2M^4}{g^4} \alpha_h - \\
& g \alpha_h M (H^3 + H \phi^0 \phi^0 + 2H \phi^+ \phi^-) - \\
& \frac{1}{8}g^2 \alpha_h (H^4 + (\phi^0)^4 + 4(\phi^+ \phi^-)^2 + 4(\phi^0)^2 \phi^+ \phi^- + 4H^2 \phi^+ \phi^- + 2(\phi^0)^2 H^2) - \\
& g M W_\mu^+ W_\mu^- H - \frac{1}{2}g \frac{M}{c_w} Z_\mu^0 Z_\mu^0 H - \\
& \frac{1}{2}ig (W_\mu^+ (\phi^0 \partial_\mu \phi^- - \phi^- \partial_\mu \phi^0) - W_\mu^- (\phi^0 \partial_\mu \phi^+ - \phi^+ \partial_\mu \phi^0)) + \\
& \frac{1}{2}g (W_\mu^+ (H \partial_\mu \phi^- - \phi^- \partial_\mu H) + W_\mu^- (H \partial_\mu \phi^+ - \phi^+ \partial_\mu H)) + \frac{1}{2}g \frac{1}{c_w} (Z_\mu^0 (H \partial_\mu \phi^0 - \phi^0 \partial_\mu H) + \\
& M (\frac{1}{c_w} Z_\mu^0 \partial_\mu \phi^0 + W_\mu^+ \partial_\mu \phi^- + W_\mu^- \partial_\mu \phi^+) - ig \frac{s_w^2}{c_w} M Z_\mu^0 (W_\mu^+ \phi^- - W_\mu^- \phi^+) + ig s_w M A_\mu (W_\mu^+ \phi^- - \\
& W_\mu^- \phi^+) - ig \frac{1-2c_w^2}{2c_w} Z_\mu^0 (\phi^+ \partial_\mu \phi^- - \phi^- \partial_\mu \phi^+) + ig s_w A_\mu (\phi^+ \partial_\mu \phi^- - \phi^- \partial_\mu \phi^+) - \\
& \frac{1}{4}g^2 W_\mu^+ W_\mu^- (H^2 + (\phi^0)^2 + 2\phi^+ \phi^-) - \frac{1}{6}g^2 \frac{1}{c_w^2} Z_\mu^0 Z_\mu^0 (H^2 + (\phi^0)^2 + 2(2s_w^2 - 1)^2 \phi^+ \phi^-) - \\
& \frac{1}{2}g^2 \frac{s_w^2}{c_w} Z_\mu^0 \phi^0 (W_\mu^+ \phi^- + W_\mu^- \phi^+) - \frac{1}{2}ig \frac{s_w^2}{c_w} Z_\mu^0 H (W_\mu^+ \phi^- - W_\mu^- \phi^+) + \frac{1}{2}g^2 s_w A_\mu \phi^0 (W_\mu^+ \phi^- + \\
& W_\mu^- \phi^+) + \frac{1}{2}ig^2 s_w A_\mu H (W_\mu^+ \phi^- - W_\mu^- \phi^+) + g^2 \frac{s_w}{c_w} (2c_w^2 - 1) Z_\mu^0 A_\mu \phi^+ \phi^- - \\
& g^2 s_w^2 A_\mu A_\mu \phi^+ \phi^- + \frac{1}{2}ig_s \lambda_{ij}^a (g_j^\alpha \gamma^\mu g_i^\sigma) g_\mu^\alpha - \bar{e}^\lambda (\gamma \partial + m_s^\lambda) e^\lambda - \bar{\nu}^\lambda (\gamma \partial + m_s^\lambda) \nu^\lambda - \bar{u}_j^\lambda (\gamma \partial + \\
& m_u^\lambda) u_j^\lambda - \bar{d}_j^\lambda (\gamma \partial + m_d^\lambda) d_j^\lambda + ig s_w A_\mu (-(\bar{e}^\lambda \gamma^\mu e^\lambda) + \frac{2}{3}(\bar{u}_j^\lambda \gamma^\mu u_j^\lambda) - \frac{1}{3}(\bar{d}_j^\lambda \gamma^\mu d_j^\lambda)) + \\
& \frac{ig}{4c_w} Z_\mu^0 \{(\bar{\nu}^\lambda \gamma^\mu (1 + \gamma^5) \nu^\lambda) + (\bar{e}^\lambda \gamma^\mu (4s_w^2 - 1 - \gamma^5) e^\lambda) + (\bar{d}_j^\lambda \gamma^\mu (\frac{4}{3}s_w^2 - 1 - \gamma^5) d_j^\lambda)\} + \\
& (\bar{u}_j^\lambda \gamma^\mu (1 - \frac{4}{3}s_w^2 + \gamma^5) u_j^\lambda) + \frac{ig}{2\sqrt{2}} W_\mu^+ ((\bar{u}^\lambda \gamma^\mu (1 + \gamma^5) U^{lep} \lambda_\lambda e^\alpha) + (\bar{u}_j^\lambda \gamma^\mu (1 + \gamma^5) C_{\lambda\lambda} d_j^\alpha)) + \\
& \frac{ig}{2\sqrt{2}} W_\mu^- ((\bar{e}^\kappa U^{lep} \lambda_\lambda \gamma^\mu + \gamma^5 \nu^\lambda) + (\bar{d}_j^\kappa C_{\lambda\lambda}^\dagger \gamma^\mu (1 + \gamma^5) u_j^\lambda)) + \\
& \frac{ig}{2M\sqrt{2}} \phi^+ (-m_e^\lambda (\bar{e}^\lambda U^{lep} \lambda_\lambda \gamma^\mu - \gamma^5 e^\kappa) + m_\nu^\lambda (\bar{\nu}^\lambda U^{lep} \lambda_\kappa (1 + \gamma^5) e^\kappa)) + \\
& \frac{ig}{2M\sqrt{2}} \phi^- (m_e^\lambda (\bar{e}^\lambda U^{lep} \lambda_\lambda (1 + \gamma^5) \nu^\kappa) + m_\nu^\lambda (\bar{e}^\lambda U^{lep} \lambda_\kappa (1 - \gamma^5) \nu^\kappa) - \frac{g m_\lambda^h}{2M} H (\bar{\nu}^\lambda \nu^\lambda) - \\
& \frac{g m_\lambda^h}{2M} H (\bar{e}^\lambda e^\lambda) + \frac{ig m_\lambda^h}{2M} \phi^0 (\bar{e}^\lambda \gamma^5 e^\lambda) - \frac{1}{4} \bar{\nu}_\lambda M_{\lambda\lambda}^R (1 - \gamma_5) \bar{\nu}_\kappa - \\
& \frac{1}{4} \bar{\nu}_\lambda M_{\lambda\lambda}^R (1 - \gamma_5) \bar{\nu}_\kappa + \frac{ig}{2M} \bar{u}_j^\lambda C_{\lambda\lambda} (1 - \gamma^5) d_j^\kappa) + m_u^\lambda (\bar{u}_j^\lambda C_{\lambda\kappa} (1 + \gamma^5) d_j^\kappa) + \\
& \frac{ig}{2M\sqrt{2}} \phi^- (m_d^\lambda (\bar{d}_j^\lambda C_{\lambda\lambda}^\dagger (1 + \gamma^5) d_j^\kappa) + m_u^\kappa (\bar{d}_j^\lambda C_{\lambda\lambda}^\dagger (1 - \gamma^5) u_j^\kappa) - \frac{g m_\lambda^h}{2M} H (\bar{u}_j^\lambda u_j^\lambda) - \\
& \frac{g m_\lambda^h}{2M} H (\bar{d}_j^\lambda d_j^\lambda) + \frac{ig m_\lambda^h}{2M} \phi^0 (\bar{u}_j^\lambda \gamma^5 u_j^\kappa) - \bar{e}^\lambda \phi^0 (\bar{d}_j^\lambda) + \bar{\nu}^\lambda \phi^0 (\bar{d}_j^\lambda) + \bar{u}_j^\lambda G^b g_\mu^c + \\
& \bar{X}^+ (\partial^2 - M^2) X^+ + \bar{X}^- (\partial^2 - M^2) X^- + \partial_\mu \bar{X}^+ X^0 + ig s_w W_\mu^+ X^0 - \partial_\mu \bar{X}^- X^0 + ig s_w W_\mu^- X^0 - \partial_\mu \bar{X}^0 X^- + \\
& \partial_\mu \bar{X}^0 X^+ + ig s_w W_\mu^+ X^+ - \partial_\mu \bar{X}^- X^+ + ig s_w W_\mu^- X^+ - \partial_\mu \bar{X}^+ X^- + ig s_w A_\mu X^0 - \partial_\mu \bar{X}^0 X^+ + \\
& \partial_\mu \bar{X}^+ X^-) - \frac{1}{2}g M (\bar{X}^+ X^+ H + \bar{X}^- X^- H + \frac{1}{c_w} \bar{X}^0 X^0 H) + \frac{1-2c_w^2}{2c_w} ig M (X^+ X^0 \phi^+ - \bar{X}^- X^0 \phi^-) + \\
& \frac{1}{2c_w} ig M (\bar{X}^0 X^- \phi^+ - X^0 \phi^- + \bar{X}^+ \phi^+ - X^- \phi^-) + ig M s_w (\bar{X}^0 X^- \phi^+ - \bar{X}^0 X^+ \phi^-) + \\
& \frac{1}{2}ig M s_w (\bar{X}^+ X^0 \phi^0 - \bar{X}^- X^- \phi^0) .
\end{aligned}$$

Any questions
so far?









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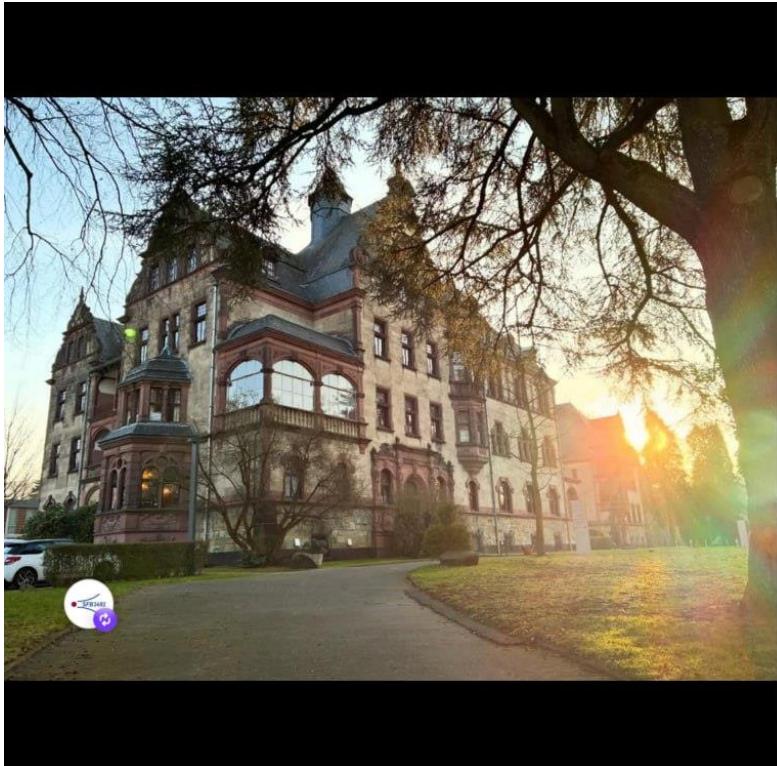
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 **rapp.center (English version in comments)**
 Diese Woche findet die „5th Graduate School on Astro-Particle Physics: Unifying views on cosmic interacting matter“ im Physikzentrum in Bad Honnef statt. 

In diesem wunderschönen Gebäude können über 80 Teilnehmende, die Vortragenden und das Organisationsteam Vorträge, Posterpräsentationen und Exkursionen genießen ... 

Organisiert wird die Graduate School von RAPP Pls im Rahmen des [@sfb1491](#)
[@dpgphysik](#) [#physics](#) [#astrophysics](#) [#astroparticlephysics](#) [#dpgphysik](#) [#science](#)
 22 Std.

 **rapp.center** This week, the 5th Graduate School on Astro-Particle Physics: Unifying Views on Cosmic Interacting Matter is taking place at the Physikzentrum in Bad Honnef. 

In this beautiful building, more than 80 participants, guest speakers, and the organizing team can enjoy lectures, poster presentations, and excursions ... 

   
 Gefällt [sfb1491](#) und weiteren Personen
 Vor 22 Stunden

 Kommentieren ... 



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...

sfb1491 Live from the 5th Graduate School on Astro-Particle Physics "Unifying view on cosmic interacting matter" at the Physikzentrum Bad Honnef! 🎉 🎉

This week, more than 80 early-career scientists meet in Bad Honnef, diving into and learning about plasma, astro, and particle physics. The SFB1491 Organizing Team is delighted to welcome so many young engaged scientists from around the world coming together for this school. 🌎 🌟 🌎

hashtag#sfb1491 hashtag#pbh hashtag#school
hashtag#astro hashtag#particle hashtag#physics

17 Std.

Heart icon, Comment icon, Share icon, Report icon, Like icon

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Vor 17 Stunden

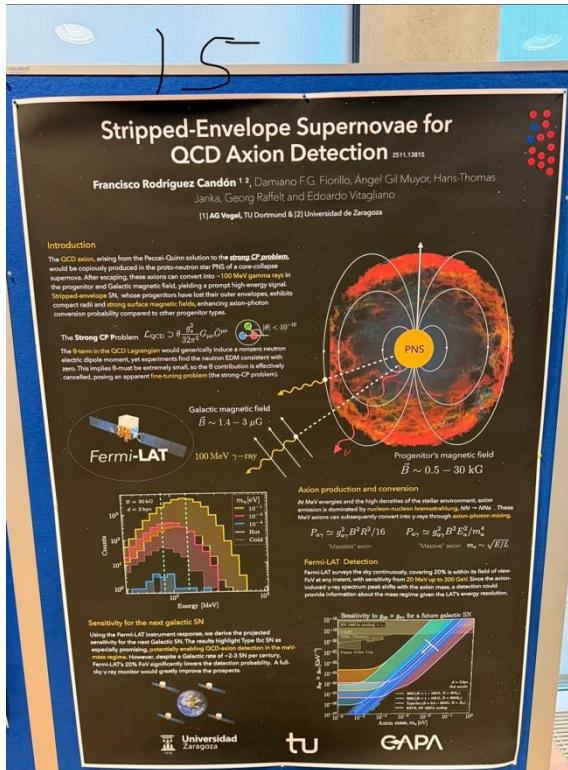
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Poster Prize

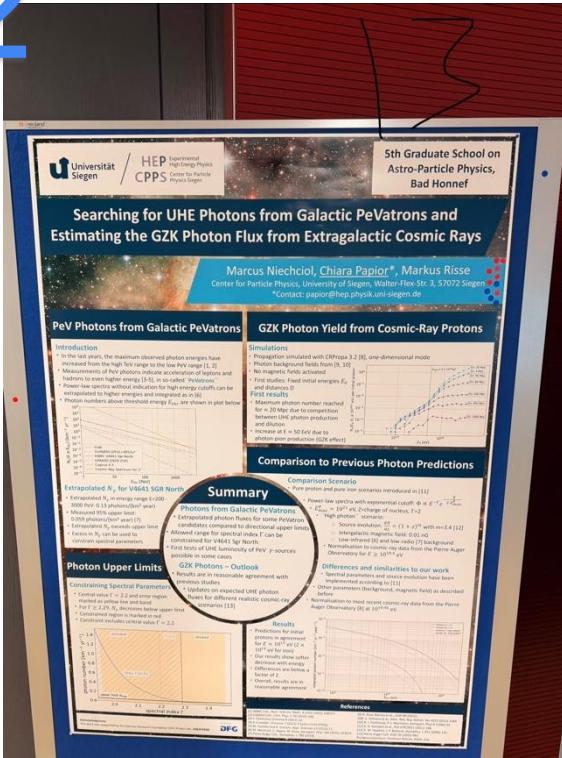
Poster Prize

1

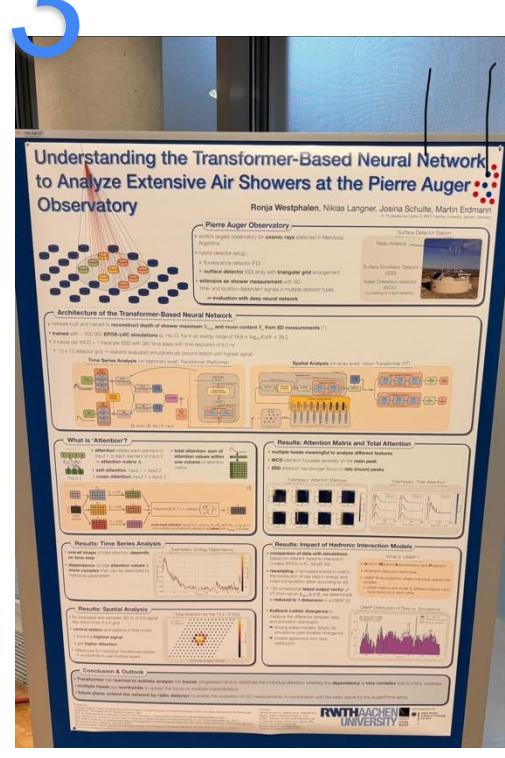


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2



3



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Good Bye

and have a safe trip home