



**SFB 1491**

**Kickoff Meeting  
May 30, 2022**





# Thank you, Bernhard



- The Brand-New SFB1491 – Physics Program
- Organizational structure – here is your chance to contribute 😊
- Documentation – here is your duty to contribute ;-)

# Three key science questions

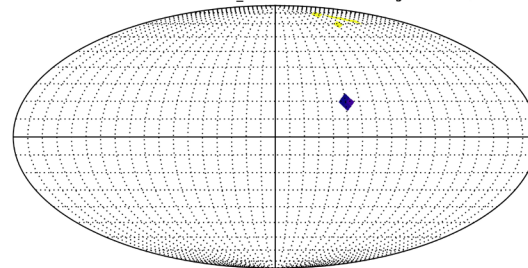
1. What are the signatures of the interplay between **magnetized, turbulent astrophysical plasmas** and cosmic rays and what can they tell us about the origin of cosmic rays?

Example ultra high energy cosmic-ray transport in Galactic B-field

**CIM: Combining...**

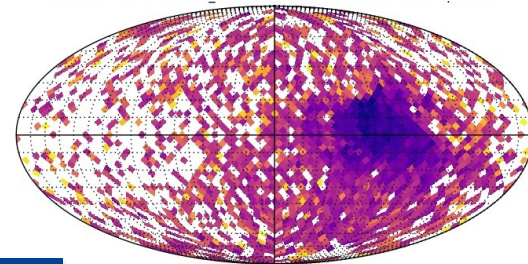
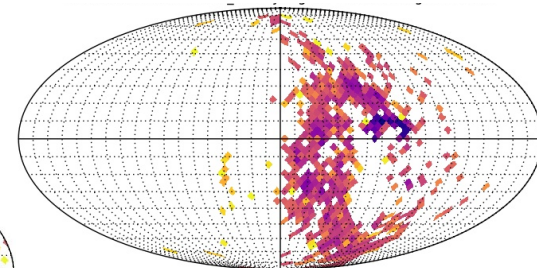
- **Plasma physics** (acceleration & diffusive transport via scale bridging: kinetic & fluid picture),
- **Astrophysics** (B-field measurements & MHD modeling),
- **Astroparticle physics** (transport in turbulent+regular B-fields & multimessenger modeling+detection)

only extragalactic



CenA(4 – 8 EeV): @ Earth

extragalactic +  
regular Galactic



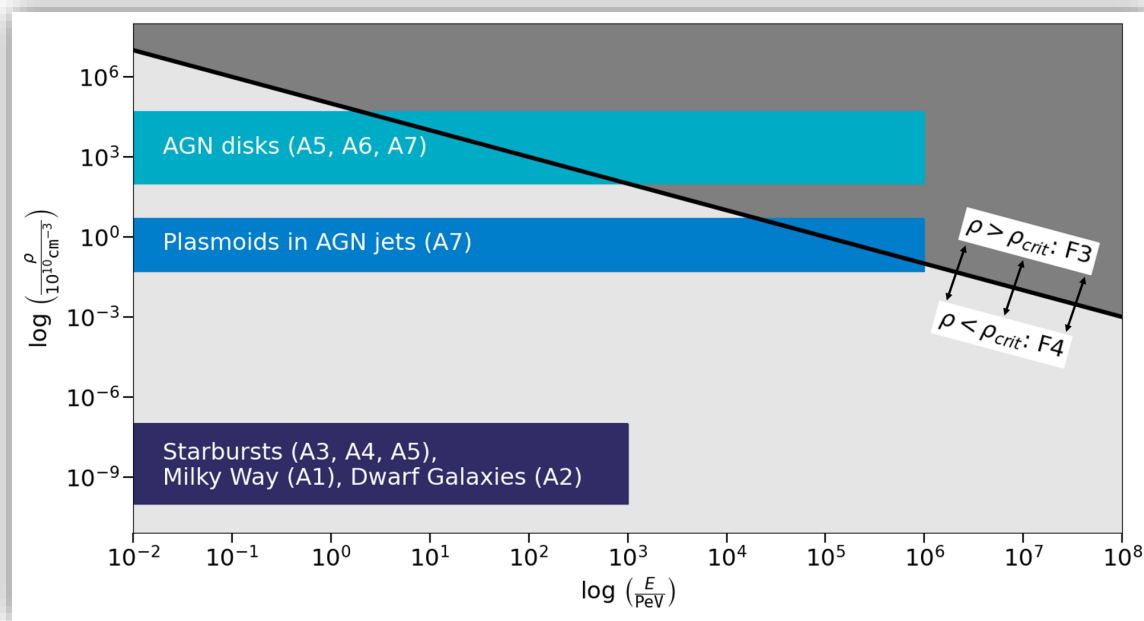
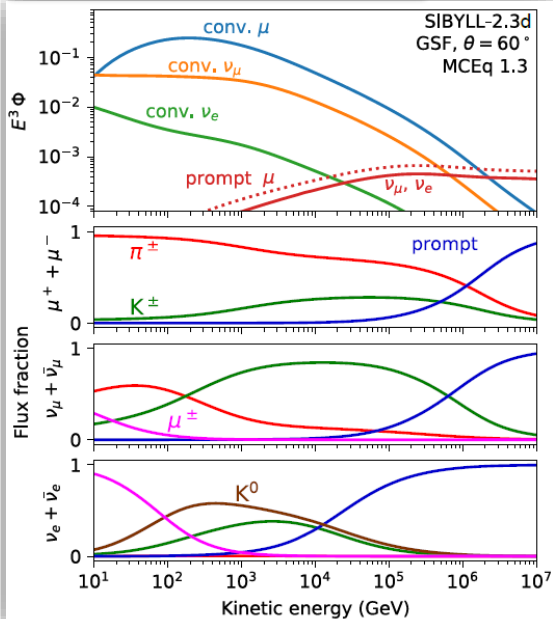
extragalactic + Galactic (regular + turbulent)

# Three key science questions



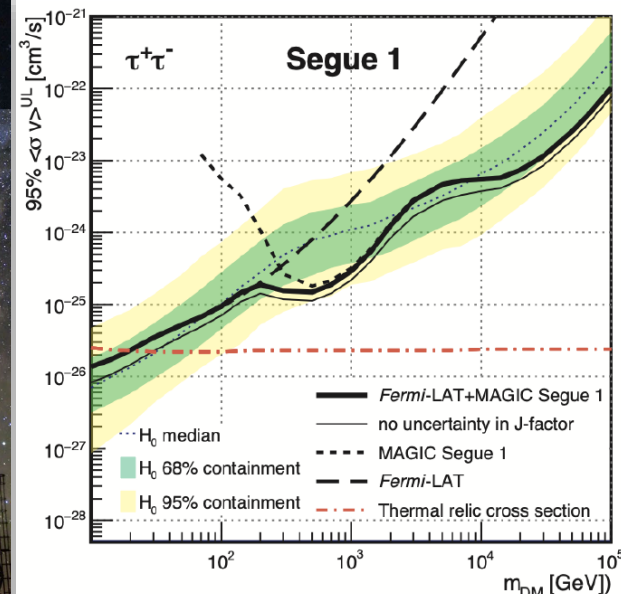
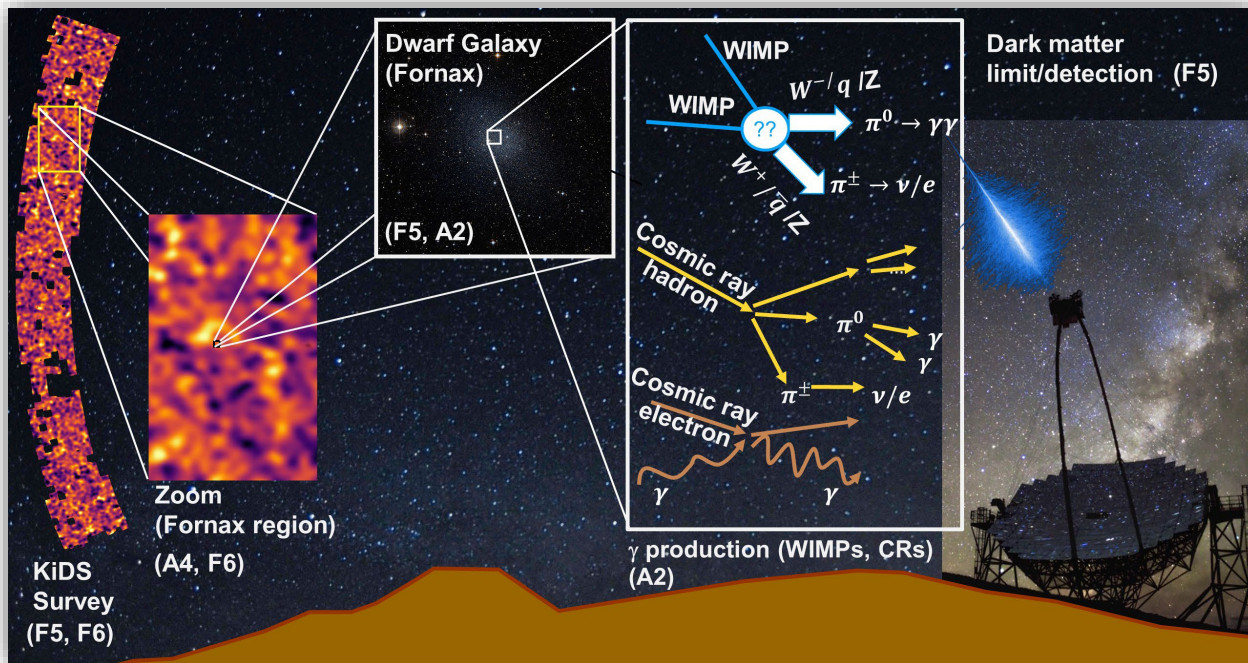
2. What are the implications of **precision measurements of hadronic interactions** at the highest energies for the astrophysical cosmic-ray signatures?

## $\nu$ fluxes Earth Atmosphere



# Three key science questions

3. What are the connections between the **cosmic signatures of baryonic and dark matter**, moving down to the lowest halo masses and out to larger galactocentric distances?



MAGIC Coll (incl. Rhode & Elsässer), JCAP 2016

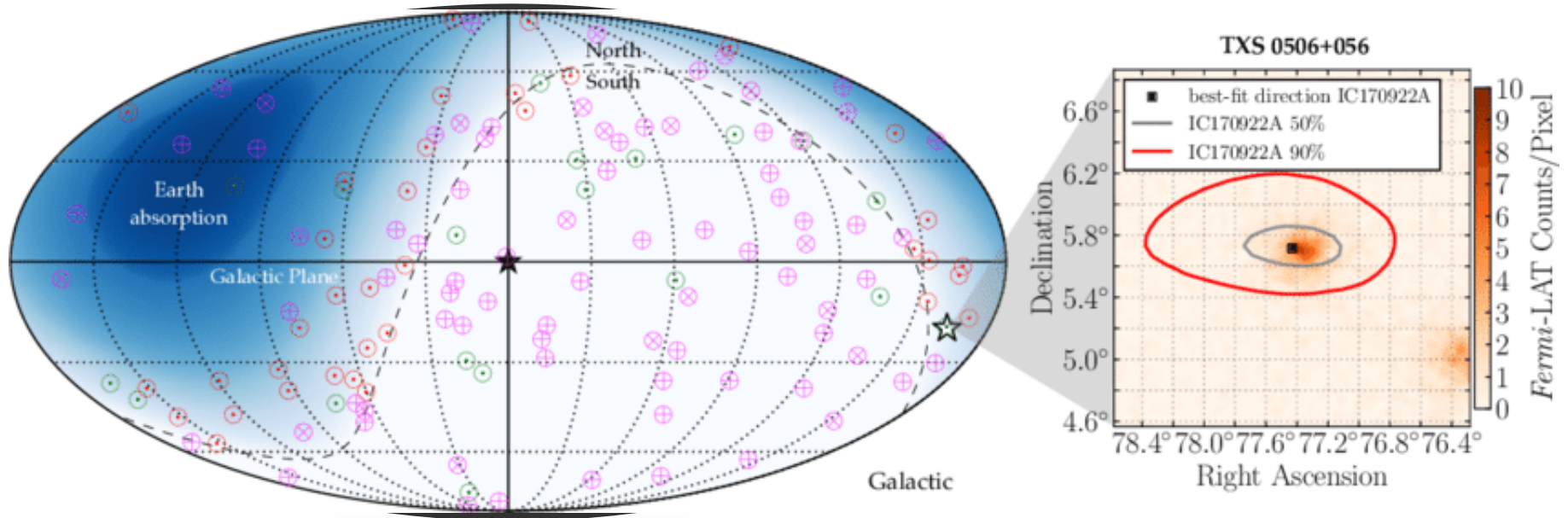
# Why here, why now?

## (1) New era of multimessenger astronomy



Fermi Coll. (incl. **Franckowiak**), ApJS (2020)

H.E.S.S./MAGIC (incl. **Elsässer, Rhode**)/VERITAS; HAWC/...



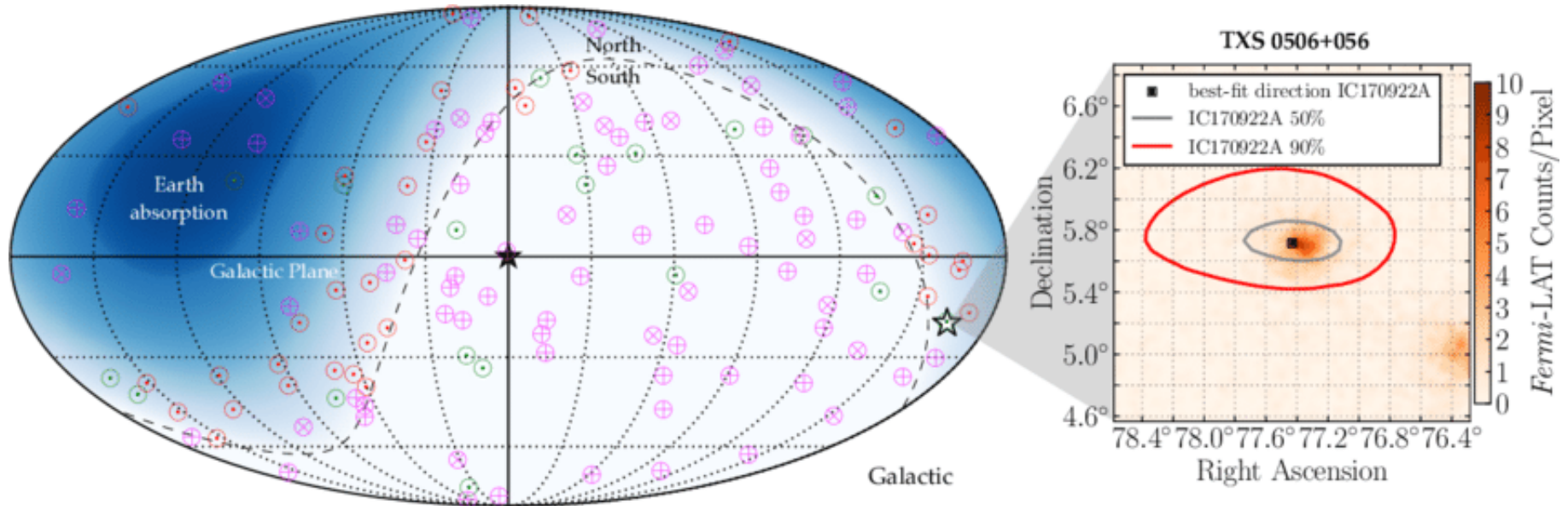
8 IceCube Coll. (incl. **Franckowiak, Rhode, Tjus**), Science (2013)

IceCube Coll. (incl. **Franckowiak, Rhode, Tjus**), Science (2018)



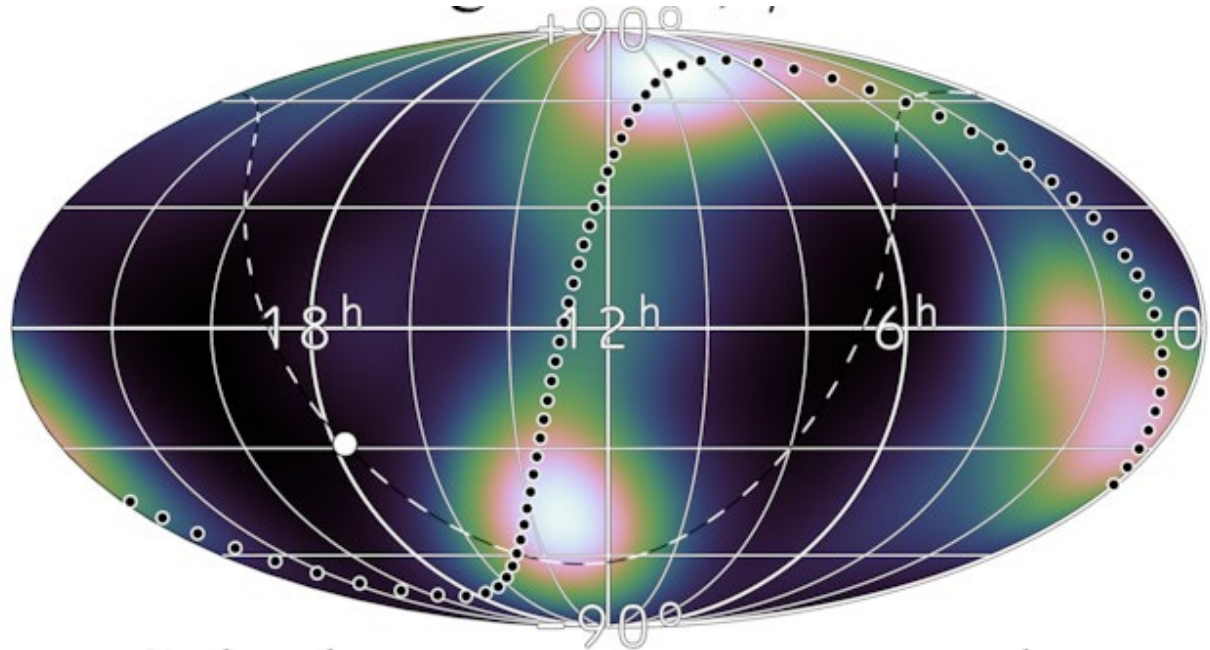
# Why here, **why now?**

## (1) New age of multimessenger data



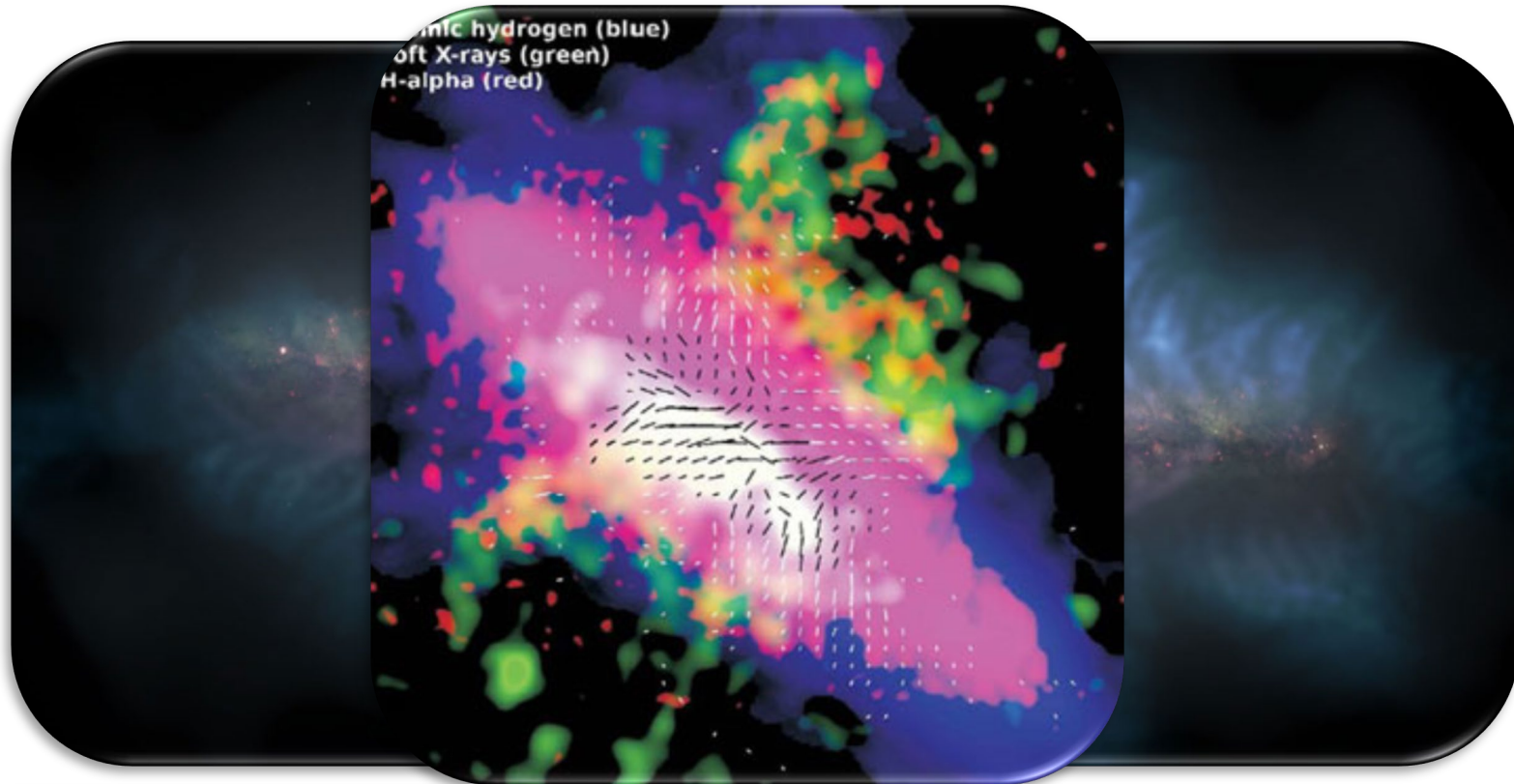
# Why here, **why now?**

## (1) New age of multimessenger data



# Why here, why now?

## (2) Global view of external galaxies



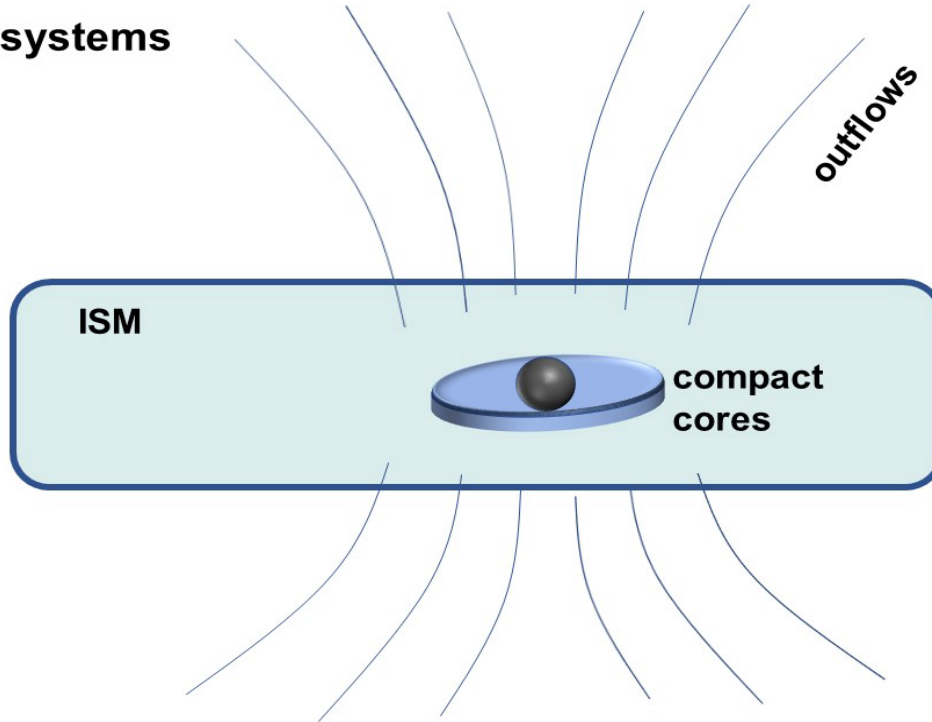
NGC5775, CHANG-ES Team (incl. Ralf-Jürgen Dettmar),  
Astronomy Picture of the Day, Jan 26, 2021

# Why here, why now?

## (2) Global view of external galaxies

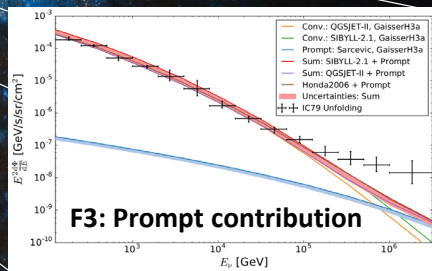
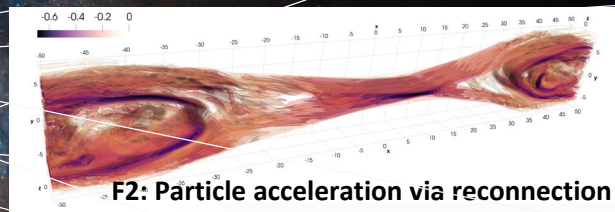
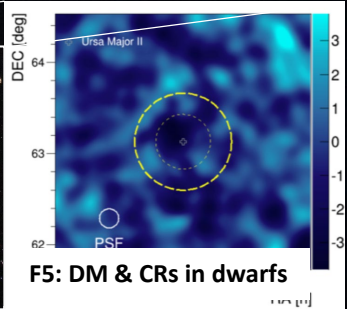
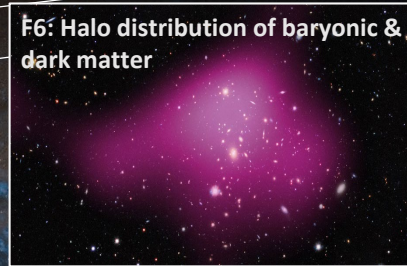
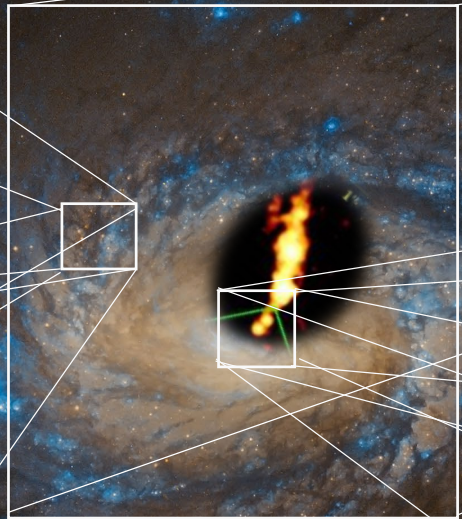
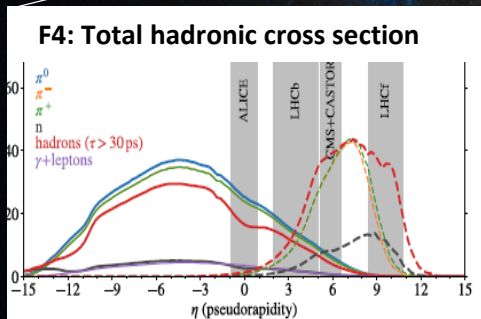
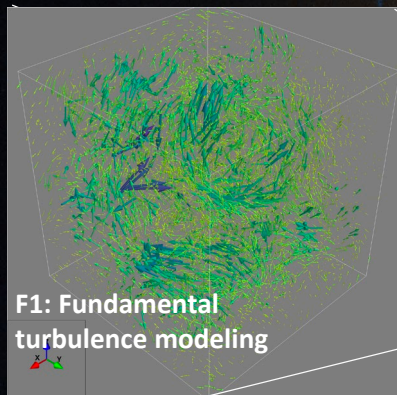
### Properties of galactic systems

- A7 Radio-loud AGN
- A5 Seyferts
- A4, A5 Starbursts
- A2 Dwarf galaxies
- A1 Milky Way ISM
- A1, A6 Galactic Center



**Why here?** – experts on AGN (Eichmann/Elsässer/Franckowiak/Rhode/Tjus), Seyferts & Starbursts (Dettmar/Eichmann/Fichtner/Tjus), dwarfs (Bomans), Milky Way (Fichtner/Franckowiak/Tjus)

# Why here, why now? (3) Fundamental physics input



**Why here? – experts on plasma (Grauer/Fichtner/Innocenti), particle (Albrecht/Kampert/Rhode/Spaan/Kröniger) & dark matter (Hildebrandt/Wright/Elsässer) on board**

# Trans-disciplinary structure of the CRC



Astrophysical signatures		PIs		Fundamental properties		PIs	
A1	Galactic Center	<u>Fichtner</u>	Francko-wiak	F1	Intermittency and diffusion	<u>Grauer</u>	<u>Fichtner</u>
A2	Dwarf galaxies	Bomans	<u>Tjus</u>	F2	Plasma Instabilities	<u>Innocenti</u>	<u>Grauer</u>
A3	Knee-to-ankle region	Kampert	<u>Tjus</u>	F3	Prompt muons	Spaan	Rhode
A4	Starburst galaxies	<u>Fichtner</u>	Dettmar	F4	Hadronic cross sections	Kampert	Spaan + Albrecht
A5	Starburst-AGN-composits	Dettmar	<u>Eichmann</u>	F5	Dark matter in dwarfs	Hildebrandt	Elsässer
A6	Tidal Disruption Events	Francko-wiak	Dettmar	F6	Dark matter and gas	Bomans	Wright
A7	Multimessenger modeling of AGN	Rhode	<u>Tjus</u>				

Theory

Experiment

~50% of projects PIs from theory & experiment

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60% of projects with PIs from different sub-disciplines

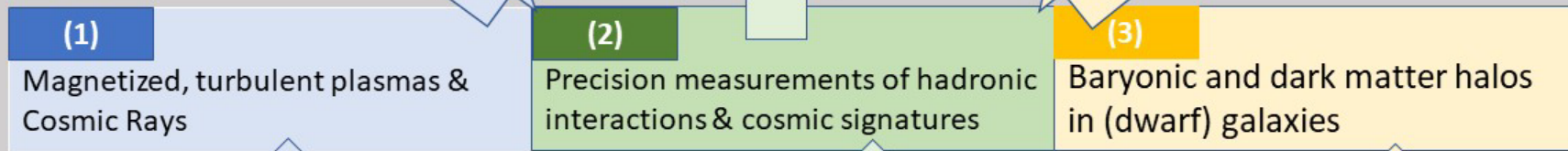
Theory

Experiment

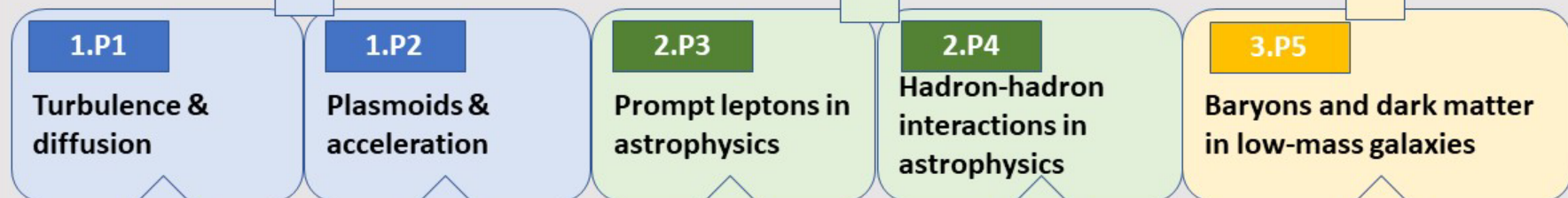
~50% of projects PIs from theory & experiment

# A unifying view on cosmic interacting matters

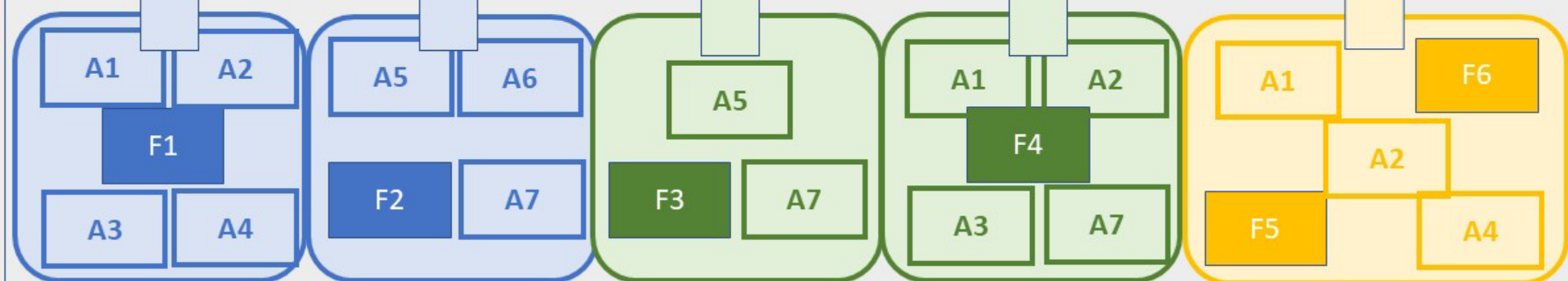
Research Questions



Guiding principles



Project contributions





- **Connect plasma-, particle- and astrophysics on the educational level**
  - Double advisory system (2 sub-disciplines)
  - Lecture program bridging the disciplines
  - International graduate school on Plasma-Astroparticle Physics
- **Foster the career of Early Career Scientists by**
  - Structured graduate program (e.g. doctoral agreement, ...)
  - Supported by RUB Research School
  - Active participation in management structure of CIM (i.e organization of schools, choice of lectures and guest scientists, international mentor, intense exchange with CIM fellows and CIM guests, ...)



1st Plasma-Astroparticle Winter School (2014)  
2nd & 3rd (2016, 2019), continuation  
**within MGK (2023, 2025)**

# So, what does that mean for me (=as an ECR)?

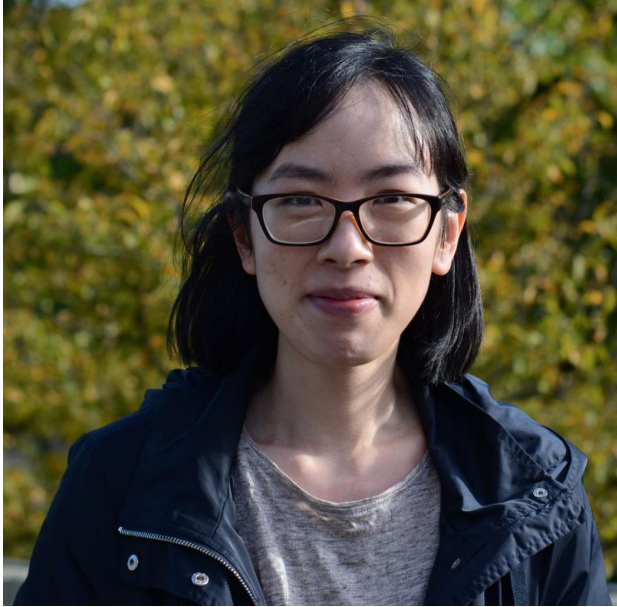


- You will get the opportunity to meet a lot of interesting physicists, and discuss life and physics with them
- You will get the opportunity to shape the structure, contents, and success of the CRC
- You will get the opportunity to organize seminars, conferences and workshops as independent researchers, shaping the contents of these events yourself
- ... and more ...

# First ECR event is on Wednesday:



- Thanks to: Linh Han Than & Sophie Aerdker



- They will tell you more during the conference

# CIM Backbone

## Research Data Management (INF)



- Different large-scale projects (experimental, observational, theoretical multimessenger data) with own research data management
- **Here:** gathering and maintaining of high-level **CIM** data on one platform
- **Data steward (RUB core funding)** to set up a long-term data management system in CIM
- Building up and maintaining **software preservation** beyond the 12-year scale of CIM in docker



The new RUB data center

# CIM Backbone Outreach Strategy (Ö)



- Close Collaboration with Zeiss Planetarium Bochum (close to 300,000 visitors per year before Covid-19)
- **Target-group-oriented** measures, for e.g. pupils and students to attract them to physics & informing the general public about our scientific achievements
- Building on already ongoing outreach activities of faculties and RAPP Center
- Central, new measures:
  - Social media strategy
  - Planetarium show (national/international)
- Our Channels:
  - [www.sfb1491.rub.de/](http://www.sfb1491.rub.de/)
  - **Twitter - @SFB1491 [active – FOLLOW US!]**
  - Instagram - @SFB1491 [not yet active]
  - Facebook - @SFB1491 [not yet active]
  - Youtube - @SFB1491 ~[not yet active]



More infos from Susanne Hüttemeister (project Ö)

# Quintessence for Early Career Researchers (= every scientist without a permanent job)



- Be creative – you can take science in your own hands!
- Organize your own workshops, invite your own international guests, organize meetings among yourselves
- You can design twitter contributions for your research results, contribute with visualizations to the planetarium show, etc
- Think you of the box – become creative

**IMPORTANT – this is YOUR chance to fame!**

- Please **send each publication** within CRC to me (ADS/Inspire Link is enough for now).
- **Write a short twitter-text, send it to Lena Linhoff**  
**lena.linhoff@tu-dortmund.de**
- **Do not forget to acknowledge funding from SFB1491!!!**
- All of this guarantees that (a) next-generation PhD students can work here; (b) you might be able to get a postdoc @ CIM 😊

- **1.P1, 2.P4 (A7)** *Becker Tjus, Hörbe, Jaroschewski, Reichherzer, Rhode, Schroller*: “Propagation of cosmic rays in plasmoids of AGN Jets – implications for multimessenger Modeling“, MDPI Physics (2022)
- **1.P1 (A1/A3/F1)** *Reichherzer, Becker Tjus, Zweibel, Merten, Püschel*: “Anisotropic cosmic-ray diffusion in isotropic Kolmogorov turbulence“, MNRAS, accepted
- **1.P2 (F1/F2)** *Walter, Effenberger, Fichtner & Litvinenko*: “A nonlinear model of diffusive particle acceleration at a planar shock“, Physics of Plasmas, submitted, 2022
- **1.P2 (F2)** *Boella, Schoeffler, Kevin, Shukla, Innocenti, Lapenta, Fonseca, Silva*: “Interaction between electrostatic collisionless shocks generates strong magnetic fields“, accepted in New Journal of Physics
- **2.P3 (F4)** R. Aaij et al (LhCb Coll; paper lead by J.Boelhave, CIM); “Measurement of prompt charged-particle production in pp collisions at  $\sqrt{s} = 13$  TeV“, *JHEP* 01:166 (2022)
- **2.P4 (A7)** *Kun, Bartos, Becker Tjus, Biermann, Franckowiak & Halzen*: “Multiwavelength search for the origin of IceCube’s neutrinos“, ApJ, submitted (2022)
- ...more papers within Auger, IceCube, LhCb, ...
- More papers coming up in A1, A4, A5, A7...

**Summary: we are already coming of age, but need to pick up speed now**



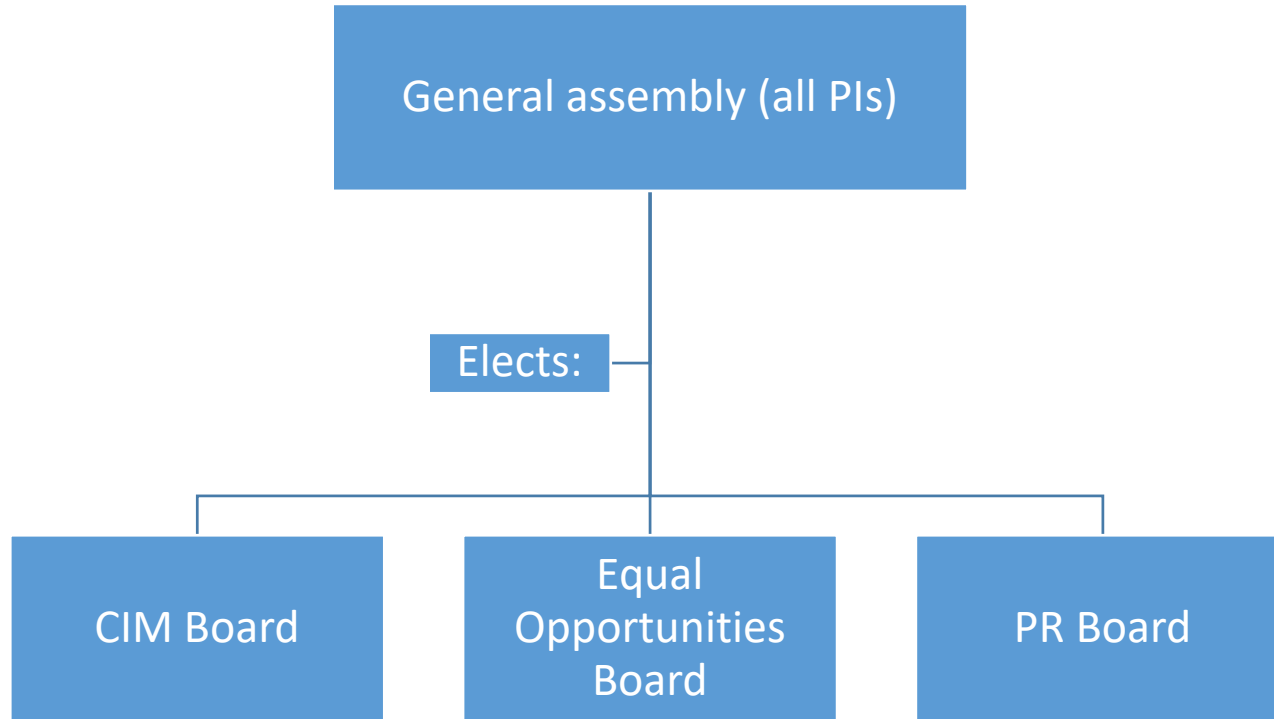
- Please send any information relevant to the CRC to me (for now)
- Twitter-contributions are always appreciated – take a short photo whenever you can



- **Lecture series, Conferences, Public Relations, ...** we need to know! For now, announcements can go to me (will let you know when transition will happen 😊)
- **Graduate School:** Early Career Scientist (ECS<sup>^\*</sup>) have big opportunities – like organizing eventy and conferences themselves (more from Hendrik)

\* ECS = everybody without a permanent and/or PI position

# Organizational structure @ CIM





**Christina Malty,  
CRC Secretary**

Responsible for general CRC business  
(event organization, signatures for personell etc, ...)

**[sfb1491@rub.de](mailto:sfb1491@rub.de)**



**Dr. Eva Jütte,  
CRC Coordinator  
(from june 01)**

Responsible for scientific project management of CRC

**[eva@tp4.rub.de](mailto:eva@tp4.rub.de)**

**Marissa Hünnefeld,  
will join coordination  
of CRC in spring**



- **CIM Board:** Speaker, Co-Speaker + 4 PIs\*, Coordinator (Eva), ECS representative\*
  - Sign off financial shifts in CIM, take structural decisions like new PIs
- **CIM Equal Opportunities Board:** Speaker, 2 PIs\*, 1 PhD student\*, 1 Postdoc\*
  - Monitors hiring process, statistics m/f/d, etc. Can take actions to contact PIs/Board if standards are not met, ...
- **CIM PR Board:** Susanne Hüttemeister + 3 PIs\*, Coordinator, 1 PhD student\*, 1 Postdoc\*
  - Helps scripting the planetarium show, helps to collect scientific images for the show, advises on social media campaign, motivates ECS to contribute to outreach activities

\* **Need to be appointed**

# CIM international network



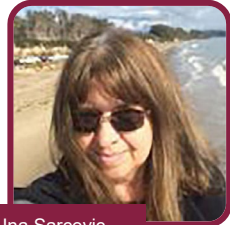
## 9 external collaborators



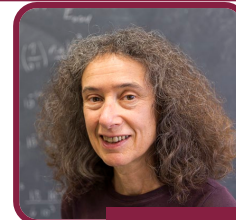
Silke Britzen  
(MPIfR, Bonn)



Andy Strong  
(MPE, Munich)



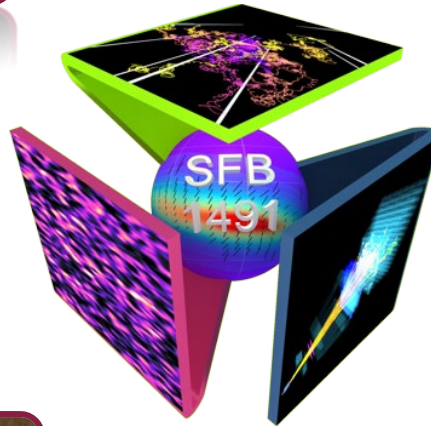
Ina Sarcevic  
(U Arizona)



Ellen Zweibel  
(UW Madison)



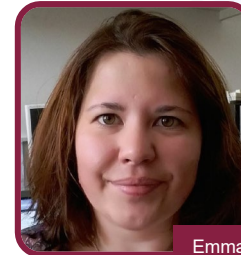
Catherine Heymans  
(Edinburgh)



Francis Halzen,  
(UW Madison)



Katia Ferrière  
(U Toulouse)



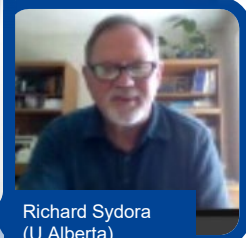
Emma Kun  
(U Budapest)



Elena Amato  
(INAF Florence)



Isabelle Grenier  
(Paris)



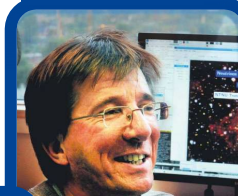
Richard Sydora  
(U Alberta)



Judith Irwin  
(Queen's U, Ontario)



Fulvia Pucci  
(Jet Propulsion Lab, California)



Michael Kachelrieß  
(Trondheim)



Ludo van Waerbeke  
(U British Columbia)

## 6 CIM Fellows

## Science development:

Phase 1:  
2022-2025

- Global view of cosmic rays (external systems);
- Solutions to specialized questions;
- Preparing for a unified approach (see proposal detail)

Phase 2:  
2026-2029

- Generalizing methods & solutions:
- Combined inclusion of fundamental properties of matter
- Extending investigations to local CR sources in the **ISM**

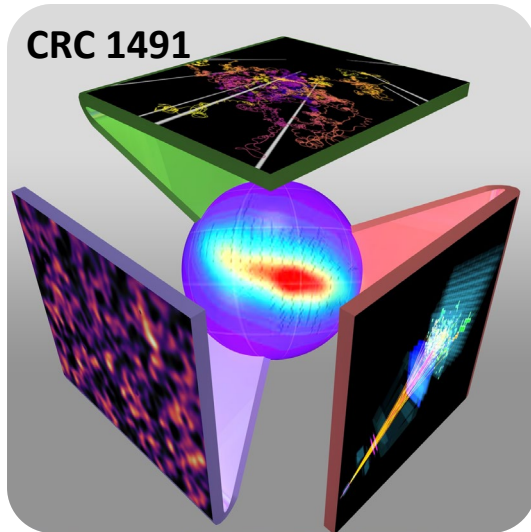
Phase 3:  
2030-2033

- Application to next-generation experimental data
- Obtain final results via modeling and interpretation
- Create a systematic view of the **cores** of the different systems

42 😊

# The world in 1491 ...

... with huge discovery potential, a scientific revolution coming up and many uncharted areas on the map



**Precision clock (ca 1491)**



Reimiser (OR/KAPP Center)

# CRC 1491: Breaking new grounds

