

# Neutrino Physics – The German Perspective



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für Kernphysik, Heidelberg**



**GDR – neutrino meeting  
27 April 2009  
LPNHE Paris**

# The Players

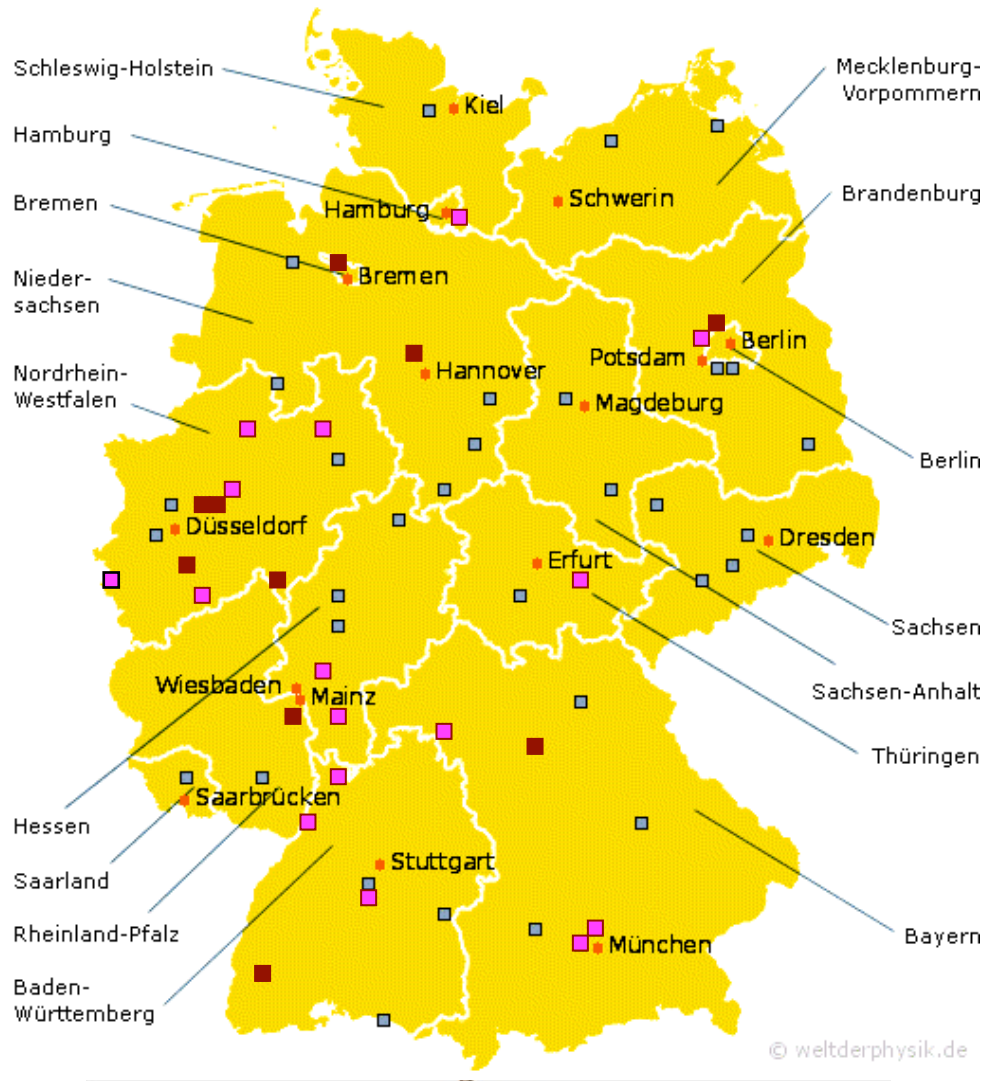
- **Institutional funding**

- **Universities**
- **Helmholtz association (HGF)**
- **Max-Planck-Society (MPG)**

- **Funding sources**

- **DFG = Deutsche Forschungsgemeinschaft**
- **BMBF = ministry**
- **HGF = Helmholtz Gemeinschaft**
- **MPG = Max-Planck-Society**
- **EU**
- **ERC**
- **others (Alexander von Humboldt foundation, ...)**

# Institutional Funding: **Universities**



**Physics Departments at 58 Universities**

**astroparticle physics at 26 universities**  
**astroparticle theory at 16 universities**

<b>RWTH Aachen</b>	<b>HU Berlin</b>
<b>U Bielefeld</b>	<b>RU Bochum</b>
<b>U Bonn</b>	<b>JU Bremen</b>
<b>TU Darmstadt</b>	<b>U Dortmund</b>
<b>U Erlangen-Nürnberg</b>	<b>U Frankfurt</b>
<b>U Freiburg</b>	<b>U Hamburg</b>
<b>U Hannover</b>	<b>U Heidelberg</b>
<b>U Jena</b>	<b>U Karlsruhe (TH)</b>
<b>U Köln</b>	<b>U Mainz</b>
<b>LMU München</b>	<b>TU München</b>
<b>U Münster</b>	<b>U Potsdam</b>
<b>U Tübingen</b>	<b>U Siegen</b>
<b>U Würzburg</b>	<b>U Wuppertal</b>

# Institutional Funding: **Helmholtz Assoc. = HGF**



-15 research centers  
→ 3 structure of matter  
- 25.000 staff  
- large instruments  
- buget €2.2 billion



**astroparticle physics  
in 'structure of matter'**

Deutsches Elektronen-Synchrotron  
in der Helmholtz-Gemeinschaft



**Ice-Cube  
Amanda  
Lake Baikal  
astroparticle theory**

Forschungszentrum Karlsruhe  
in der Helmholtz-Gemeinschaft

**KATRIN  
AUGER  
Kascade-Grande  
Edelweiss  
astroparticle theory**

# Institutional Funding: **Max-Planck-Society= MPG**

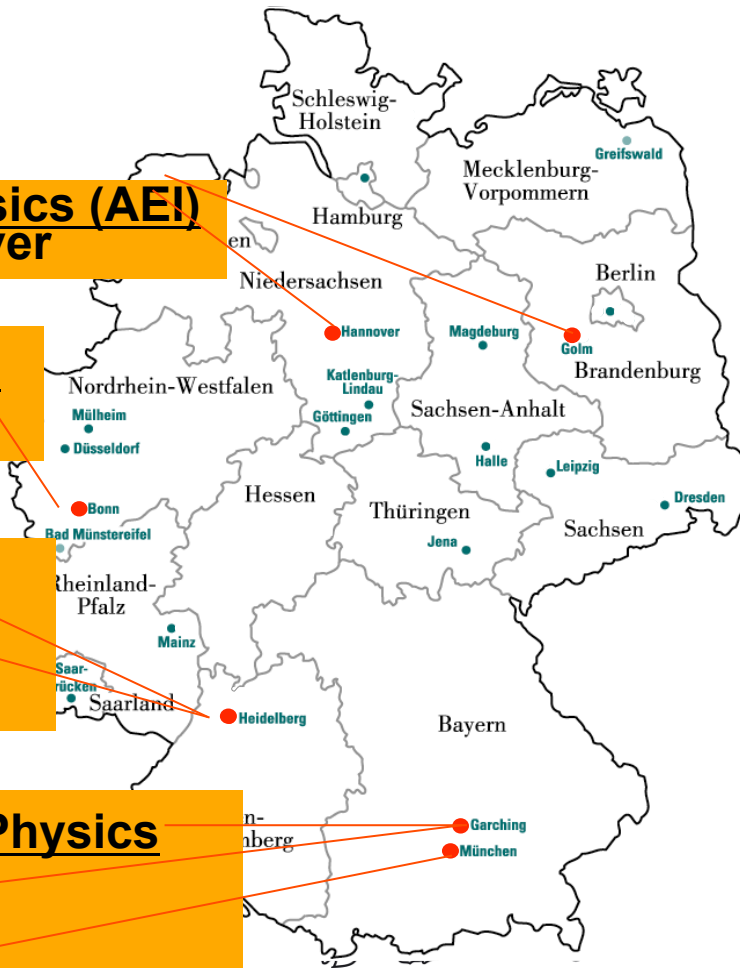


**Gravitational Physics (AEI)**  
Potsdam / Hannover

**Radio Astronomy**  
Bonn

- **Astronomy**  
- **Nuclear Physics**  
Heidelberg

- **Extraterrestrial Physics**  
- **Astrophysics**  
- **Physics**  
Munich / Garching



**78 institutes**

**~12.500 staff**

**~10.000 junior/guest scientists**

**budget ~ €1.4 billion**

**3 sections:**

- **Biology, Medicine**

- **Human sciences**

- **Chemistry, Physics, Technology**

**Many projects:**

particle physics: ATLAS, LEP, ...

astro/cosmo: GEO, Planck, LBT,

Magic, CAST, Glast, INTEGRAL,

ROSAT, XMM-Newton,

particle-astro: HESS, CRESST

Neutrino: GERDA, Double

Chooz, Borexino

5 astroparticle theory groups

# Development of AP Research

## RWTH Aachen

*A. Stahl (acc. Exp,  $\nu$ -mixing)* *exp*  
*C. Wiebusch (neutrinos)* *exp*  
*N.N. (astroparticle theory)* *theo*

## U Bochum

*N.N. ( $\nu$ -theory)* *theo*

## U Dortmund

*H. Paes (astroparticle theory)* *theo*

## U Dresden

*K. Zuber (dark matter/ $0\nu\beta\beta$ )* *exp*

## U Erlangen-Nürnberg

*C. Stegmann (HESS)* *exp*  
*N.N. (astroparticle/cosmology)* *theo*  
 + 2 further W2 positions

## U Hannover

*G. Heinzl (gravitational waves)* *exp*

## U Hamburg

*C. Hagner ( $\nu$ -mixing)* *exp*  
*D. Horn (TeV  $\gamma$ 's)* *exp*  
*G. Sigl (astroparticle theory)* *theo*

## New professorships in astroparticle physics, cosmology, astrophysics since 2005

### Uni/MPIK Heidelberg

*M. Lindner (astroparticle)* *theo +exp*

### U Karlsruhe

*G. Drexlin ( $\nu$ -mass)* *exp*  
*N.N. (astroparticle theory)* *theo*

### Munich: TUM/LMU/MPP/MPE/ESO

*N.N. (astroparticle theory)* *theo*  
*N.N. (particle physics/APP)* *theo*  
**10x N.N.** W1/W2/W3 groups *exp/theo*  
 (astroparticle, astrophysics, particle physics, cosmology)

### U Potsdam/DESY

*N.N. (astroparticle theory)* *theo*

### U Wuppertal

*K. Helbig (HE- $\nu$ 's, IceCube)* *exp*

# Funding Agencies: **DFG**

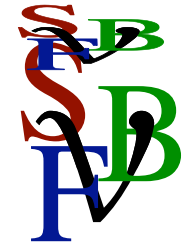


- **Budget: ~ € 1,35 billion**
- **Different grant schemes:**
  - **all fields**
  - **individual research grant** (→ postdocs, PhDs, travel)
  - **research groups** (→ postdocs, PhDs, travel)
  - **graduate schools** (→ PhDs, travel for PhDs)
  - **Sonderforschungsbereich (collab. research cluster**  
→ postdocs, PhDs, travel)
  - **excellence initiative** → research clusters & whole universities
- **Review system**  
**peer review** → works very good!
- **Pro's and con's:**
  - + **a good idea gets funding!**
  - + **reliable structure, good gain/effort ratio**
  - **no funding for large projects above ~few M€**



Deutsche  
Forschungsgemeinschaft  
**DFG**

Transregional  
Collaborative  
Research  
Centre  
SFB-TR 27



## *Neutrinos & Beyond*

University Karlsruhe (TH)  
TU München  
University Tübingen

&

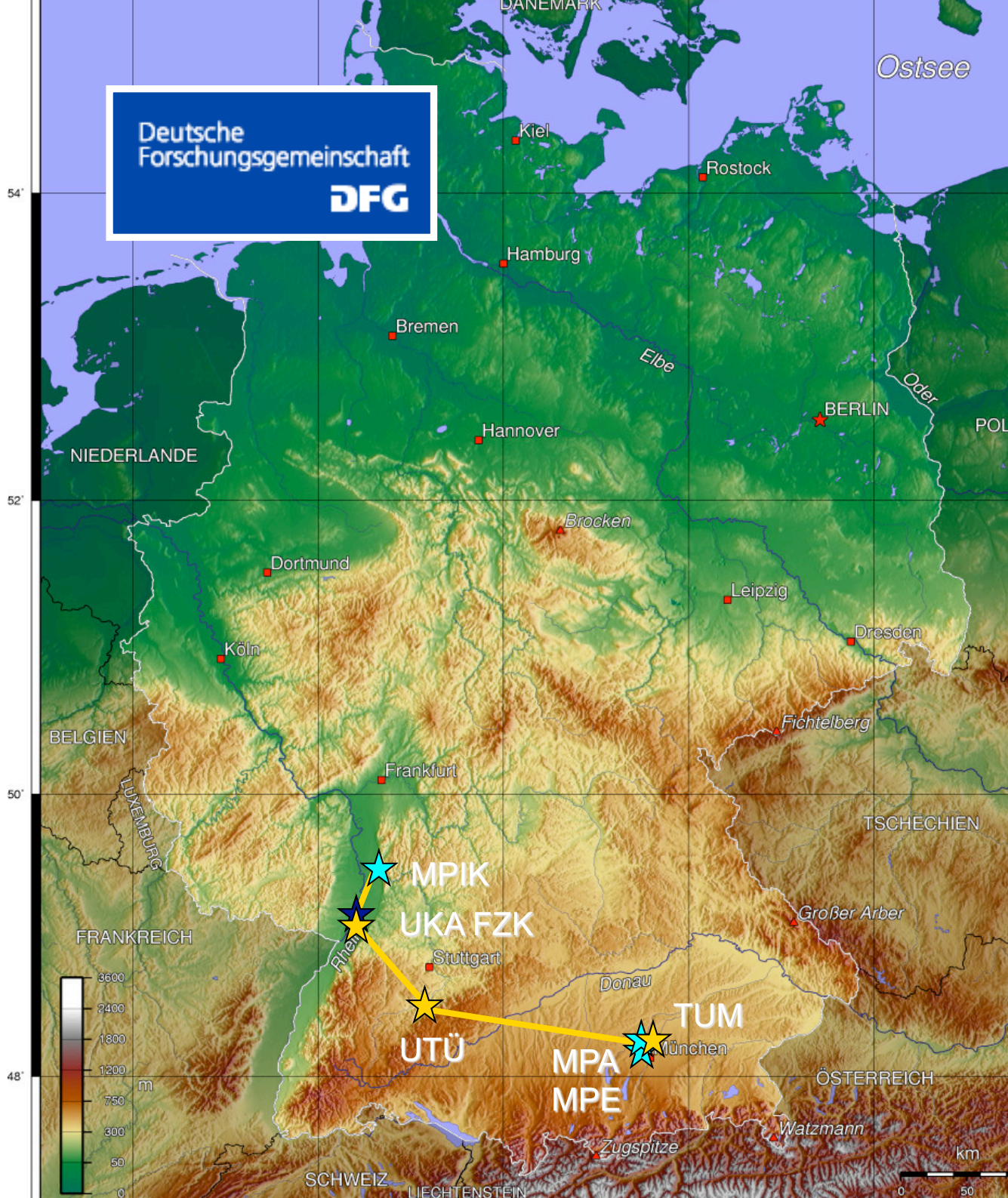
Forschungszentrum K'he  
3 Max-Planck-institutes  
MPIK-MPA-MPE

 Universität Karlsruhe (TH)

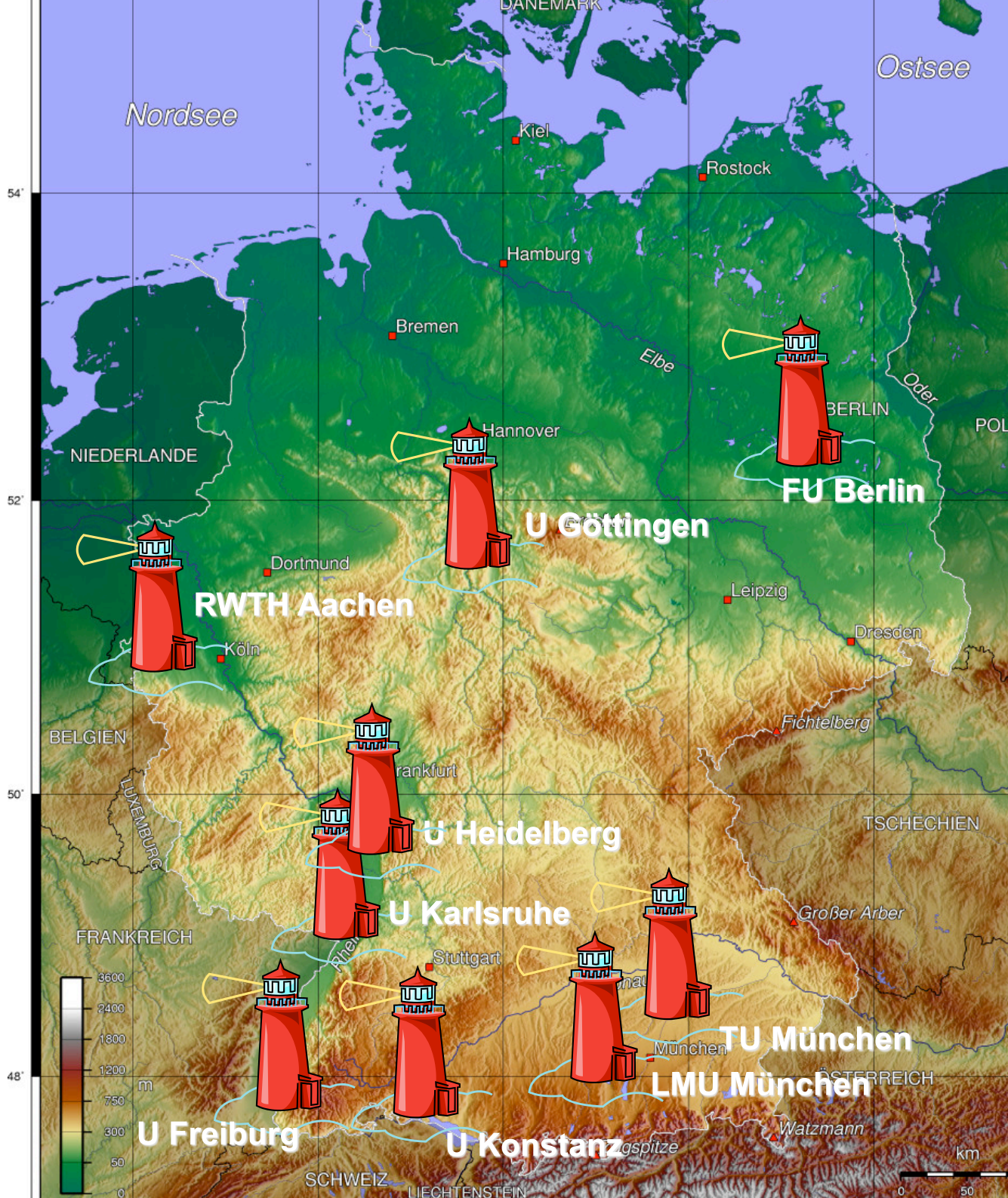


EBERHARD KARLS

UNIVERSITÄT  
TÜBINGEN







**WR**

Deutsche  
Forschungsgemeinschaft  
**DFG**

WISSENSCHAFTSRAT

[German Science Council]

## Excellence Initiative

5 year funding period  
strengthening and  
advancing science  
in Germany

- Graduate Schools  
(young researchers)
- Clusters of Excellence  
(world-class research)
- Institutional Strategies  
(top-level University  
research)

# Funding Agencies: **BMBF**

- **Intention:**
  - federal support for large scale projects
  - ↔ basic state funding for individual university chairs
- **CERN → fixed contribution**
- **Verbundforschung - categories:**
  - particle physics  $\simeq$  LHC + ...?
  - nuclear physics  $\simeq$  FAIR @ GSI + ...?
  - astroparticle physics
- **Review system**
  - calls
  - selection board chooses projects from proposals ; little theory
- **Pro's and con's:**
  - + good for large scale projects
  - mega projects ↔ large projects above ~few M€ ??
  - boundaries to rigid



# Funding Agencies: HGF & MPG, EU, AvH, ...

- **Both HGF and MPG:**
  - + constant institutional funding
  - + extra funding for specific projects / purposes upon application examples:
    - Helmholtz alliances, MPG project startup funds
    - HGF and MPG young investigator groups
    - IMPRS (International Max-Planck-Research Schools)
- **European Funding**
  - FP7 programs of EU
  - ERC startup grants
- **Alexander von Humboldt Foundation**
  - independent organization, peer review
  - Humboldt research awards
  - Humboldt research stipendia
  - Theodor Lynnen stipendia
- **Others**
  - various other sources, e.g. for PhD stipendia
  - Studienstiftung des Deutschen Volkes (German merit foundation)
  - Landesgraduiertenprogramme

# The Funding Matrix

	<b>DFG</b>	<b>BMBF</b>	<b>HGF</b>	<b>MPG</b>	<b>EU/ERC</b>	<b>AvH</b>
<b>University</b>	+++	+++	+	+	+++	+++
<b>Max-Planck-Institutes</b>	+	(+)	+	+++	+++	+++
<b>Helmholtz</b>	+	(+)	+++	+	+++	+++
<b>Young researchers</b>	+++	+	+++	+++	+++	+



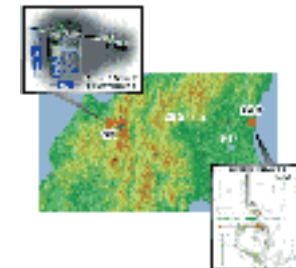
# Self-Organization of Science

- **Committees for sub-fields**
  - **KET (particle physics ~ accelerators ~ LHC)**
  - **KHuK (nuclear physics ~ ... → FAIR ...)**
  - **KAT (astroparticle physics ...)**
- **Neutrino physics is broad (BSM, cosmology, sources, ...)**
  - **structural issues**
  - **disadvantages:**
    - **where does project X belong???**
    - **everybody claims to do neutrino physics...**
  - **advantages:**
    - **N \* partial funding can also be good...**
    - **everybody claims to do neutrino physics...**

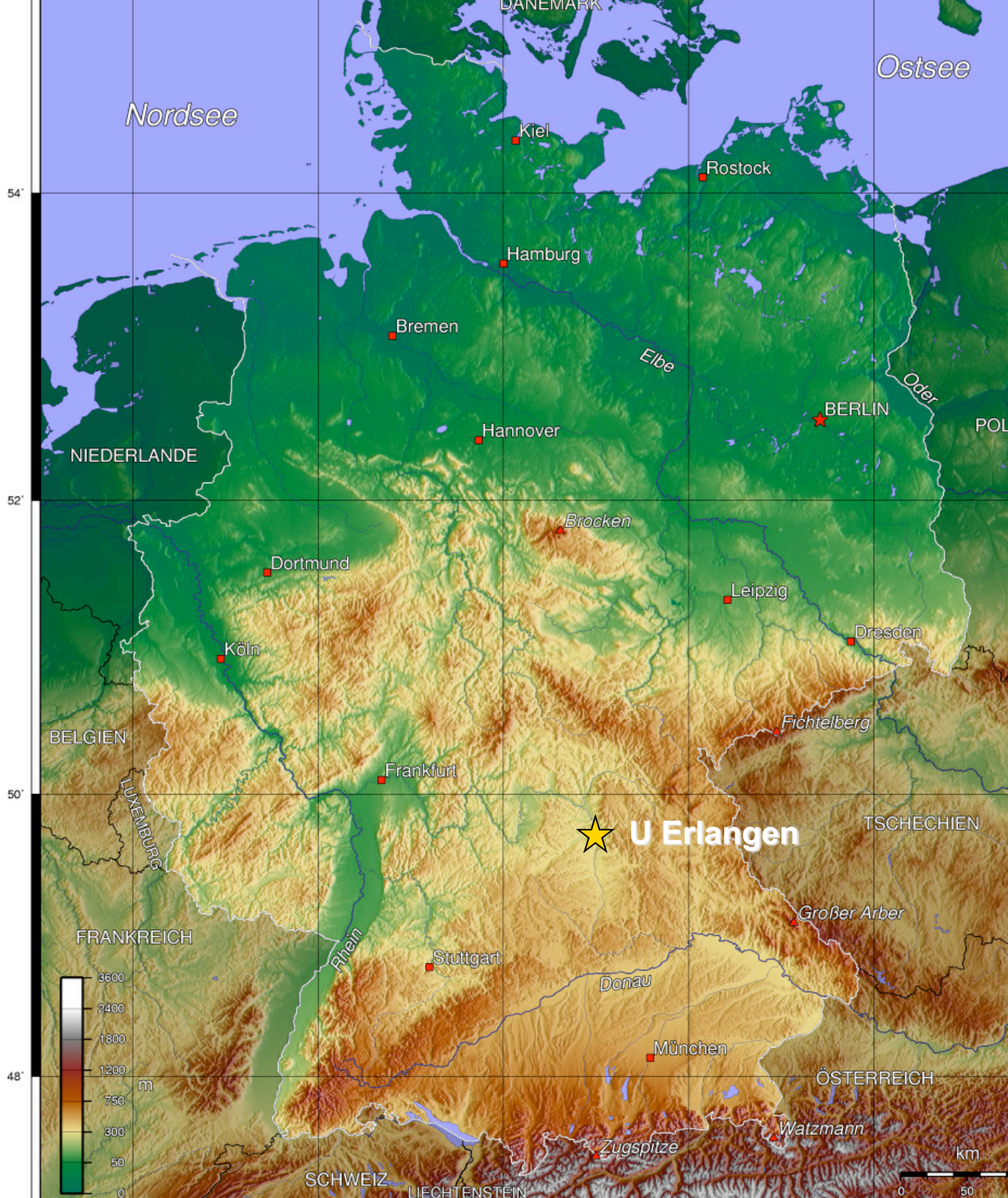
# Neutrino Projects: Now

## Current projects:

- Antares
- Borexino
- (AUGER)
- Double Chooz
- Gerda
- IceCube
- KATRIN
- NOvA
- OPERA
- T2K
- ...





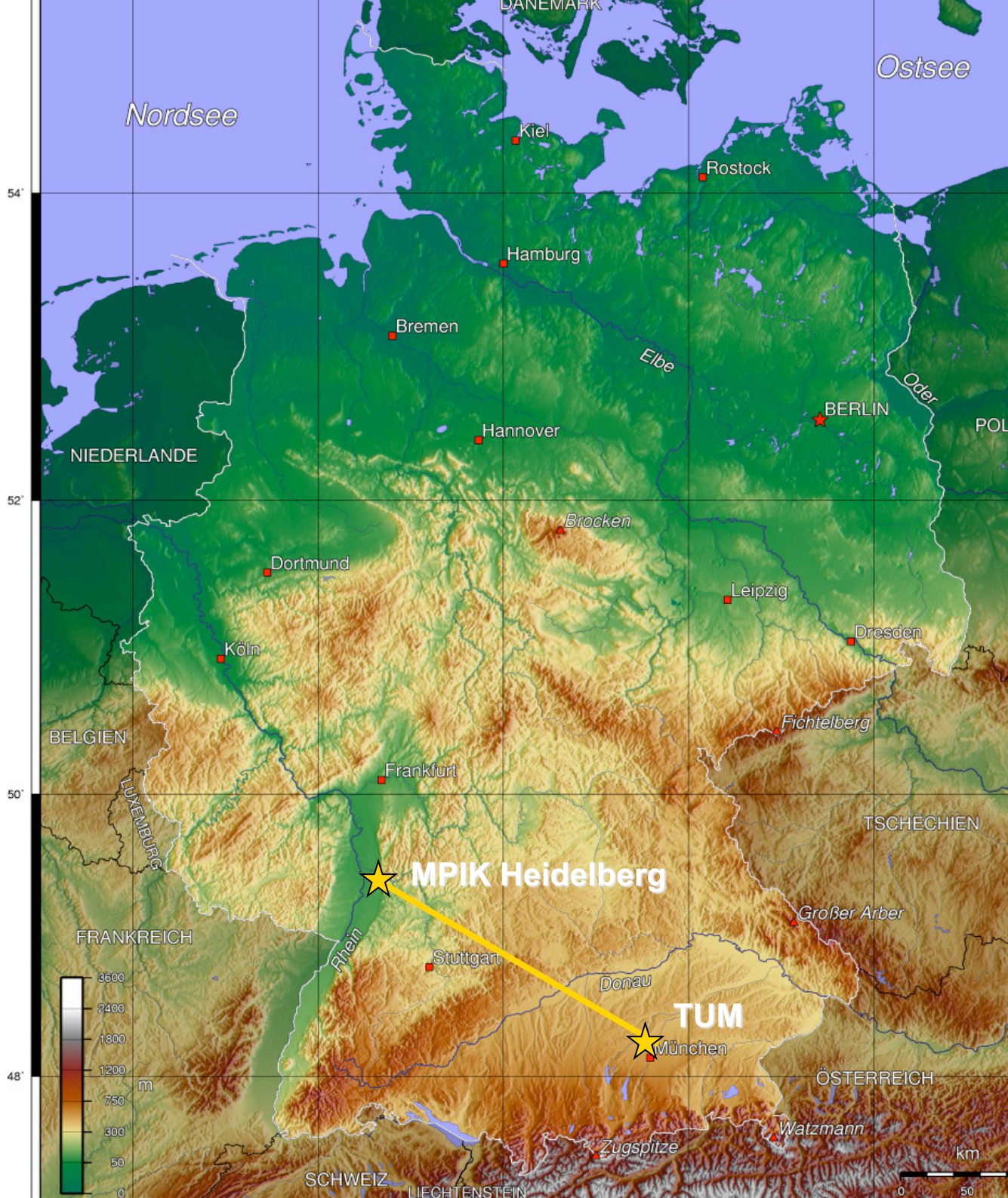


# Antares



- University Erlangen





# Borexino



- **TU Munich**
- **MPIK Heidelberg**



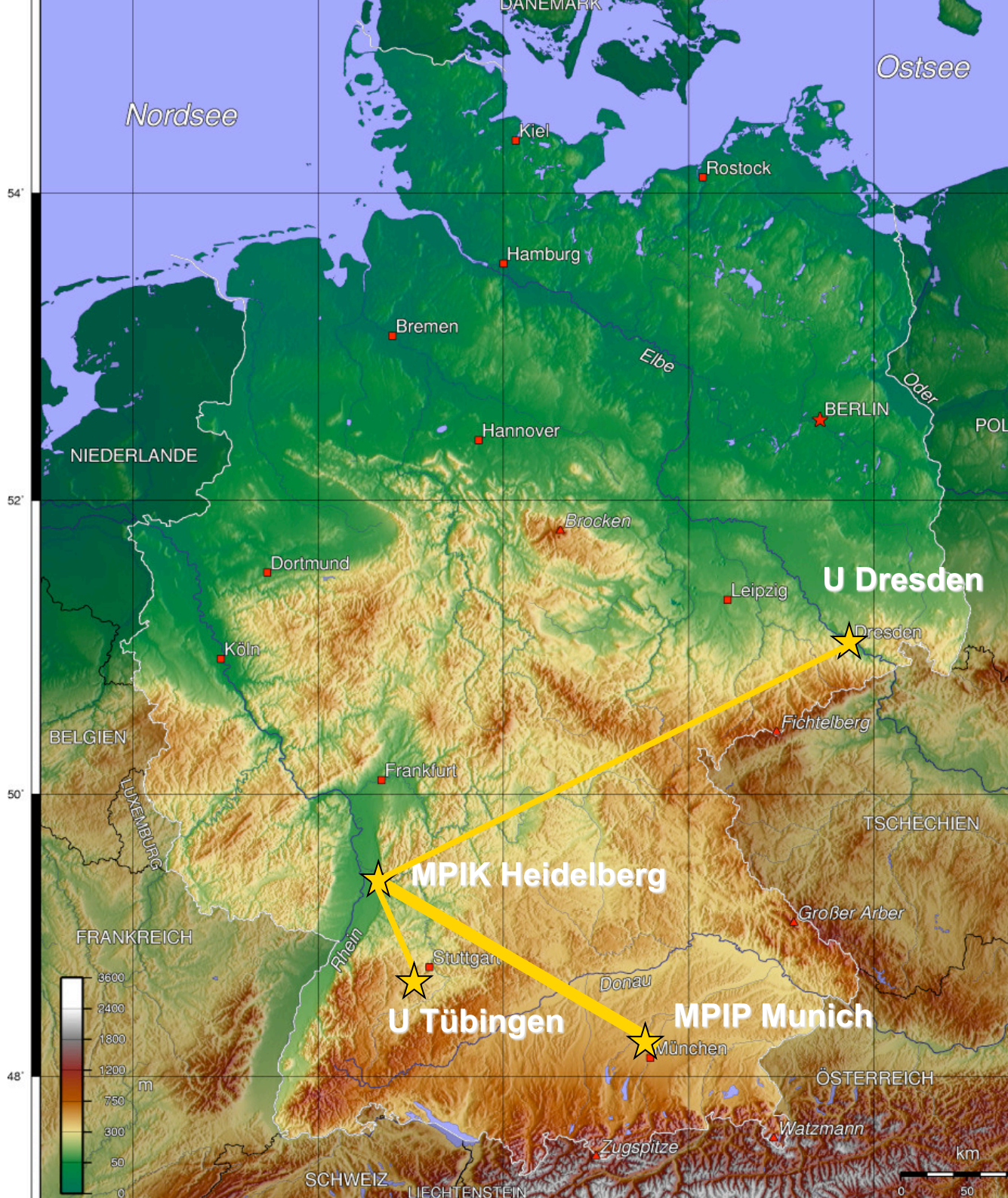


# Double Chooz



- MPIK Heidelberg
- TU Munich
- RWTH Aachen
- U Tübingen
- U Hamburg



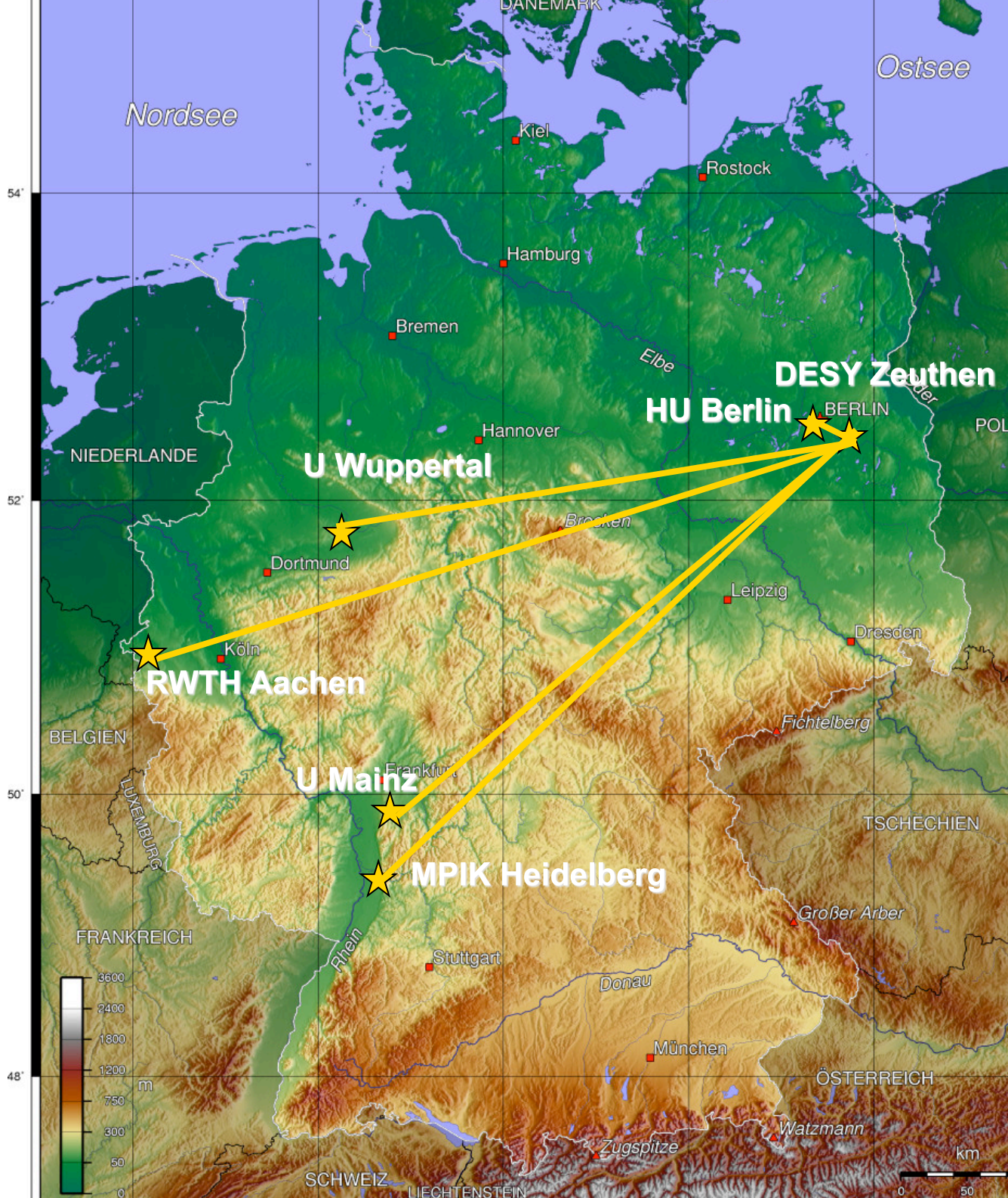


# Gerda



- MPIK Heidelberg
- MPIP Munich
- U Tübingen
- U Dresden





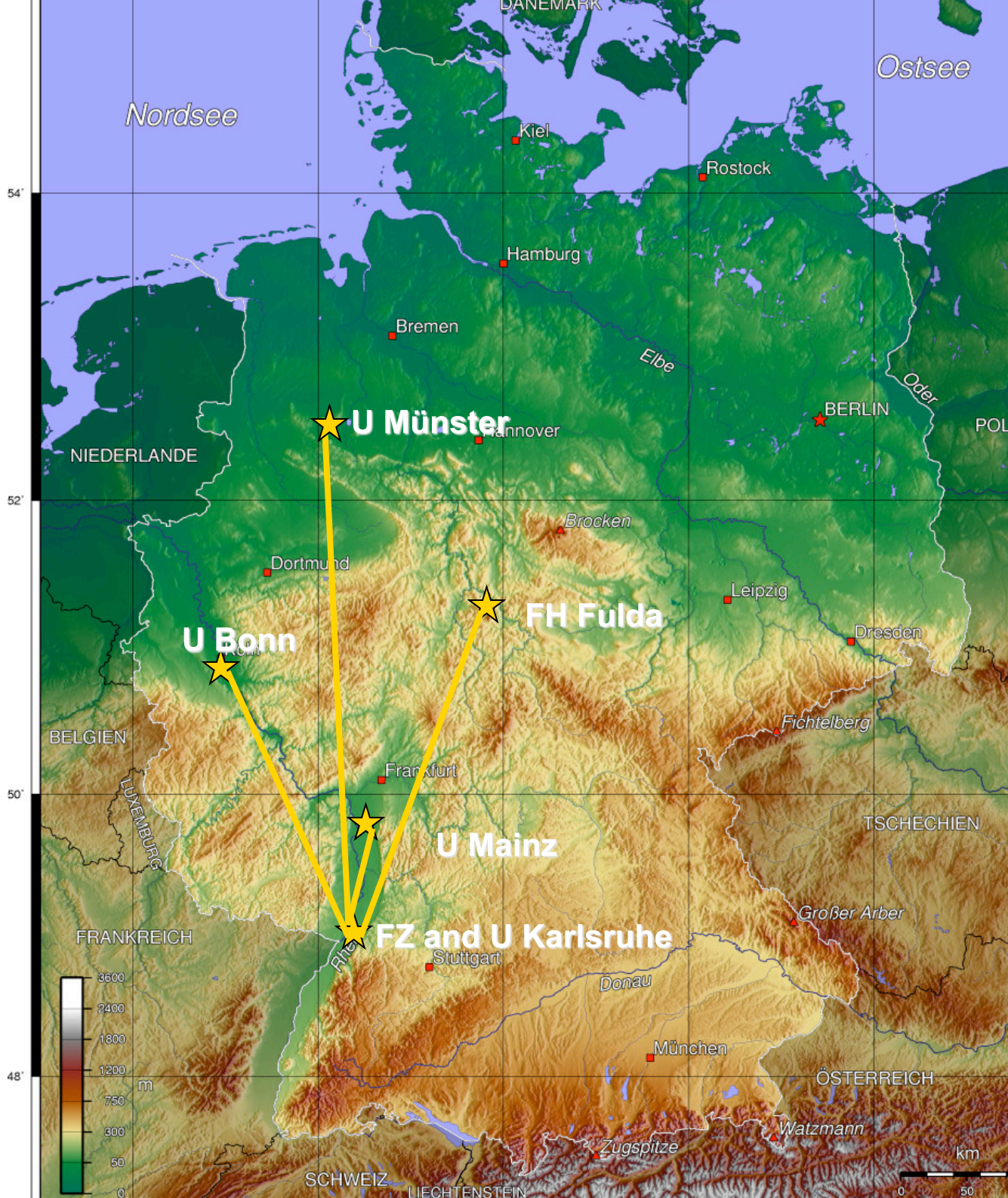
# IceCube



IceCube

- **DESY-Zeithen**
- **RWTH Aachen**
- **U Wuppertal**
- **HU Berlin**
- **U Mainz**
- **MPIK Heidelberg**





# KATRIN



- FZ + U Karlsruhe
- U Münster
- U Bonn
- U Mainz
- FH Fulda



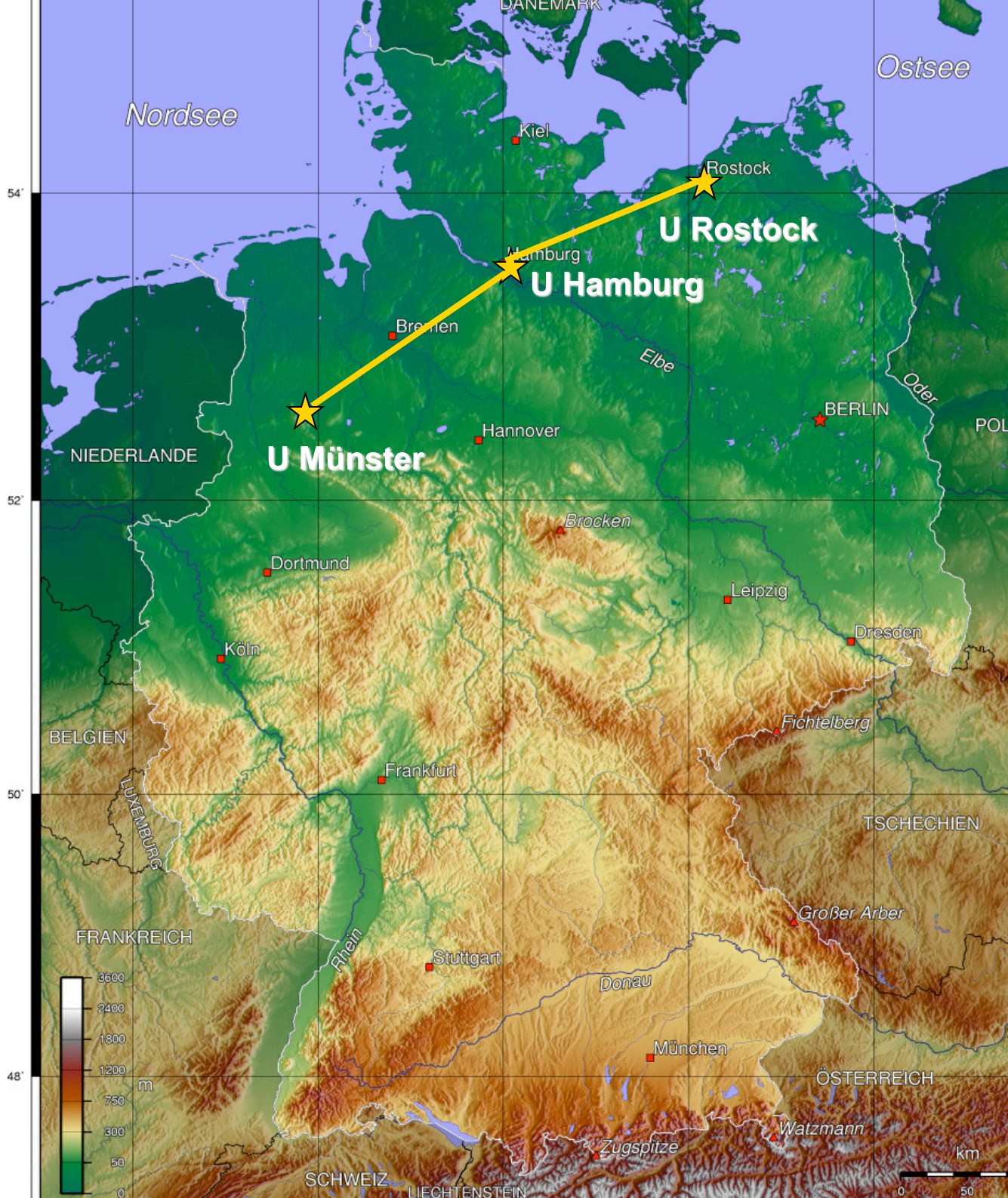


NOVA



- MPIK Heidelberg ?



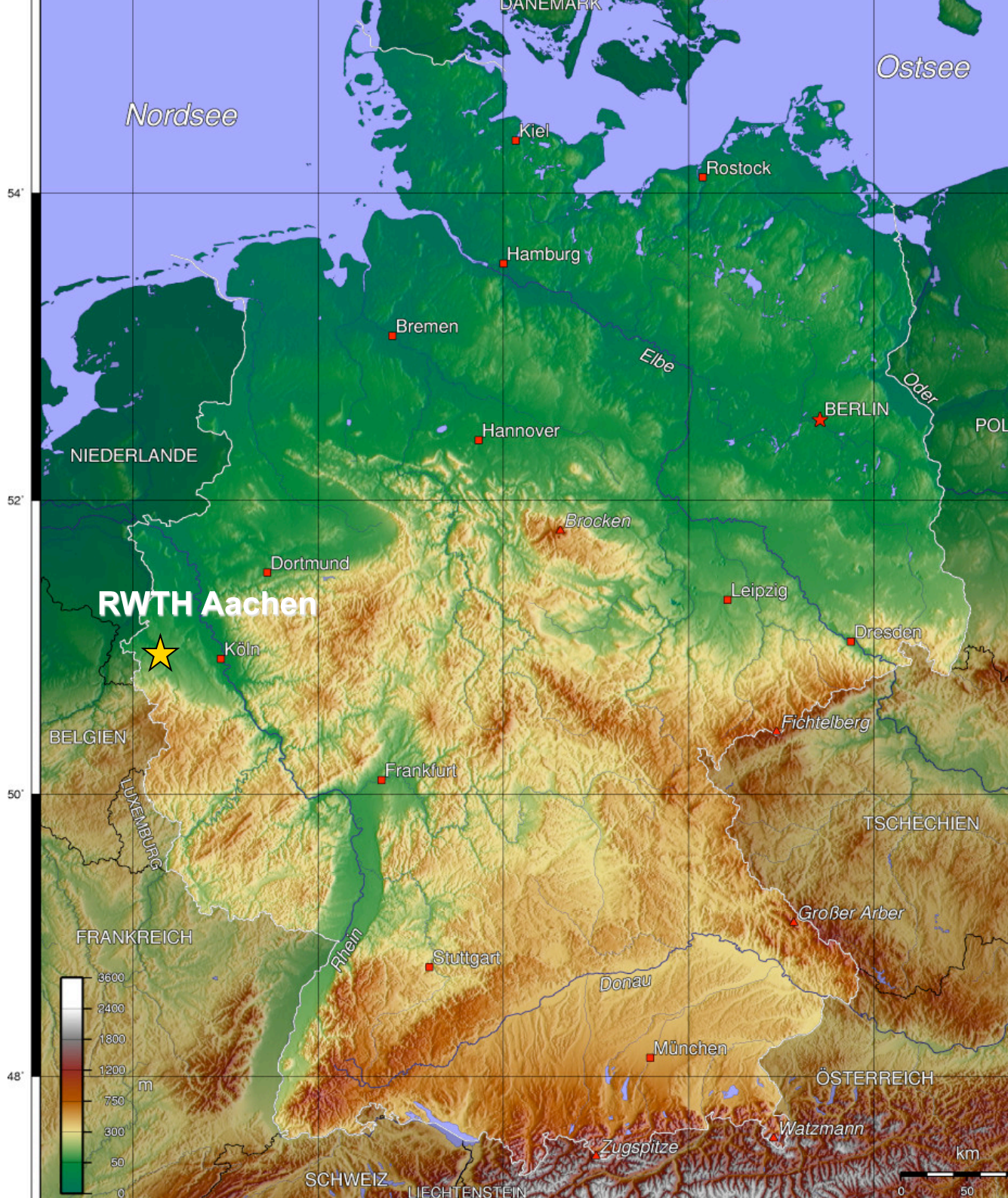


# OPERA

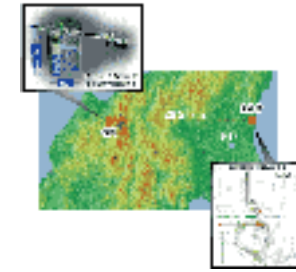


- U Hamburg
- U Münster
- U Rostock





T2K



- RWTH Aachen





# Theory



- 3x Munich
- 2x Heidelberg
- Hamburg
- Dortmund
- ...

# Neutrino Projects: Future

**German system: Self-organization + some moderation**

- **Institutions strengthen their expertise by**
  - **on-going projects**
  - **R&D efforts for future projects**
  - **develop technologies  $\leftrightarrow$  on-going projects**
- **Various communication channels between institutions**
  - **KET, KAT, KHuK**
  - **national meetings**
  - **personal contacts**
  - **...**
- **Some guidelines from BMBF and DFG**
  - Institutions develop ideas/plans for future projects**
  - R&D towards these plans**

# Future Directions

## Participation in R&D efforts

- low background physics  $\leftrightarrow$  low E neutrino physics
  - LAGUNA  $\leftrightarrow$  best technology, R&D  $\rightarrow$  large underground detector
  - ton scale double beta decay
  - next generation neutrino telescope
- high energy neutrino physics  $\leftrightarrow$  ...LHC
- scaling of existing technologies / projects
- theory:
  - theory  $\leftrightarrow$  which questions are interesting, can be answered?
  - phenomenological motivation for next generation projects
  - optimization of future LBL projects
    - $\rightarrow$  GLoBES (NuFact,  $\beta$ -beams, superbeams)
  - next generation dark matter, p decay, ...

$\leftrightarrow$  interplay with other topics: LHC  $\rightarrow$  ?, b-physics dark matter, dark energy, ...