

Empfang der Stereo-Raumsonden in Bochum

Hartmut Päsler
AMSAT-DL

Warum Sonnenbeobachtung?

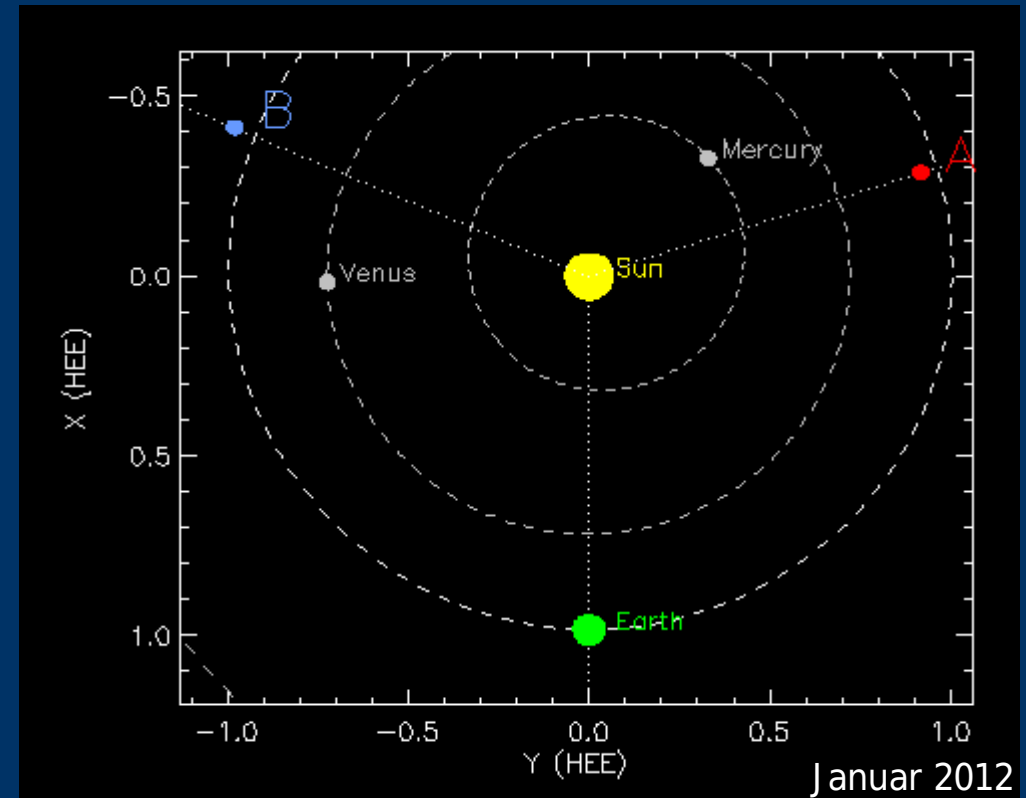
Auswirkungen von solaren Stürmen auf die Erde:

- Polarlichter
- Störungen in Energieversorgungsnetzen, Pipelines (induzierte Ströme)
- Einfluß auf Kommunikationssysteme: Funkausbreitung, Satelliten (ca. 150 Ausfälle/Jahr allein bei US-Satelliten)
- Gefahr für bemannte Raumfahrt

→ Großer volkswirtschaftlicher Schaden möglich

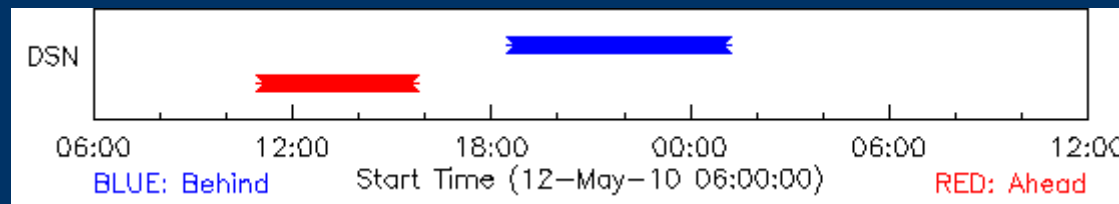
STEREO A/B

- Solar Terrestrial Relations Observatory
- 2 Sonnenobservatorien
 - der Erde vorausgehend: Stereo-A (**A**head)
 - der Erde nachfolgend: Stereo-B (**B**ehind)
 - auf L4 bzw. L5
- Verschiedene Blickwinkel auf die Sonne
- Ereignisse detektierbar, bevor sie von der Erde aus sichtbar werden
- Strukturen und zeitliche Entwicklung von aktiven Regionen auf der Sonne gut sichtbar



Motivation AMSAT-DL, IUZ

- Anfrage des JPL/der NASA
 - Kapazität ca. 8 Stunden pro Tag
 - Nur eingeschränkt Echtzeitdaten



- Vorbereitung für AMSAT P5-Mond- bzw. P5-Marsmission
 - Erfahrung Dauerbetrieb 24/7 Bodenstation (Mechanik + Elektronik)
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Motivation: Nutzung der Daten

- Offline/Highspeed-Daten: Etwa 24 Stunden Verzögerung bis Download und Auswertung
 - Echtzeitdaten: Verzögerung in der Größenordnung Minuten
 - Warnungen an
 - Stromnetzbetreiber (gesichert: US-Betreiber)
 - Satellitenbetreiber
 - ISS (insbesondere bei EVAs)
 - Verwendung für wissenschaftliche Projekte, u.a. bei deutschen bzw. europäischen Universitäten
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Beispiel: Nutzung der Echtzeitdaten



Projekt AFFECTS

Advanced Forecast For
Ensuring Communications
Through Space

AFFECTS

AFFECTS – Beneficiary List and Collaborators

Beneficiaries	Organisation name	Country
1 (Lead)	University of Göttingen (UGOE)	Germany
2	Royal Observatory of Belgium (ROB)	Belgium
3	Space Research Institute of National Academy of Sciences Ukraine and National Space Agency of Ukraine (SRI NASU-NSAU)	Ukraine
4	Fraunhofer Institute for Physical Measurement Techniques IPM (FHG)	Germany
5	Tromsø Geophysical Observatory, University of Tromsø (UoT)	Norway
6	German Aerospace Center, Neustrelitz (DLR)	Germany
7	Astrium Satellites GmbH Friedrichshafen (Astrium ST)	Germany
<i>External Collaborator</i>	<i>NOAA Space Weather Prediction Center (NOAA-SWPC)</i>	<i>USA</i>
<i>Space Weather Education and Public Outreach Center</i>	<i>Planetarium Hamburg (PH)</i>	<i>Germany</i>

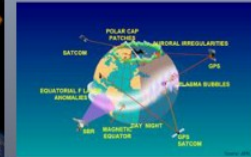
Each partner will bring in world leading expertise to address the specific tasks of six dedicated working packages

AFFECTS

AFFECTS – Project Goals

- State of the art analysis and modeling of the Sun-Earth chain of effects on the Earth's ionosphere and their subsequent impacts on communication systems
- Quantitative and timely (advanced) forecast - based on multi-point space observations complemented by ground-based measurements of auroral electrojet and ionospheric activity - of the relevant space weather effects on the ionosphere
- Provision of Europe's first advanced early warning and space weather forecast system to help European citizens mitigating the impact on its telecommunication and -navigation systems
- Timeline: 1st March 2011 until 28th February 2014

AFFECTS



AFFECTS

Advanced Forecast For Ensuring Communications Through Space

Project Overview

v.290711





UNITED STATES DEPARTMENT OF COMMERCE
 National Oceanic and Atmospheric Administration
 National Weather Service
 National Centers for Environmental Prediction
 Space Weather Prediction Center
 325 Broadway W/NP9
 Boulder, CO 80305
 Telephone: (303) 497-3311 Fax: (303) 497-4006
 Mobile: (720) 384-7659 Tom.Bogdan@noaa.gov

JUN 16 2011

Dr. Thomas J. Bogdan
 Director

Amsat-DL e.V.
 Ernst-Giller-Strasse 20
 D-35039 Marburg
 Germany

Dear Herr Guelzow:

The National Oceanic and Atmospheric Administration's Space Weather Prediction Center is delighted to commend and thank the Bochum AMSAT team for their ongoing essential contribution to the provision of near real time data from the NASA Solar Terrestrial Relations Observatory (STEREO) spacecrafts. The work of the volunteer team at Bochum in adapting the 20m antenna, and designing and building new control and receiving equipment for both AMSAT and NASA missions has been both outstanding and truly professional. The AMSAT team has provided support commensurate with that provided by some government laboratories that have also participated in providing near real time STEREO data; such as the Communication Research Laboratory in Japan, the Centre National d'Études Spatiales in France, and the Rutherford Appleton Laboratory in the United Kingdom, for example.

The near real time data we get from the STEREO spacecrafts are invaluable to the international effort providing Space Weather monitoring and prediction services. Together with nearer Earth satellites, STEREO now provides us with an unprecedented ability to monitor the development of solar active regions and solar activity over the whole of the sun's surface and provides a unique perspective of activity that will impact the Earth. In particular the data from the coronagraph instruments are vital to the real time detection and characterization of Coronal Mass Ejection events. When reaching the Earth these can have major economic impacts on many terrestrial systems including the supply of electric power and GPS based services.

Sincerely,

Thomas J. Bogdan



National Aeronautics and
 Space Administration

Goddard Space Flight Center
 Greenbelt, MD 20771



Reply to Attn of: 671

2011 June 9

Mr. Peter Gülzow
 Amsat-DL e.V.
 Ernst-Giller-Strasse 20
 35039 MARBURG
 Germany

Dear Mr. Gülzow:

It is my great pleasure to thank the Bochum AMSAT team for the crucial support they provide NASA's Solar Terrestrial Relations Observatory (STEREO) mission through your extensive and reliable coverage of "space weather beacon mode" downlink from both STEREO spacecraft. In doing so, the Bochum team has shown themselves fully the equal of the government-supported beacon mode we receive from CNES (France), CRL (Japan), and, formerly, RAL (UK). Truly, this is a remarkable accomplishment for a group of volunteers, but your experience and professionalism are obvious.

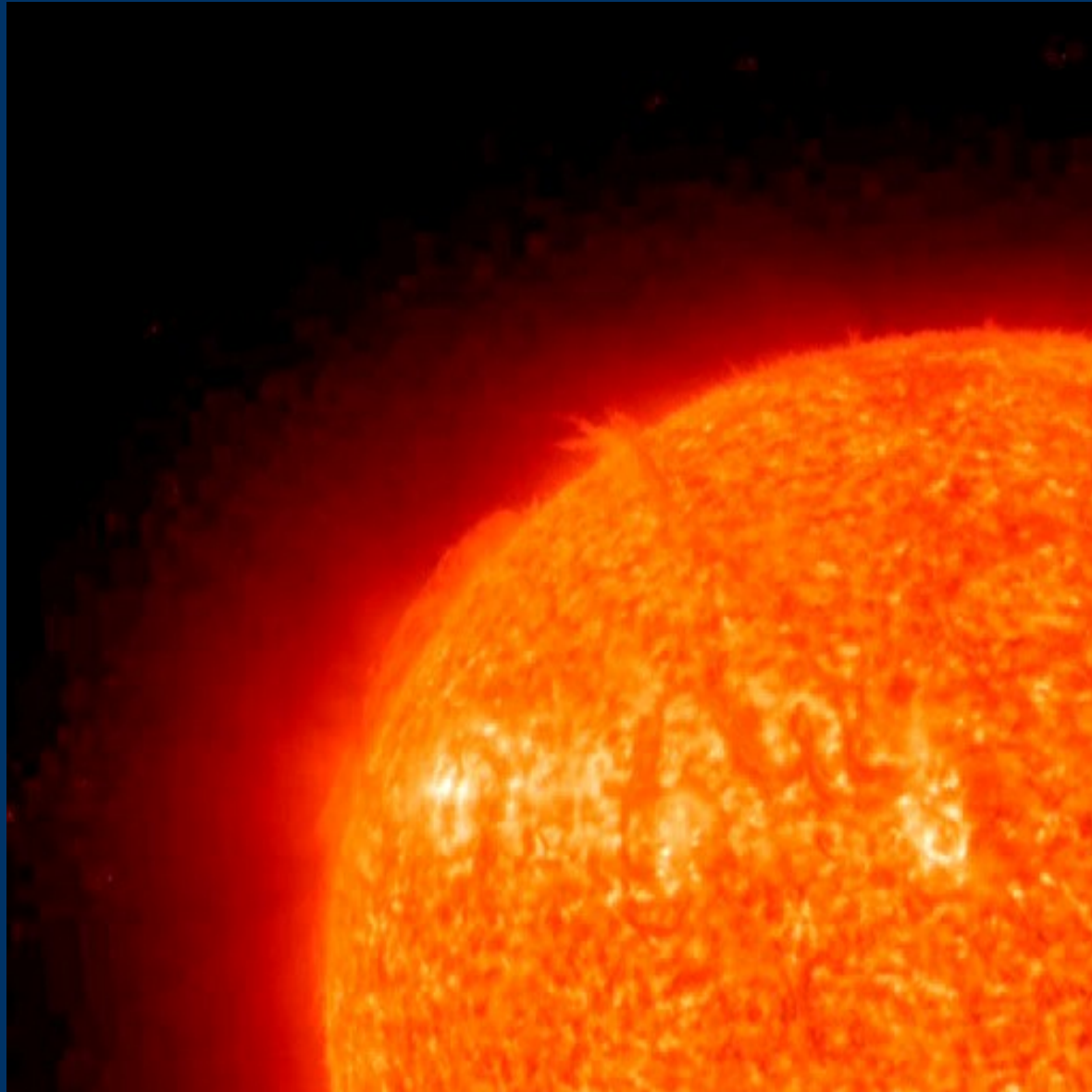
The near-realtime, beacon mode data received from the STEREO spacecraft are used by both the US National Oceanic and Atmospheric Administration's Space Weather Prediction Center and the Community Coordinated Modeling center here at NASA Goddard to issue warning of space weather events that may be of concern here on earth, and with the increasing separation of the STEREO spacecraft, throughout the solar system. These warnings are studied carefully by power system, hospital, airline, and spacecraft operators, and provide our best way of determining when such complex systems may be subject to space weather effects.

On behalf of the NASA STEREO team and all the end users of the predictive services based on your STEREO beacon mode telemetry capture, I would like to offer you our profound thanks and a heartfelt "Gut gemacht!"

Sincerely,

(Dr.) Joseph B. Gurman
 STEREO Project Scientist

Solar Flare



Datenformate: High Speed



- max. 720 kBit/s
- Nur ca. 8 h pro Tag
- viele Missionen zu betreuen

DSN-Empfangsstationen

- Goldstone, Kalifornien/USA
 - Madrid, Spanien
 - Canberra, Australien
-
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Datenformate: *Low Speed - Real Time*

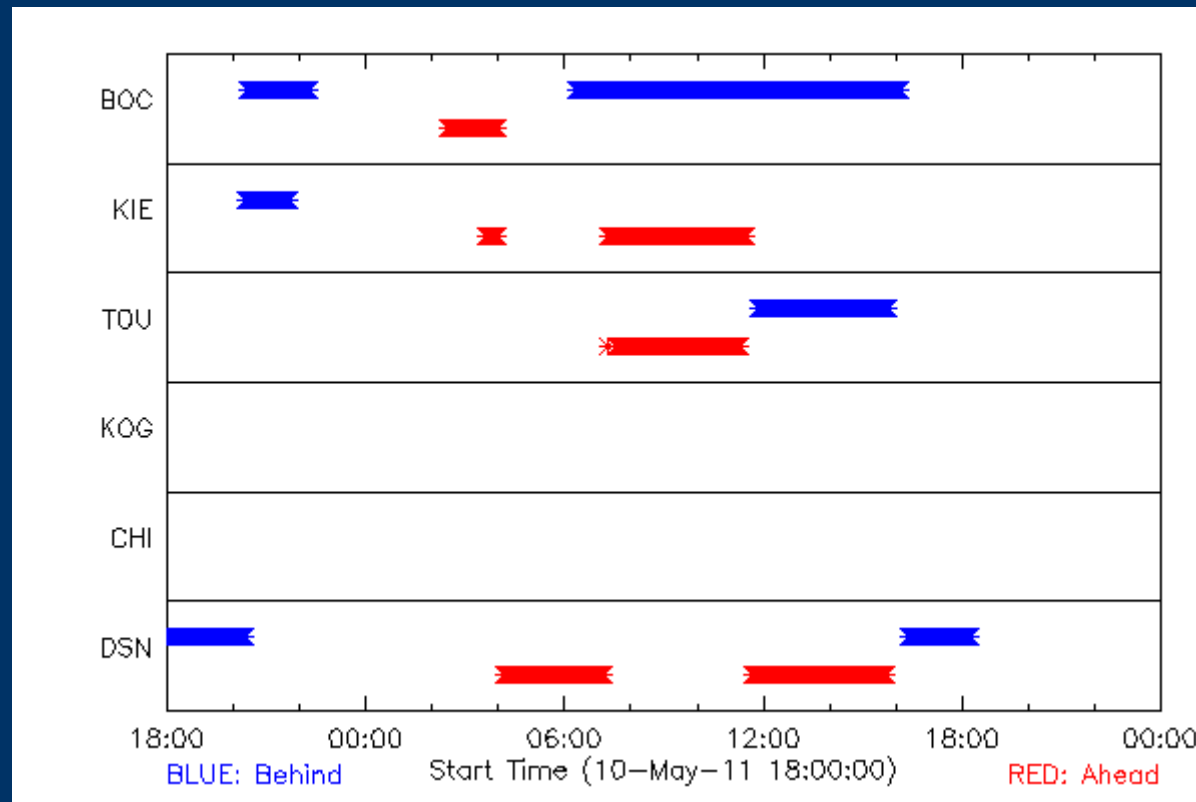


- 633 Bit/s
- während der Sichtbarkeit von STEREO A/B
- nahezu exklusiv für STEREO

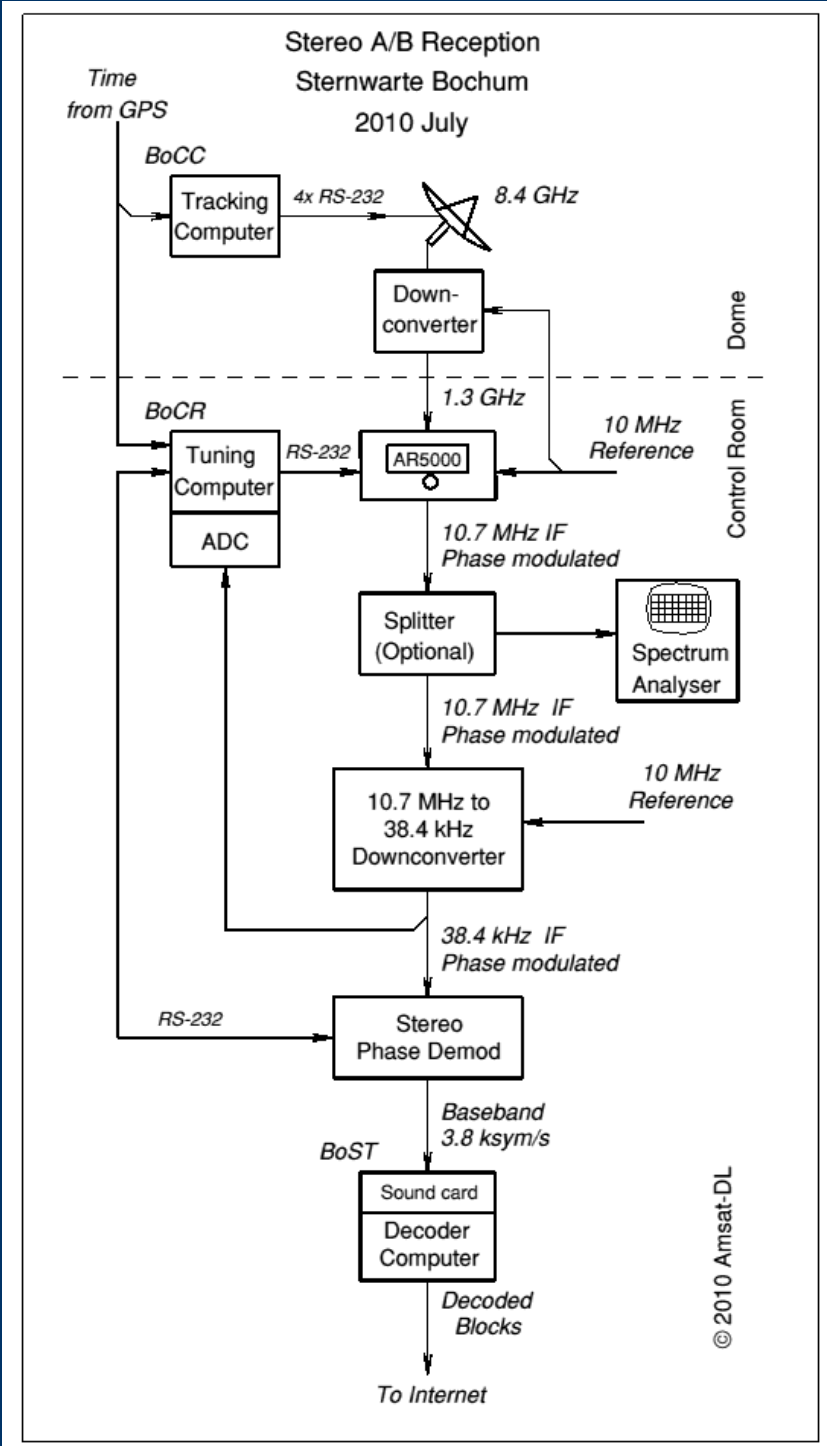
STEREO-Empfangsstationen

- **CHI:** Rutherford Appleton Laboratory:
Chilbolton, UK (inaktiv)
 - **KOG:** National Institute of Information and
Communications Technology: Koganei, Japan
 - **TOU:** Centre National d'Etudes Spatiales:
Toulouse, France
 - **KIE:** Amateur station DL0SHF, Kiel-Ronne,
Germany
 - **BOC:** AMSAT-DL/Bochum Observatory,
Germany
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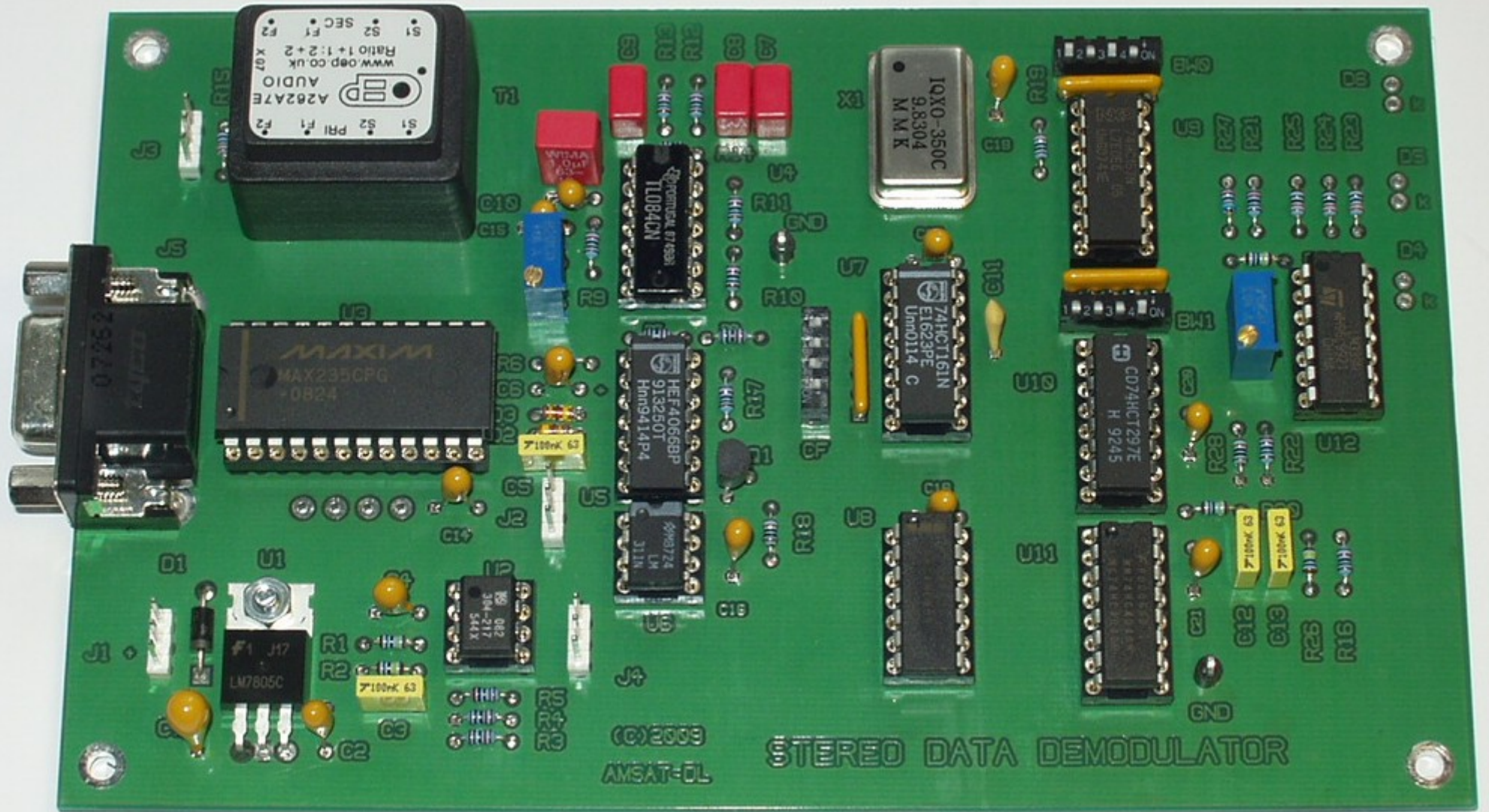
STEREO-Netzwerk



Bochum: Übersicht Empfangsanlage



Demodulator



Demodulator



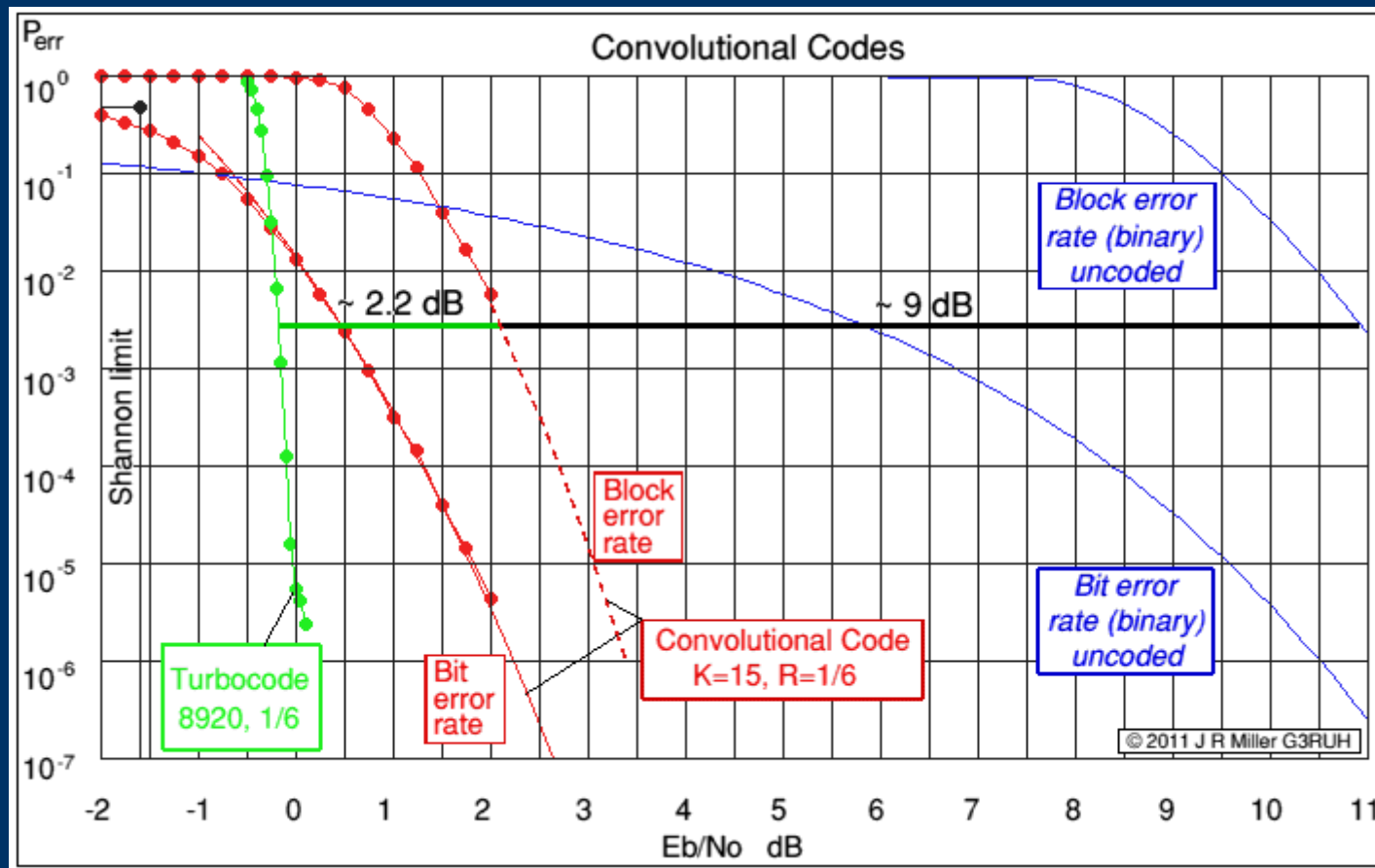
Fehler bei der Datenübertragung

- Fehler treten in Gruppen auf, nicht in zufälligen einzelnen Bits
- Ein einziger Fehler macht den gesamten Datenblock ungültig
- Metrik daher: Block-Fehlerrate
- Differenz zwischen „unbrauchbar“ und „fehlerfrei“ beträgt nur 2 dB.
- Mit Turbo-Code: noch extremer, nur ca. 0,5 dB.

Beispiel:

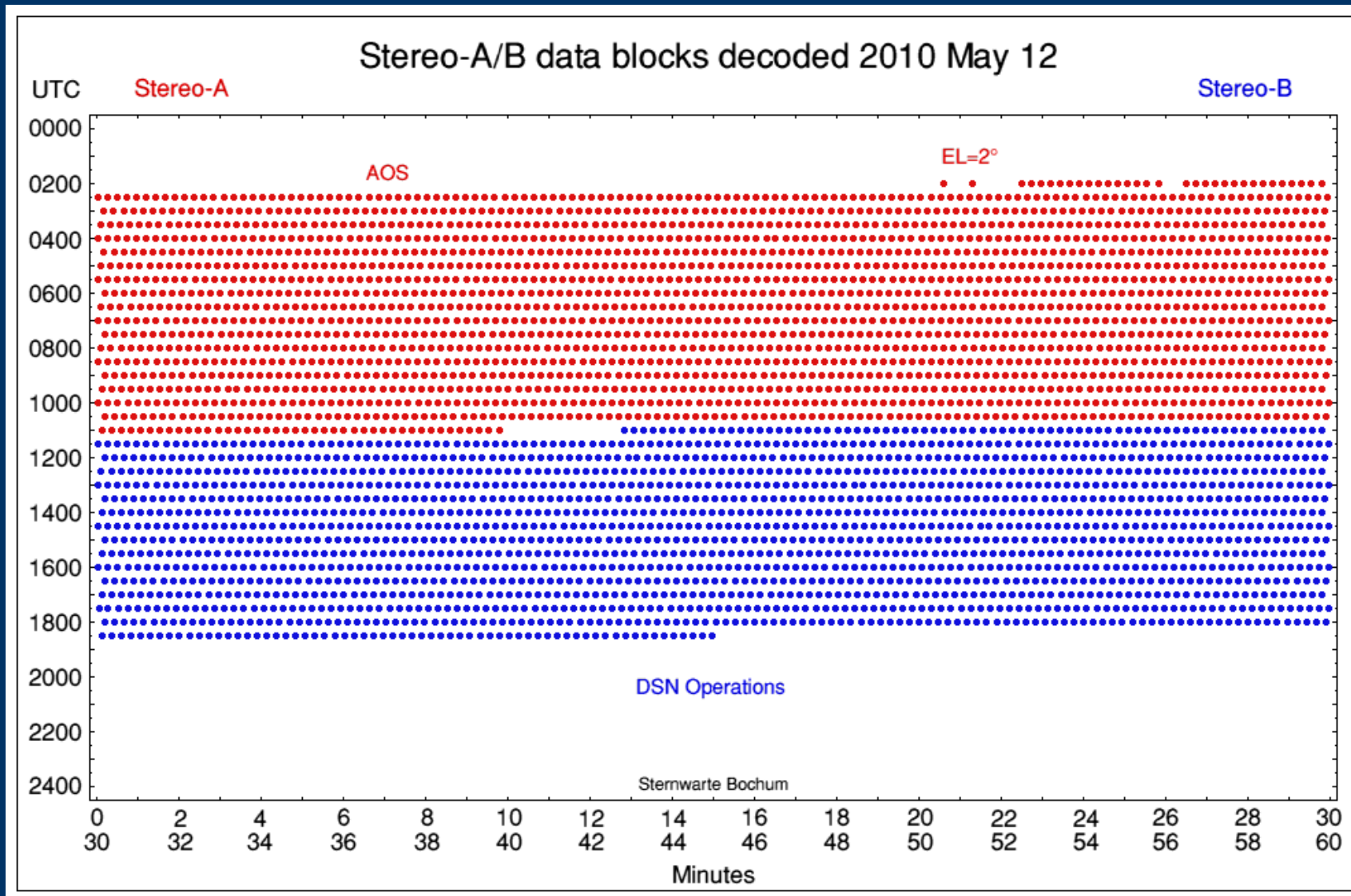
Eb/No/dB	Blockfehler/%	Symbolfehler/%	Kommentar
0,00	100	28,2	unbrauchbar
0,75	50	26,5	
2,1	ca. 0	23,1	fehlerfrei

Decodierung

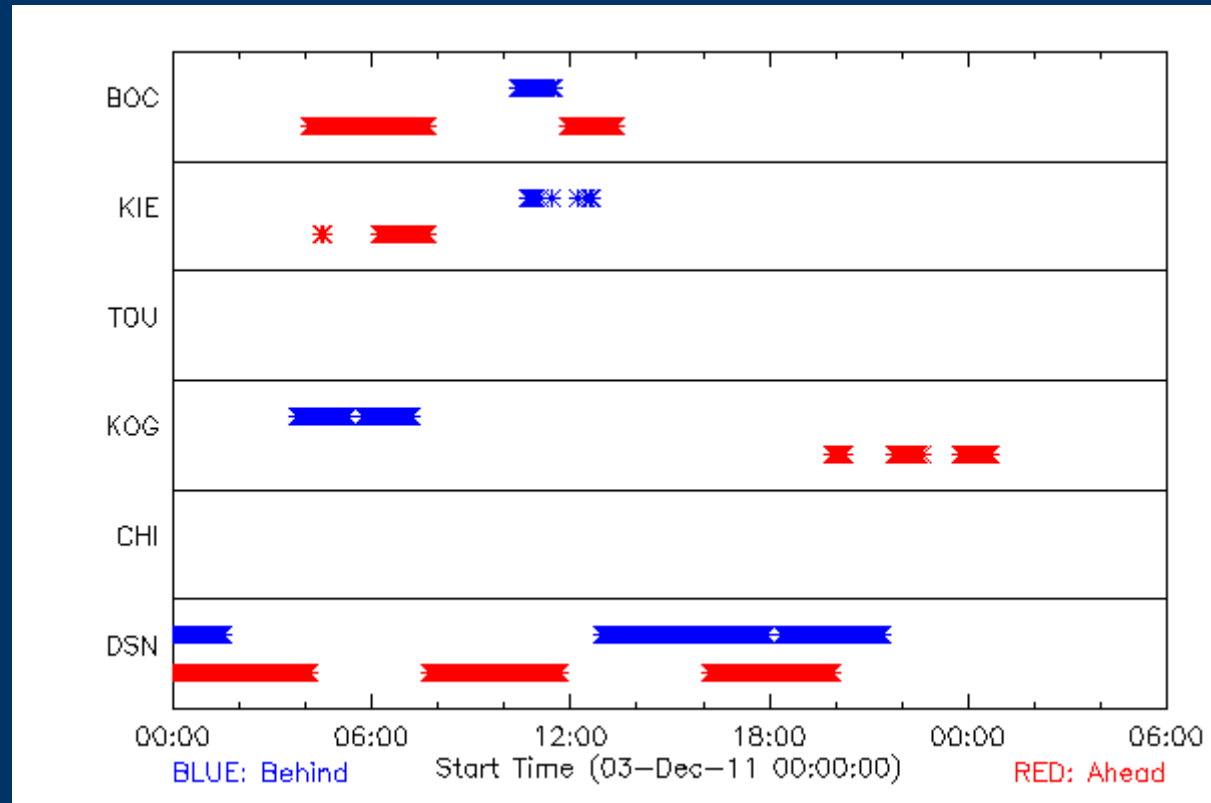


Simulation: Codierung/Turbo Code gegenüber uncodierten Daten

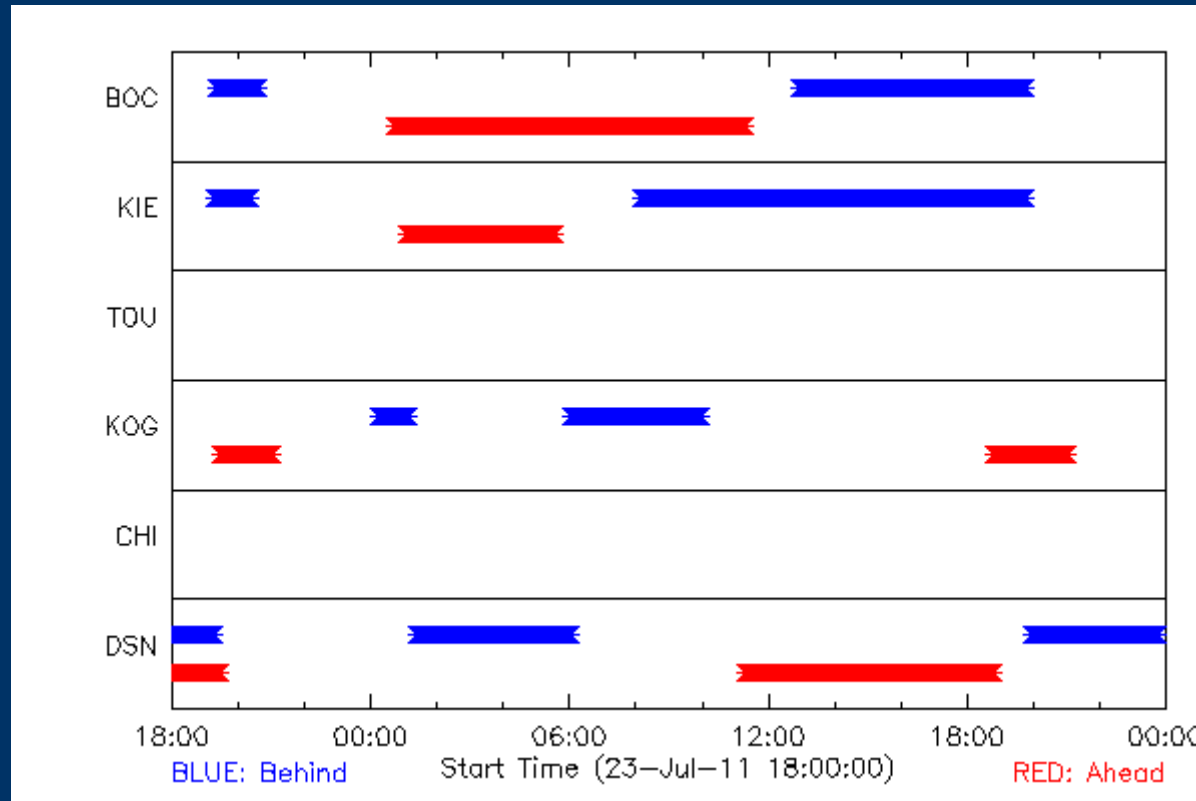
Auswertung Empfangsqualität



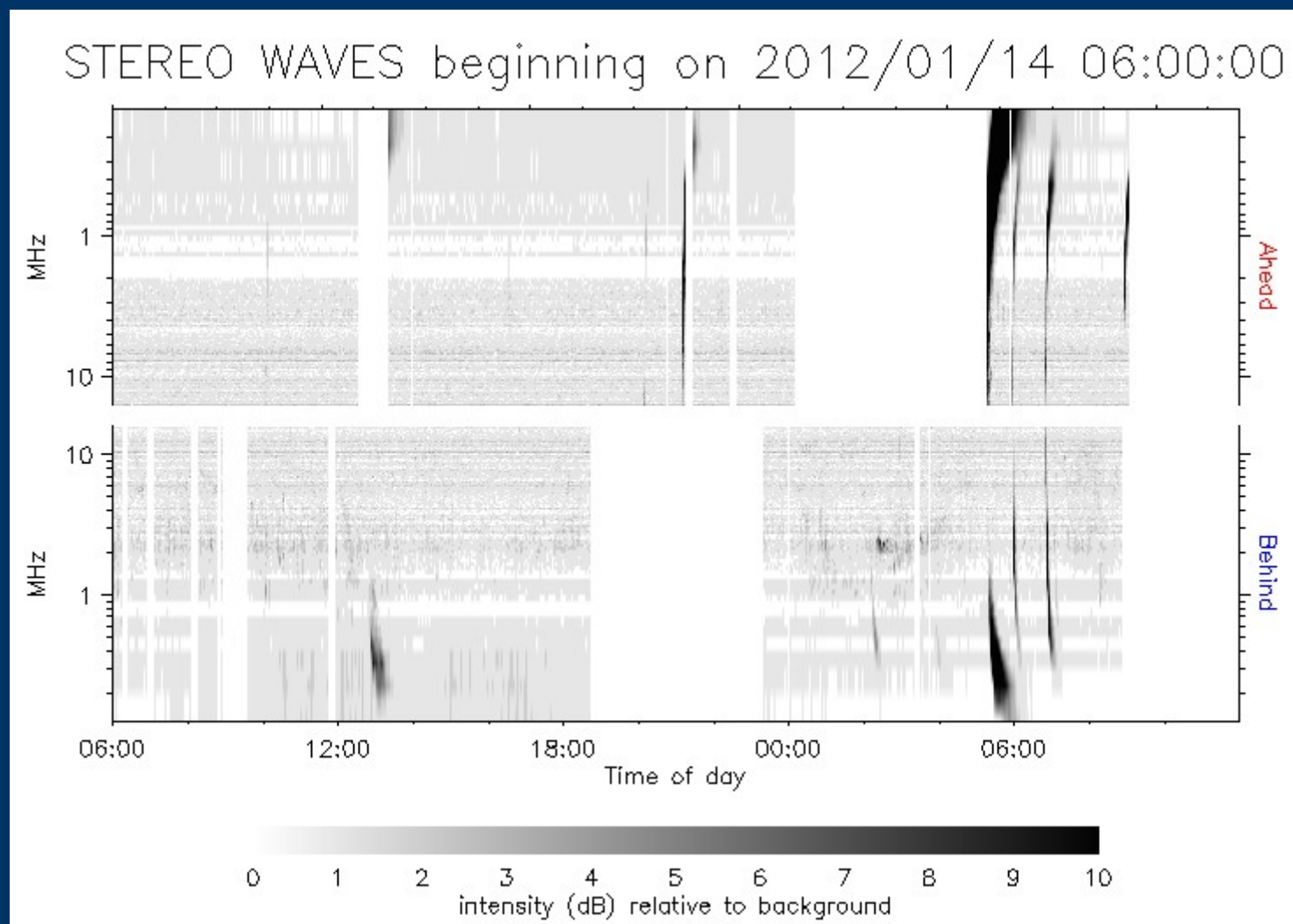
Situation Ende 2011



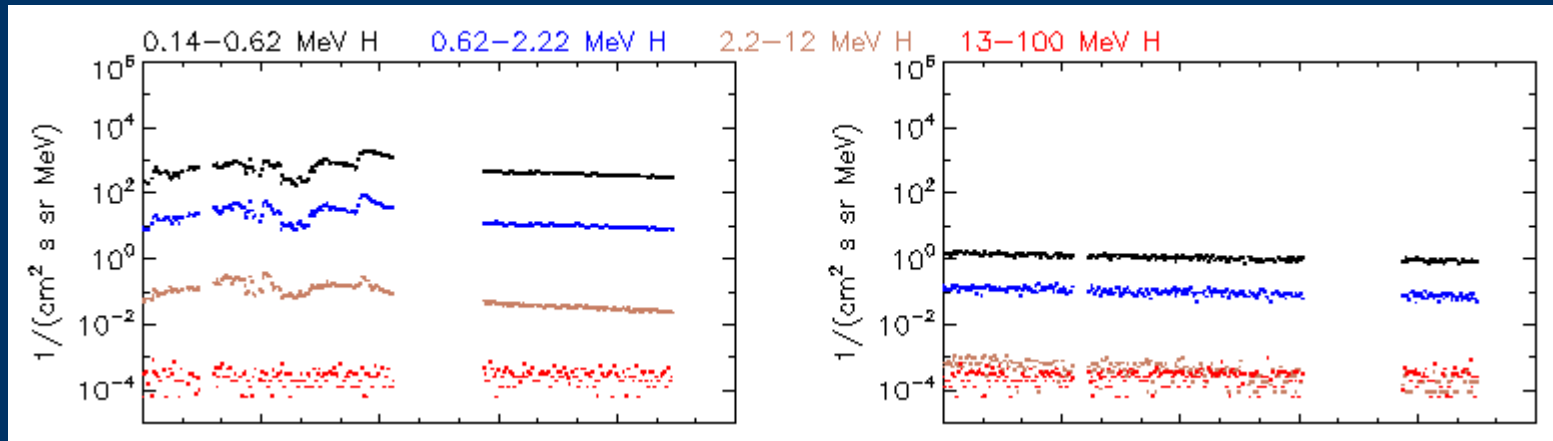
Vergleich: Situation Mitte 2011



Situation Januar 2012

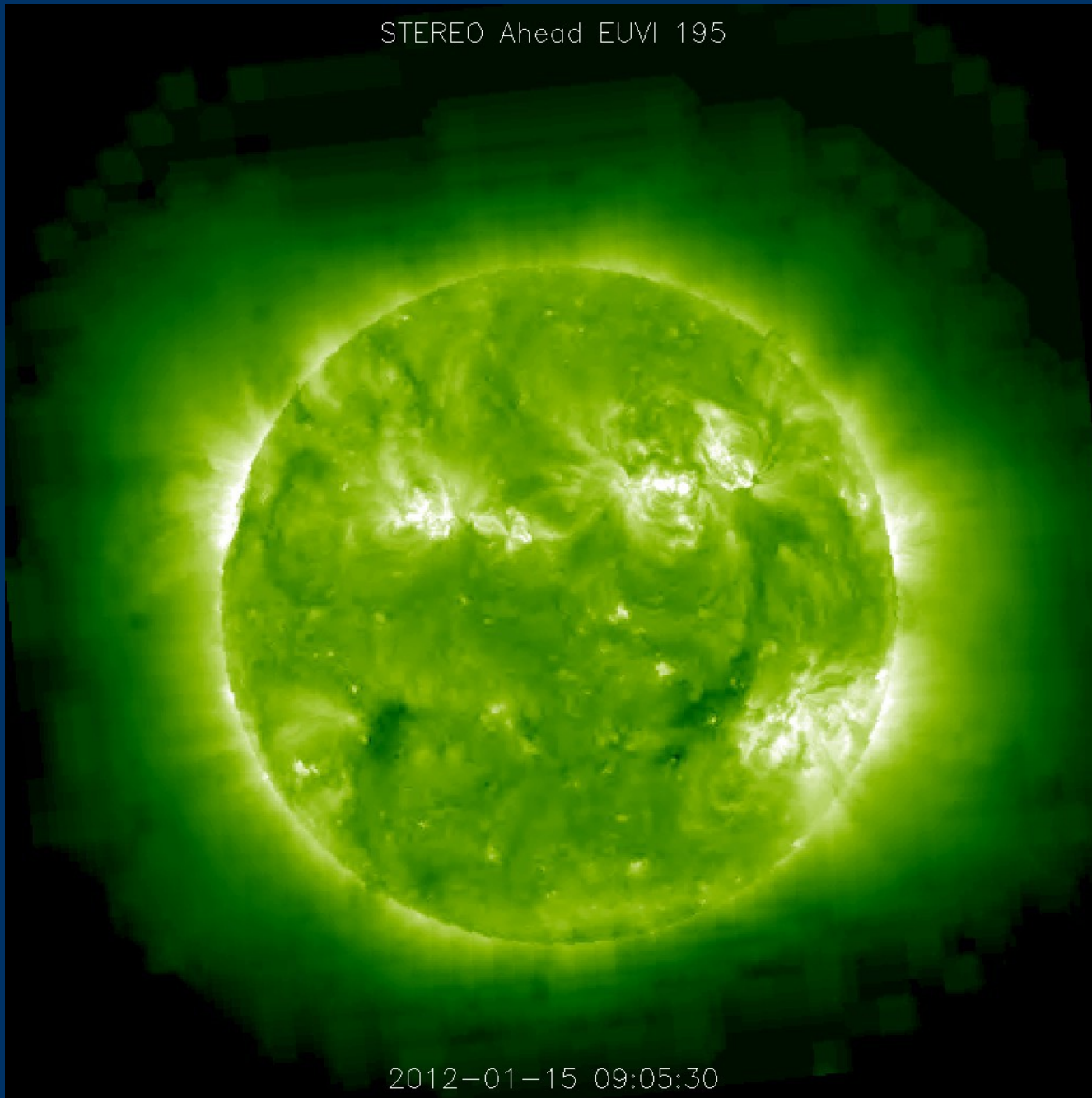


Situation Januar 2012



Dringender Handlungsbedarf bei Echtzeitdaten!

STEREO Ahead EUVI 195



2012-01-15 09:05:30

Erzeugt aus Daten, die während des Erstellens dieses Vortrages in Bochum empfangen wurden.
