

UNIVERSITY OF TWENTE.

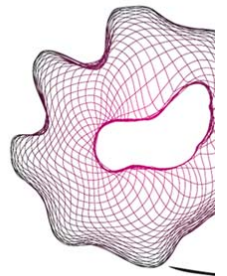
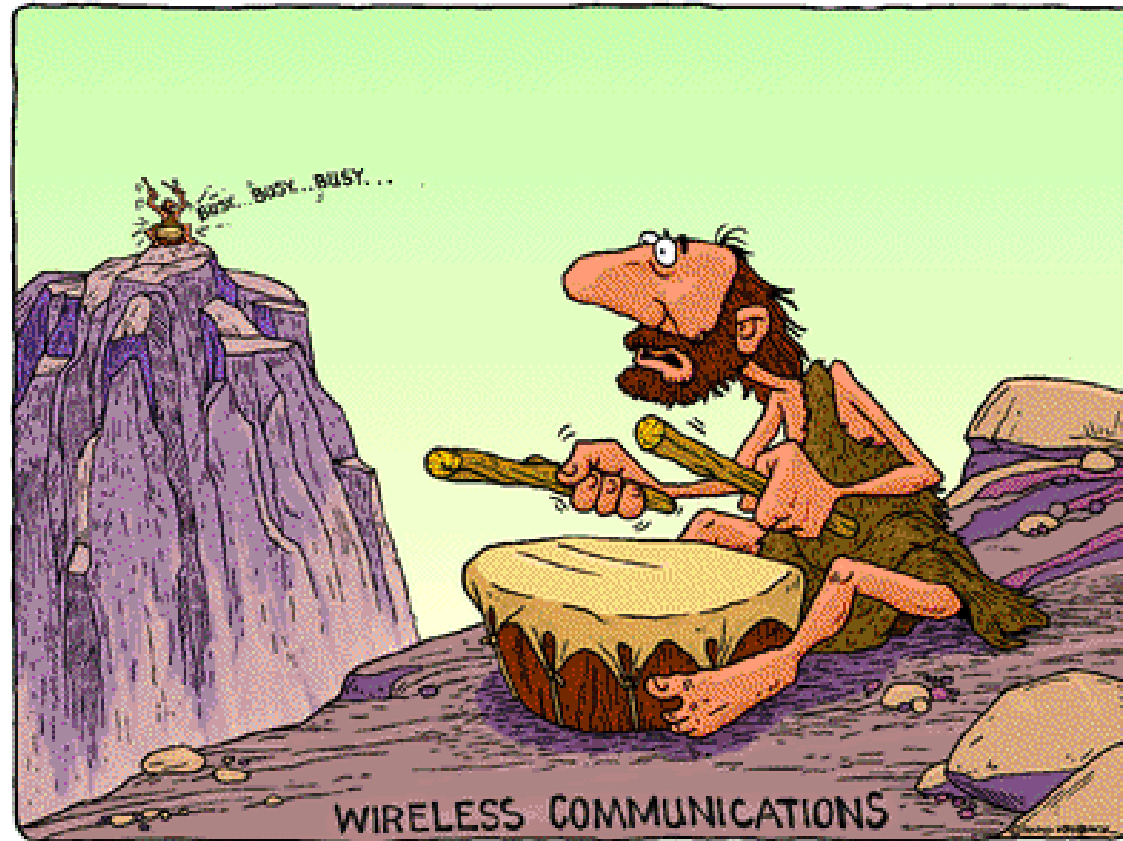
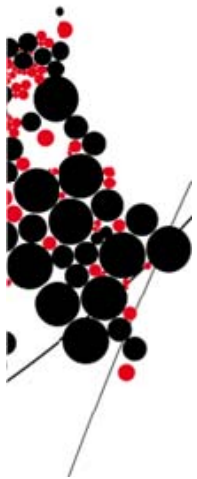
# High Frequency Wireless Introduction

Mark Bentum

URSI-NERG winter meeting  
January 18, 2010, Utrecht



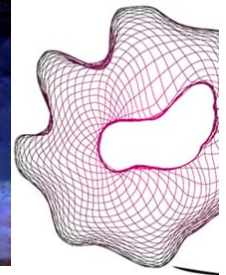
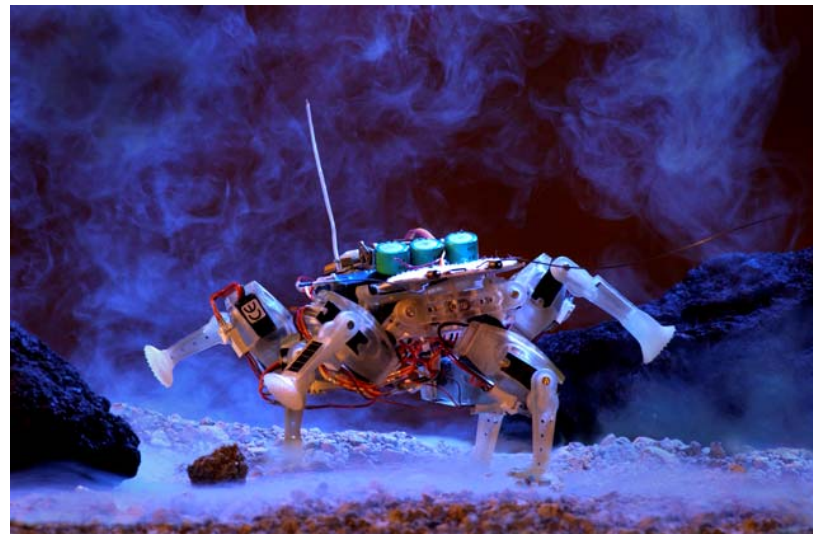
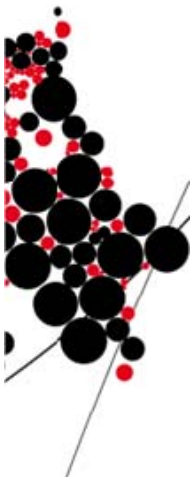
# The past



# Today's products

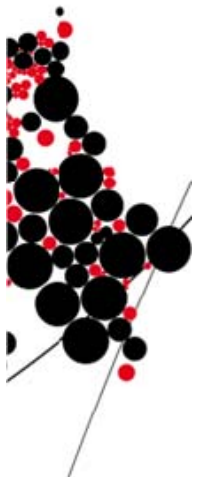


# Imagine the future

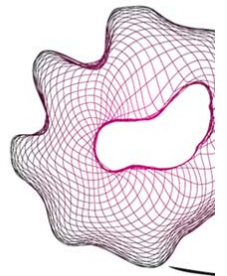


# Prediction in telecommunication

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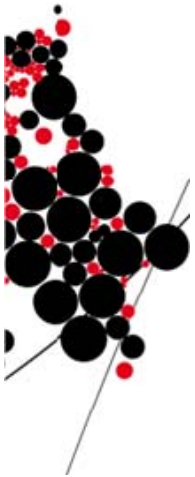
- "I think there is a world market for maybe five computers."  
--Thomas Watson, chairman of IBM, 1943
- "Computers in the future may weight no more than 1.5 tons."  
--Popular Mechanics, forecasting the relentless march of science, 1949
- "There is no reason anyone would want a computer in their home."  
--Ken Olson, president, chairman and founder of Digital Equipment Corp., 1977
- "640K ought to be enough for anybody."  
-- Bill Gates, 1981



# We can do it better ... (of course) ...

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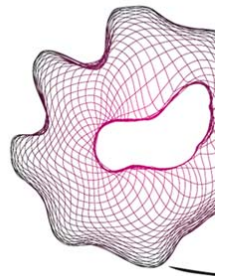
- Wireless World Research Forum  
[www.wireless-world-research.org](http://www.wireless-world-research.org)



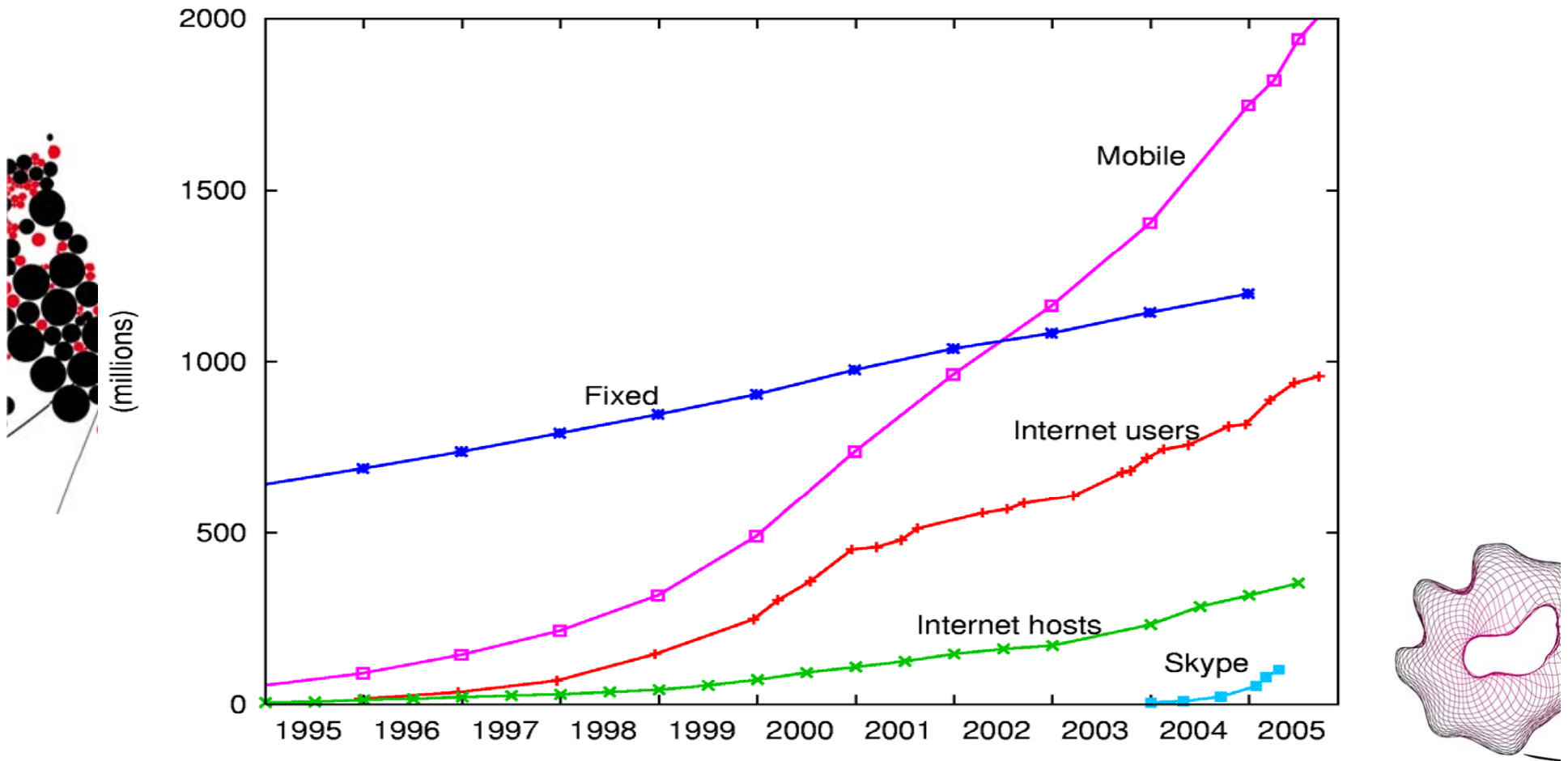
In 2017:

7 trillion wireless devices are serving  
7 billion people.

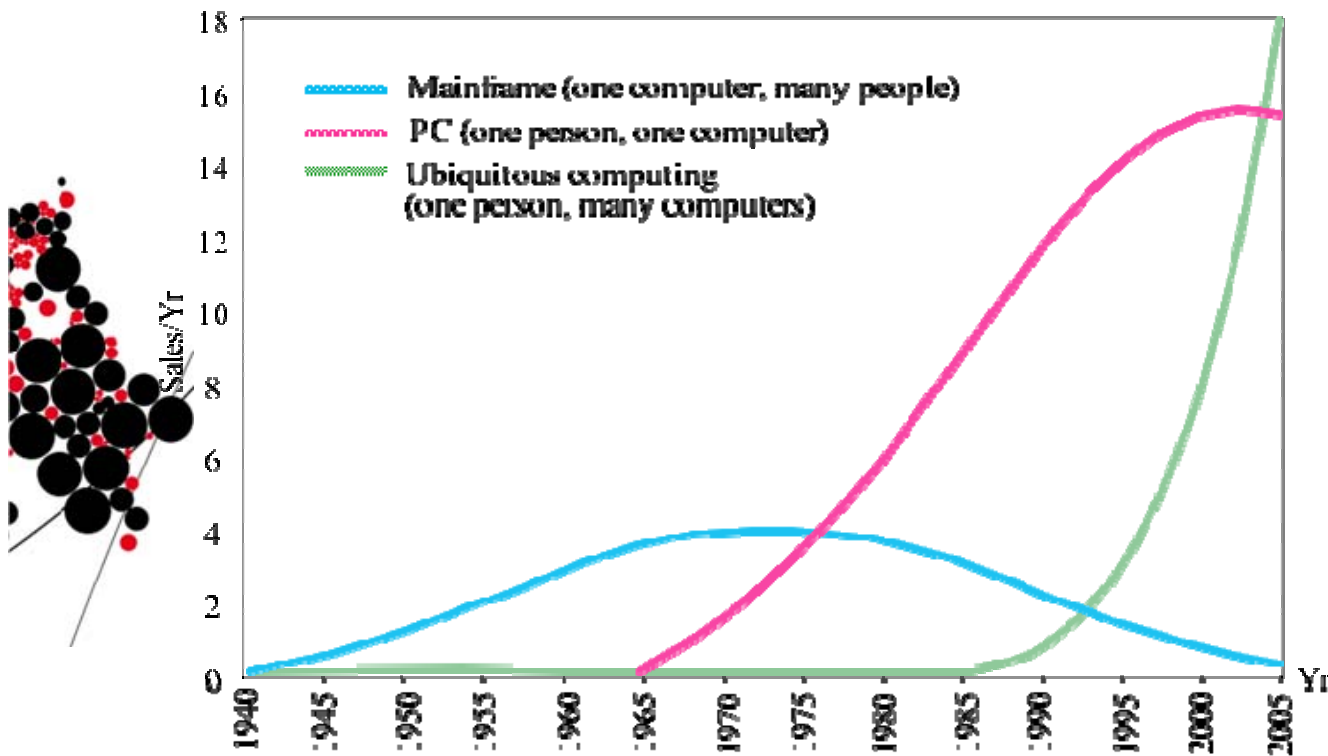
→ 1000 (!) wireless devices per person



# Trends in telecommunication



# From: one computer, many people to: one person, many computers



***In 2017 every person has 1000 (!!)***  
***communication devices***

***Might be true ..***

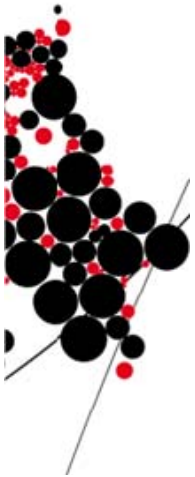
Source: Marc Weiser, Xerox PARC



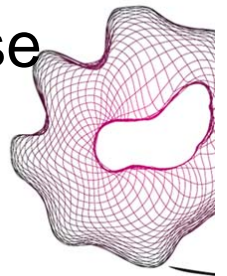
# Trends wireless systems

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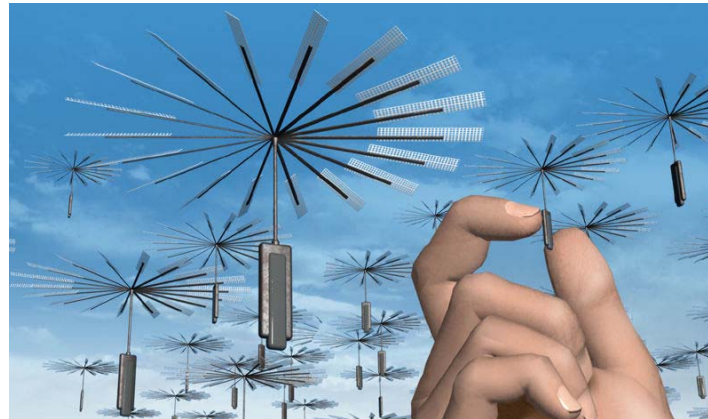
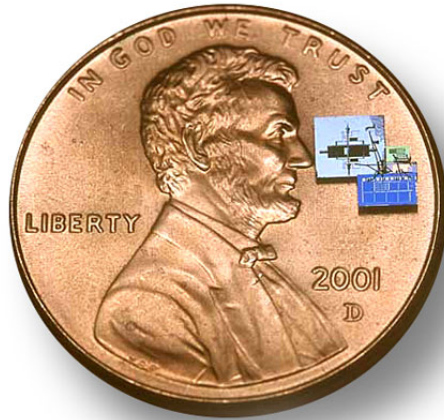
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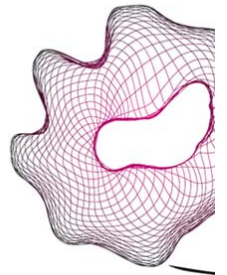
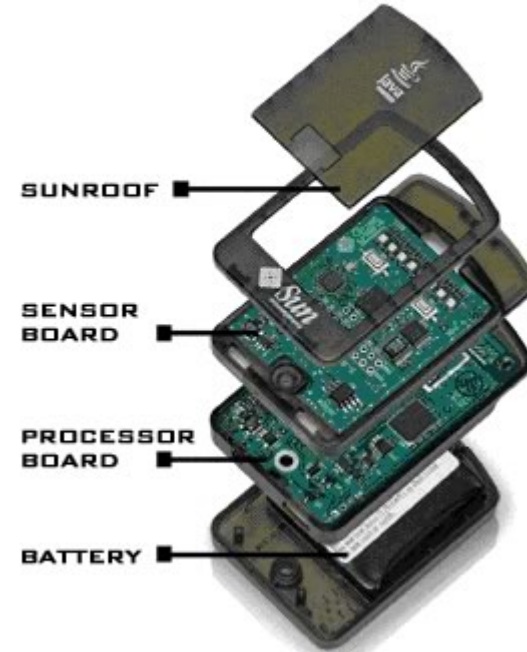
- Co-existing of many radio systems, which includes research on cognitive radio and software defined radio techniques. spatial multiple-access and beam forming, and adaptive interference cancellation techniques.
- Huge bandwidth communication, which includes research at very high frequency bands (60 GHz and beyond - towards Terabit communications) and free-space optics.
- Minimize EM-radiation exposure, using smart antennas, cognitive radio techniques, power-controlled communication systems, novel low-noise amplifiers, extreme low-power transmitters, novel communication protocols, etc.



# Smart dust

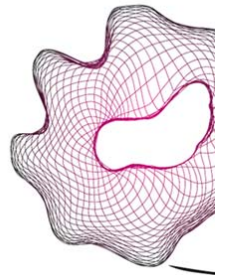
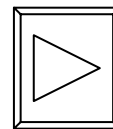
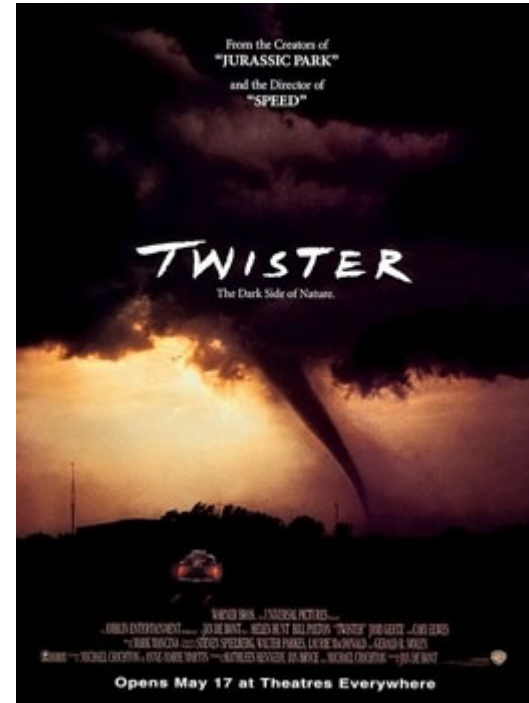
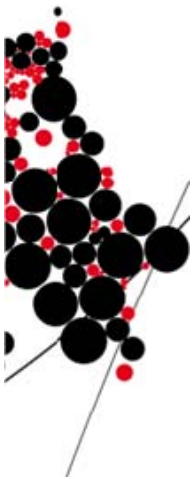


## SUNSPOT



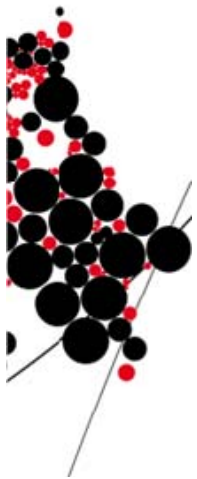
# Example of smart dust

- Movie Twister
- Using sensors (the Dorothy sensor systems)

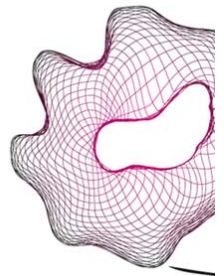


# High frequency wireless

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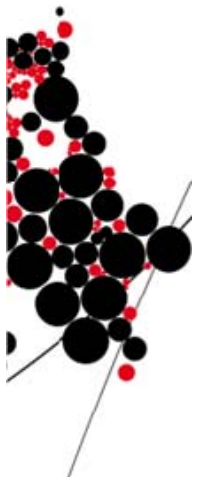
- Larger bandwidths
  - Higher data rates
  - Higher accuracy
  - Co-existence
  
- Short range radio
  - Propagation properties
  - Bandwidth requirements
  
- Passive use
  - Radio Astronomy
  
- ...



# Agenda

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13



- 18:15 Peter Baltus (TU/e)  
*High speed communications*
- 18:45 Bart Smolders (NXP, TU/e)  
*Integration of antennas at microwave frequencies*
- 19:15 Giampiero Gerini (TNO, TU/e)  
*Mm and sub-mm wave imaging antenna systems*
- 19:45 Pause
- 20:00 Frank van Vliet (TNO, UT)  
*From DC to Daylight: On the electronic frontiers*
- 20:30 Frank Helmich (SRON)  
*High frequency astronomy*
- 21:00 Jian-Rong Gao (TUD)  
*THz quantum cascade lasers and their applications*
- 21:30 Closing and drinks

