Astronomy = Big Science = ICT/ Big Data

Opportunities for cooperation between Africa and Europe

Ronald Stark

Head of Astronomy

Netherlands Organisation for Scientific Research

chair ASTRONET – a comphrehensive long-term planning for the development of European Astronomy

Brussels, AERAP EP meeting, 6-7 March 2013

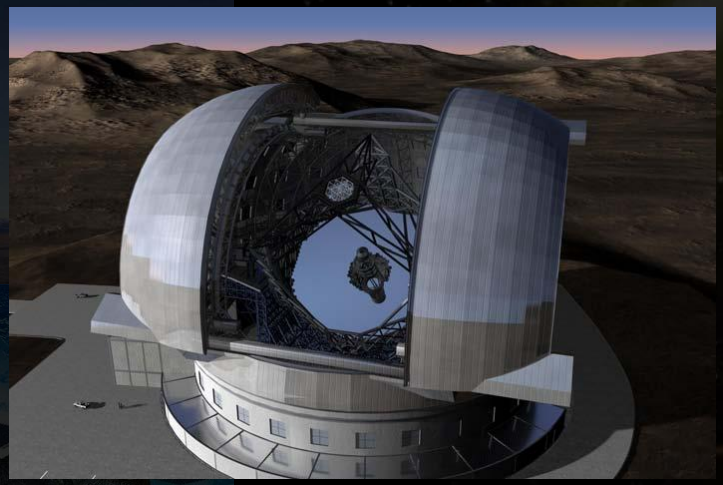
Future: New BIG facilities

ASTRONET Infrastructure Roadmap 2010-2020

Strategic plan for European Astronomy

- Ground-based top-priorities:
  - European Extremely Large Telescope (E-ELT, Chile)
  - Square Kilometre Array (SKA, Africa/Australia)

E-ELT



SKA

Astronomy and innovation

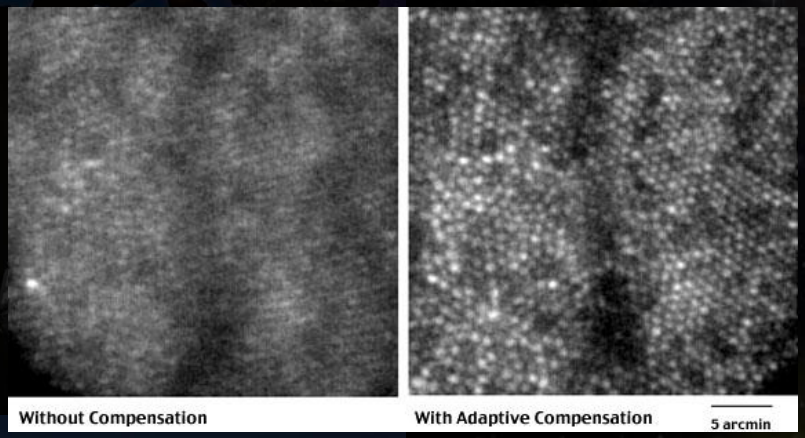
Requirements Astronomy: push for high tech developments

1. Most applications originating from Astronomy are unexpected and cannot be predicted.
   Result from funding cutting-edge astronomical research.

2. Public-Private-Partnerships
   advance both science and industry,
   and often aim at applications.

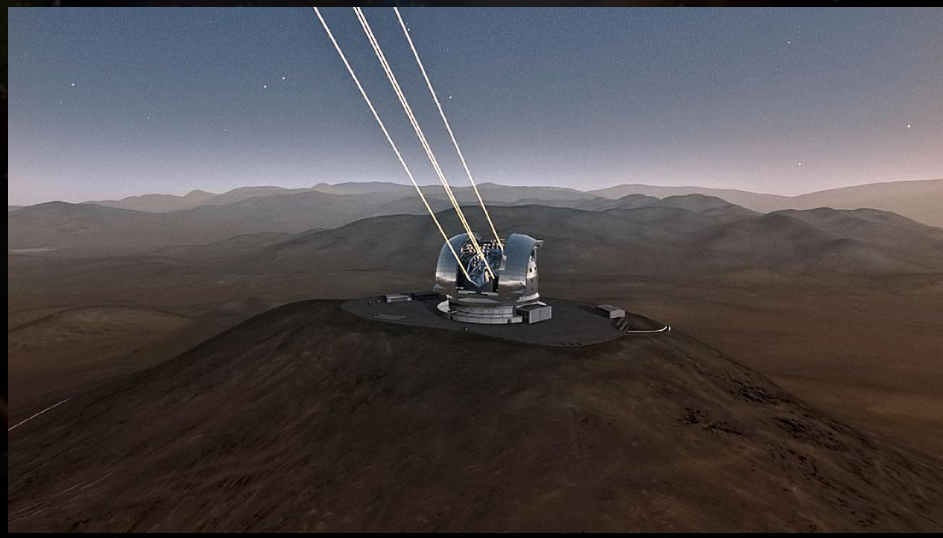
NL innovation policy: 9 top-sectors
High Tech Systems ↔ Astronomy

Spin-offs from Optical Astronomy



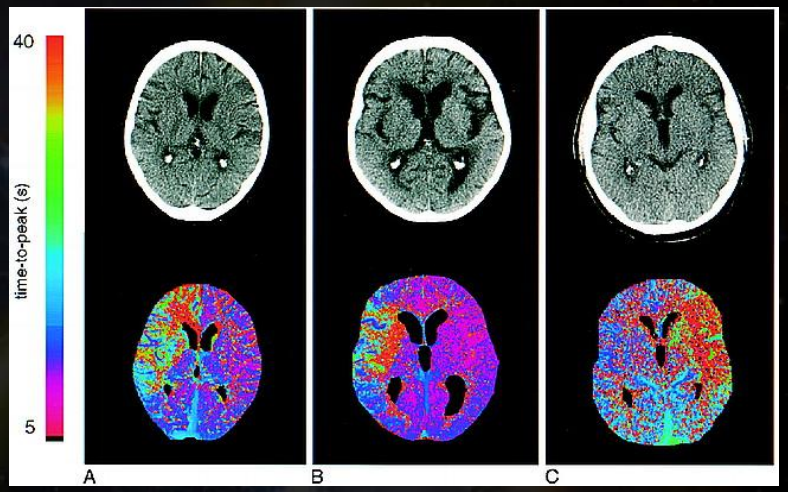
Adaptive optics: measuring optical aberrations in the eye, and guiding laser eye-surgery

- Controlling laser beams: laser-materials processing
- High-performance detectors: biomedical imaging and security
- Large scale precision optics: microelectronic devices



spin-offs from radio astronomy

Wifi: Search for radio signals from evaporating black holes



Medical: CAT scan technologies

Mobile telephones: Digital suppression of interference

Big Science Public Private Partnerships

50 new jobs directly
150 new jobs in follow-up projects
500 new jobs indirectly
(numbers from Sensor Universe)

5 start-ups
50 companies involved, quoting
- growth and innovation
- increase in export, new markets

1 new polytechnic (BSc)
1 new knowledge institute

International position for region
Increased attraction for talent

Total private investment in LOFAR: 8.4M€

Total investment volume in follow-up projects: 200 M€

ASTRON

ASTRON: Big Science public-private-partnerships in NL

- Strengthen competitive power of companies in R&D phase
- Collaborate with techno-starters
- Formation of clusters and themes in major innovation programs

Smart Antenna R&D
Total budget ~10M€
Private investment 600k€

Satellite of IBM Research
Total budget ~29M€
Private investment 5M€ + IP

Potential applications from VLBI

- VLBI: Very Long Baseline Interferometry
  - An astronomical technique with radio telescopes thousands kilometres apart to obtain highest possible resolution

NEXPRES
Novel EXplorations Pushing Robust e-VLBI Services

NEXPRES project: e-VLBI

Relevant for business:

- Techniques are pioneering bandwidth-on-demand protocols
- Fast storage installations

JOINT INSTITUTE FOR VLBI IN EUROPE

VLBI for Space applications…

JUICE/PRIDE

Planetary Radio Interferometer & Doppler Experiment

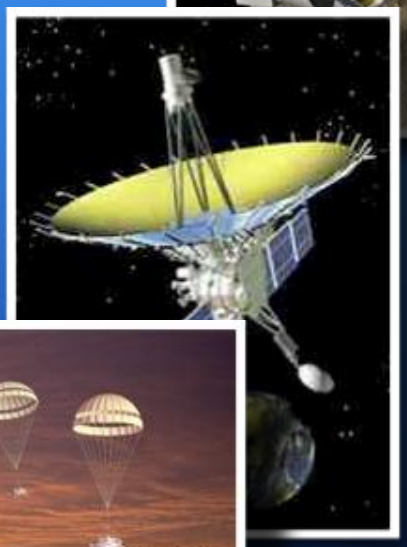
MarcoPolo-R?

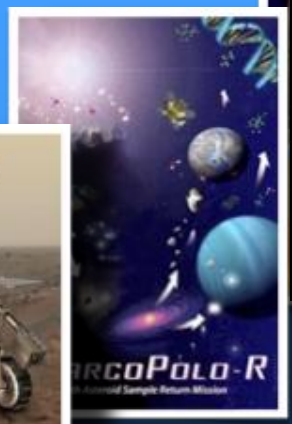
ExoMars

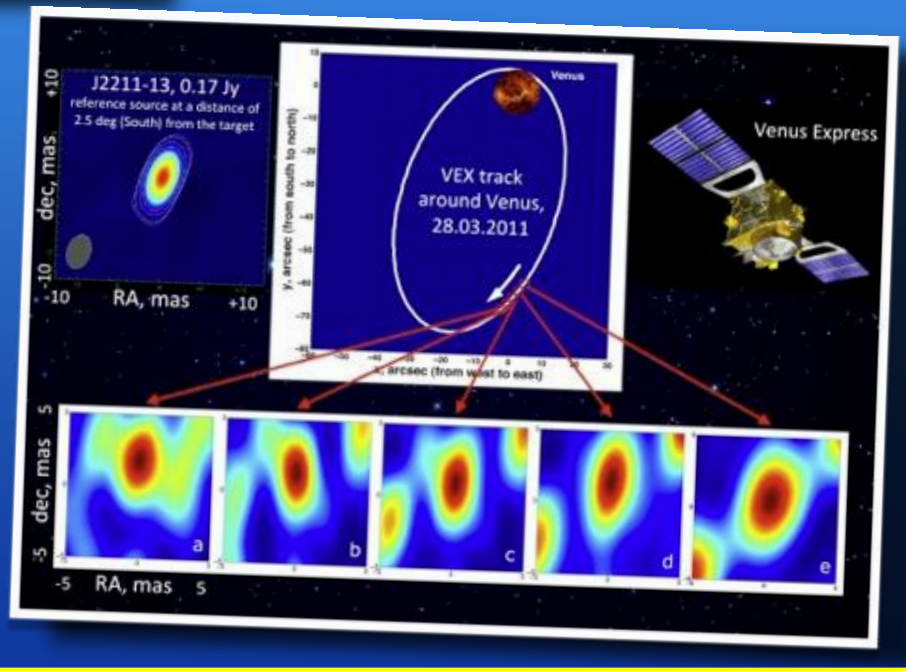
BepiColombo

RadioAstron

Huygens







Important: GPS accuracy for spacecraft outside GPS ranging …

NL – SA partnership in Astronomy

Agreements signed in April 2012

1. **NWO – NRF: Exchange programme for Astronomy and Enabling Technologies**
2. **DOME – SA: Public Private Partnership on ICT for Radio Astronomy**
3. **NWO – OAD: Visiting Experts Programme**
4. **NWO – TIA: Programme of Innovation Cooperation**

PPP: DOME South-Africa project

Bilateral Public-Private Partnership

4x4 model:

- NWO: Physical Sciences & ASTRON
- IBM - The Netherlands
- NRF / SKA project office
- IBM - South Africa

Focus: Advanced ICT targeted at Radio Astronomy (LOFAR/MeerKAT/SKA), including Green Supercomputing and Extreme Streaming

The African VLBI Network (AVN)

Opportunities:

- Projects related to the African VLBI network (AVN). Example: conversion of old satellite communication dishes for Radio Astronomy
- South-Africa has recently become a member of JIVE
- NWO-OAD Visiting Experts programme

Ghana's 32-m satellite communications antenna

ICT/Big Data Challenges

SKA preparations = Bandwagon for societal ICT issues:

→ R&D of intelligent & power efficient systems

- to deal with many streams of semi-structured data and extract useful information (e.g., banking, transportation)
- to build self-learning machines
- keeping up with extreme data rates (internet 4 everything)
- combine new data and compare with existing data sources and software systems (e.g., healthcare)
- Cloud based techniques
- Power efficient computing & storage (e.g., energy)

→Capacity building: High Tech pan African campuses e.g., along the AVN, **connecting people, processes,and data**


African European Radio Astronomy Platform:
Think BIG Data!
The sky is the limit