LARMOR: A Multipurpose Polarised Neutron Instrument for Looking into Materials.

Investment Subsidy NWO Large

Kick-off Meeting

Utrecht, October 2nd, 2012

university of groningen

TU Delft Delft University of Technology

TU/e Technische Universiteit Eindhoven University of Technology

Agenda of the Meeting

14:00-14:30 : Katia Pappas: the present state of LARMOR@TU Delft.
14:30-15:00 : Robert Dalgliesh: LARMOR@ISIS.
15:00-15:30 : Jeroen Plomp: LAMROR the technical part.

15:30-15:45 : coffee break

15:45 -16:15 : Ilja Voets: Soft Matter
16:15 -16:45 : Graeme Blake: Magnetism
16:45 -17:15 : Jilt Sietsma: Materials

LARMOR: A Multipurpose Polarised Neutron Instrument for Looking into Materials.

prof. Catherine Pappas

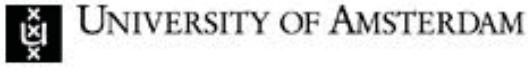
university of groningen

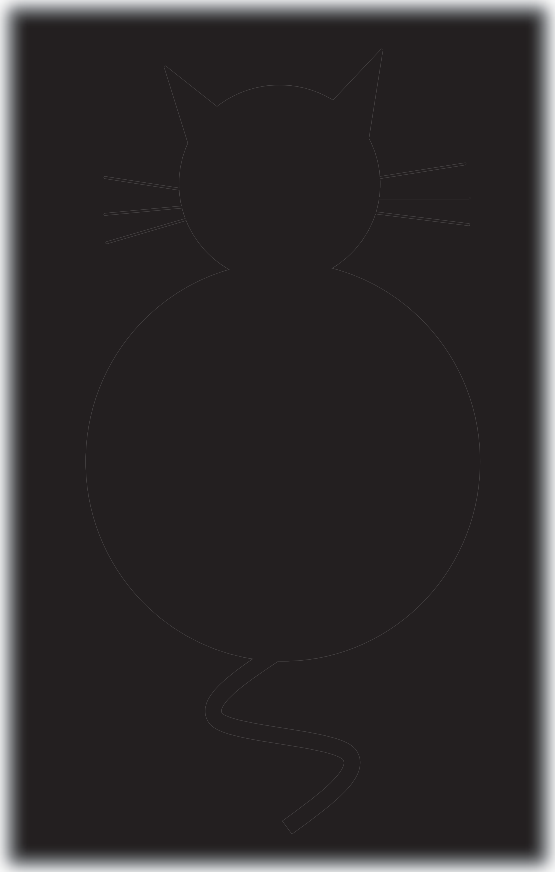
TU Delft Delft University of Technology

TU/e Technische Universiteit Eindhoven University of Technology

prof. Thom Palstra, prof. Jilt Sietsma, dr. Ilja Voets

LARMOR: A Multipurpose Polarised Neutron Instrument for Looking into Materials.

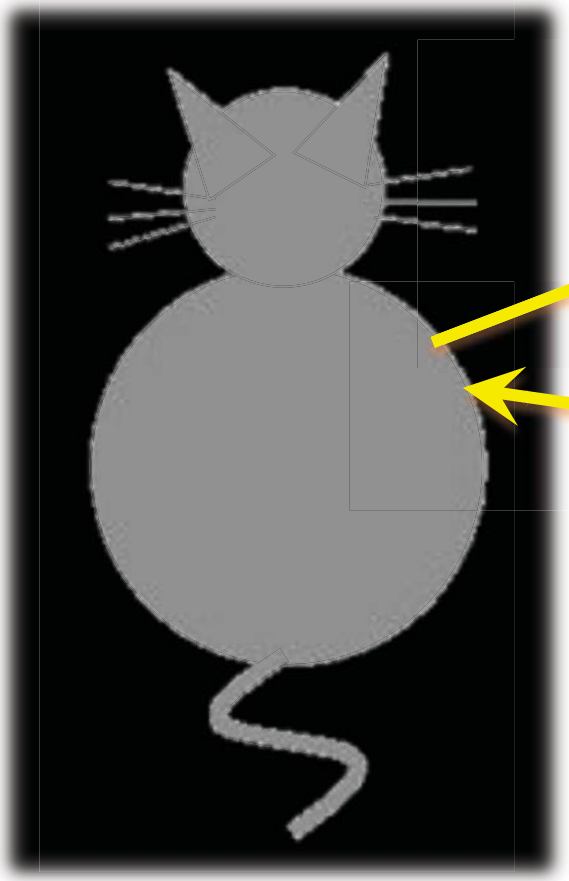




How to find a black cat in a dark room ?

by a scattering experiment with an appropriate radiation

Light shows macroscopic details at the surface



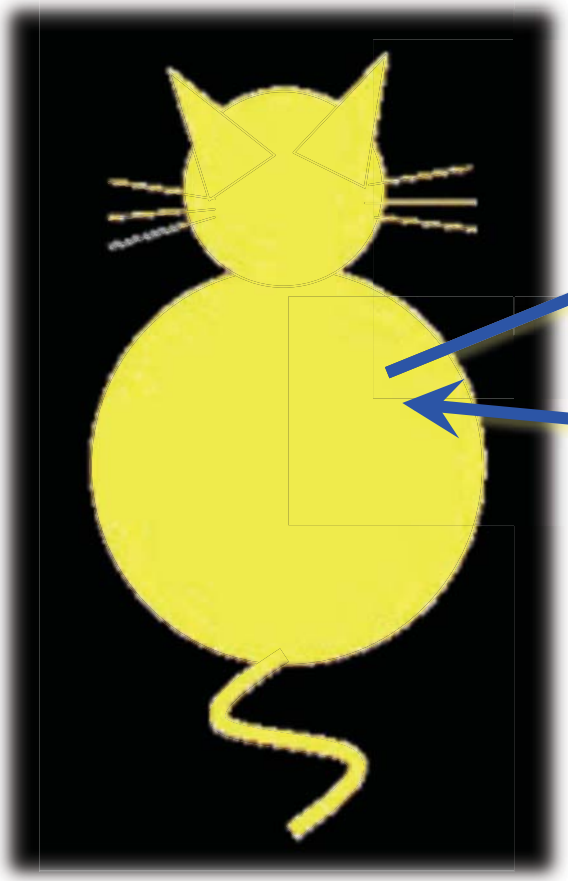
Eye or camera:
detector

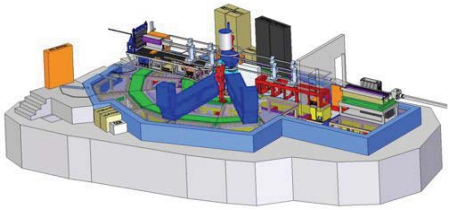
Flashlight: source
of visible light

properties of light radiation

- Strong interaction – large absorption
  Small penetration depth: surface only
- Frequency ~ 6 10^{14} Hz (2.5 eV, ~3 10^{4} K)
- Wavelength ~ 500 nm

Neutrons show what is happening in the bulk





neutron instrument

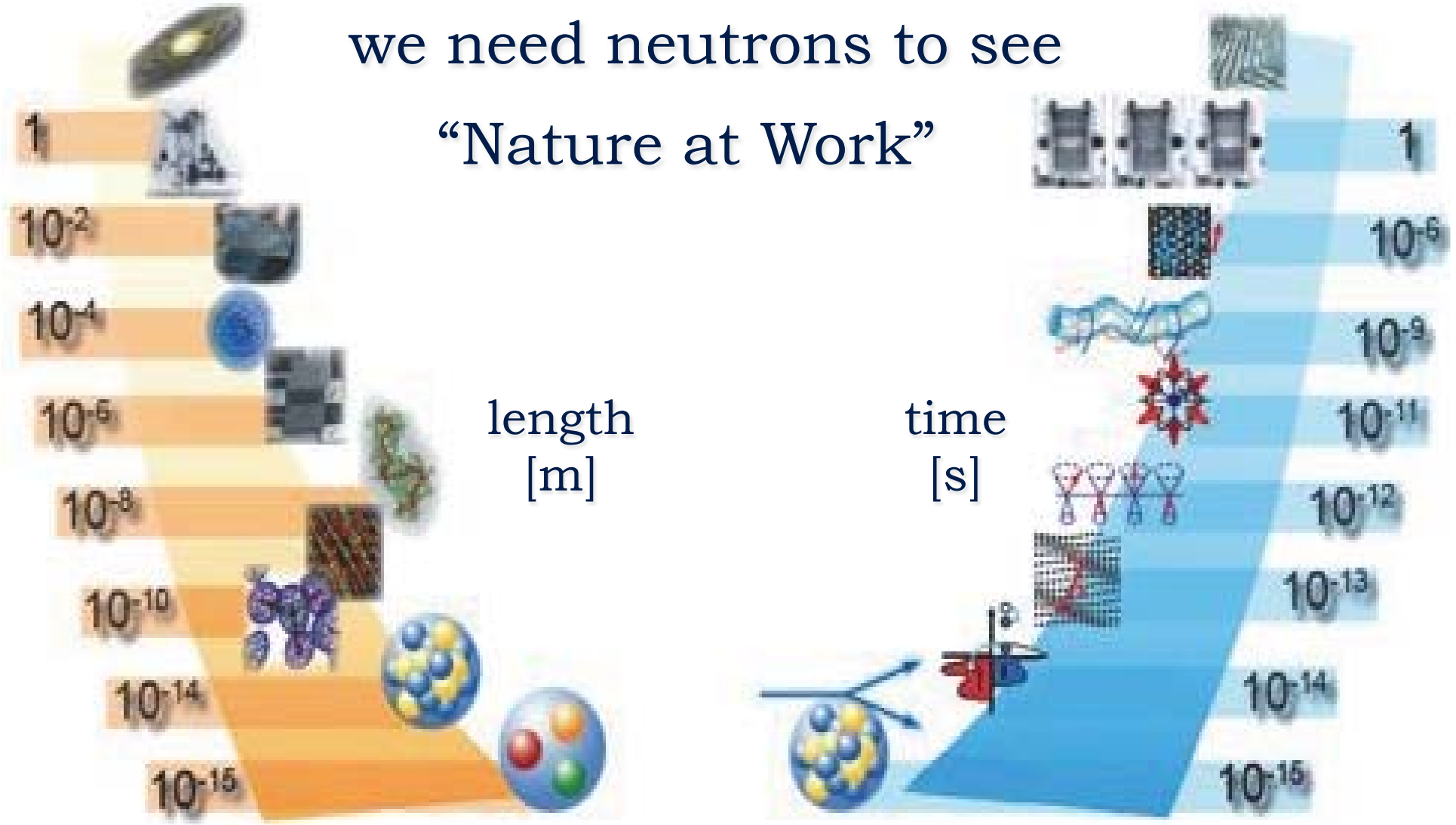
Reactor or spallation neutron source

properties of neutron radiation

- Weak interaction – often small absorption
  Large penetration depth: sees inside
- Frequency 2 10^{13} - 2 10^{11} Hz (82-0.82 meV, ~ 1000 – 10 K)
  comparable to thermal energies
- Wavelength 0.1 – 1 nm
  comparable to atomic distances

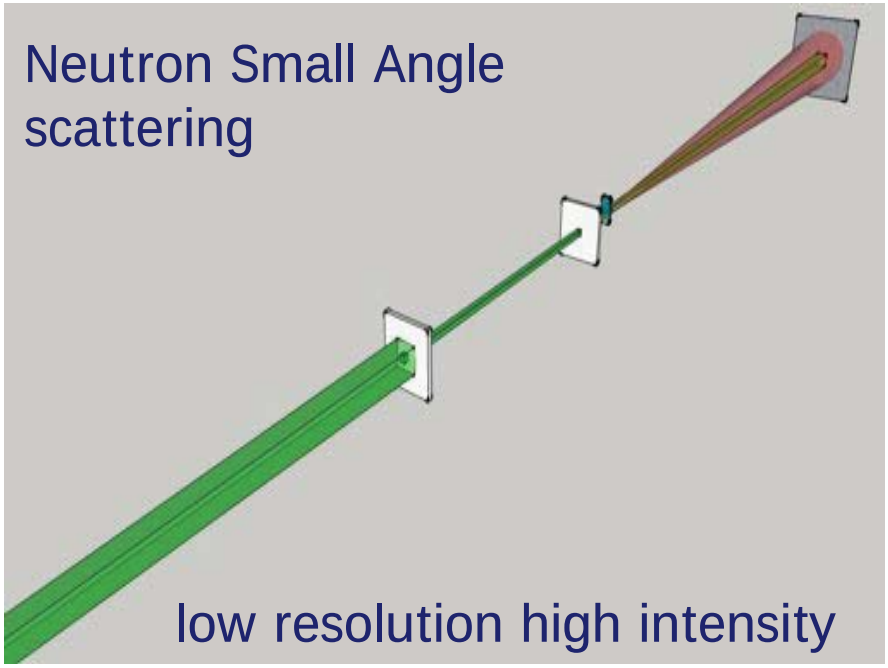
we need neutrons to see

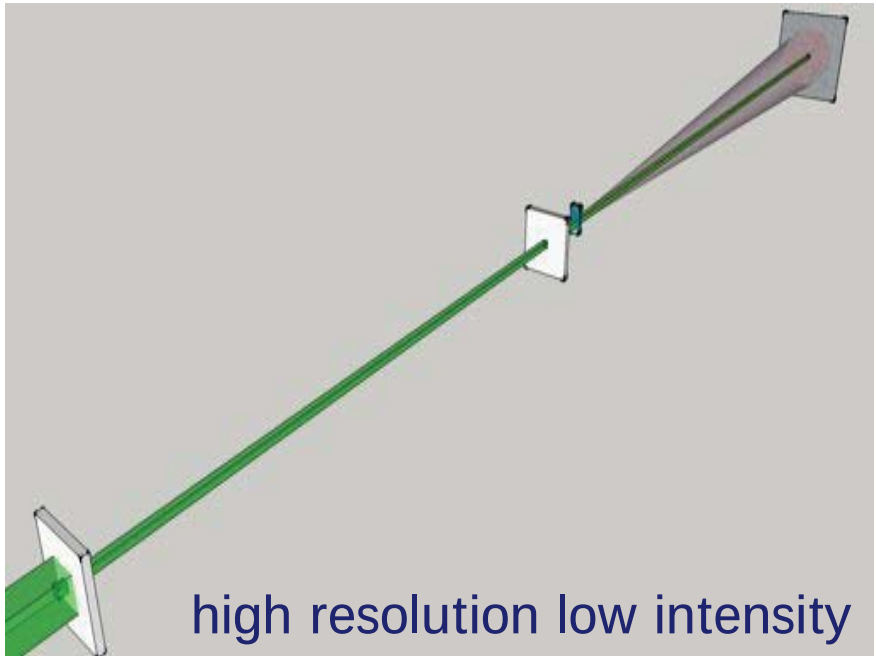
“Nature at Work”



Neutron scattering trades off resolution and intensity

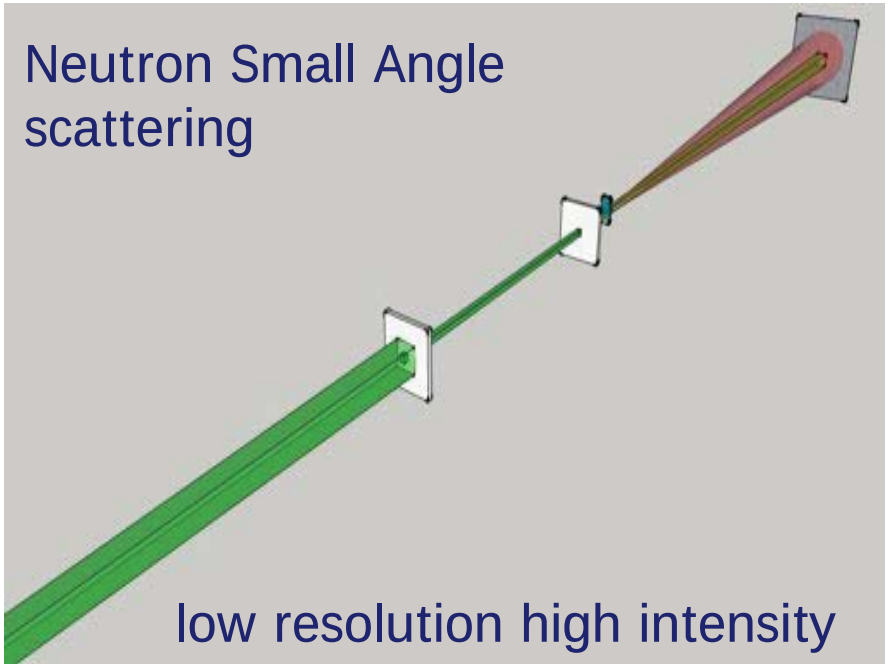
intensity and resolution are in conflict

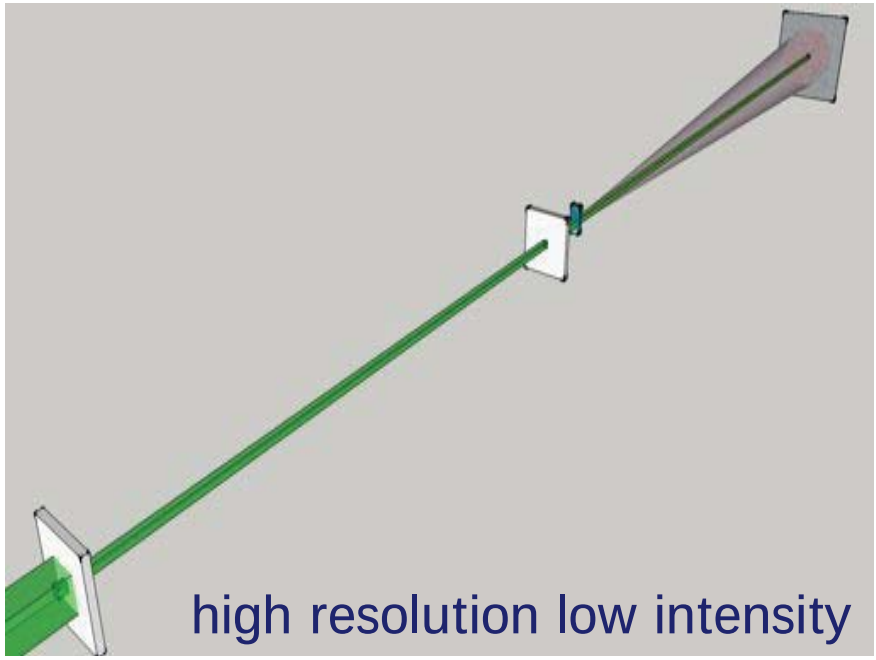




Neutron scattering trades off resolution and intensity

But you can use tricks: optics, polarised neutrons



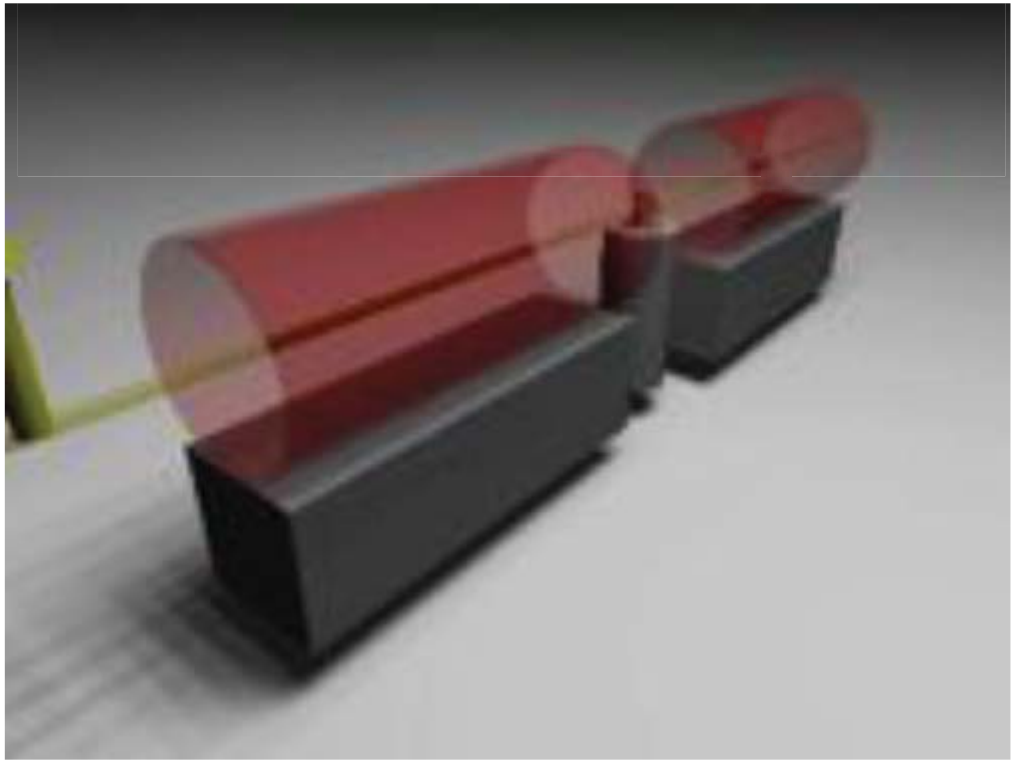


Neutron Spin Echo decouples resolution from beam design

High resolution
AND
High intensity

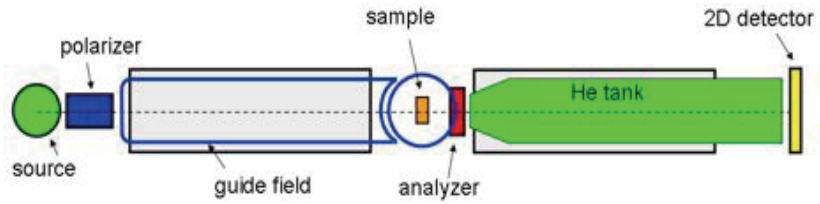
Larmor precession

$$\frac{d\vec{\mu}}{dt} = -\gamma\,\vec{\mu} \times \vec{H} = \vec{\mu} \times \vec{\omega}_L$$

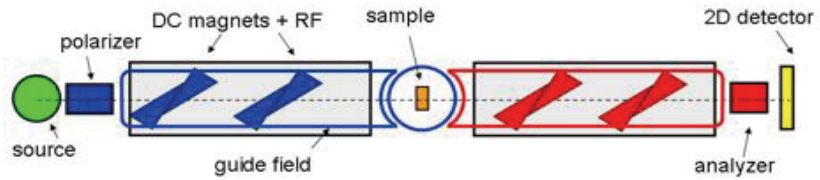


LARMOR Layout

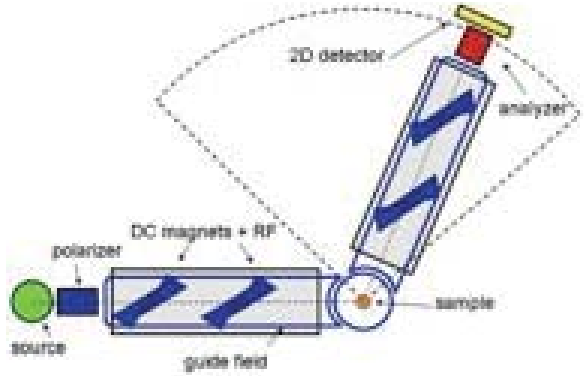
structure



Small Angle Neutron Scattering (SANS)
with option for polarised neutrons

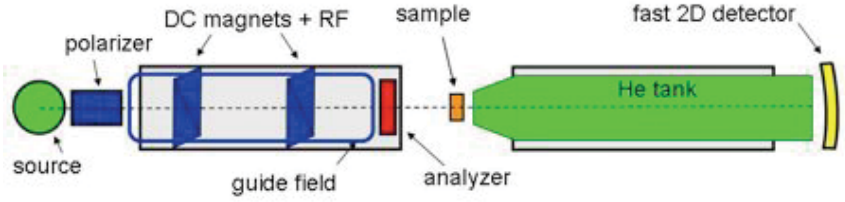


Spin Echo Small Angle Neutron Scattering
(SESANS)

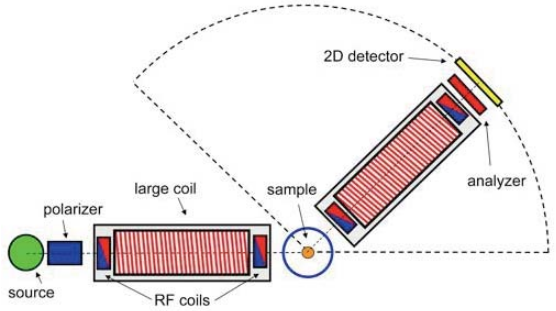


Larmor
diffraction

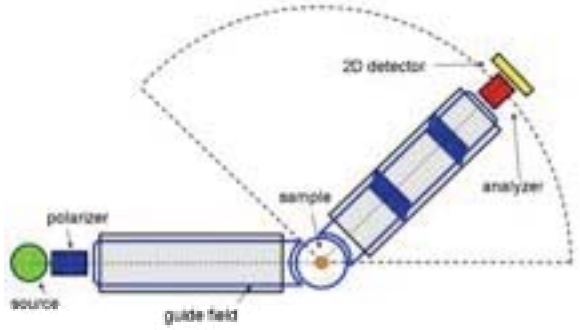
dynamics



Modulated Intensity Small Angle Neutron
Scattering (MISANS)

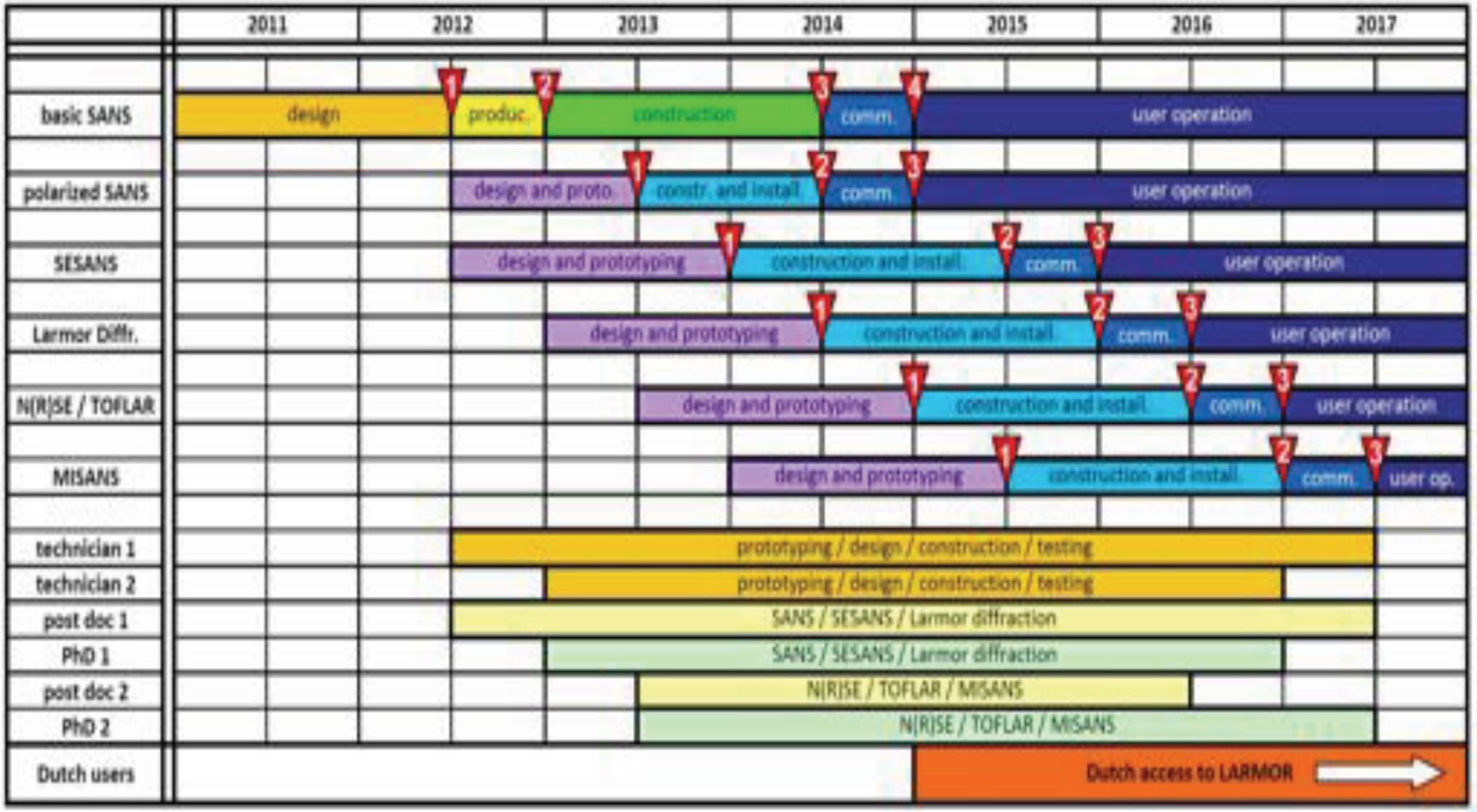


Neutron
Resonance
Spin Echo
(NRSE)



Time-of-Flight
Larmor
labeling
(TOFLAR)

LARMOR timeline over 5 years



LARMOR Budget over 5 years

Requested NWO funding								Total
Item description	2011	2012	2013	2014	2015	2016	2017	
Personnel costs								
Postdoc 3y, 1 fte			32	63	63	32		189
Postdoc 5y, 0,5 fte		18	35	35	35	35	18	175
PhD 1			45	45	45	45		181
PhD 2			23	45	45	45	23	181
technician 4y, 1 fte		35	70	70	70	35		280
Material costs								
POLARISED SANS		33	110	77				220
SPIN ECHO SANS			94	187	436	218		935
LARMOR DIFFRACTION			75	125	175			375
N(R)SE			47	94	219	110		470
MISANS				40	67	93		200
Neutron beam usage		8	16	16	16	8		64
Travel & subsistence		2	10	20	20	10	3	65
Total								3335

LARMOR Budget

allocated:

- 2. 335 M€
- 1.000 M€
  - 400 K€ CvB
  - 350 K€ AS
  - 250 K€

LARMOR responsible and promoter
Katia Pappas
(0.15 fte)

Advisor, co-ordinator Soft Matter
I.K.Voets (0.05 fte)

Advisor, co-ordinator Material Science
J.Sietsma (0.05 fte)

Advisor, co-ordinator Magnetism
T. Palstra (0.05 fte

Advisor
G.R. Blake (0.1 fte)

Instrument development, build and functioning

Technical project leader
Jeroen Plomp
(0.4 fte)

Scientific exploration data treatment, science cases and methods
Scientific project leader
Ad van Well
(0.1 fte)

Technician LARMOR (1 fte)

Technician NPM2 (1 fte)

Postdoc 1 (0.5 fte)

PhD 1 (1 fte) Co-promotor Ad van Well (0.1 fte)

PhD 2 (1 fte) Co-promoter Wim Bouwman (0.2 fte)

Postdoc 1 (0.5 fte)

LARMOR Budget stretched over 6 years

Requested NWO funding								otal
Item description	2012	2013	2014	2015	2016	2017	2018	
Personnel costs								
Postdoc 3y, 1 fte		32	63	63	32			189
Postdoc 6y, 0,4 fte	10	29	29	29	29	29	20	175
PhD 1		45	45	45	45			181
PhD 2			45	45	45	45		181
technician 4y, 1 fte		35	70	70	70	35		280
Material costs								
POLARISED SANS	33	110	77					220
SPIN ECHO SANS		94	187	436	218			935
MISANS		40	67	93				200
LARMOR DIFFRACTION			75	125	175			375
N(R)SE			47	94	219	110		470
Neutron beam usage	4	16	16	16	8	4		64
Travel & subsistence	3	10	10	11	11	10	10	65
Total								3335

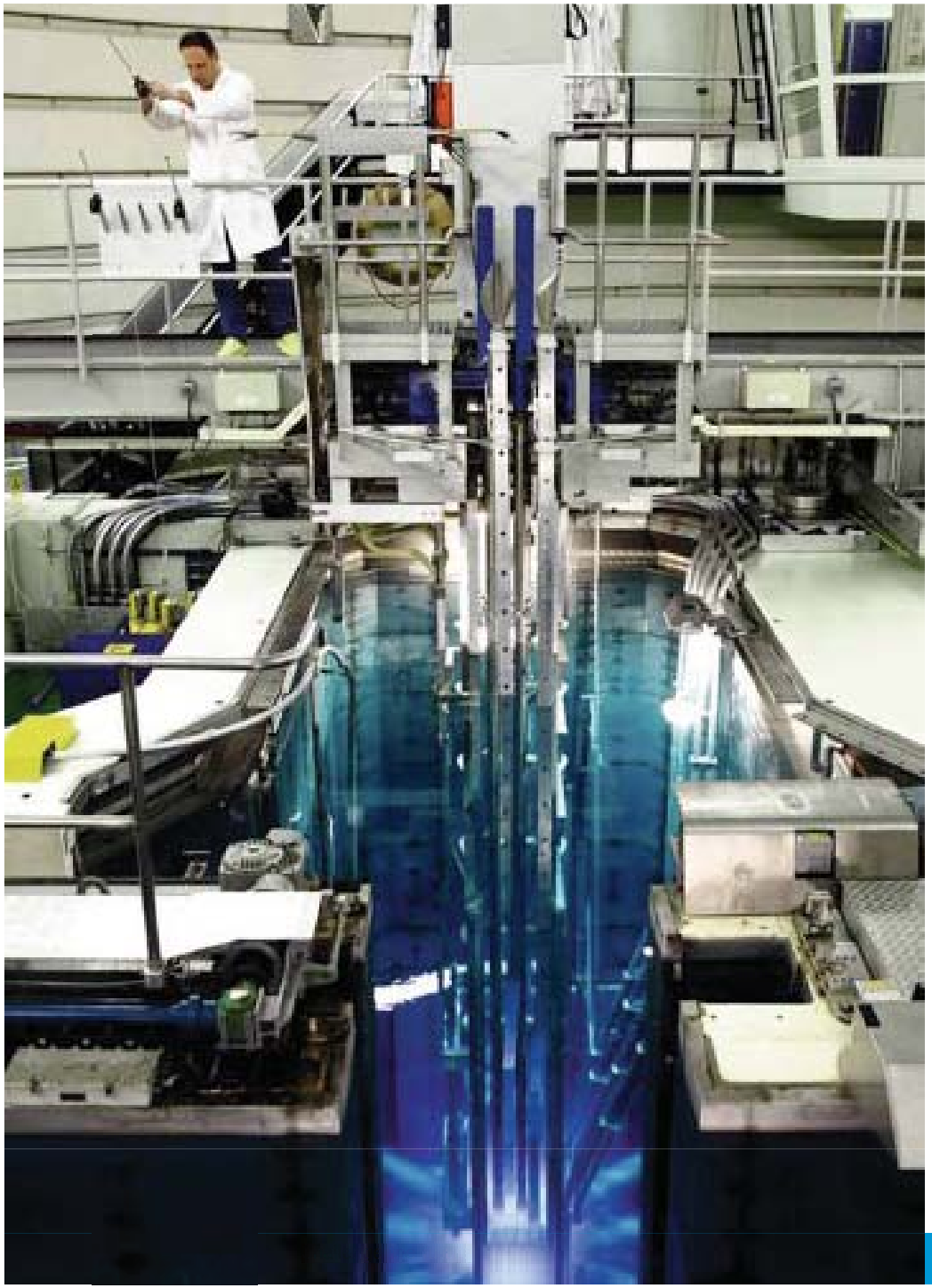
Other Recent Developments

◆ OYSTER

Optimized Yield for Science, Technology and Education – of Radiation

◆ ESS

European Spallation Source



OYSTER @ TU Delft

2 MW reactor
HOR @ RID

Install a cold neutron source

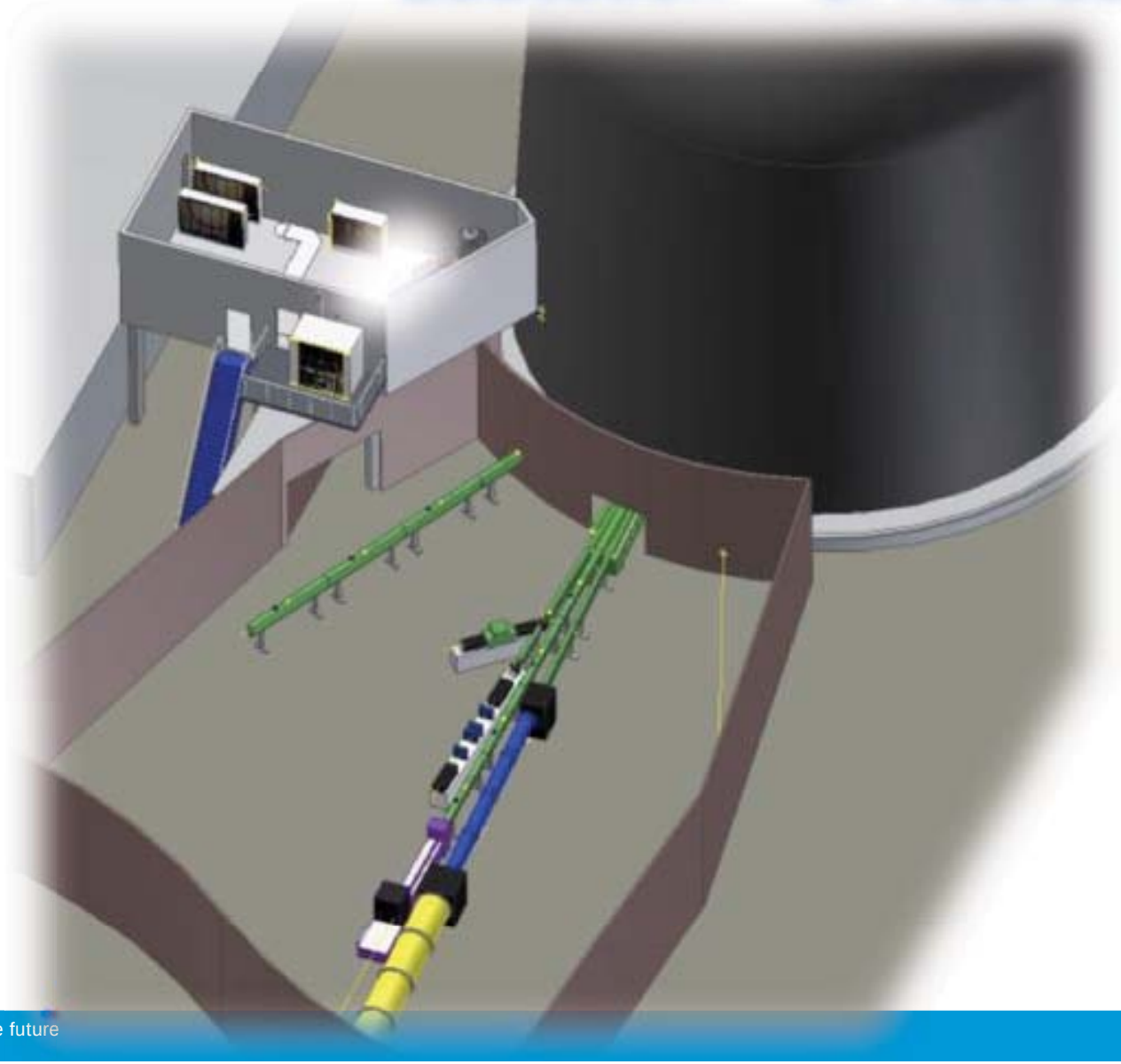
Increase the reactor power

Build new and innovative instruments for material science

Optimized Yield for Science, Technology and Education – of Radiation

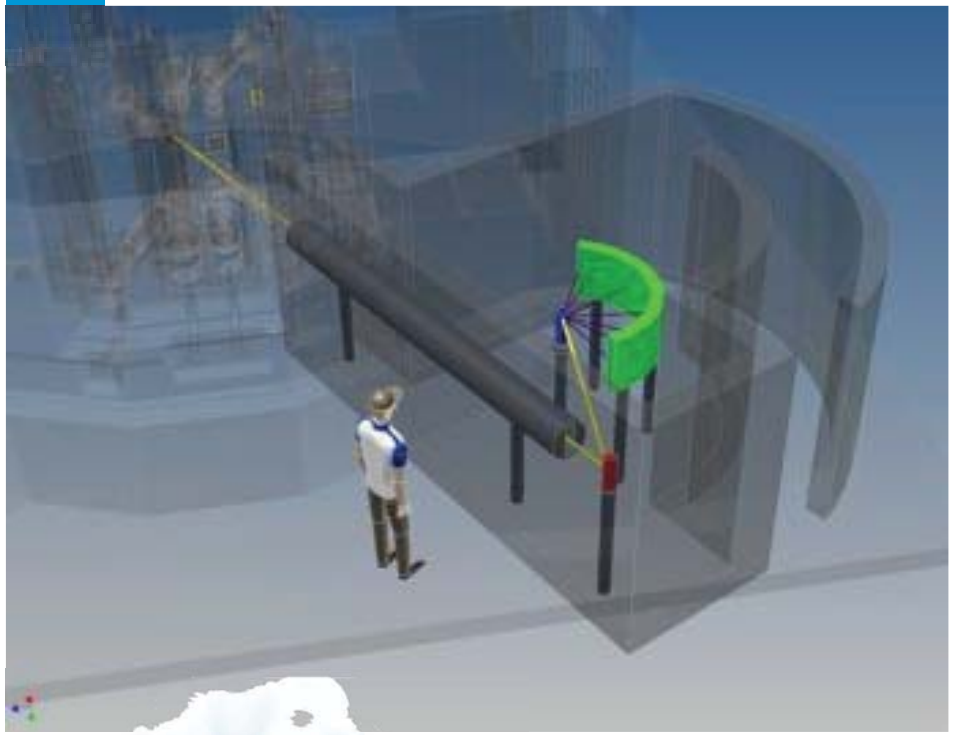
OYSTER

Optimized Yield for Science, Technology and Education – of Radiation



OYSTER

Optimized Yield for Science, Technology and Education – of Radiation



PEARL :

Neutron Diffractometer

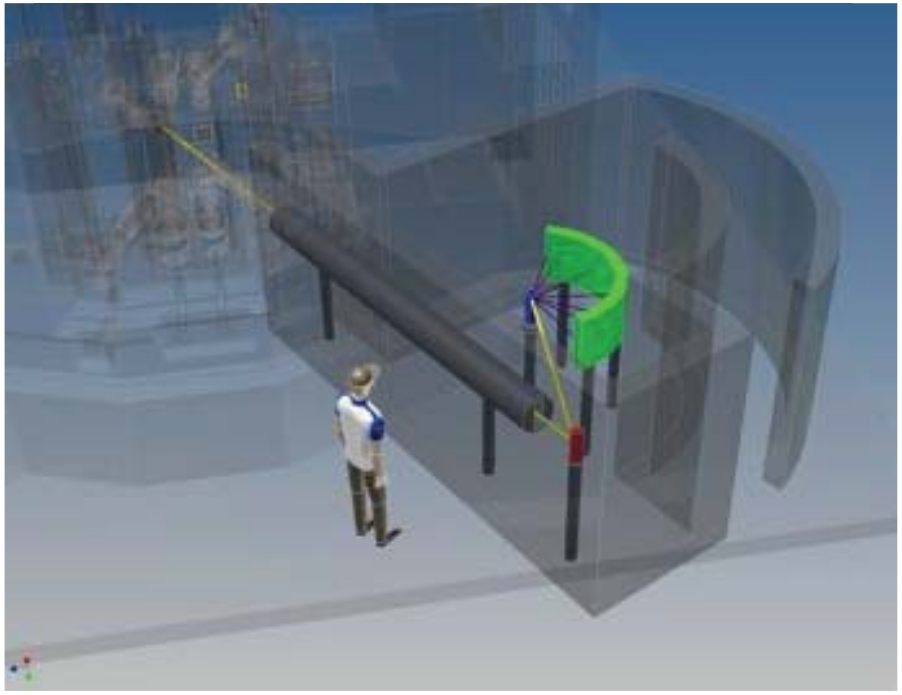
Innovative optics
High flux

Competitive with existing instruments in Europe

OYSTER

OYSTER

PEARL :



Neutron Diffractometer

Innovative optics
High flux

Competitive with existing instruments in Europe

Optimized Yield for Science, Technology and Education – of Radiation

✓ Establish RID as a Dutch national facility

within and besides the TU Delft

OYSTER

Follow the developments on the weblogs :

LARMOR : larmor.weblog.tudelft.nl

PEARL : pearl.weblog.tudelft.nl

SANS : sans.weblog.tudelft.nl

ESS : hollandess.weblog.tudelft.nl