Attracting and addressing potential new users for large-scale facilities

Committees Research with

Synchrotron Radiation,

Neutrons and

Nuclear Probes and **I**on beams

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Outline

The Neutron Pathfinder: a web tool for potential users

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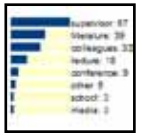
How can we attract new users and help them in the starting phase?



The New Users Survey: 100 users told us how they found method and facility and what they think about the access procedure

?

What can we learn from the answers? What could be improved?

⇨

My ideas / Your ideas!

PATHFINDER
Methods
Science Pathfinder
Experiment Pathfinder
Instrument Pathfinder
Facilities
Access Guidelines

Neutron pathfinder

A neutron instrument database from 2005

130 instruments from these facilities: ILL, LLB, HMI, FRM II, NPL, FZ Jülich, JEEP II, ISIS, SINQ, BNC, FLNP, GeNF

- Methods (for generally interested people)
- Science Pathfinder (for generally interested people)
- Experiment Pathfinder (for scientists with an experiment in mind)
- Instrument Pathfinder (for experienced users)
- Facilities
- Access Guidelines

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PATHFINDER

- Methods
  - Diffraction
  - Small Angle Scattering
  - Time of Flight Spectroscopy
  - Spin Echo Spectroscopy
  - 3-Axis-Spectroscopy
  - Reflectometry
  - Grazing Incidence Diffraction
  - Radiography and Tomography
  - Neutron Activation
  - Particle and Nuclear Physics
- Science Pathfinder
- Experiment Pathfinder
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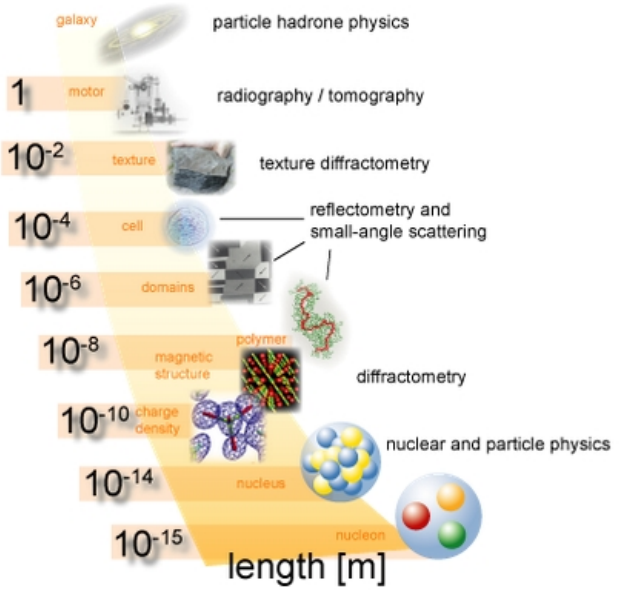
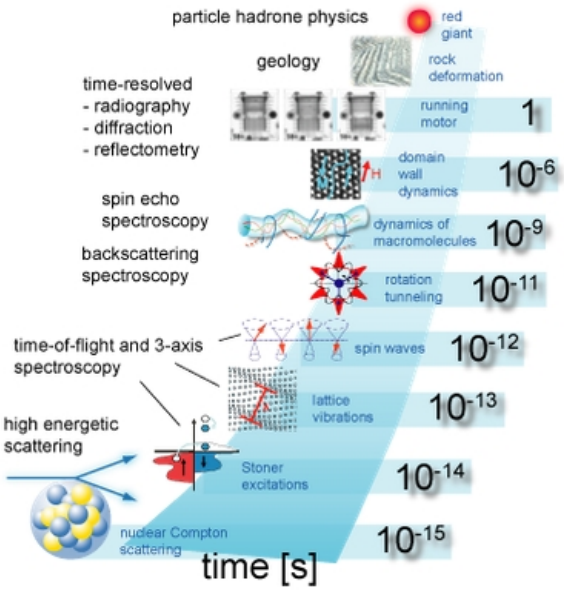
Neutron Methods

Measurement principles explained

Just like a beam of light, X-rays or electrons a neutron beam can be reflected, scattered and absorbed. The special feature of neutrons is their deep penetration into materials, their interaction with nuclei and their sensitivity to magnetic sources in condensed matter due to their magnetic dipole. What is more, neutrons - unlike X-rays - can distinguish light elements (e.g. H). Neutron scattering is a means to study the structure, dynamics (movement of atoms) and the compositions of materials.

The structure of material can be studied by **diffraction** or **small angle scattering**, while the dynamics can be determined by **spectroscopy**. The most common spectroscopical methods are in the order of increasing energy resolution: **time of flight, backscattering, spin echo and 3-axis spectroscopy.**
Surfaces and interfaces are analysed by **reflectometry** and **grazing incidence diffraction**.
Neutron Radiography and Tomography allows imaging that shows quite different information than X-ray imaging does.
Precise composition analysis is done by **neutron activation analysis**.
Last, but not least, **particle and nuclear physics** use neutrons in several ways - in this field, measurements are done directly at the source or in special setups, not at conventional instruments.





Source: Forschung mit Neutronen - Status und Perspektiven, KFN (in press)

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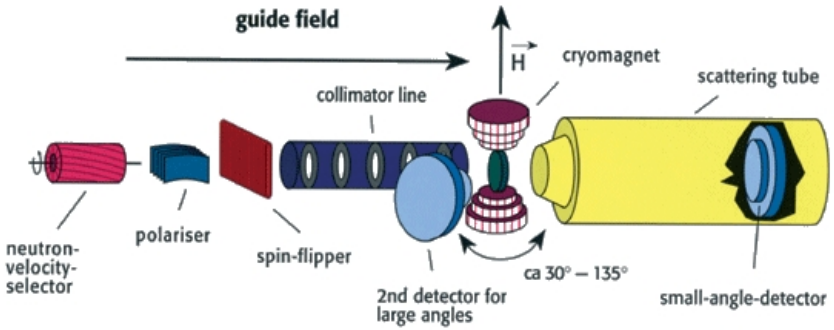
Neutron Small Angle Scattering

Small Angle Scattering relies on diffraction on larger structures than just atoms, such as molecules or other structures that can be hundreds times larger than an atom.

Neutron Small Angle Scattering is a non-destructive method for determination of microstructures with lengths between 0,5 nm and 500 nm. It is based on the principle that an initially parallel neutron beam is scattered by inhomogeneities of a sample. These can be due to fluctuations in density, concentration or magnetisation. This method is widely used in biological structure research (viruses, proteins, enzymes), polymer research (conformation analysis), energy and environmental engineering (porosity and surfaces of filter materials and catalysts) and the development of materials. Since the scattering length densities of the elementary volumes can readily be influenced for neutrons by modifying the isotopic composition of the sample, this technique ("contrast variation") has largely determined the success of small-angle neutron scattering in the fields of soft matter and biological structures.



Source: GKSS, SANS-2

There are three variants of small angle diffraction: pin hole small angle diffraction, double-crystal diffraction and focussing small angle diffraction. Of those double-crystal diffraction, which uses two silicon crystals as reflectors, allows for the highest resolution. Most small angle instruments are pin hole instruments, which have apertures that determine the size of the neutron beam. The focussing small angle scattering is a further development. Here, a mirror is used to focus the beam.

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Science Pathfinder

Find the instruments for your field of work

Find examples of what you can do with neutrons at the "About-Section" and on the German Neutron Website (English and German). A more detailed search can be done with the Experiment Pathfinder.

We assume that you looked for one instrument for one specific purpose, therefore combinations lead to those instruments which allow all of your choices.

The following information allows you

- *to find the instrument homepage at the facility for more detailed information*
- *to contact the responsible of the instrument at the facility and discuss your planned experiment.*

Take into account that to perform an experiment you have to submit a proposal to the facility.

- ☐ phase transitions

- ☐ magnetism
- ☐ magnetic surface studies

- ☐ structural analysis
- ☐ surfaces and interfaces
- ☐ disordered systems
- ☐ phonons
- ☐ functional materials
- ☐ molecular systems
- ☐ textural analysis
- ☐ superconductivity
- ☐ modelling
- ☐ reaction mechanisms
- ☐ catalysis
- ☐ residual stress analysis
- ☐ self-assembly
- ☐ bio-crystallography

- ☐ particle physics
- ☐ nuclear physics

- ☐ polymers
- ☐ colloids
- ☐ metallurgy
- ☐ fibres
- ☐ glasses
- ☐ emulsions
- ☐ membranes
- ☐ micelles
- ☐ liquids
- ☐ biopolymers
- ☐ biomembranes
- ☐ proteins
- ☐ absorbates

- ☐ earth sciences
- ☐ rock properties
- ☐ photonics
- ☐ element composition of materials
- ☐ imaging
- ☐ archaeomtery

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Instrument Pathfinder

Find instruments of a certain type:

We assume that you looked for one instrument for one specific purpose, therefore combinations lead to those instruments which allow all of your choices.

The following information allows you

- *to find the instrument homepage at the facility for more detailed information*
- *to contact the responsible of the instrument at the facility and discuss your planned experiment.*

Take into account that to perform an experiment you have to submit a proposal to the facility.

Diffractometers

- [ ] All diffractometers
- [ ] Single crystal
- [ ] Powder
- [ ] Liquids and amorphous materials
- [ ] Texture
- [ ] 2-axis
- [ ] Residual stress analysis
- [ ] Time-of-flight
- [ ] Other type

Small Angle Scattering Instruments

- [ ] All small angle scattering instruments
- [ ] Pin-hole
- [ ] Focussing
- [ ] Double crystal
- [ ] Time-of-flight
- [ ] Grazing angle
- [ ] Other type

Reflectometers

- [ ] All reflectometers
- [ ] Horizontal scattering geometry (vertical surface)
- [ ] Vertical scattering geometry (horizontal surface)
- [ ] Grazing angle
- [ ] Time-of-flight

Spectrometers

- [ ] All spectrometers
- [ ] Backscattering
- [ ] Spin echo
- [ ] 3-axis
- [ ] Time-of-flight chopper
- [ ] Time-of-flight crystal
- [ ] Time-of-flight filter
- [ ] Other type

Other instrument types

- [ ] Neutron Activation Analysis Irradiation Facility
- [ ] Neutron Radiography Facility
- [ ] Neutron Depolarization Setup
- [ ] Holography and Neutron Scattering Facility
- [ ] Instrument for Nuclear or Particle Physics

Detailed search with criteria chosen above >

Show the list of instruments selected so far >

Last mo

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Experiment Pathfinder

Find the instruments for your experiment

We assume that you looked for one instrument for one specific purpose, therefore combinations lead to those instruments which allow all of your choices.

The following information allows you

- *to find the instrument homepage at the facility for more detailed information*
- *to contact the responsible of the instrument at the facility and discuss your planned experiment.*

Take into account that to perform an experiment you have to submit a proposal to the facility.

Experiment types

- [x] All
- [ ] Structure
- [ ] Dynamics
- [ ] Surfaces and Interfaces
- [ ] Imaging
- [ ] Element Composition of Materials
- [ ] others

Any of these sample environments needed?

- [ ] Cooling or heating
- [ ] Pressure
- [ ] Magnetic field
- [ ] Electric field

Detailed search with criteria chosen above >

Show the list of instruments selected so far >

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An example:

Experiment Pathfinder

Find the instruments for your experiment

To get a list of instruments that you could use for a certain experiment, please enter in the first step basic information about the planned experiment.
We assume that you are looking for one instrument for one specific purpose, therefore combinations will lead to those instruments which allow both of your choices.
If you want to get all instruments, choose "all" and leave the sample environment empty.

Experiment types:

- ☐ All
- ☑ Structure
- ☐ Dynamics
- ☐ Surfaces and Interfaces
- ☐ Imaging
- ☐ Element Composition of Materials
- ☐ others

Any of these sample environments needed?

Detailed search with criteria chosen above >

Show the list of instruments selected so far >

Output:

Search results

22 instruments found

Instrument short name	Instrument name and link to instrument homepage	Facility and link to its homepage (location at the facility), operator
DMC	Cold neutron powder diffractometer DMC	PSI SINQ (SINQ guidehall, guide RNR12), Paul Scherrer Institute, ETH Zuerich
DN-12	DN-12 spectrometer	FLNP (IBR-2 pulsed reactor), FLNP JINR
D10	Four-circle diffractometer with three-axis energy analysis	ILL (Institut Laue Langevin), Institut Laue Langevin
HRPT	High Resolution Powder diffractometer for Thermal neutrons	PSI SINQ (SINQ target hall, thermal beam 1RNS41), Paul Scherrer Institute
EPSILON-MDS 7A-E	High resolution strain/stress diffractometer EPSILON-Multi-Detector-System	FLNP (Beam 7A), Christian Scheffzuek, GeoForschungsZentrum Potsdam (Germany) and JINR Dubna (Russia)
SKAT 7A-T	High resolution texture diffractometer	FLNP (Beam 7A), University of Freiburg (Germany)
D1A	High resolution two-axis diffractometer	ILL (Institut Laue-Langevin), Institut Laue-Langevin
D20	High-intensity two-axis diffractometer with variable resolution	ILL (ILL), ILL
5C2	Hot Neutron Four-Circle Diffractometer	LLB (5C2), LLB (CEA-CNRS)
IN1	Hot neutron IN1-TAS, IN1-BeF	ILL (ILL5, level C), Institut laue-Langevin
D9	Hot-neutron Four-circle diffractometer	ILL (Institut Laue Langevin), Institut Laue Langevin
D22	Large dynamic range small-angle diffractometer	ILL (ILL22/H512), Roland May, Charles Dewhurst, Bruno Demé
D11	Lowest momentum transfer & lowest background small-angle neutron scattering instrument	ILL (ILL7/ H15), Peter Lindner, Ralf Schweins
G6-1	Micro	LLB (G6-1), LLB (CEA-CNRS)
SANS-I	Small angle neutron scattering facility SANS-I	PSI SINQ (SINQ guidehall, guide RNR16), Paul Scherrer Institute
SANS-II	Small angle neutron scattering facility SANS-II	PSI SINQ (SINQ guidehall, guide RNR12), Paul Scherrer Institute, Risoe National Laboratory
YuMO	Small-angle neutron scattering spectrometer YuMO	FLNP (4-th beam line IBR-2), FLNP, JINR
D3	Spin Polarised Hot Neutron Beam Facility	ILL (ILL), ILL
SALSA	Strain Analyser for Large and Small engineering Applications	ILL (H22 thermal guide), T.Pirling, G.Bruno
6T2	Thermal Four-Circle Diffractometer	LLB (6T2), LLB (CEA-CNRS)
PUMA	Thermal three-axis spectrometer	FRM II (FRM-II), University of Göttingen/TU München
VIVALDI	Very-Intense Vertical-Axis Laue Diffractometer	ILL (Institut Laue Langevin), Institut Laue Langevin

D10:

Instrument short name	D10
Full instrument name	Four-circle diffractometer with three-axis energy analysis
Location at facility (building/guide)	Institut Laue Langevin
Operating institution	Institut Laue Langevin
Link to the instrument homepage in the website of the facility	http://www.ill.fr/YellowBook/D10/
Instrument type	Diffractometer - Single crystal
Instrument description	The three-axis diffractometer D10 is unique in being the only four-circle diffractometer with optional energy analysis as on three-axis spectrometers. It also possesses a unique four-circle cryostat for temperatures as low as 0.1 K, a small area detector, and offers high reciprocal-space resolution and low intrinsic background, to medium real-space resolution. It is intended primarily for conventional structural and magnetic crystallography, detailed study of modulated structures, quasielastic scattering and diffuse scattering.
Equipment for the sample environment	In the four-circle mode, the offset C-shaped Eulerian cradle can be equipped with unique helium-flow cryostats (1.6 K to 450 K, or 0.1 K to 10 K in dilution mode), or a hot-air furnace (up to 1000 K), both with full four-circle accessibility. A double-mirror furnace (up to 1800 K in air, in argon, or in vacuum) can be used with access to at least a quadrant of reciprocal space. In the two-axis mode, all standard ILL cryostats, furnaces, pressure cells and cryomagnets can be mounted with computer control of the double-axis tilt stage to allow limited out-of-plane access. Computer control of the temperature is possible for all standard cryostats and furnaces, and of the magnetic field for all standard cryomagnets.
Instrument parameters	**Sample state** Single crystal Polycrystalline solid Powder Thin film **Structure** Q-range (Q = momentum transfer) or range of typical length scales (d) of the instrument from 0.18 to 9.6 1/Å **Dynamics** Energy transfer (E = ħω) range or Fourier time (t) range of the instrument. from 0 to 9.999 meV **Polarisation Analysis** **SAMPLE ENVIRONMENT** **Temperature**

	from	to	max. sample diameter
Continuous temperature range 1	1.6 K	450 K	0 mm
Continuous temperature range 2	0.1 K	10 K	0 mm
Continuous temperature range 3	295 K	1000 K	0 mm
Continuous temperature range 4	295 K	1800 K	0 mm
Continuous temperature range 5	1.2 K	300 K	0 mm
Continuous temperature range 6	295 K	2000 K	0 mm
Continuous temperature range 7	295 K	1400 K	0 mm
Continuous temperature range 8	0.05 K	300 K	0 mm

Pressure
Maximum pressure: 3 GPa
Uniaxial stress can be applied

Magnetic field

Detailed search:

Experiment Pathfinder

Find the instruments for your experiment

To get a list of instruments that you could use for a certain experiment, please enter in the first step basic information about the planned experiment.
We assume that you are looking for one instrument for one specific purpose, therefore combinations will lead to those instruments which allow both of your choices.
If you want to get all instruments, choose "all" and leave the sample environment empty.

Experiment types:

- ☐ All
- ☑ Structure
- ☐ Dynamics
- ☐ Surfaces and Interfaces
- ☐ Imaging
- ☐ Element Composition of Materials
- ☐ others

Any of these sample environments needed?

Detailed search with criteria chosen above >

Show the list of instruments selected so far >

Detailed search:

Experiment type

Structure:

Please select the typical length scales (d) or momentum transfer (Q) for your experiment:

From 0.5 to 10 Q, Å^-1 (alt.: d, Å)

☐ Polarisation Analysis

Sample state:

☑ Any
☐ Single crystal
☐ Polycrystalline solid
☐ Powder
☐ Liquid
☐ Gas

Sample environment: Pressure

Maximal pressure required 0.1 GPa

Is uniaxial stress required? No

Facilities:

☑ All

☐ ILL
☐ LLB
☐ HMI - BENSC
☐ FRM-II

☐ NPL
☐ FZ Jülich
☐ JEEP-II
☐ ISIS

☐ SINQ
☐ BNC
☐ FLNP, Dubna
☐ IRI

☐ NFL
☐ GeNF

Display instruments >

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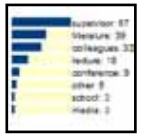
How can we attract new users and help them in the starting phase?



The New Users Survey: 100 users told us how they found method and facility and what they think about the access procedure

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What can we learn from the answers? What could be improved?

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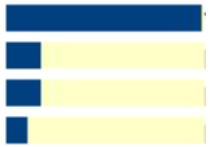
My ideas / Your ideas!

New Users Survey (May 2017)

At which stage did you plan or take part in your first experiment at DESY, HZB or MLZ? (Total: 69)

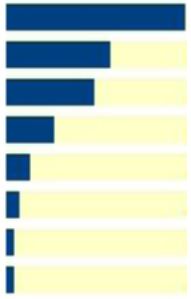
PhD Student: 30
Postdoc: 14
Senior Scientist: 10
Master Student: 8
Diploma Student: 4
Bachelor Student: 1
HiWi: 0

Do you come from a working group that has a tradition of working at large-scale facilities? (Total: 108)



Yes: 73
Do not work in working group: 13
Less than 3 experiments: 13
No: 8

How did you get the idea of using neutron and/or photons when you first started? (Total: 108)

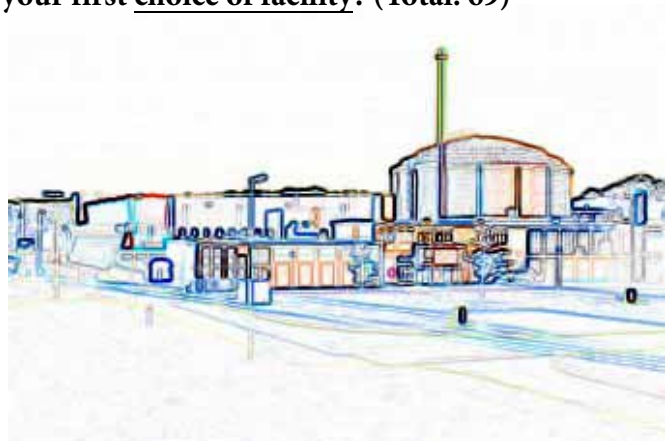


supervisor: 67
literature (scientific articles): 39
colleagues: 33
lecture: 18
conference: 9
other: 5
school: 3
media: 3

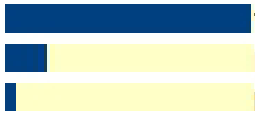
Other ideas: from beamline scientist, from scientific collaboration

Which criteria were most important for your first choice of facility? (Total: 69)

instrument type: 34
cooperation / personal contacts: 32
supervisor: 26
sample environment: 17
vicinity: 13
time: 11
lab: 11
cost: 6
work: 4
other: 3
Attendance of a course: 1
Other reasons: User support on site, future opportunities , best brillance, good reputation of beam line

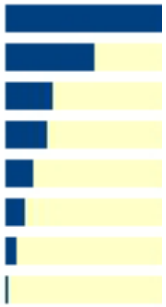


Do/Will measurements at large-scale facilities play a key role in your research? (Total: 108)



Yes: 88
I do not know yet: 15
No: 4

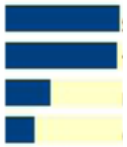
Which field(s) do you work in? (Total: 108)



Materials Sciences: 58
Chemistry: 32
Condensed Matter Physics: 17
Soft Matter Physics: 15
Other: 10
Life Sciences: 7
Geosciences: 4
Cultural Heritage: 1

Other field of work: Fundamental Physics with slow neutrons, Electrical Engineering, Detector development, Nuclear Physics, X-ray optics, QED, Femtosecond Photon Science, Biomedicine, Optics, Food technology

What is your impression of the access procedure at the relevant large-scale facilities? (Total: 108)



straight-forward: 43
takes some energy: 42
not yet: 17
course: 11

Which information sources were most important to you for preparing the proposal? (Total: 69)

collegues: 43
supervisor: 32
Instrument / Beamline Scientist: 30
Facility web sites: 17
User offices: 8
Does not apply to me: 4
Other web sites: 2
Others: 1

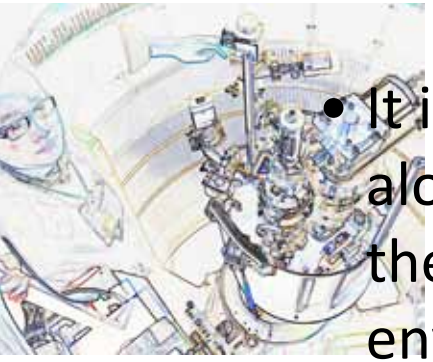
Other information sources: Articles, papers...

Do you have any suggestions on how to improve the access procedure to large-scale facilities? (Total: 69)

- Create a uniform application form for all facilities. Do not use Word or Word macros
- The experienced person, e.g. supervisor, plays the most important role for the new user, e.g. students. The experienced person can help us more efficiently, when they have collected more information and built richer contacts.
- Open statistics on available beamtime and chances of a proposal
- Application on a central European platform
- a fair review process
- Would be very useful to have more specific examples in the webpage about the applications of each beamline

- New users are mostly **PhD-Students or postdocs** (65%) from working groups with a **tradition** of working with photons or neutrons at large-scale facilities (70%).

- Working at large-scale facilites is mostly suggested by the **supervisor**. Also **literature, colleagues and lectures** play a role. Conferences, schools and media are of minor importance. For users who do not come from working groups with a tradition in the field, literature (scientific articles) is most important, followed by colleagues and schools.



- It is the **instrument type** that determines which facility is chosen, along with **cooperations or other personal contacts**. The advice of the supervisor comes next in the statistics, followed by the sample environment and the vicinity of the facility to the home institution. This is independent of the experience of the working group.

- Main information source for preparing the proposal: mostly **people**, such as colleagues, supervisor, instrument / beamline scientiststs. 12% relied mostly on the facility website and 6% on user offices.

- Personal contacts are most important for users
- Web resources are of minor importance
- Representation in the media has indirect impact (public / politicians > research funding etc.)

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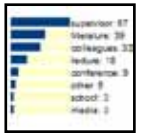
How can we attract new users and help them in the starting phase?



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What can we learn from the answers? What could be improved?

⇨

My ideas / Your ideas!

- How can the established pathways be used to reach more potential users?
- Which new ways are most promising?

Stages	Survey	established	new
Finding method	supervisor literature colleagues lectures	positions PhD programs lectures	-highlight applica- tions in new fields -symposia at topical conferences
Preparing proposal	colleagues supervisor beamline scientist faciliy website	contact persons cooperations of exp. / non-exp. users	-web pathfinder - beamline application examples (DB?)
Proposal	50% straightforward 50% takes energy standardisation transparency	standardisation	-European platform ?