

EUROPEAN SPALLATION SOURCE

Neutron Optics and Shielding

Phil Bentley Group Leader

www.europeanspallationsource.se 13th November, 2013

Scope



- Summary of Charter Document (Aug 2012) in two lines:
 - Prepare technical solutions, generic methodology and standards for delivering high performance, low cost neutron beams (brilliance transfer and low backgrounds)
 - Provision of design, optimization, procurement and installation services for optical and shielding systems to instrument projects (under R. Connatser)

Horizon



- Provision of services for hot commissioning and beyond, i.e.
 - Identifying and correcting design flaws (debugging the systems)
 - Updating our methodology and standards
 - Repairing and/or replacing defective components
 - Upgrading instruments, designing for next set of instruments, etc
- Up to a half the cost of an instrument can be optics and shielding (c.f. high level risks outside project)
- 70% of TDR reference instruments are exposed to high energy background phenomena ("prompt pulse") due to long pulse source characteristics. Unacceptable backgrounds (100x) are typical (c.f. high level risks outside project)
- Small sample volumes
- Exciting science frequently involves weakly-scattering phenomena
- Focussing and backgrounds are our priorities

Methodology



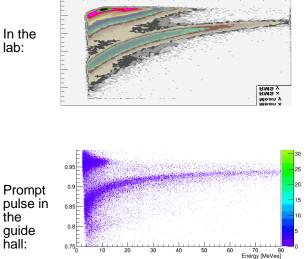
- The activities in the group are by definition cross-functional. Meeting performance criteria requires a coordinated effort.
- "...it is only through effective communication across all ESS design teams (Optics + Detectors + Targets and moderators + Accelerator) that ESS will achieve its objective to rank amongst the top neutron facilities worldwide"

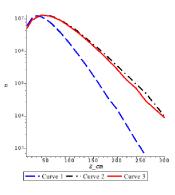
-Technical Advisory Panel on Neutron Optics and Shielding, August 2013





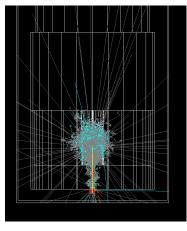


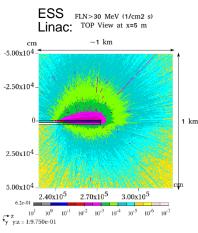




Shielding materials: laminate structures; copperbased (blue line); highperformance & cost-Effective alternatives to common steels (e.g. red line) and iron (black line)







L. Tchelidze, Accelerator Div.

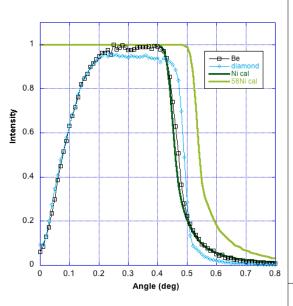
Modelling facilities, benchmarking models with measured data

Have PSI, SNS, ISIS and ESS models, some in multiple packages (need 2 packages on all)

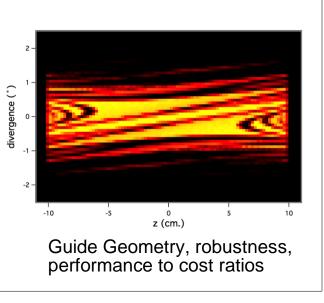
High energy nuclear physics: Study of key processes of high energy backgrounds over eV-GeV range

Scope

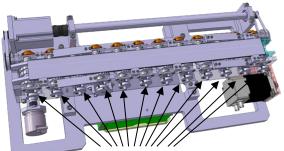




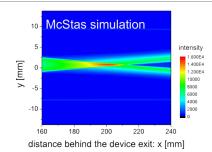
Alternative supermirrors with reduced gamma emission e.g. carbon-carbon (diamond-graphite), beryllium... Above shown only m=1, current work in going to higher m

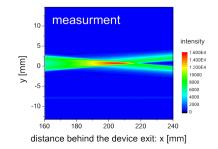


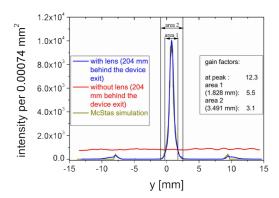
Adaptive Optics for focussing and alignment: **small samples**



12 camshafts to realize 16 different parabolic functions

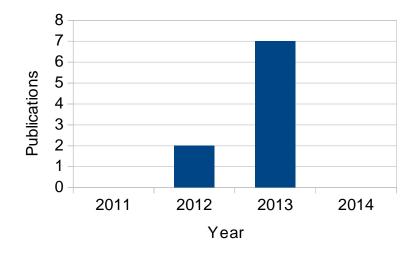






Scope





Total Number of Publications



Reduced overall costs Higher performance Lower backgrounds

Partners, Collaborators & Suppliers



























CFA HARVARD-SMITHSONIAN CENTER FOR ASTROPHYSICS













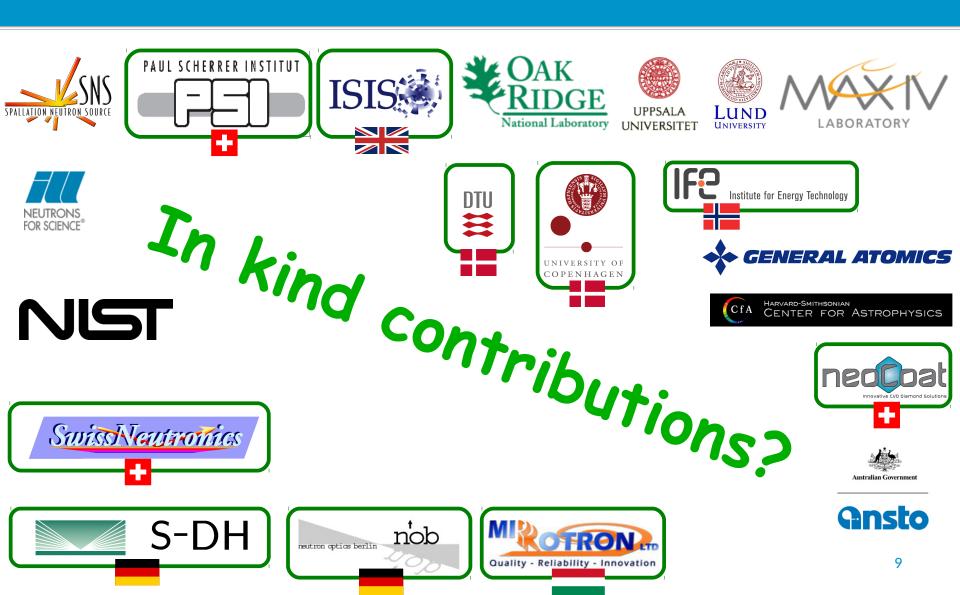






Partners, Collaborators & Suppliers





A Detailed Gantt Chart Exists...



EUROPEAN SPALLATION SOURCE

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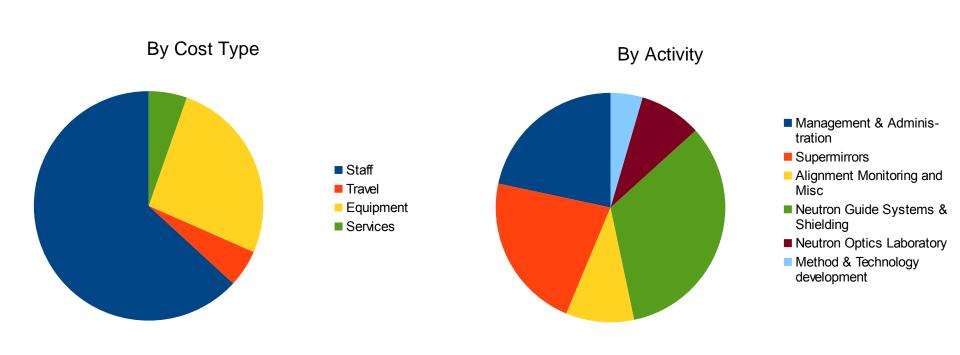
Key Milestones & Activities



	2014	2015	2016	2017	2018	2019	2020	2021	2022
In-house supermirror preparation)				
In House Supermirror Capability B	egins								
Adaptive Optics Preparation)				
ESS, SNS, PSI, ISIS BG Models)							
Instrument Cave Models Ready									
Facilities BG Models Ready									
BG Collimator Blocks & Beamstop	S								
Prototype shielding blocks demon	strated								
DBL LOS In Bunker)							
Compact Bender Tests									
Optics Lab Work PSI									۲. ۲.
Optics Lab Work In-House (for gu	de prep. & in	stallation)							۲ <mark>۲</mark>
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Cost Estimate: 8.7 M Euro

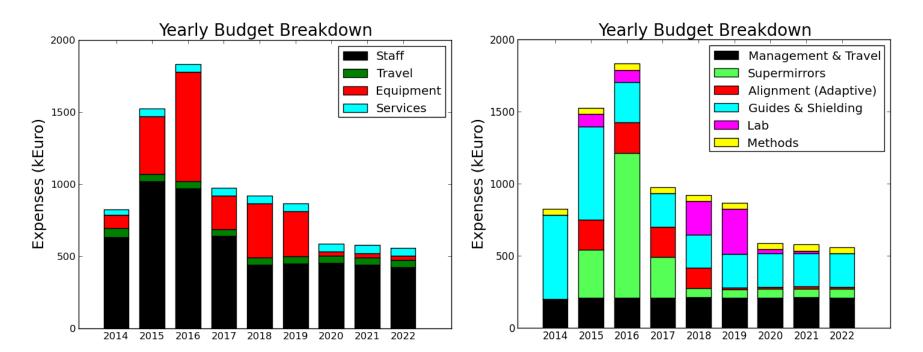




Cost Estimate

By Cost Type

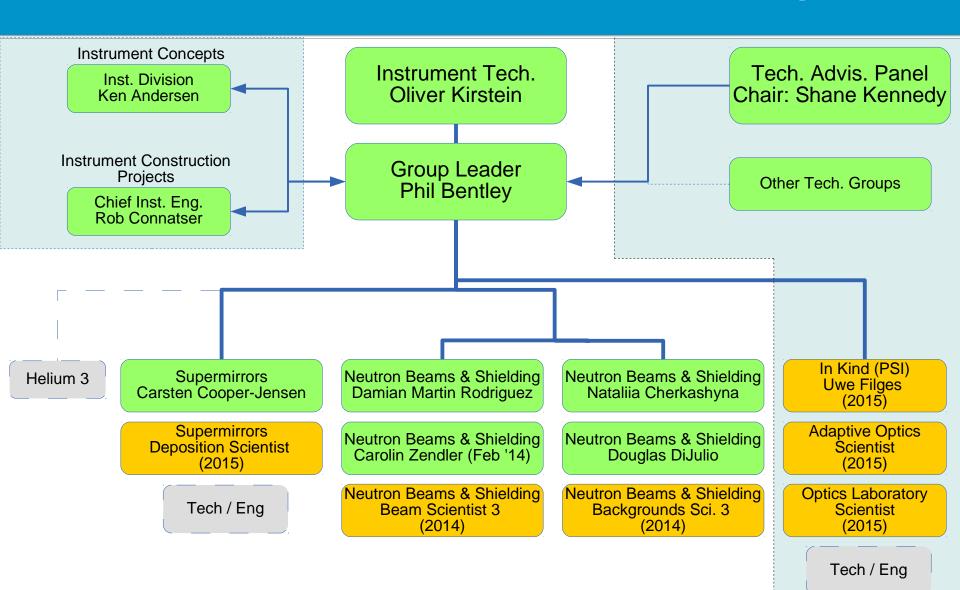




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Project Team Organisation

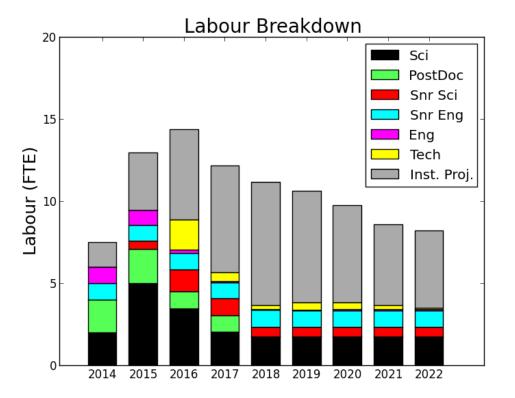




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Projected Labour

- Significant fraction of resources for future work is applied to instrument construction (gray bars)
- These roles are ideal in-kind opportunities for our partners

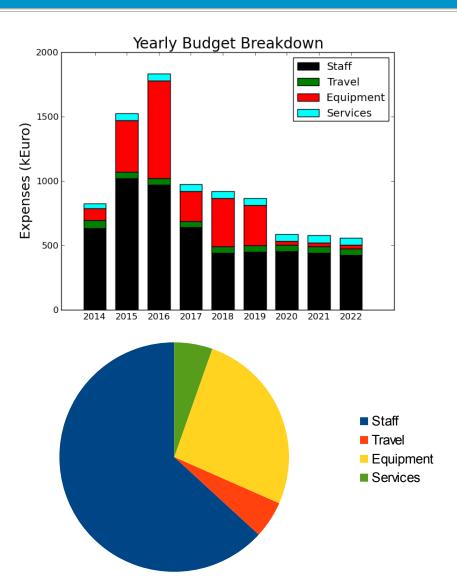




Main Conclusions



- Main cost driver for the project is labour
- Small quantity (25%) of budget is for hardware
- Labour is peaked during next 3 years



Risks and Mitigating Actions



- **Staff retention** is greatest risk to project. Staff development, morale, teamwork, and individual character are top priorities for the team. Cross training activities and knowledge transfer are important planned activities.
- **Technical risks are low**. Team members and collaborators bring methods and concepts from NASA & CERN, we simply apply these ideas to neutron scattering.
- Failure of these activities impacts at high level of ESS: instrument cost, schedule, performance & background. Optics and Shielding Group do not own these risks.

Role of Project & Interfaces



- Instrument concepts: **advisory and/or collaboratory** at the discretion of the instrument proposal team
- Instrument projects & in-kind optics/shielding work within instrument projects: propose solutions and contribute services. Technical work in instrument projects related to Optics and Shielding is delegated back.
- Instrument suite & quality control: **define and evolve standards** with our partners and stakeholders.
- Instrument backgrounds: coordinating facility-wide efforts in partnership with risk owner (K. Andersen), but some interfaces need improvement:
 - Communication, teamwork and trust across some interfaces require continuous attention.
 - Knowledge credibility from sources outside peer-reviewed scientific literature is an issue. (i.e. there is lots of good knowledge outside science literature, e.g. engineering, and it is essential we do not disregard it).
 - Cost-schedule-scope prioritisation

Next Six Months



- Detailed modelling and measurements of backgrounds at SNS, PSI, ISIS. These allow us to:
 - Finalise some new shielding concepts based on work at CERN and ISIS
- Launch 3 holistic shielding-optics activities in January with the aim of reducing the instrument costs significantly: line of sight vs performance vs total system cost





- Fantastic post docs have been brought into the team: extremely bright and motivated people.
- Productive collaborations are delivering
- One partner in particular (Uwe Filges, PSI) strongly aligned for significant in-kind contributions from Switzerland
- Technical risks within optics and shielding activities are low, with numerous fall-back options for the individual instrument projects.
- Optics and Shielding risks at higher level than this project (instrument backgrounds, cost) are significant. Stakeholders have a strong interest that these project activities should succeed