EUROPEAN SPALLATION SOURCE

Neutron Optics and Shielding

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Group Leader

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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

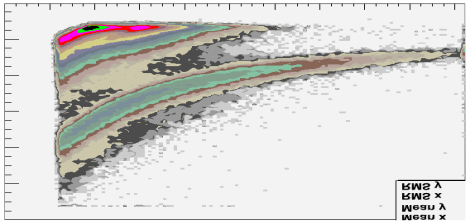
Methodology

- 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”

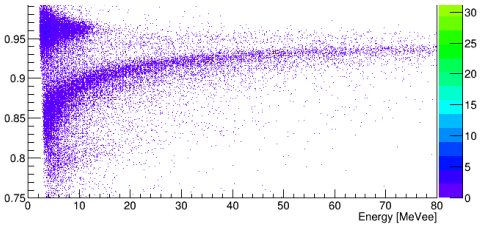
-Technical Advisory Panel on Neutron Optics and Shielding, August 2013

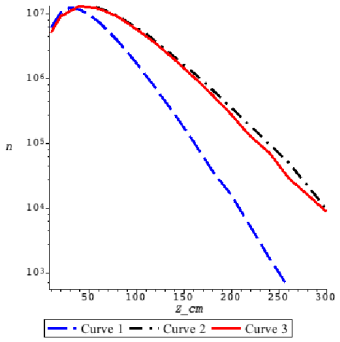
Scope

In the lab:



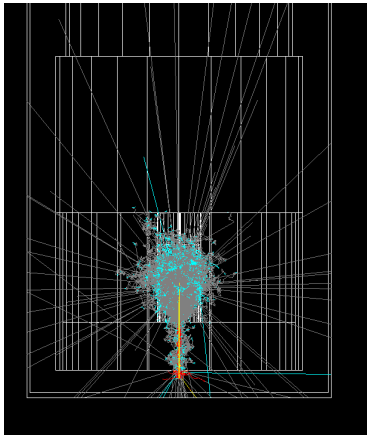
Prompt pulse in the guide hall:



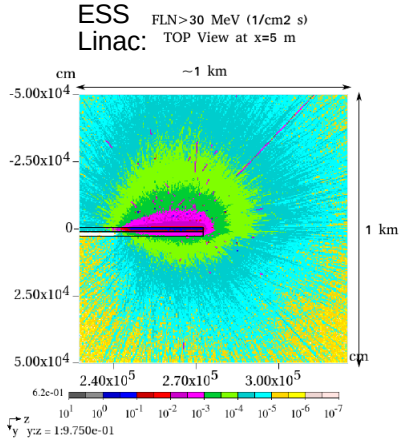


Shielding materials: laminate structures; copper-based (blue line); high-performance & cost-Effective alternatives to common steels (e.g. red line) and iron (black line)

PSI Target:



ESS Linac:



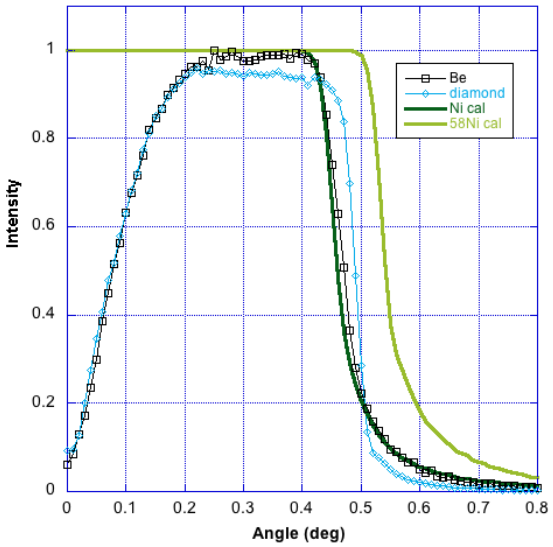
L. Tchelidze, Accelerator Div.

Modelling facilities, benchmarking models with measured data

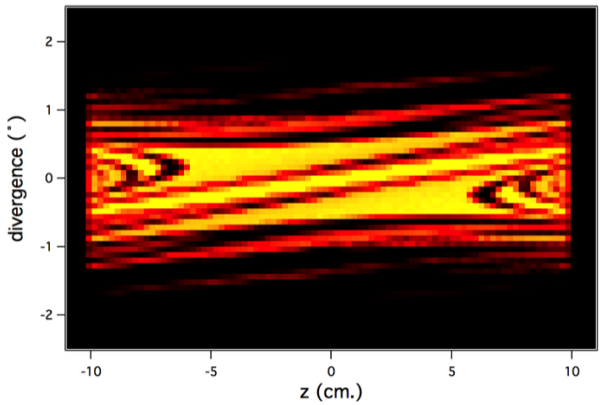
High energy nuclear physics:
Study of key processes of high energy backgrounds over eV-GeV range

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

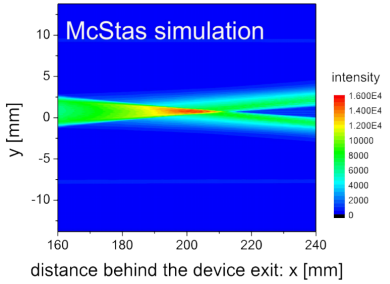
Scope

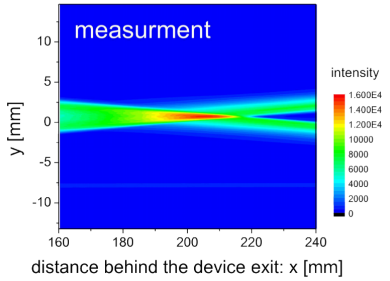


Alternative supermirrors with reduced gamma emission
e.g. carbon-carbon (diamond-graphite), beryllium...
Above shown only m=1, current work in going to higher m

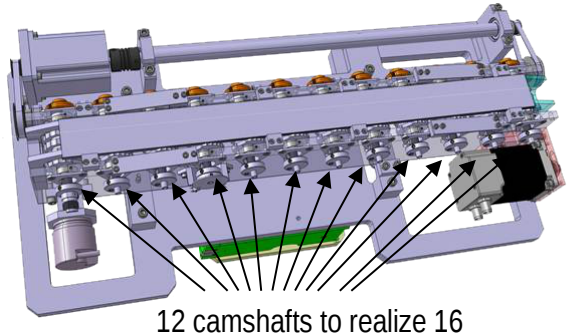


Guide Geometry, robustness, performance to cost ratios

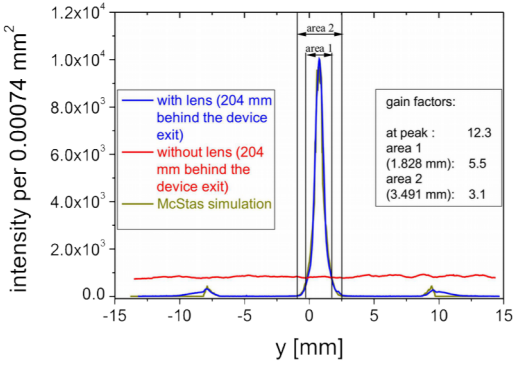




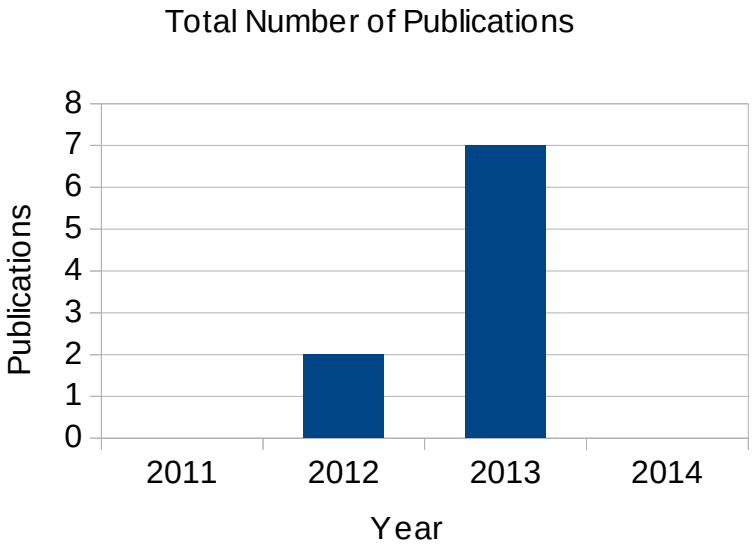
Adaptive Optics for focussing and alignment: **small samples**



12 camshafts to realize 16 different parabolic functions



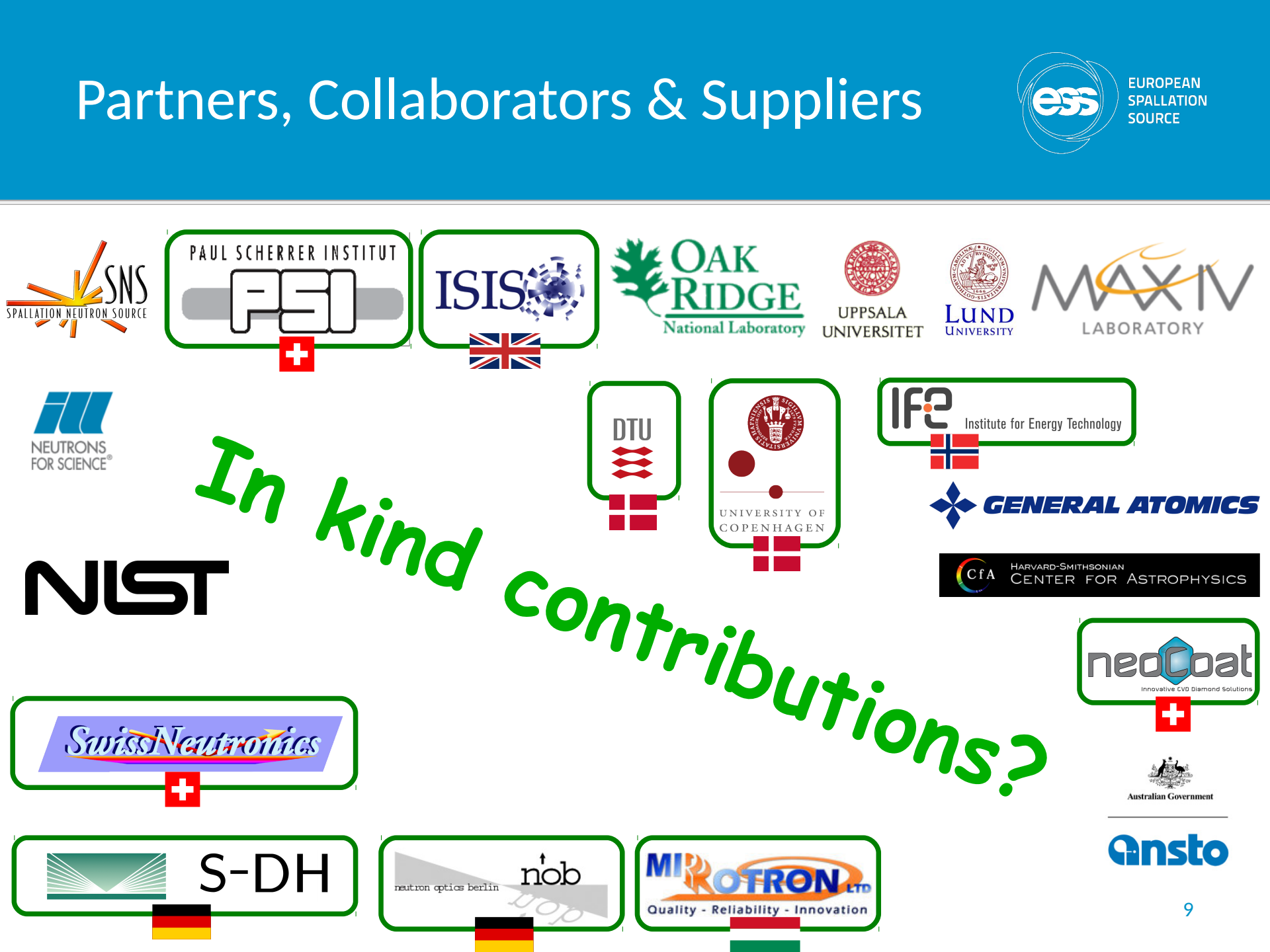
Scope



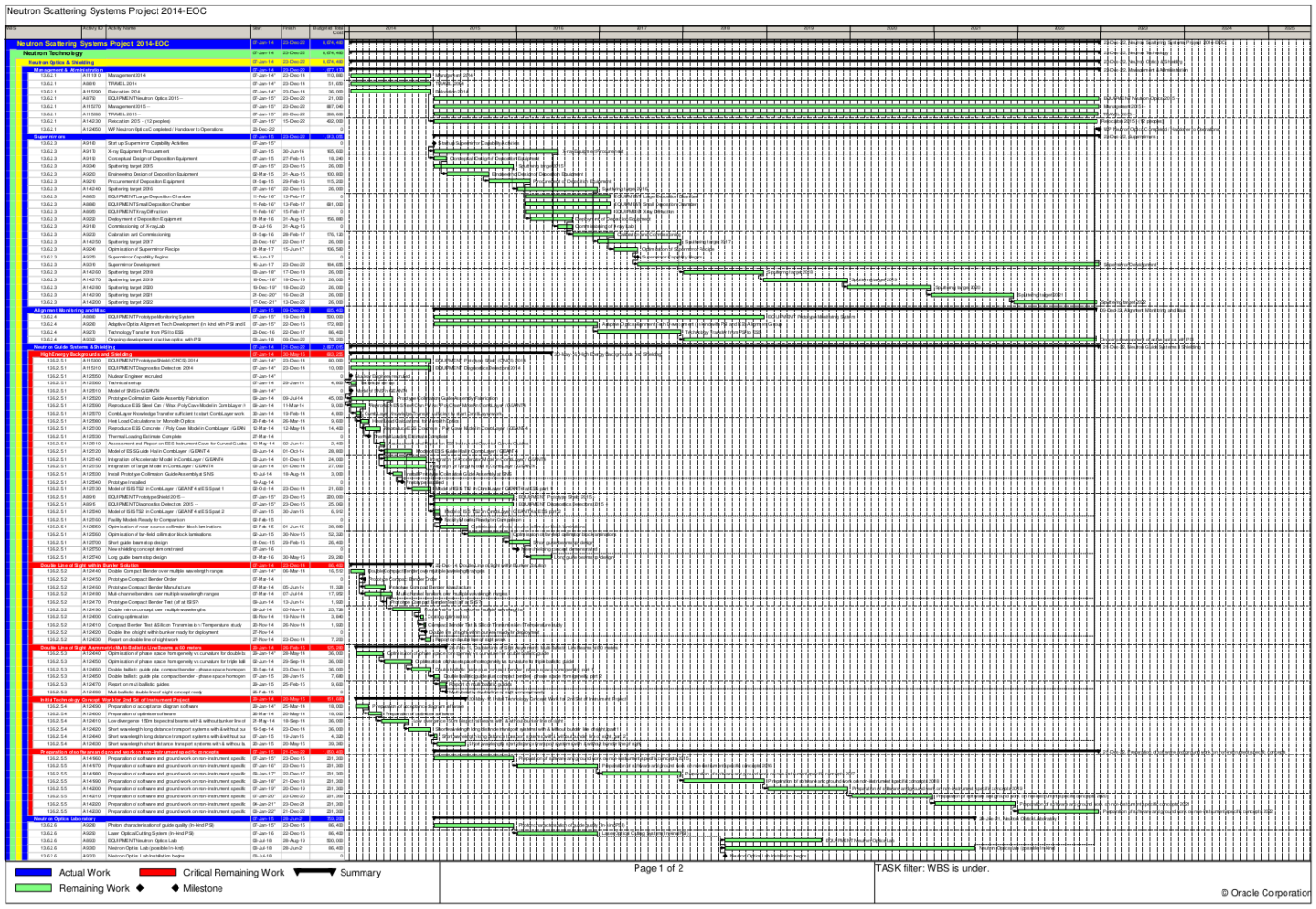
Reduced overall costs
Higher performance
Lower backgrounds

Partners, Collaborators & Suppliers

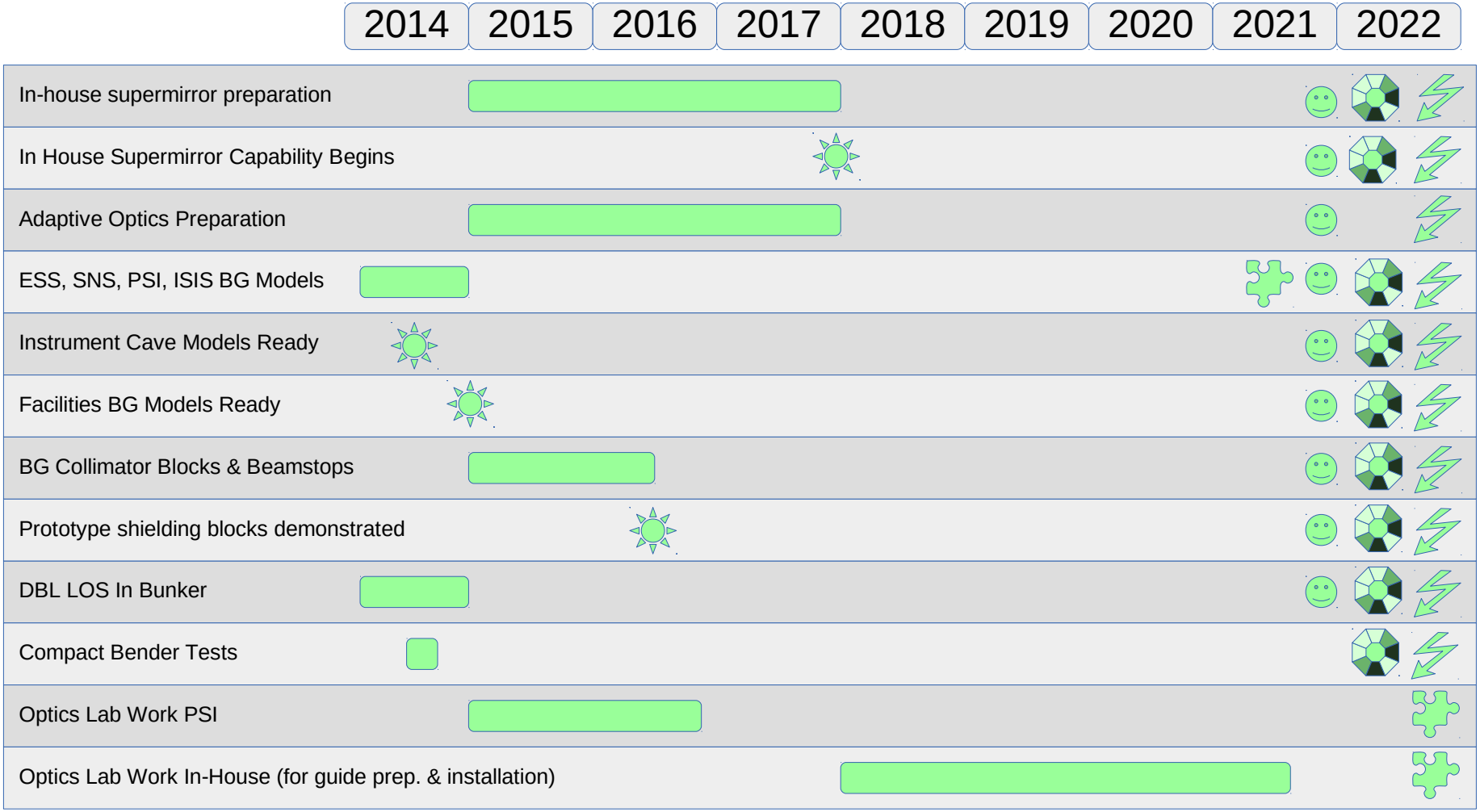
Partners, Collaborators & Suppliers



A Detailed Gantt Chart Exists…



Key Milestones & Activities



Cost Estimate: 8.7 M Euro

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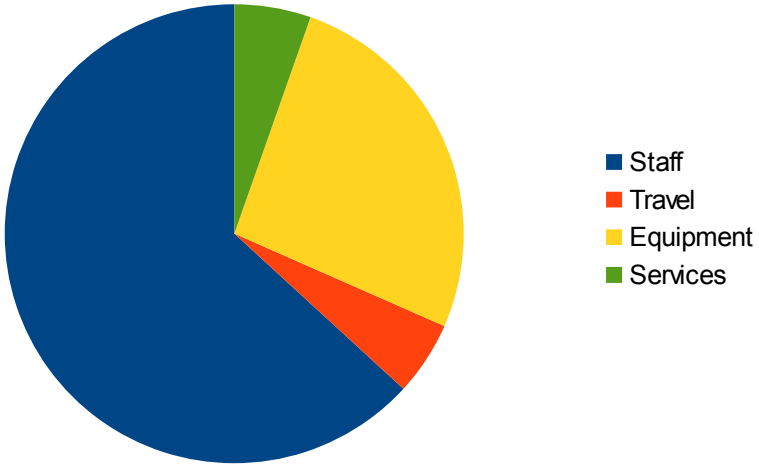
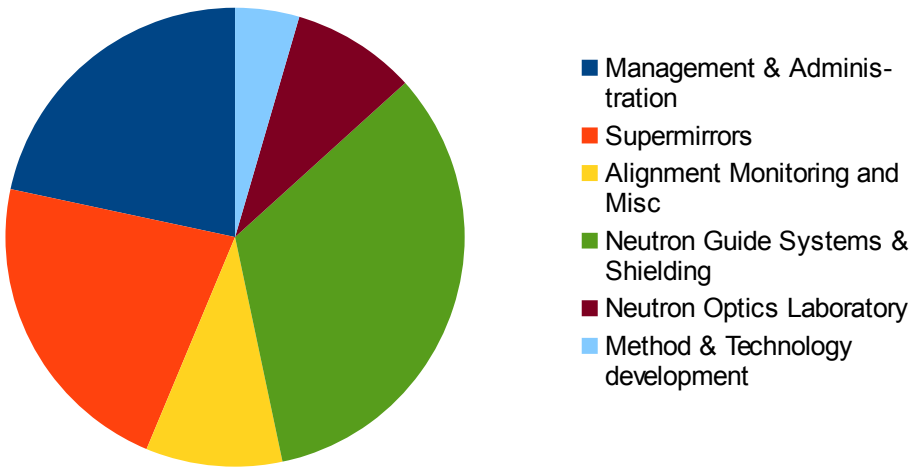
By Cost Type

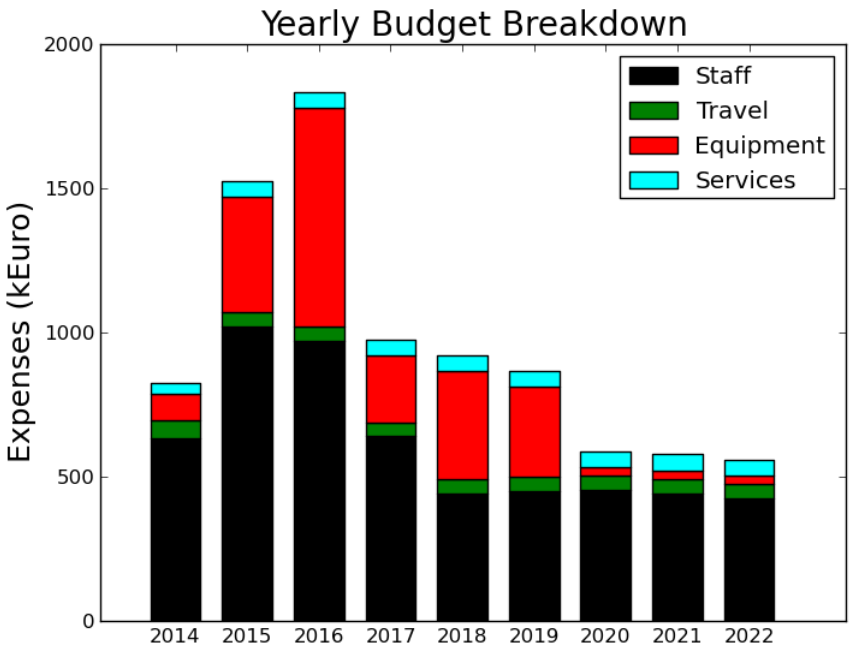


By Activity

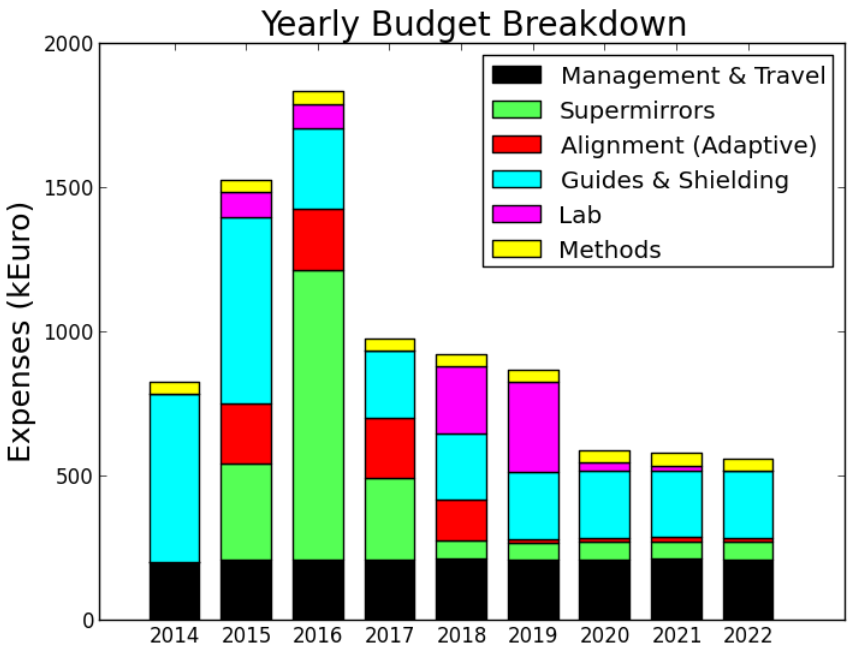


Cost Estimate

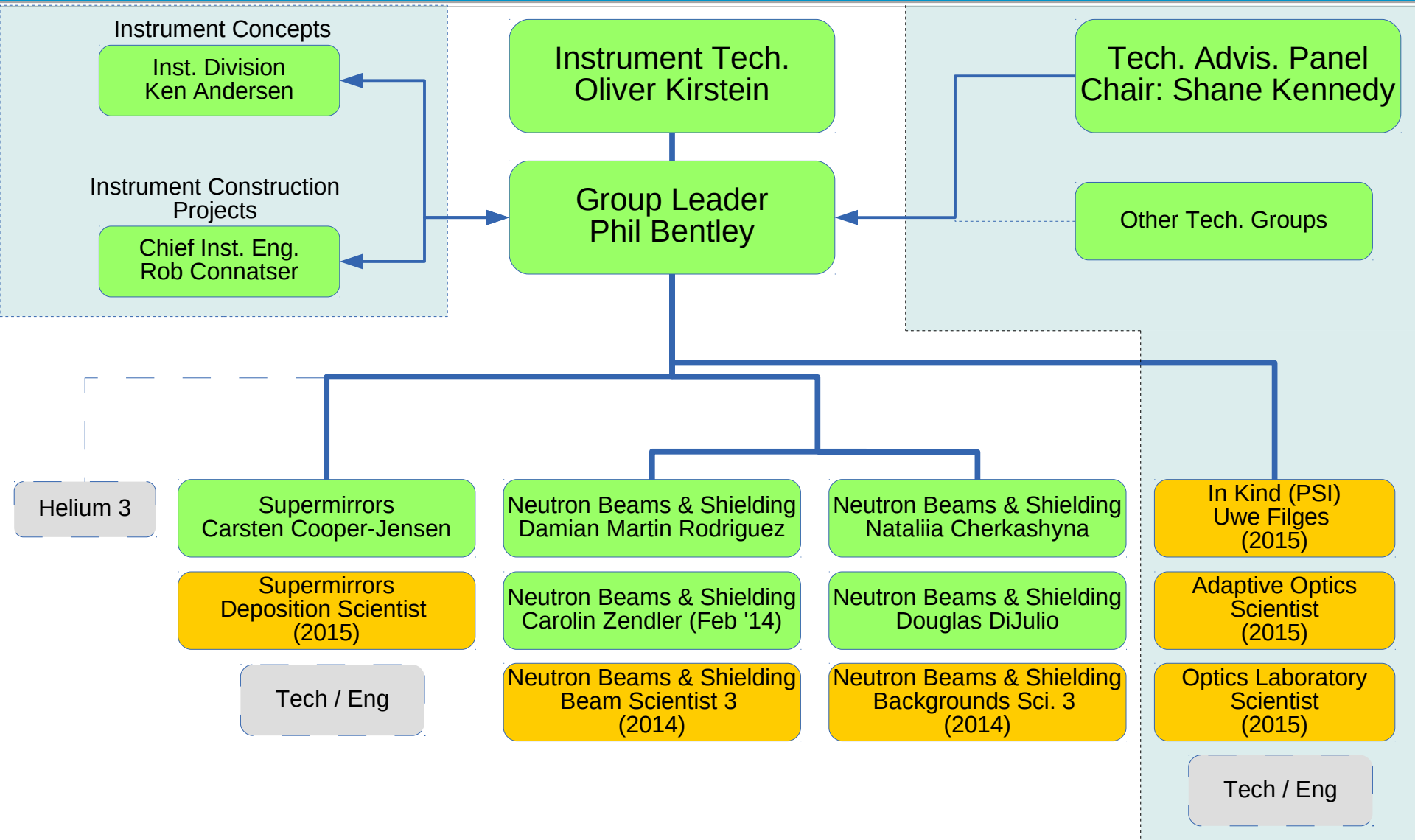
By Cost Type



By Activity

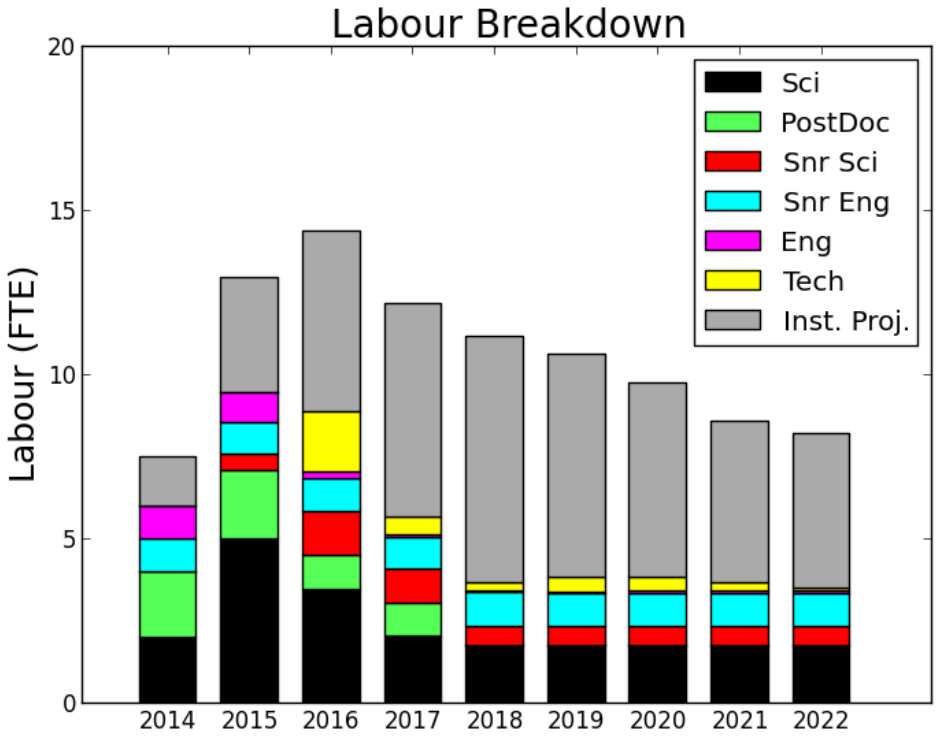


Project Team Organisation



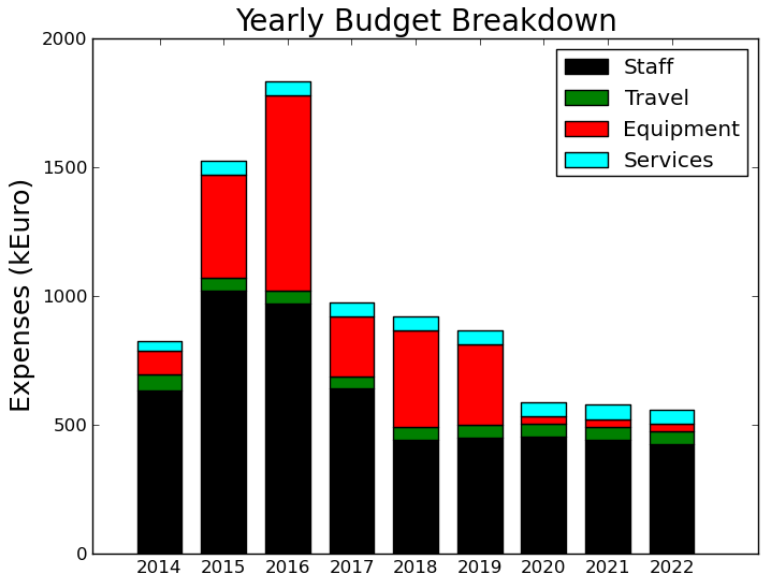
Projected Labour

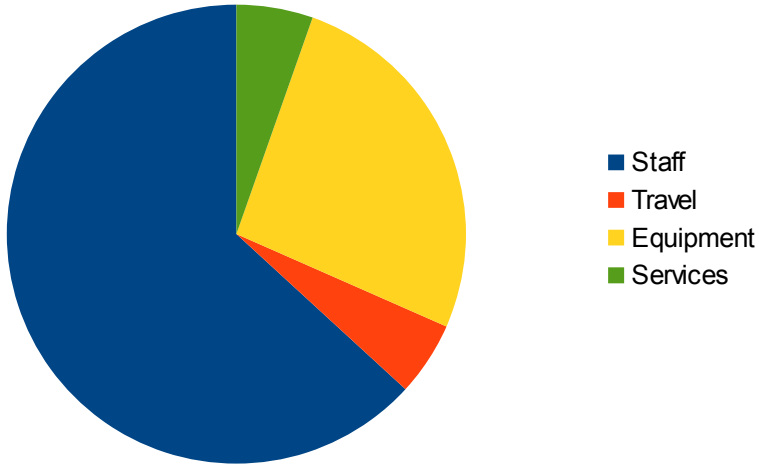
- Significant fraction of resources for future work is applied to instrument construction (gray bars)
- These roles are ideal in-kind opportunities for our partners



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

Summary

- 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