2014 LISE^{++} development

- Main features
- Fragment separator design
- Statistic from LISE^{++} site
- LISE^{++} development: past & present

- 2014 development: Organization charts

Main functions

- The main functions of the program:
  - predict the *fragment separator settings* necessary to obtain a specific RIB;
  - predict the intensity and purity of the chosen RIB;
  - simulate identification plots for on-line comparison;
  - provide a highly user-friendly graphical environment;
  - allow configuration for different fragment separators.

- The program is constantly expanding and evolving from the feedback of its users around the world.

- The LISE^{++} package includes configuration files for most of the existing fragment and recoil separators found in the world.

Main Features

Fast analytical calculations

(Monte Carlo calculations are available too)

Reaction mechanisms

- **Projectile Fragmentation**
- **Fusion-Evaporation**
- **Fusion-Fission**
- **Coulomb Fission**
- **Abrasion-Fission**
- **Two-body reactions *(kinematics)***

Highly user friendly environment

Built-in help support

Ion charge state distribution calculations

Range and energy loss in material calculations

Contribution of secondary reactions in the target

Fragment production in Material

Different selection methods

Optics calculation

Built-in powerful tools

- **Physical Calculator**
- **LISE for Excel**
- **Nuclide and Isomeric states* Databases utilities**
- **Relativistic Reaction Kinematics Calculations**
- **Curved degrader calculation**
- **PACE4 – evaporation MC code for Windows**
- **The spectrometric handbook of J.Kantele & Units converter**
- **Codes "Global" & "Charge" (charge state distributions)**
- **Range optimization utility**
- **"Brho" analyzer, Solenoid (Twinsol)* & ISOL-catcher* utilities**
- **Transport envelope packet package**
- **"Evaporation" calculator**
- **…..**

Types of transmission calculations in LISE++

- "Distribution" (analytical) method

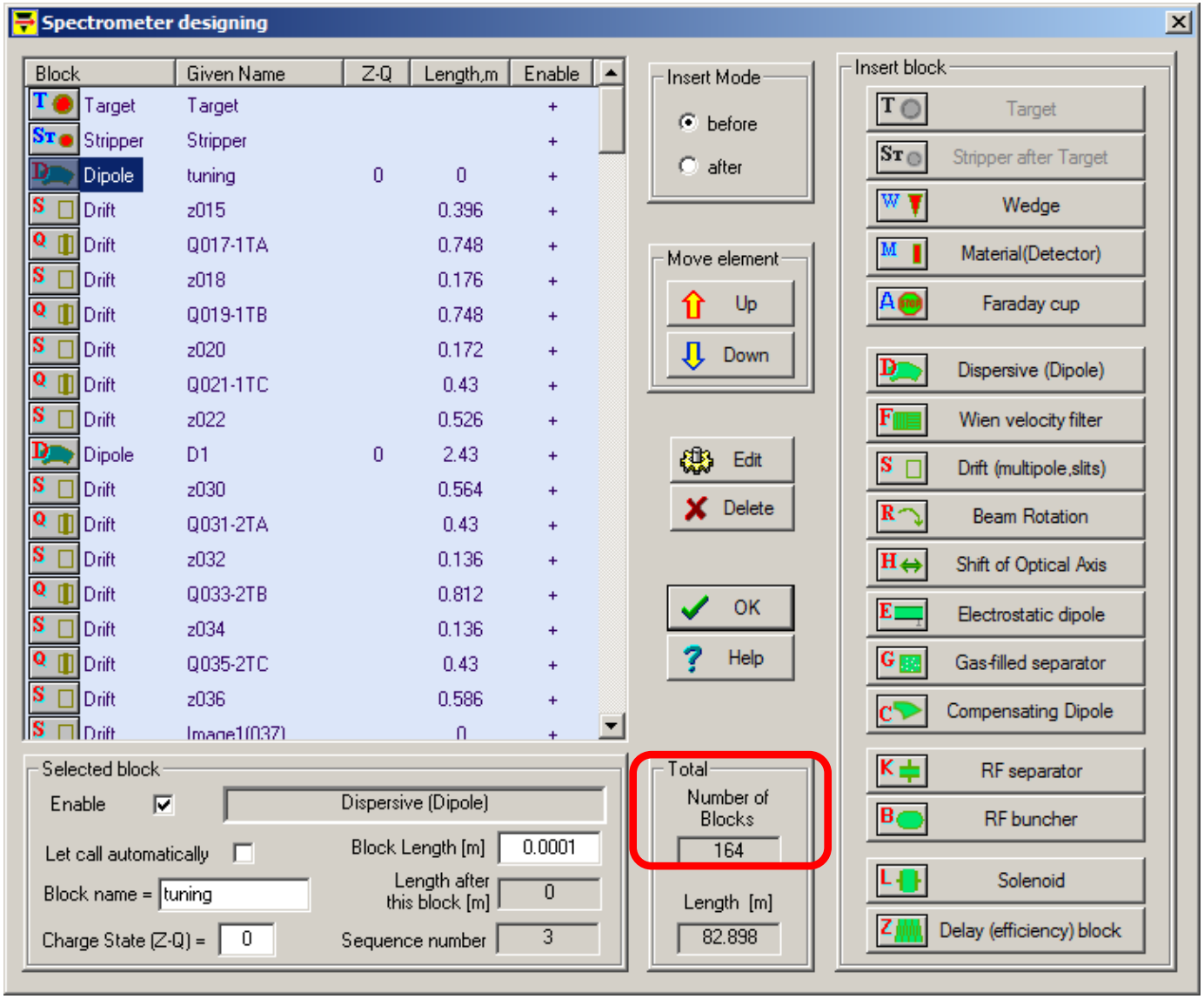
  - Fast calculations
  - All Optimization procedures in the code based on this method
  - Effective with segmented configurations for experiment planning
  - Calculation of low transmission

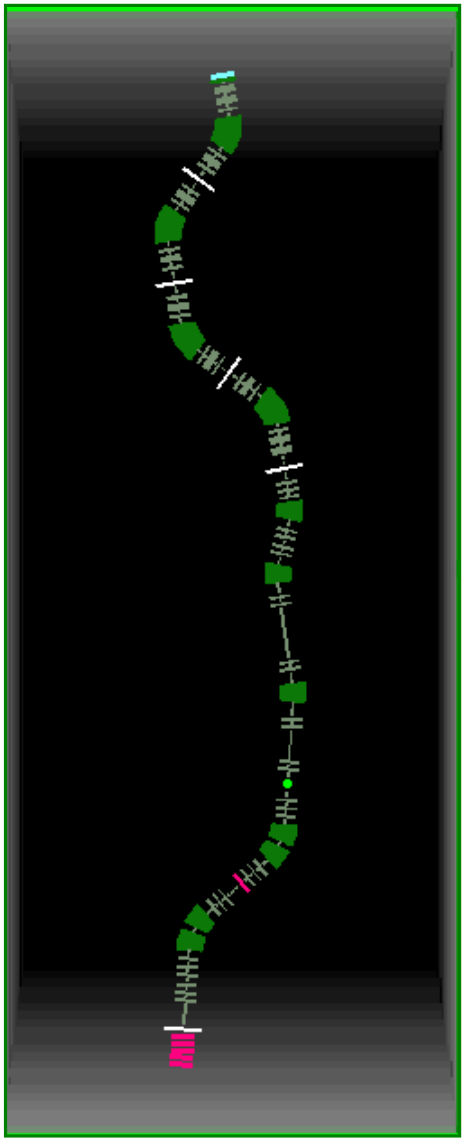
- Monte Carlo method: (from 2007)

  - Benchmark for the "Distribution" method
  - Detailed analysis of transmission with extended configurations
  - Possibility to use High Order Optics
  - Observation of correlations between different parameters of different blocks
  - Possible gates on different parameters
  - Good tools for understanding (learning) ion-beam optics issues
  - Effective for fragment separator design
  - Some optical blocks (Solenoid, RF buncher) are effective only in MC mode

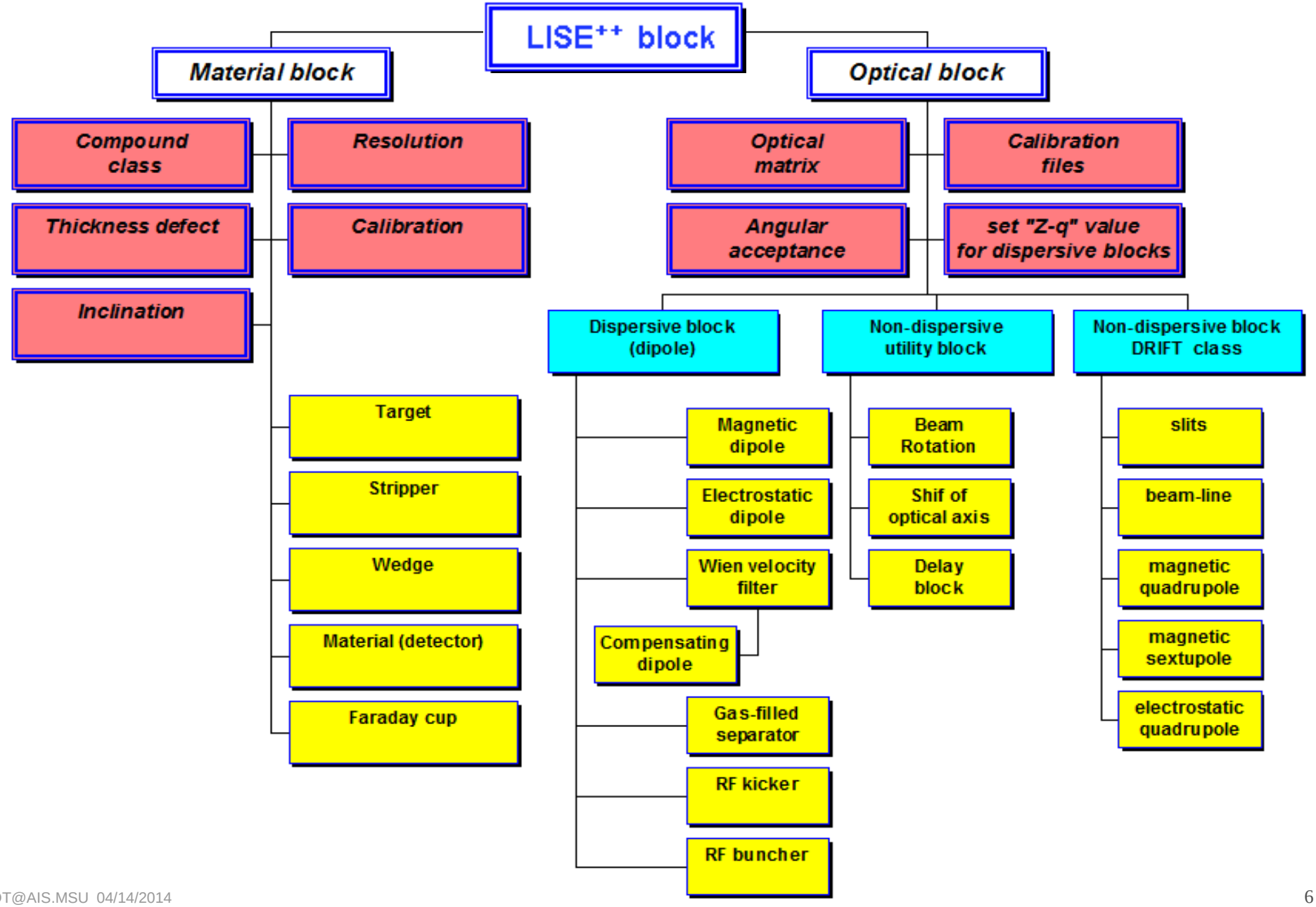
Fragment separator design using LISE++ Blocks

Configuration: A1900_S800BL_extended_LISE 2012 2nd order





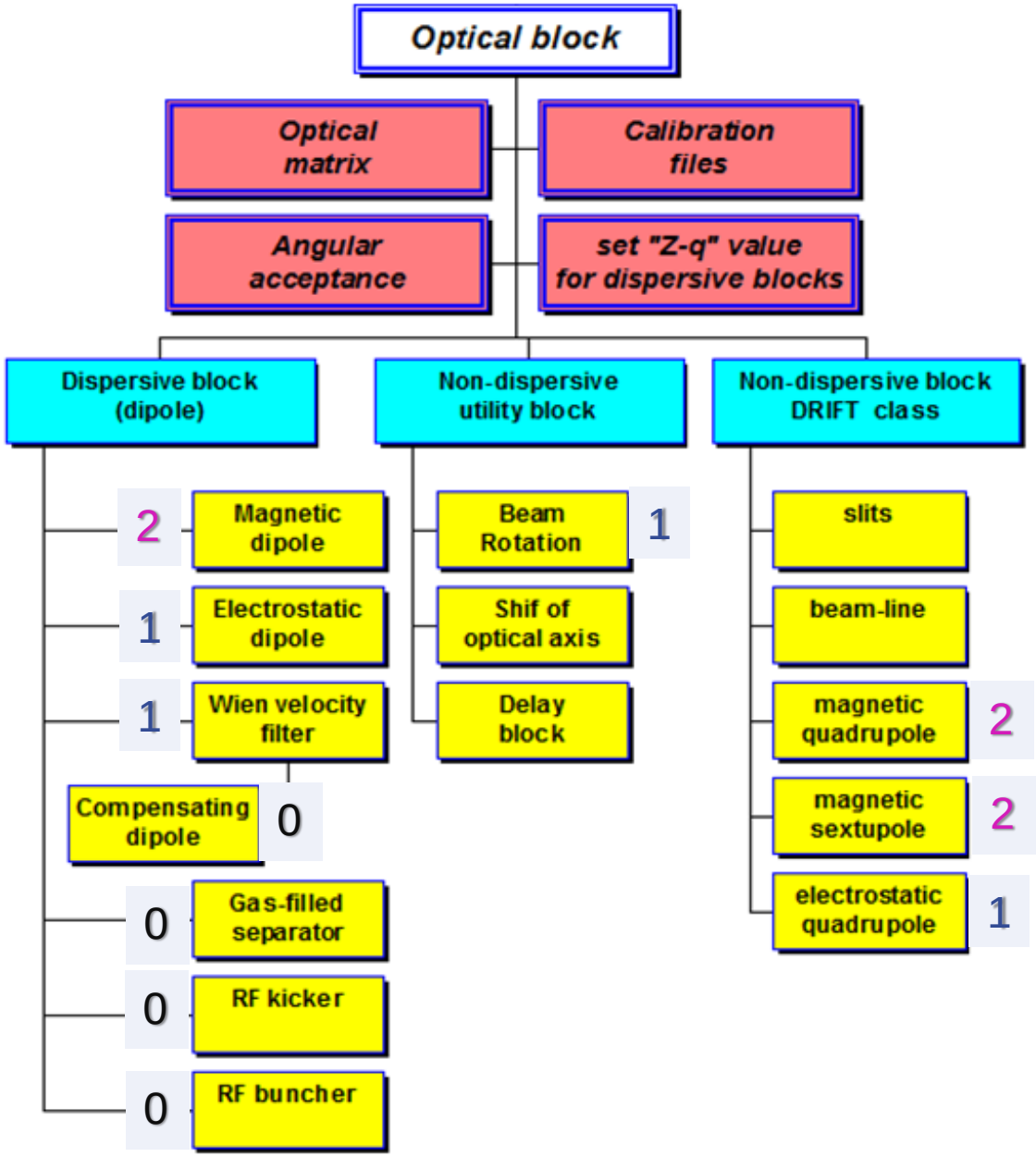
LISE^{++} block classification (2013)



LISE^{++} optical blocks (2013)

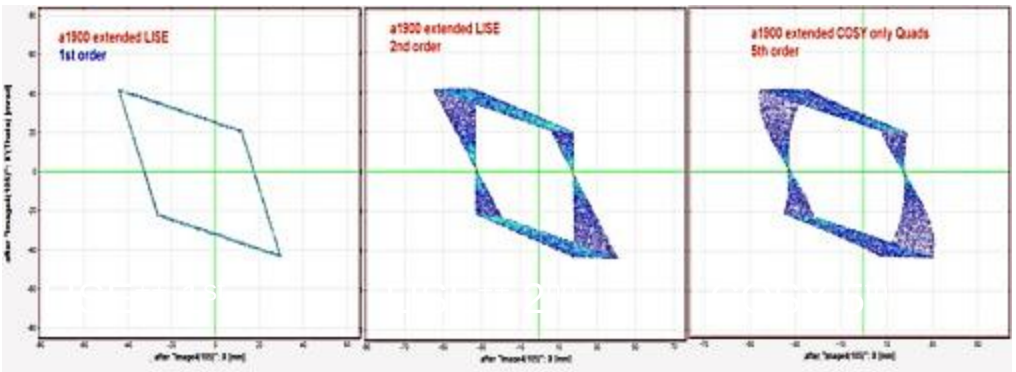
High order optics calculated by LISE^{++}

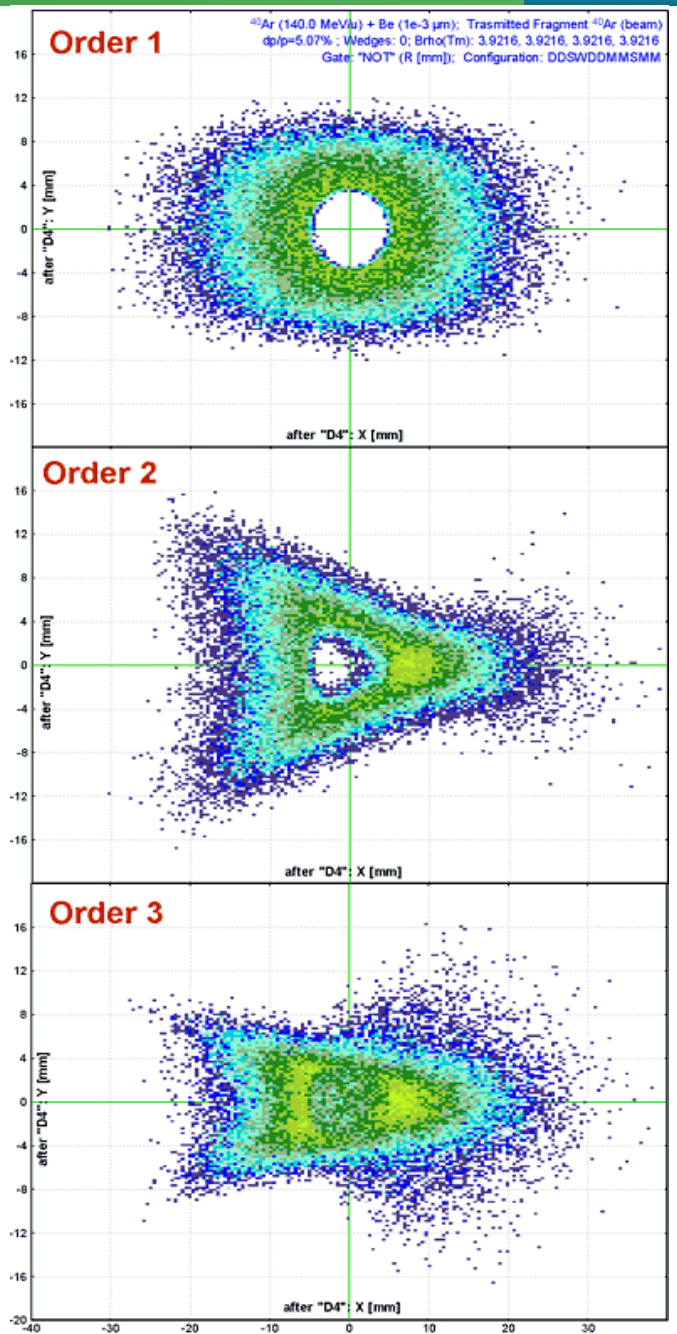
0 1 2



High Order Optics in LISE^{++}

- LISE^{++} is able to operate with 5th order matrices
- High order optics can be used only in Monte Carlo mode
- LISE^{++} can calculate 1st and 2nd order matrices based on the Transport formalism
- Higher matrices can be loaded (or linked) from files prepared by the COSY code





Classical Segmented & Extended configurations : Pros & Cons

➢ Classical (segmented) configuration:

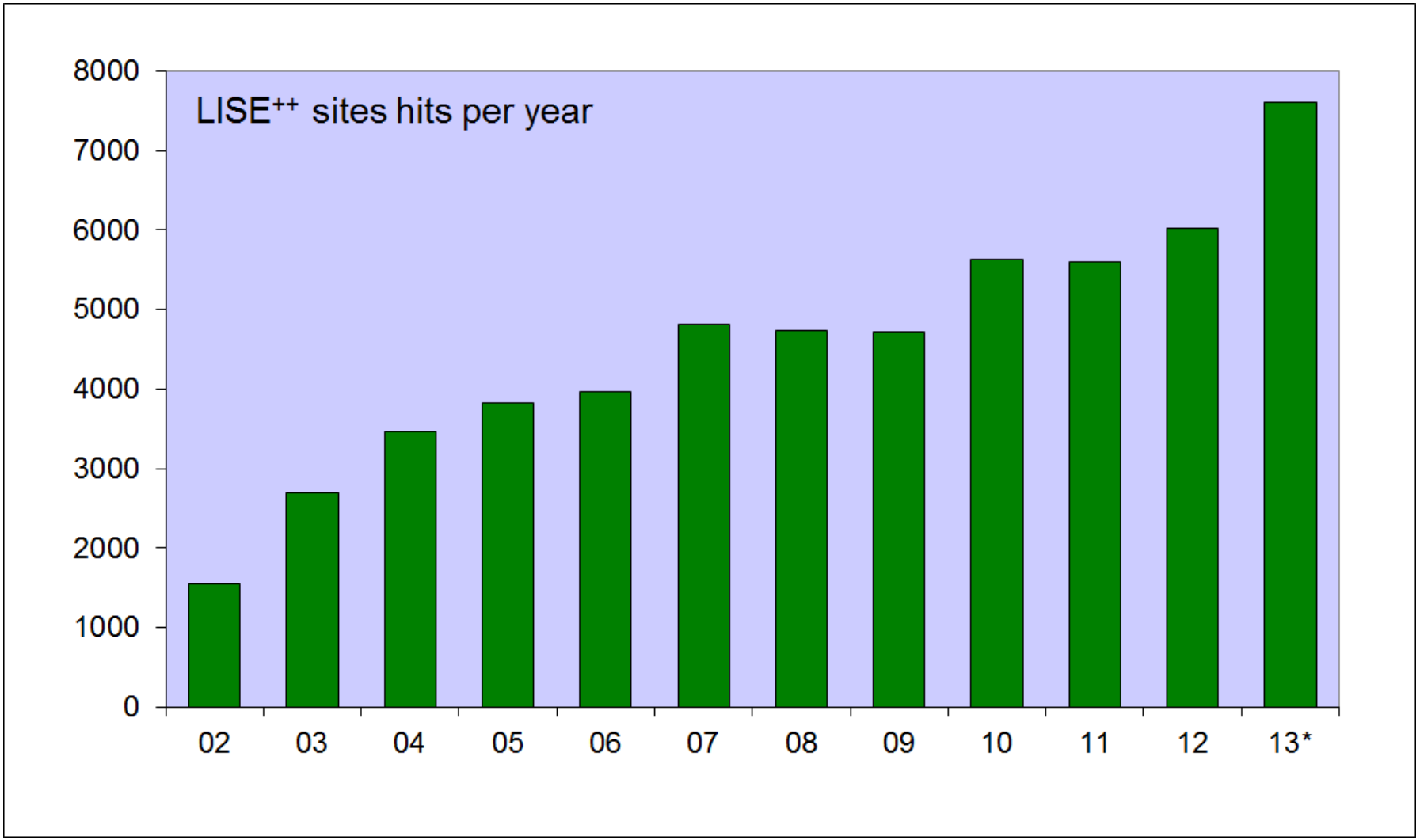
- Fast transmission calculations
- Simple structure
- Effective with analytical calculations for experiment planning

➢ Extended (elemental) configuration:

- Detailed analysis of transmission
- Optical matrices can be calculated in the code, and used in segmented configurations
- Tools to obtain angular acceptances, which can be used in segmented configurations
- Good tools for understanding (learning) ion-beam optics issues
- Effective with Monte Carlo calculations for fragment separator design

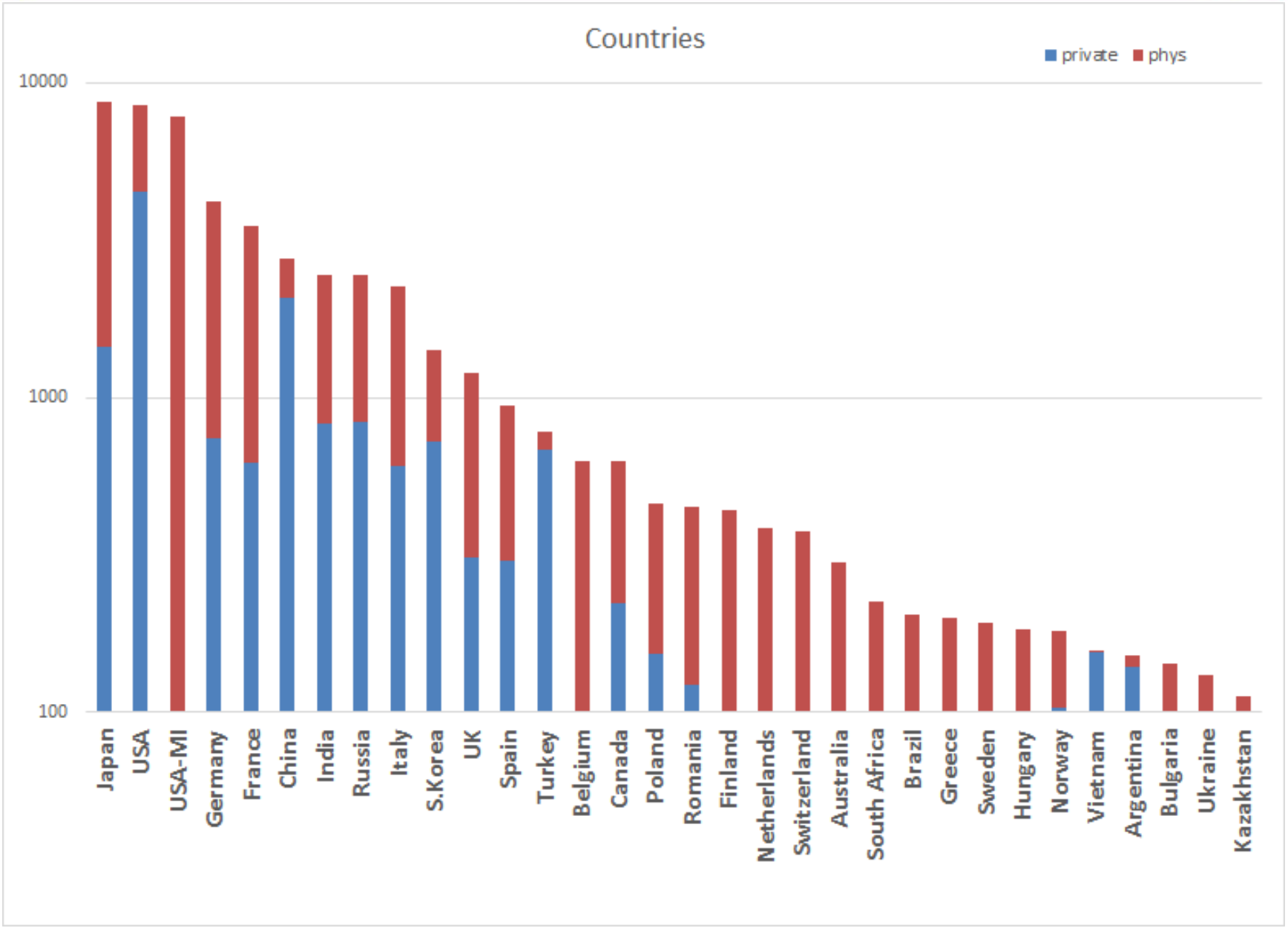
Statistics from LISE^{++} site

Statistics by year



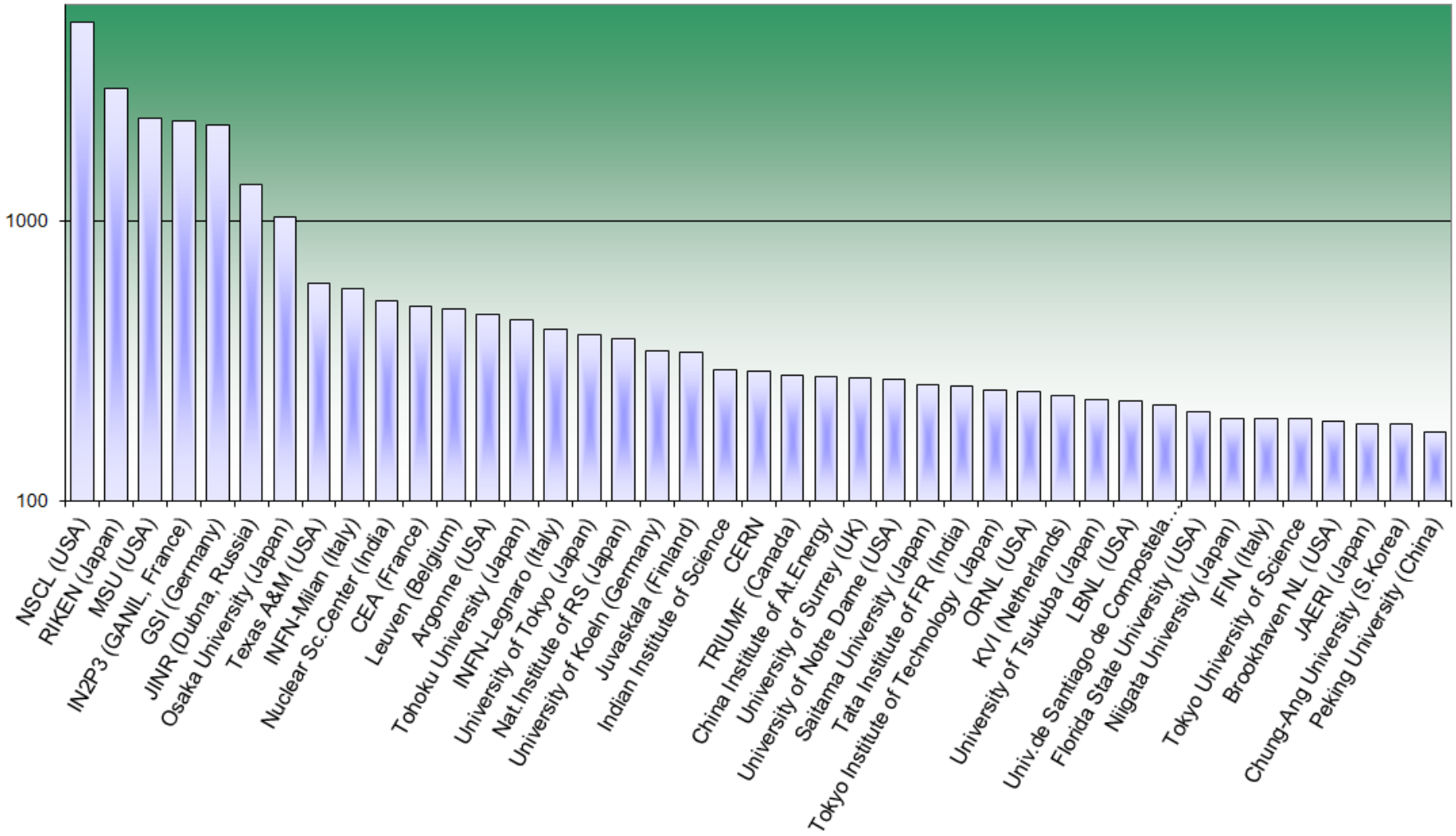
Becomes more popular

Statistics : country



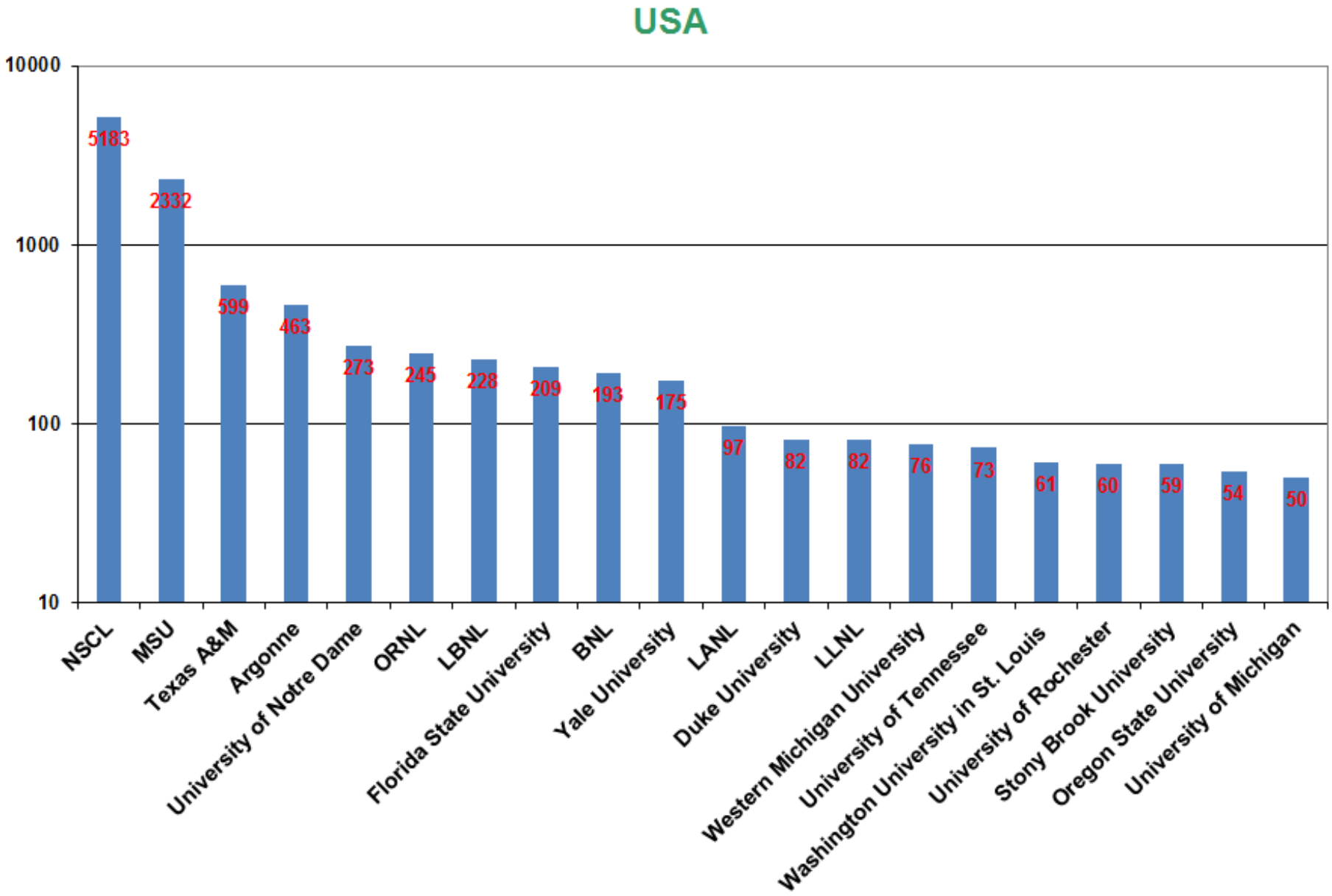
It is used not only in USA

Statistics : Laboratory



It is used not only in USA labs

Statistics : USA



It is used in different USA places: wide spectrum of energies, separators

LISE^{++} development : past & present

Current development strategy

High priority

- Bug fix (if still exist)
- Requests
  - FRIB fragment separator group
  - A1900 fragment separator group
  - FRIB “isotope” group?
- User support
- Tasks from the accepted high priority list
- Sufficient improvement of existent blocks

Low priority

- Requests
  - Outside
- Tasks from the accepted low priority list

Medium priority

- Documentation
- Requests
  - Local (MSU)
  - Collaborations
- Tasks from the accepted medium priority list
- Sufficient improvement of existent utilities

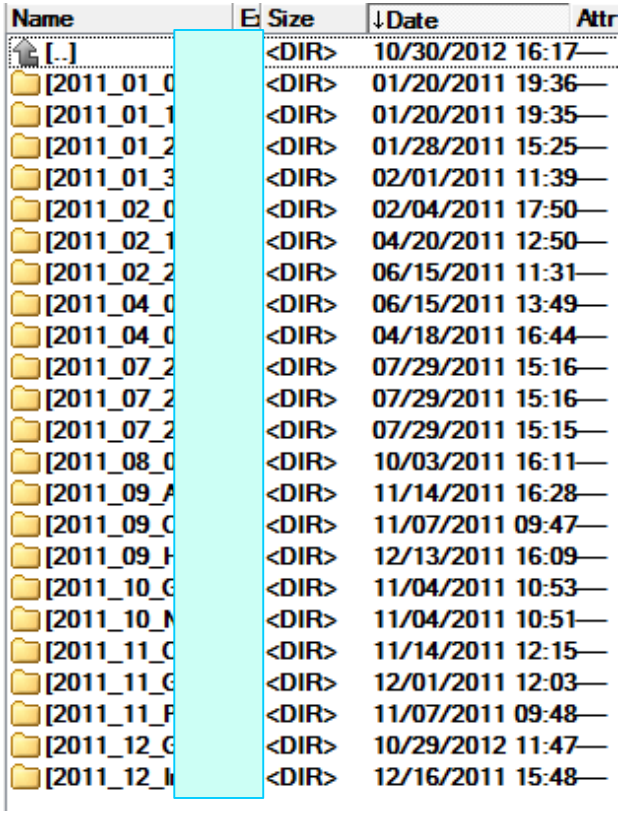
Strategy

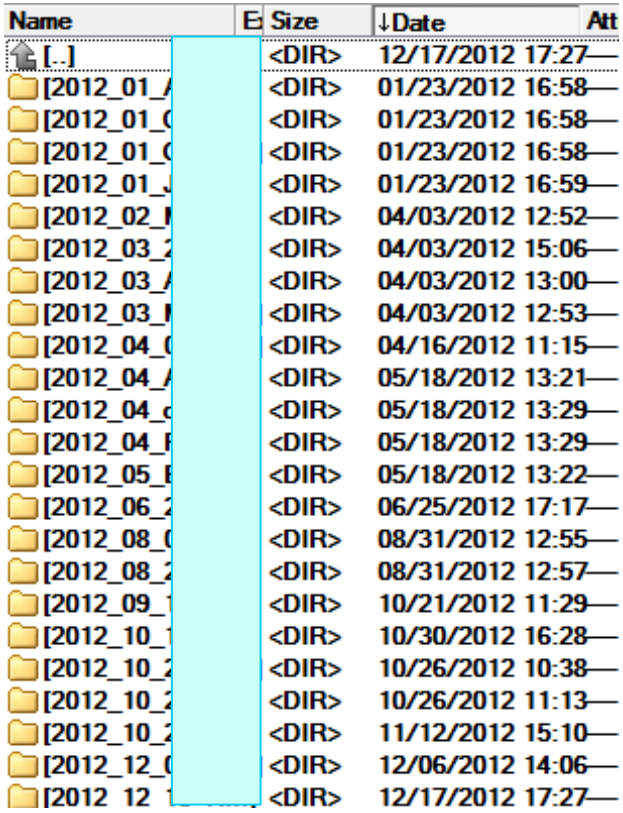
- Engage users in the creation and use of the extended configurations
- Do not create utilities based on outside requests, which wont be widely used

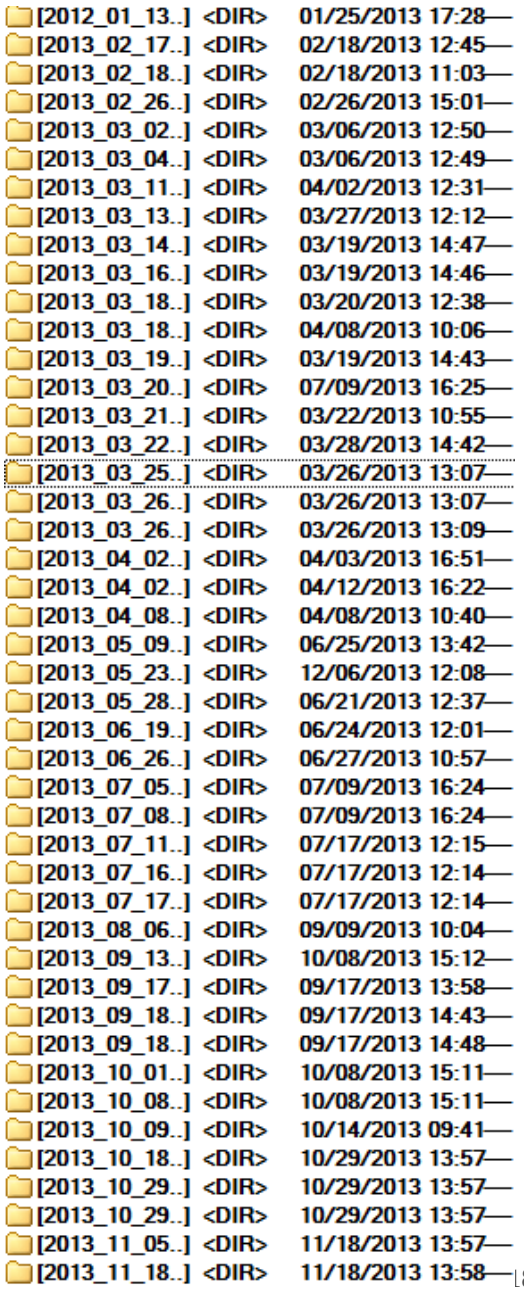
User requests, the code support : high priority

Evidently a lot of simple questions : version for MAC, why I could not produce it.. How to get that and so on..

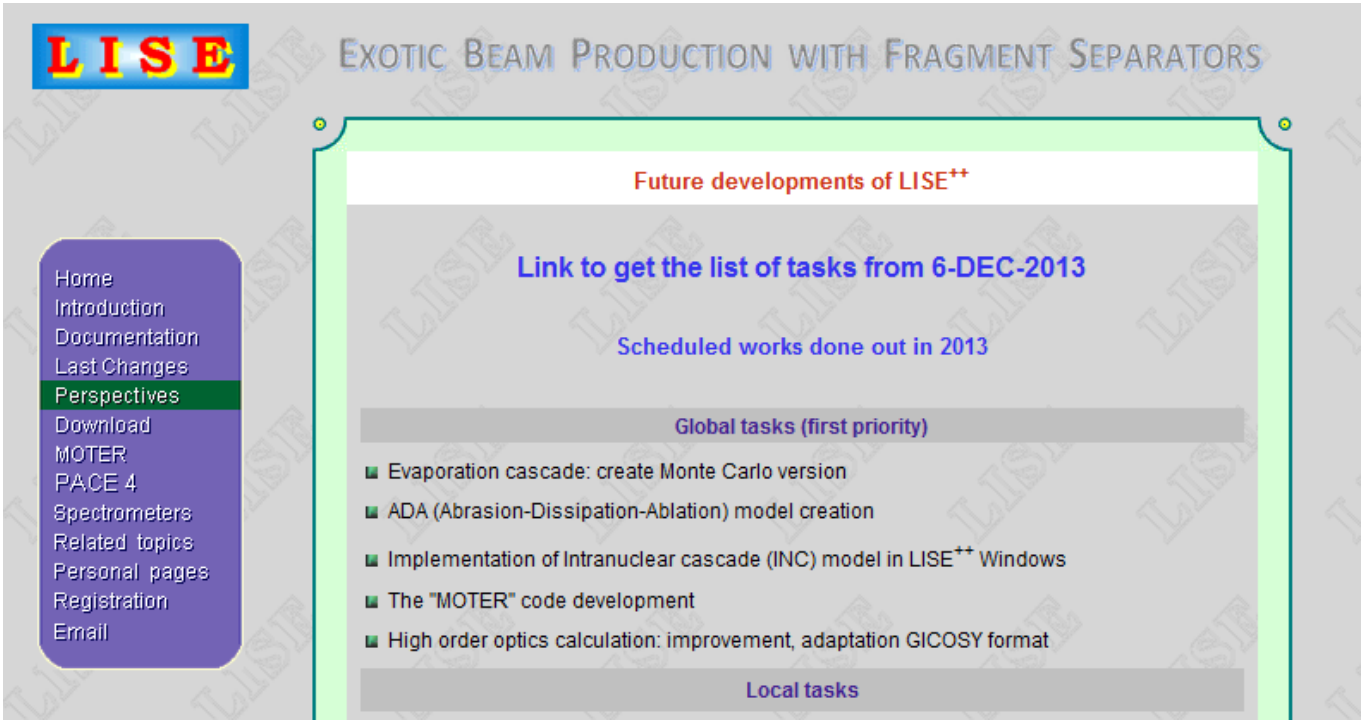
Serious requests: bugs, configuration questions-analysis-requests , questions-presentations on 10 pages,
then answer needs some power point presentation, LISE^{++} file







LISE^{++} site : current plans for future development



2013 LISE++ tasks : done

10/10/2013 7:05 PM

LISE++ development done

Subject	Priority	Status	new	Order	Time
LongTerm					
LISE for Mac EXCEL	high	done	X	1	1.5 weeks
Two-body reactions : user differential cross section - utilities	high	done	X	5.1	1.5 week
Two-body reactions : user differential cross section - using in transmission calculations	high	done	X	5.3	1 week
ShortTerm					
Help links from dialogs on the LISE++ site	high	done	X	2	2 days
Two or more locations for the MC output file	high	done	X	3.2	2 days
Input source of ions @ MC (A,Z,q,E,E*,dt,x,x',y,y')	high	done	X	3.3	2 days
Corrections in PACE4's Quantum-Mechanical mode	high	done	X	4	2 days
Two-body reactions : manually set excitation energy of fragment	high	done	X	5.2	3 days
Develop a subroutine to calculate a reduced dispersion for large values of dP/P	high	done		6.1	< 4 days
Improvement of existent blocks : Electrostaticx dipole, transport solution	high	done	X	6.2	< 5 days
Creation of Electrocstatic Quad (see Drift block)	high	done	X	6.3	< 3 days
New block : SHIFT (position & direction of optical axis)	high	done	X	6.4	< 3 days
MC Gates : A,Z,Q, A/q	medium	done		3.1	< 2 days
MC gates procedure optimization for speed	medium	done	X	3.4	1 day
Easy way to change the charge state option	medium	done	X		< 1 day
Beam and setting fragment charge state distributions @ selected point	medium	done	X		1 day
neutron channel in Two-body reaction in the "User Diff.CS" case	medium	done		7	4 days
Kinematics calculator: g, n	low	done	X	7.1	2 days

2014 LISE++ long term tasks

Subject	Priority	Status	new	Order	Time
LongTerm					
Evaporation cascade: improvement, create Monte Carlo version	high			1	1 month
Abrasion-Ablation: create Monte Carlo version	high			2	2 weeks
Abrasion-Fission: create Monte Carlo version	high			3	2 weeks
Abrasion-Fission: new analytical model. Calculations (CS, E*,TKE) are kept in files	high		X	4	1 month
Time in the distribution4 class (RF-buncher, RF-kicker)	medium		X		1-2 weeks
Custom shape degrader optimization in MC mode for high order optics	medium				< 2 weeks
Input angles in wedge in MC mode	medium				< 1 week
ETACHA implementation	medium				1.5 months
ADA (Abrasion-Dissipation-Ablation) model creation	medium				2 months
Implementation of Intranuclear cascade (INC) model in LISE++ Windows	medium				3 months
Minimization in LISE++ (light version -- only for quad fields)	medium				1 months
Minimization in LISE++ (TRANSPORT, MC, Ray tracing cases)	medium				2 months
Write full LISE++ documentation	medium				3 months
Ray tracing in LISE++	low				1 year
New compliler, New Shell	low				6 months
PACE4 generator of one event (creation dll-library)	low				< 1 week
PACE4 in MC LISE++ (using PACE4 dll-library)	low				< 1 week
The "MOTER" code development	low				1 year
Energy loss in PACE4	low				< 1 week
Three-body kinematics relativistic calculator	low				1 month
Water wedge procedure (wedge with one moving plane and filled by liquid)	low				< 2 weeks
Trochoidal Mass Separator	low		X		1-2 weeks
Calculation of composition from time of isotope implanted in detectors	low		X		1-2 weeks

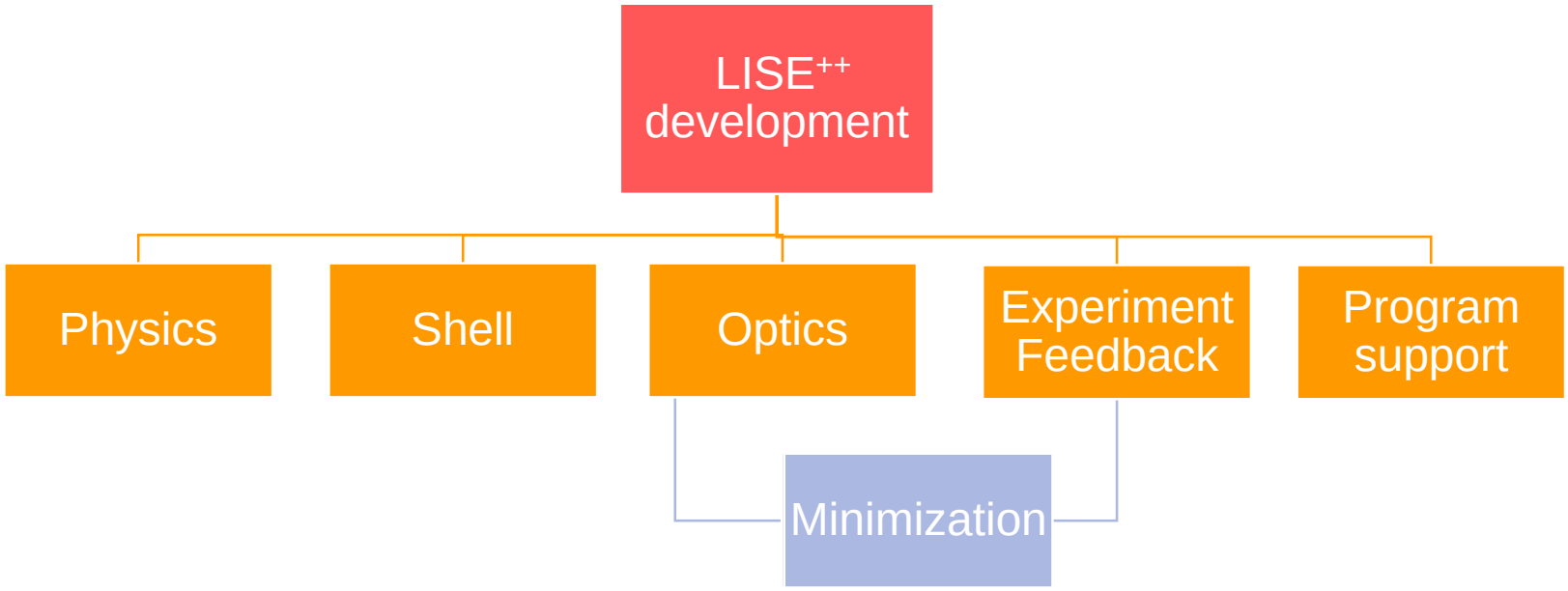
2014 LISE++ short term tasks

Subject	Priority	Status	new	Order	Time
ShortTerm					
Superposition Quadrupole and Sextupole fileds in LISE++	high		X	1	< 2 days
Improvement of existent blocks : Compensating dipole	high		X	2	< 5 days
MARS fragment-separator & Compensating dipole	high		X	3	< 5 days
Improvement of existent blocks : gas-filled dipole	high		X	4	< 5 days
Gas-filled dipole : rays-tracing mode in MC	high		X	5	< 5 days
Gates for analytical solutions (like done for MC)	medium		X		< 2 days
Cross section for stripper	medium				< 2 days
Create possibility to Insert a material before the target	medium		X		2 days
Rutherford scattering of the primary beam (transmission)	medium		X		< 2 days
User database: import, edit, plot	low				< 5 days
Wedge (including curved profile wedge) inclination	low				< 4 days
Brho method to measure T1/2 (MC: possibility of decay in flight)	low				< 5 days
High order optics calculation: improvement, adaptation GICOSY format	low				< 3 days
MOCADI <-> LISE++ converter	low				< 4 dyas
Transport <-> LISE++ converter	low				< 2 days
m-rad dimensions for LISE++ optics	low				< 2 dasy
Problem with Projectile Fragmentation in the Catcher utility	low				< 1 day
Simulation reactions in Si-telescope in MC mode	low				< 4 days

2014 LISE^{++} development

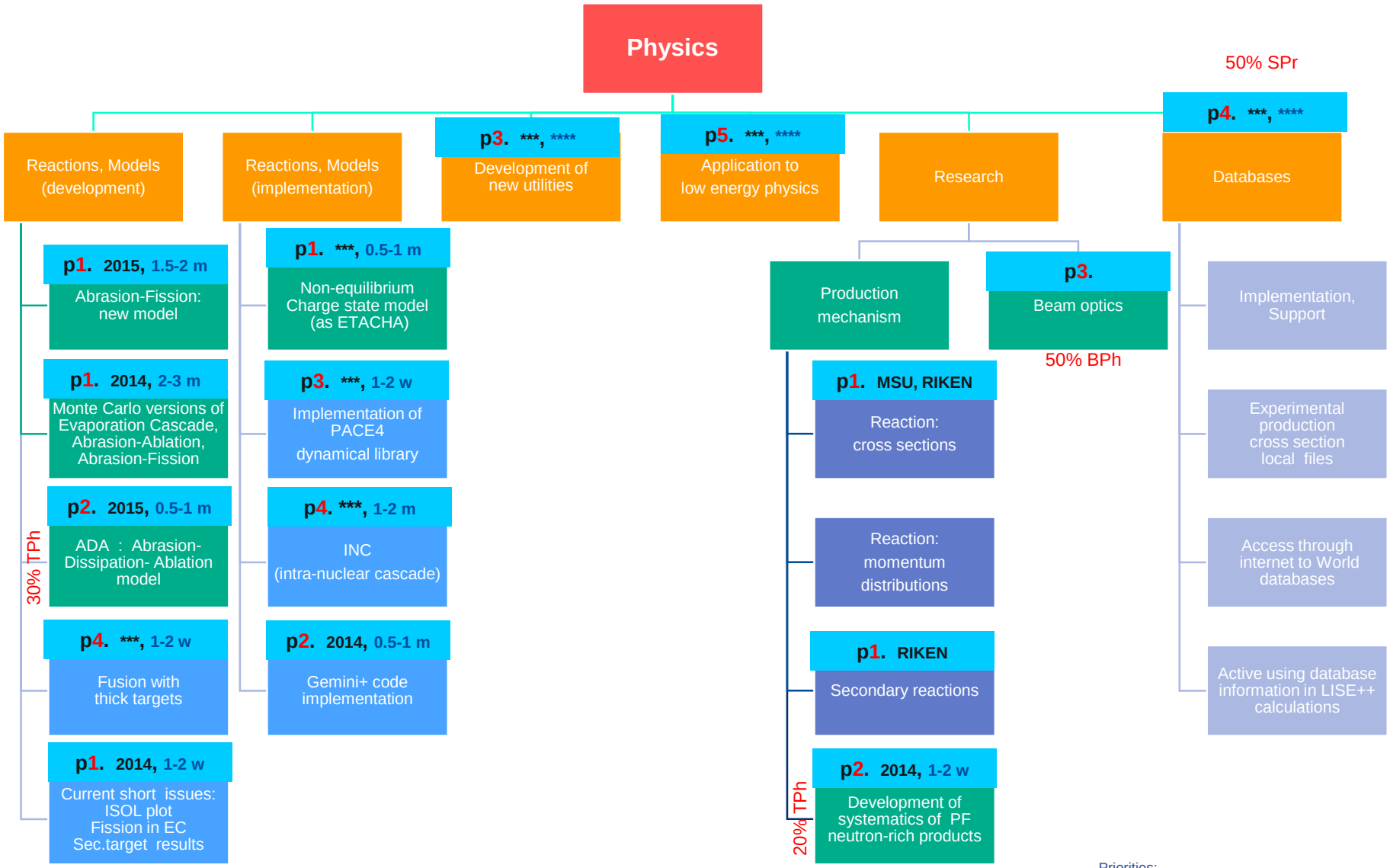
Organization charts

Show ?
Collaborators
How has interest (Labs, people)
Direction (Floating time) & Projects (fixed time)



Experts:
Beam physicist (BPh)
Theory physicist (TPh)
Software programmer (SPr)
Hardware programmer (HPr)

Priorities:
1 – highest
2
3
4
5 - lowest


Physics
50% SPr
Reactions, Models (development)
Reactions, Models (implementation)
p3. ***, ****
Development of new utilities
p5. ***, ****
Application to low energy physics
Research
p4. ***, ****
Databases
p1. 2015, 1.5-2 m
Abrasion-Fission: new model
p1. 2014, 2-3 m
Monte Carlo versions of Evaporation Cascade, Abrasion-Ablation, Abrasion-Fission
p2. 2015, 0.5-1 m
ADA : Abrasion-Dissipation- Ablation model
30% TPh
p4. ***, 1-2 w
Fusion with thick targets
p1. 2014, 1-2 w
Current short issues: ISOL plot Fission in EC Sec.target results
p1. ***, 0.5-1 m
Non-equilibrium Charge state model (as ETACHA)
p3. ***, 1-2 w
Implementation of PACE4 dynamical library
p4. ***, 1-2 m
INC (intra-nuclear cascade)
p2. 2014, 0.5-1 m
Gemini+ code implementation
Production mechanism
p3.
Beam optics
50% BPh
p1. MSU, RIKEN
Reaction: cross sections
Reaction: momentum distributions
p1. RIKEN
Secondary reactions
p2. 2014, 1-2 w
Development of systematics of PF neutron-rich products
20% TPh
Implementation, Support
Experimental production cross section local files
Access through internet to World databases
Active using database information in LISE++ calculations
Priorities:
1 – highest
2
3
4
5 - lowest
Experts:
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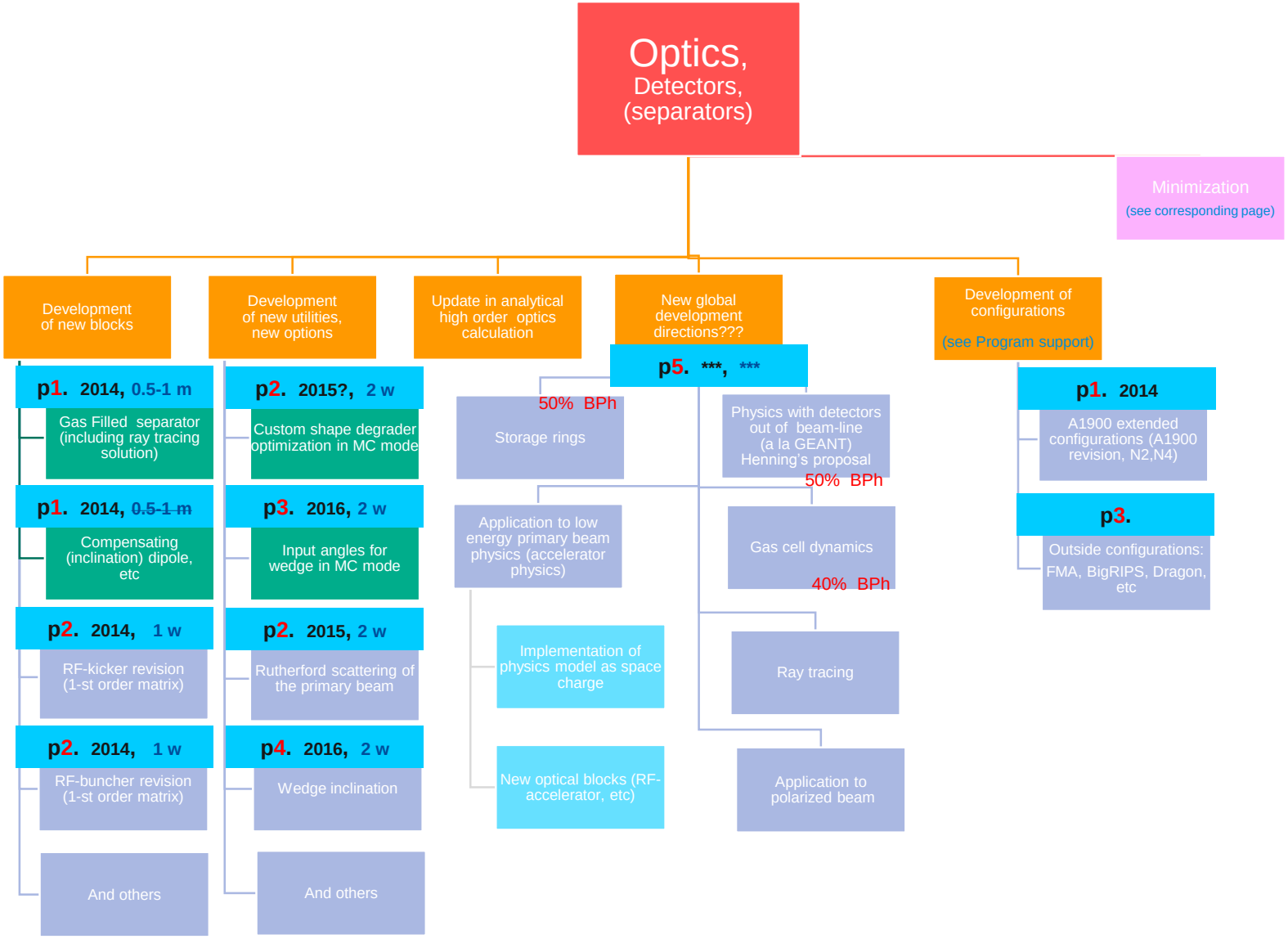

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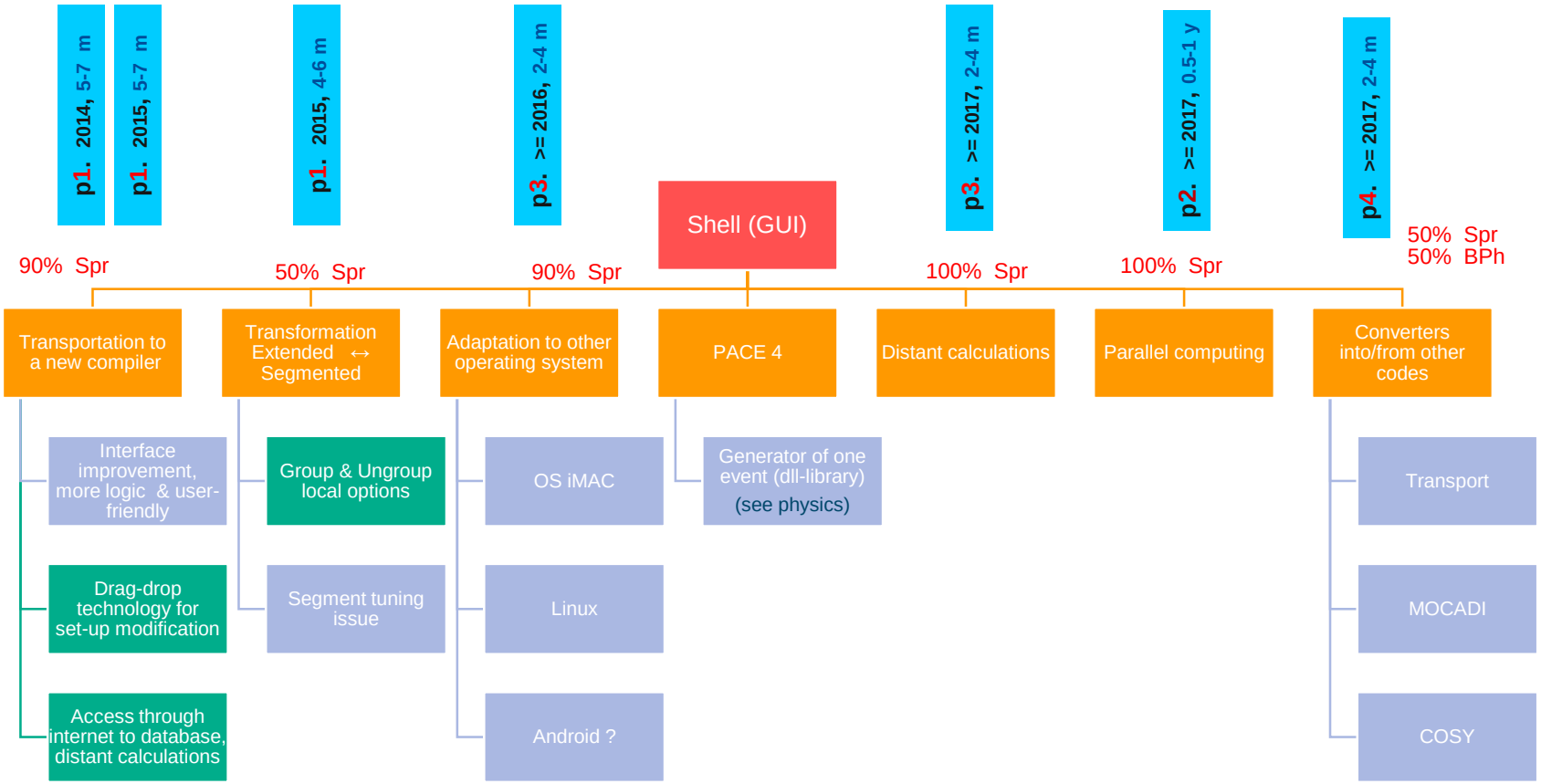

Priorities:
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2
3
4
5 - lowest

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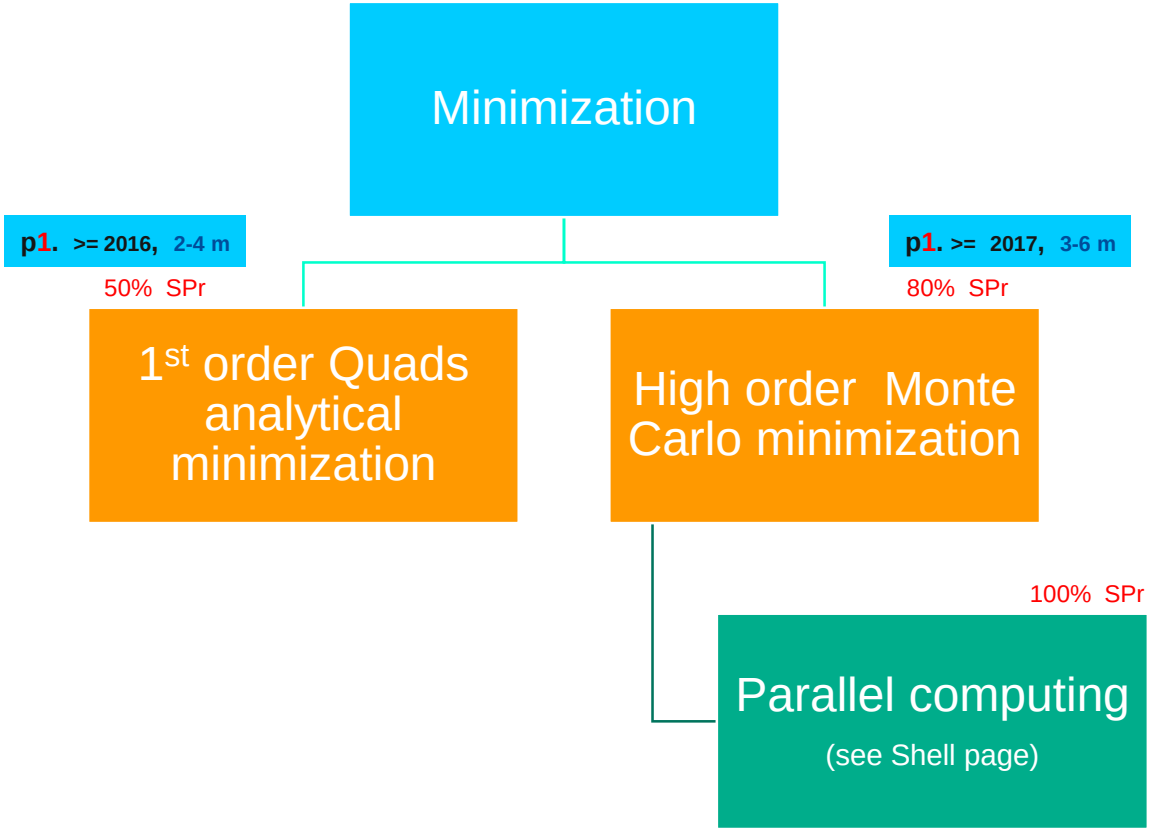
Hardware programmer (HPr)



Priorities:
1 – highest
2
3
4
5 - lowest

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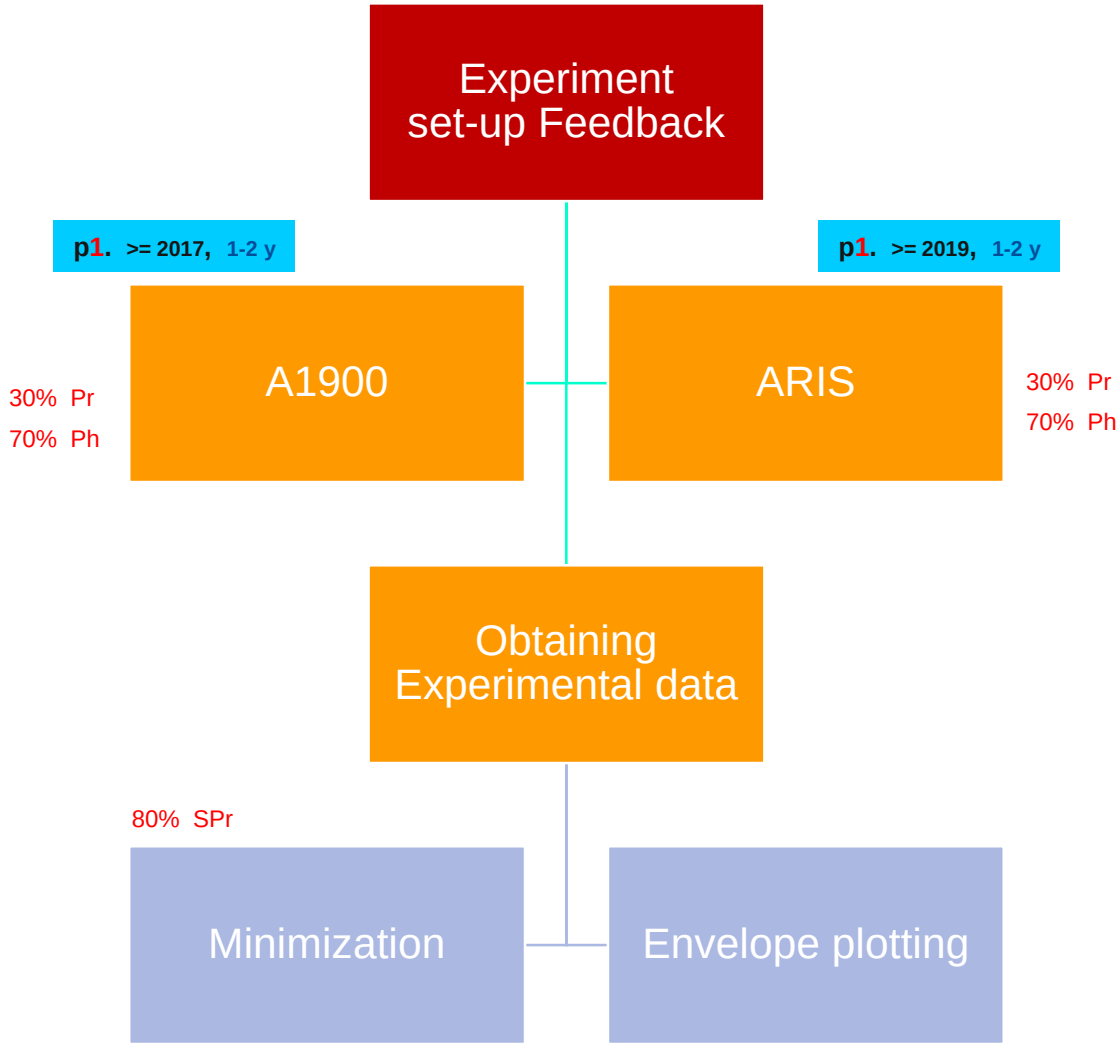
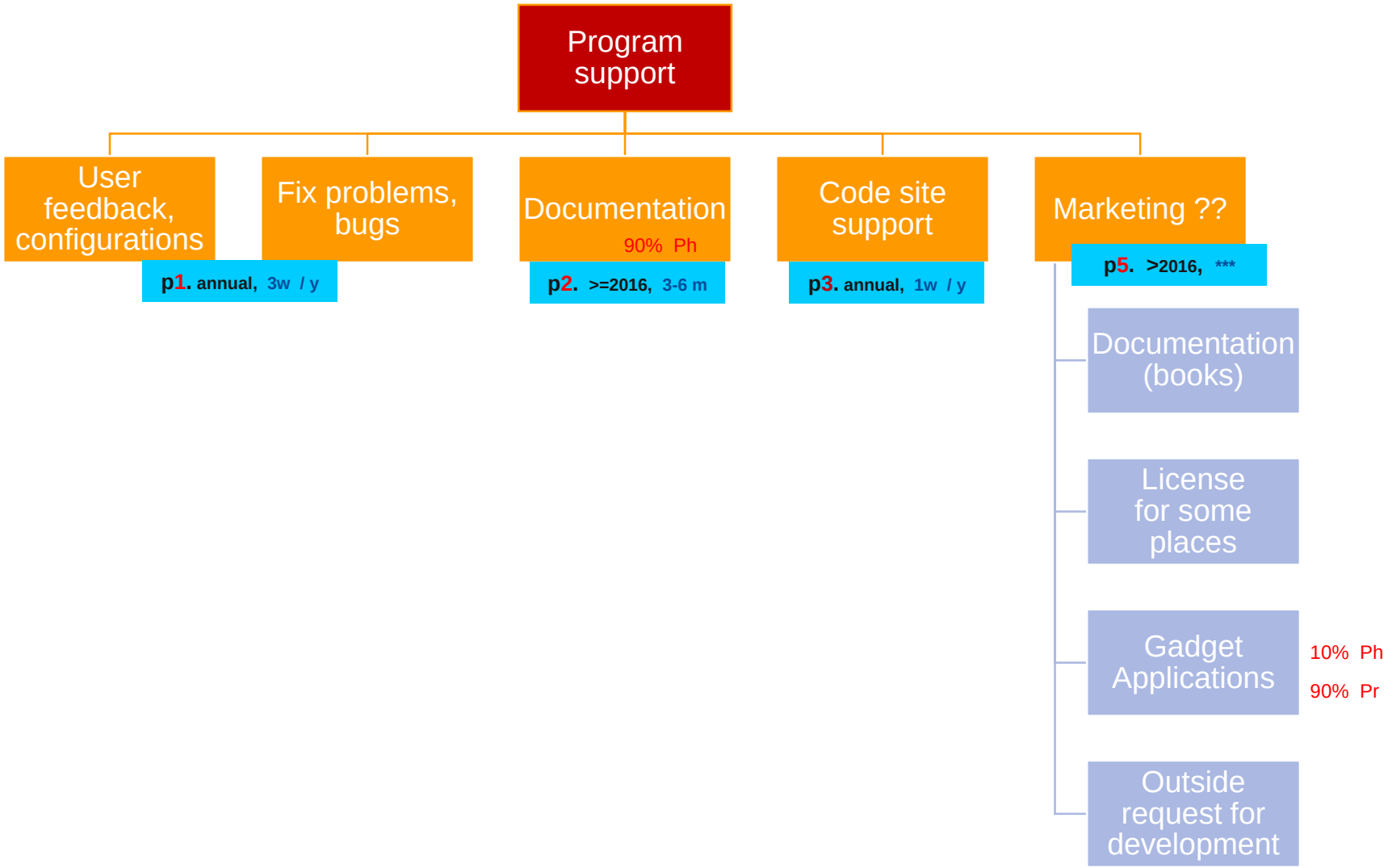
Theory physicist (TPh)
Software programmer (SPr)
Hardware programmer (HPr)


Experiment
set-up Feedback
p1. >= 2017, 1-2 y
p1. >= 2019, 1-2 y
A1900
ARIS
30% Pr
70% Ph
30% Pr
70% Ph
Obtaining
Experimental data
80% SPr
Minimization
Envelope plotting


Program support
User feedback, configurations
p1. annual, 3w / y
Fix problems, bugs
Documentation
90% Ph
p2. >=2016, 3-6 m
Code site support
p3. annual, 1w / y
Marketing ??
p5. >2016, ***
Documentation (books)
License for some places
Gadget Applications
10% Ph
90% Pr
Outside request for development

Physics◊:

2014	3-4 m
2015	2-3 m
>=2016	2-4 m

Minimization:

>=2016	2-4 m	50% Pr
>=2017	3-6 m	80% Pr

Shell:

2014	5-7 m	90% Pr
2015	5-7 m	90% Pr
2015	4-6 m	50% Pr
>=2016	2-4 m	90% Pr
>=2017	2-4 m	100% Pr
>=2017	6-12 m	100% Pr
>=2017	2-4 m	50% Pr + 50% Ph

Experiment Set-up feedback:

>=2017	1-2 y	30% Pr + 70% Ph
>=2019	1-2 y	30% Pr + 70% Ph

Optics:

2014	1.5-2.5 m
2015	1 m
>= 2016	1 m

Program support:

>=2016	3-6 m	90% Ph
annually	1 m	

◊ - without research

Experts:
Beam physicist (BPh)
Theory physicist (TPh)
Software programmer (SPr)
Hardware programmer (HPr)

2014:

Physics	3-4 m	
Shell	5-7 m	90% Pr
Optics	1.5-2 m	
Support	0.5 m	
Total	10-13.5 m	

2015:

Physics	2-3 m	
Shell	5-7 m	90% Pr
Shell	4-6 m	50% Pr
Optics	1 m	
Support	1 m	
Total	13-18 m	

>=2016:

Physics	2-4 m	
Shell	2-4 m	90% Pr
Optics	1 m	
Minimization	2-4 m	50% Pr
Support	1 m	
Documentn	3-6 m	90% Ph
Total	11-20 m	

>=2017:

Shell1	2-4 m	100% Pr
Shell2	6-12 m	100% Pr
Shell3	2-4 m	50% Pr + 50% Ph
Support	1 m	
Minimization	3-6 m	80% Pr
Experiment Set-up		
Feedback	12-24 m	30% Pr + 70% Ph
Total	26-49 m	

>=2019:

Experiment Set-up		
Feedback	1-2 y	30% Pr + 70% Ph

Summary

2014-2015 : 2 (Ph & Pr)
2016 : 2-3? (2xPh & Pr)
>=2017 : 3 (2xPh & Pr)