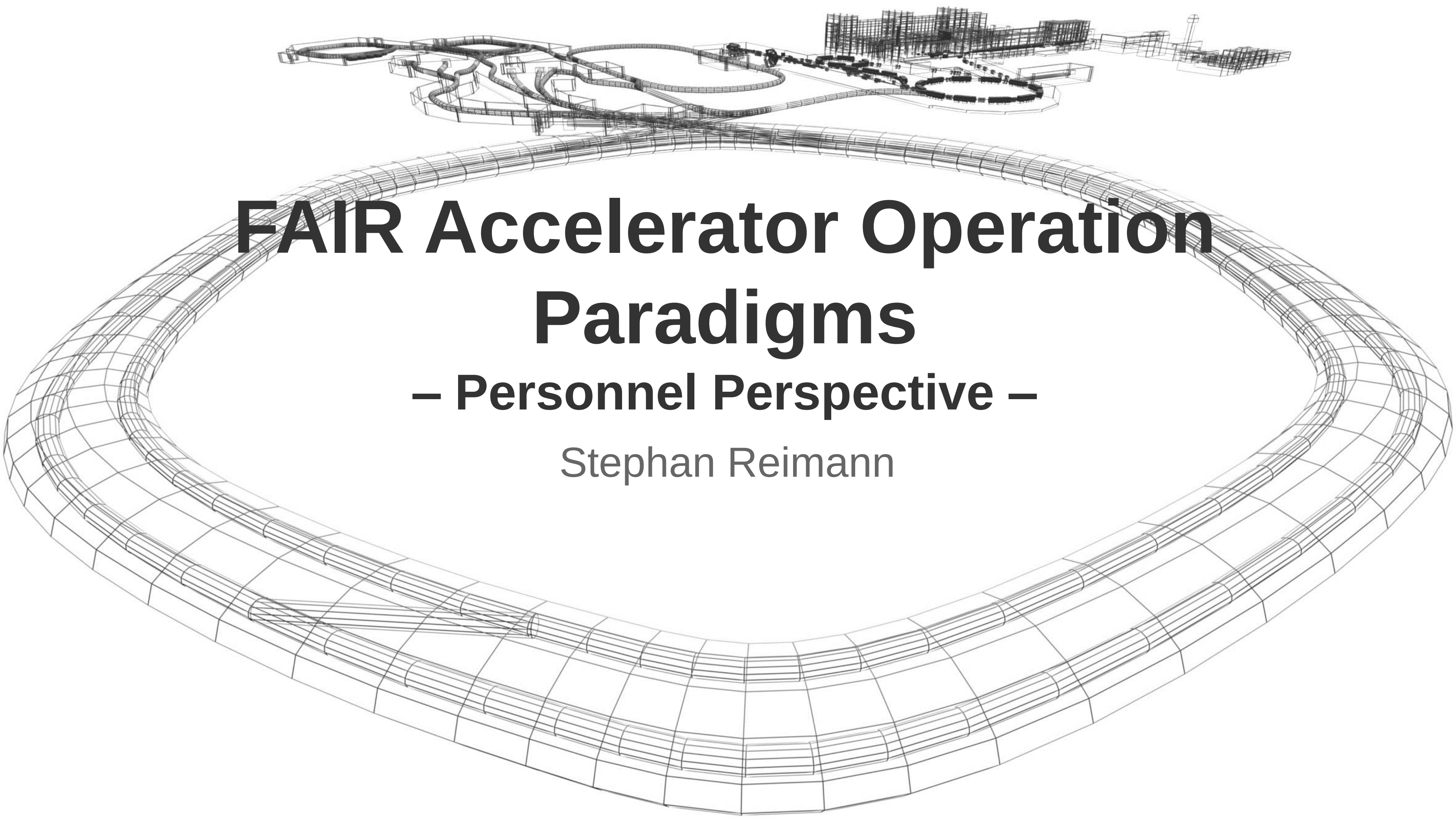


FAIR Accelerator Operation Paradigms

– Personnel Perspective –

Stephan Reimann

Overview

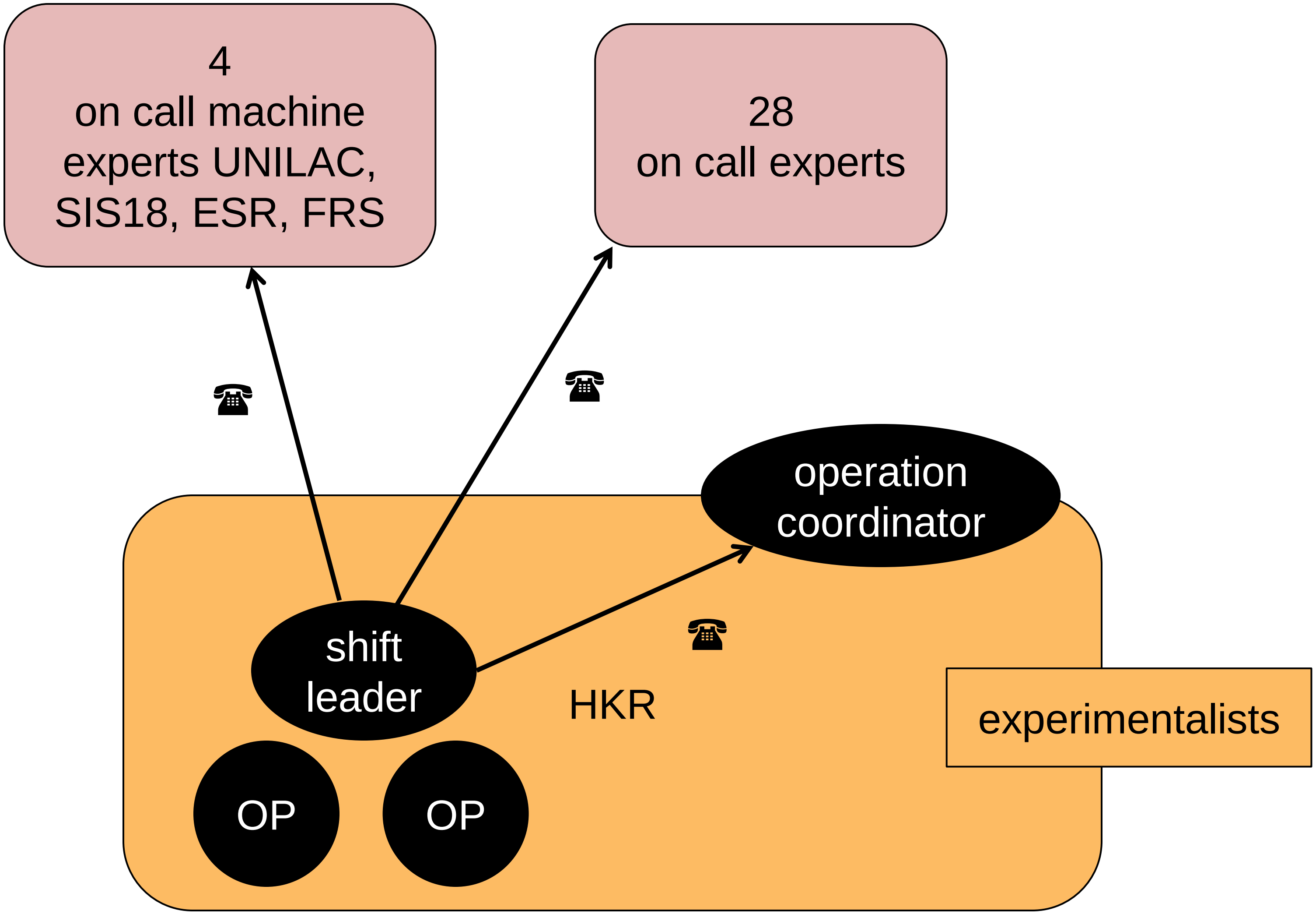
1. GSI operation until 2012
2. staff requirements per shift working place
3. basic paradigms for FAIR operation
4. implications, recommendations

Previous GSI operation until 2012

- 3 accelerators (UNILAC, SIS18, ESR)
- UNILAC and SIS18 operation by operators, ESR operation 50/50 by experts and operators
- 3 persons on shift (2 operators + 1 experienced operator = shift leader)
- staff: pool of 23 operators (in 2012)

- Additional personnel:
  - 1 on call operations coordinator
  - 4 on call machine experts (UNILAC,SIS18,ESR,FRS)
  - 28 on call experts (controls, RF, magnets, vacuum, infrastructure, ...)

organization of GSI operation



staff requirements per shift working place

- operation agreement („*Betriebsvereinbarung*") + TVöD
  - max. 5 shift working days in a row
  - not more than 3 night shifts in a row
  - 2 free Sundays per month in general
  - balanced shift distribution (#early = #late = #night)
  - 66h free time after a 5-days-block, which leads to 3 free days after last night or late shift
  - ascending rotation (early → late → night)
- avoid gaps in shift schedule, else many free days will be generated and the availability of personnel decreases heavily. Example: one single night shift on Sunday creates 2 free days (Fr + Mo)

Optimized Standard-Shift Pattern (15days- Rotation)

	Montag	Dienstag	Mittwoch	Donnerstag	Freitag	Samstag	Sonntag	Montag	Dienstag	Mittwoch	Donnerstag	Freitag	Samstag	Sonntag	Montag
early	a	a	a	b	b	b	c	c	c	d	d	d	e	e	e
late	e	d	d	a	e	e	b	a	a	c	b	b	d	c	c
night	c	c	c	d	d	d	e	e	e	a	a	a	b	b	b
normal		e			a			b			c			d	
free	b,d	b	b,e	c,e	c	a,c	a,d	d	b,d	b,e	e	c,e	a,c	a	a,d

- 5 persons (a-e) permanently needed, to fill the pattern
- 1 normal working day every 15 days
- only 1 additional free day after shift every 15 days
- resource saving
- compatible with operation agreement
- equal distribution of all 3 shift types
- at 80% availability => 6.25 persons per shift working place

realistic availability of one shift worker at GSI

- availability factor of one FTE (holidays, leave days, illness, company leisure time) = 80% (1)
- day off after shift → 14/15 = 93% (2)
- normal working day → 14/15 = 93% (2)
- 6 days of additional holidays per year for shift workers → 199/205 = 97% (3)
- parental leave (per child (1,38/2) 0.5years / 40years) → 79,3/80 = 99% (4)
- not discussed: from 48th birthday on, night shifts are not obligatory

$$v = 80\% \cdot 93\% \cdot 93\% \cdot 97\% \cdot 99\% = \mathbf{67\%}$$

5 / 67% = **7.4 persons per shift working place**

(1) availability of one FTE (W.Bayer)
(2) necessarily results from the standard pattern
(3) specified in TVöD §27
(4) rough estimate: ca. 0,5 years parental leave per child
(„Studie zu den Auswirkungen des BEEG auf die Erwerbstätigkeit und die Vereinbarkeitsplanung“)

Overview staff requirement vs. number of shift working places

Shift working places	Staff	Example
2	15	Beam time 2015
3	22	GSI standard
4	30	re-commissioning 2017* and SIS100 commissioning
5	37	FAIR-operations**

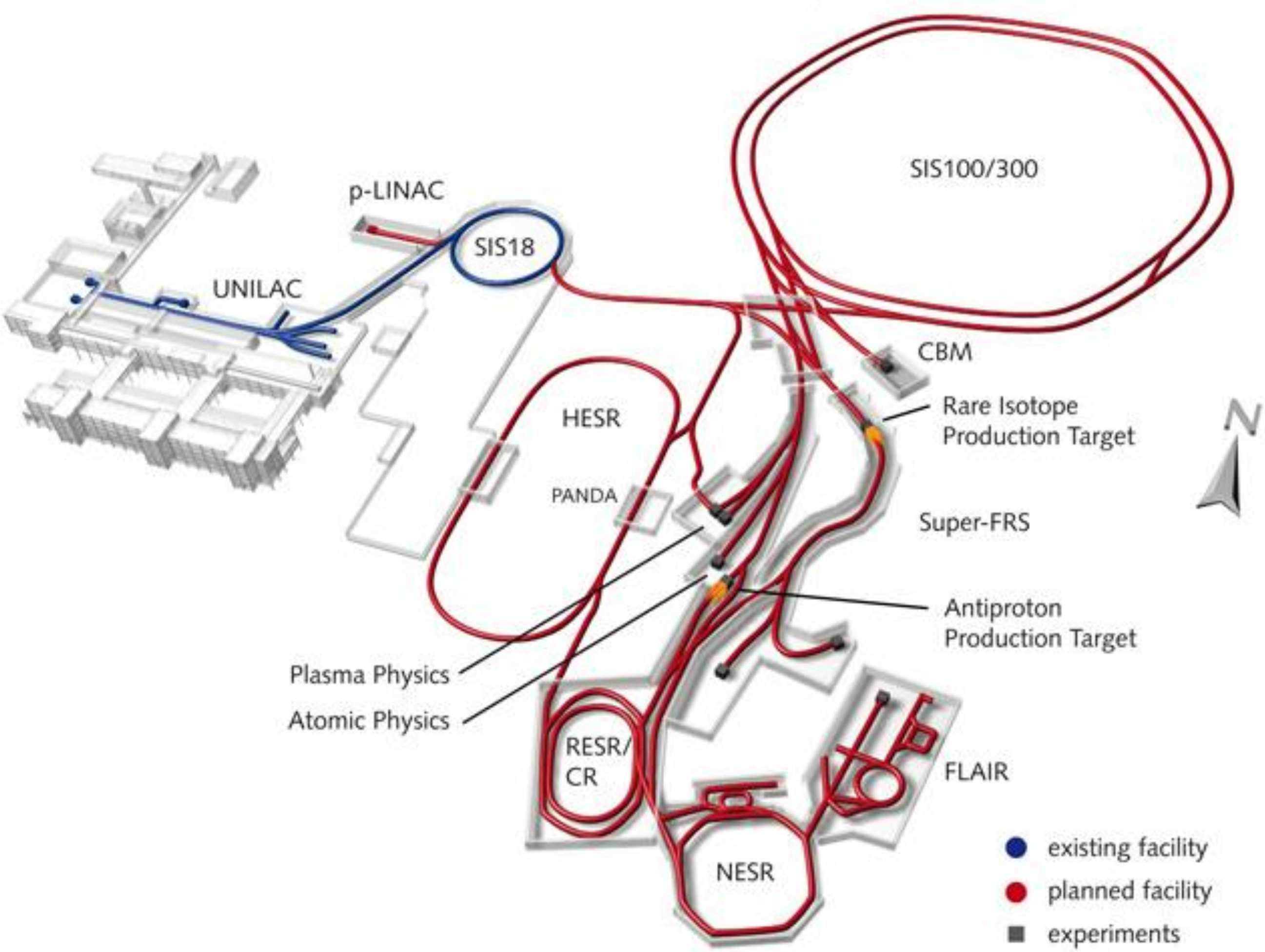
- Consistent with experience of n years of operation at GSI (23 persons were foreseen for operation in the past)
- Consistent with shift scheduling 2015 (currently 14 persons are available for 2 person shift => shifts could be scheduled, but in holiday season no substitutes are available)

* new employees have to be assigned as 4th operator on shift as BV says
** see FAIR Operating Paradigm (30 persons core team + 7 persons on demand)
to these must be added 7-8 persons for infrastructure (cryo)

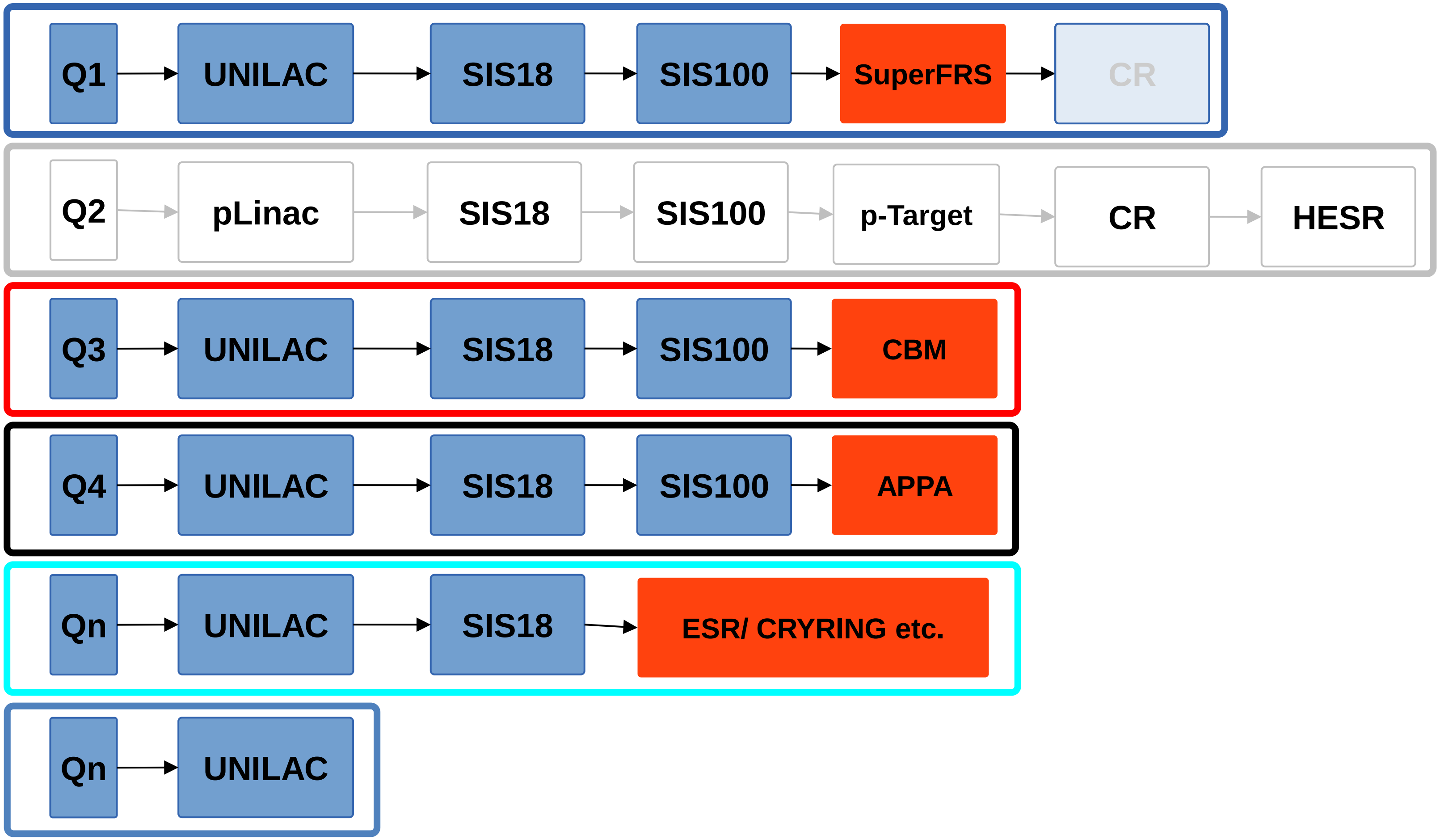
3 phases of operation

1. Setup & Commissioning
   - all operators are busy (4-5+1[cryo] persons)
   - machine experts for support (4-5 persons)
   - on call experts from accelerator departments
   - accelerator near experimentalists (5-8 persons)
   - parallel machine development (4-5 persons)
   - peak: ca. 24 persons permanent in control room
2. Monitoring & Adjustment
   - conditions: machine setup is done, high level automation
   - only “skeleton-crew” needed
   - ca. 5-6 persons permanent in control room
3. Problems
   - depending on the kind of problems, something between 1 and 2

FAIR: 5 additional accelerators



FAIR: 5 main experiment chains



Implications

- massive parallel operation (FAIR Operation Modes)

→ new operator skill requirements
→ more manpower needed (status quo: 14 operators available = max. 2 persons on shift)
→ present control room and operation team does not fit FAIR conditions (only limited UNILAC-operation possible at the moment)

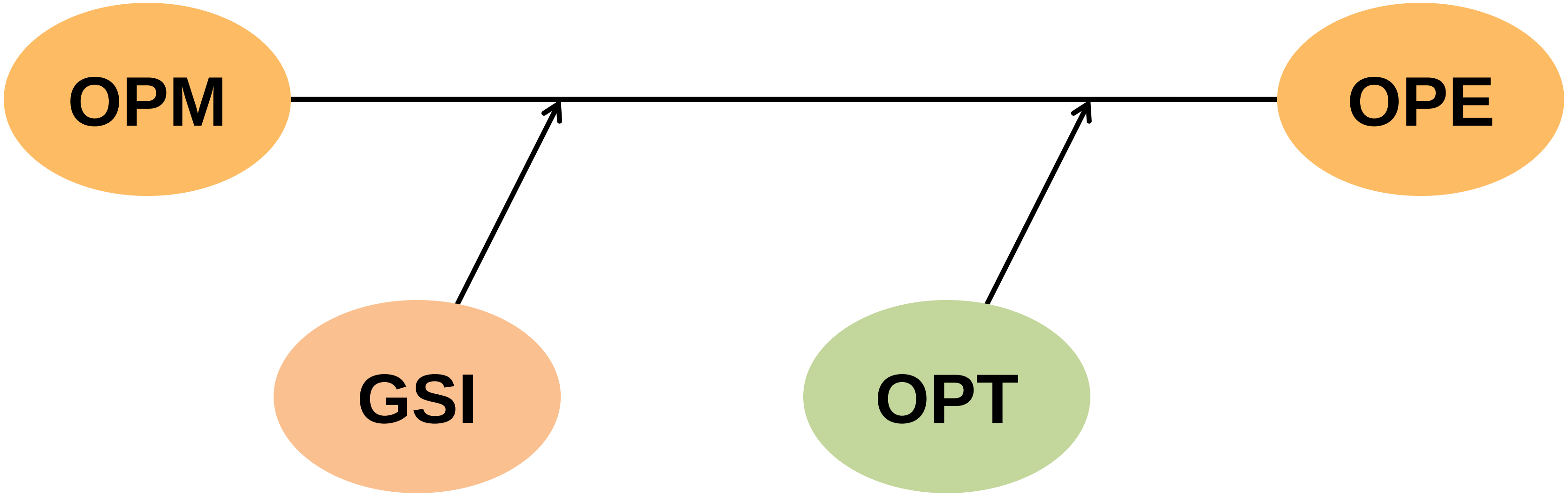
how should we do operating in the future?

what are the requirements?

how many operators do we need?

Basic Paradigms

a) 1 operator per machine (OPM)
b) 1 operator per experiment (OPE)
c) optimization (OPT)



A: one operator per machine

- Pro
  - operator is an expert of his domain (LINAC, Ring)
    - less operation errors on machine setting
    - faster beam setup
  - dedicated training possible
    - skill targeted training
    - less expensive personnel
- Contra
  1. you can only replace an operator with one, who is an expert of the same domain → limits flexibility of shift planning
  2. for each machine (MSV: 8 accelerators) we need 7.4 operators → **59 persons**
     - which is expensive (ca. 400000€/a per shift working place)
     - which leads to idle staff, when not all accelerators are operated
  3. interface problem + multiple experiments cannot be setup simultaneous
- Loopholes
  1. shift leader has to be an expert of every machine
  2. none
  3. none

B: one operator per experiment

- Pro
  - one responsible person per experiment
    - the operator is an expert of the experiments requirements
    - a good motivation to run “my” experiment better
    - there is a dedicated contact person for the experimentalists
  - less personnel needed as in OPM paradigm (5 big experiment chains (SuperFRS, ~~pBar-Target~~, CBM, APPA, SIS+ESR, UNILAC)
  - better redundancy because of Contra 2.
- Contra
  1. after the setup phase, the operator is usually idle
  2. the operators must know every machine perfectly
  3. the operator must have a look on all running machines and have to switch his console during the setup process
  4. two operators may access the same machine setting at the same time (possible interferences) → unlikely, but a problem for global parameters
  5. **44 persons** is still a big personnel need
- Loopholes
  1. Operator could be responsible for more than one experiment, which then must be scheduled sequential
  2. a higher education level for operators is needed in general → higher costs
  3. The console settings have to be defined in a way that the operator can operate everything from one console working place
  4. see 3. + reporting on parallel access

C: Optimization

- shift leader is very experienced (accelerator physicist or further trained existing shift leader)
- operators are machine type specialists (LINACs, synchrotrons, storage rings, beam lines incl. FRS)
- operators are responsible for one or two experiments
- shift structure depends on the demand (core team + operators on demand)

- Conditions
  - OP+SL have to be recruited soon and trained appropriate
  - stable long term beam time scheduling is needed, the big experiments must be scheduled sequential
  - The MCR console settings have to be defined in a way that the operator can operate everything from every console working place (fully digital control room)
  - high level automation, no misuse of rare manpower
  - same machine types can be set up in the same way (generic operating software/ consistent look and feel)

- Pro
  - an expert is present for every machine type (as in OPM)
  - redundancy
  - only 4-5 operators needed, to run the whole facility (incl. 1 shift leader) → **30-37 persons**
  - responsibility + motivation as in OPE

- Contra
  - ?

Summary

	OPM	OPE	OPT
operators on shift	8	6	4-5
personnel needs	59	44	30-37
Unsolved problems	• Interface problem • Suboptimal use of setup time → • Very much idle time for operators	• Idle operators after setup phase or if less than 6 Experiments are running	
requirements	• larger control room • Shift leader should be an expert of all machines	• larger control room • Experienced and homogeneously trained operators • digital control room • generic operating software • restricted parallel access on machine settings	• larger control room • specialized operator training • stable long term beam time scheduling • digital control room • generic operation software • consistent look and feel • high level automation • restricted parallel access on machine settings

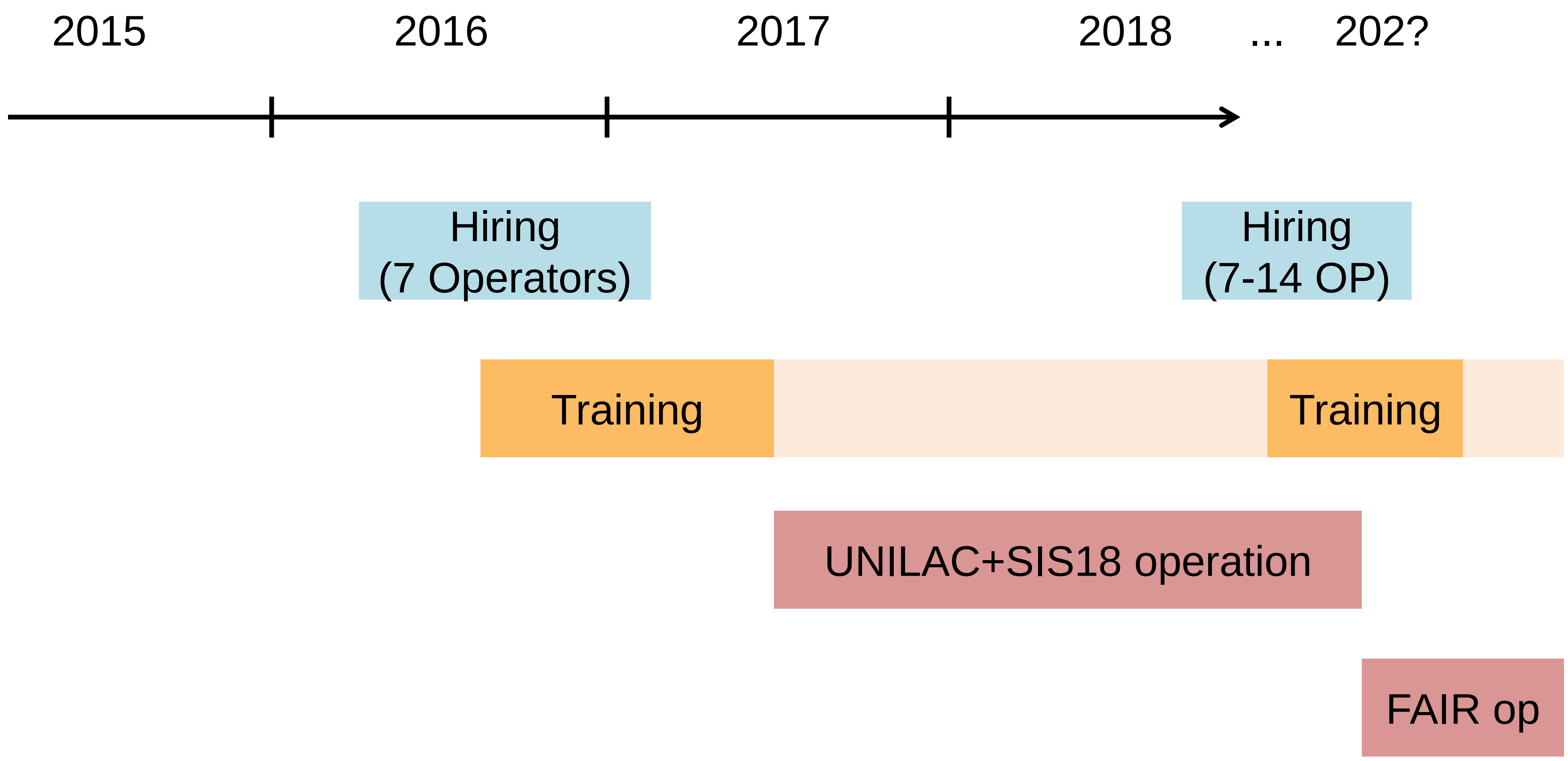
Recommendations

- fit the requirements of the optimized paradigm

\+

- for future hiring in accelerator departments: add option for shift work to new contracts (operators on demand)
- add software skills as an requirement for operators (creating automation procedures)
- new operators should also have some theoretical background in physics
- development of a dedicated operator training concept
  - periodic lectures (similar to AXEL@CERN)
  - hands on training (2016 CRYRING, from 2017 on dedicated training shifts)
  - operator exchange with other facilities

raw personnel development schedule



Questions?