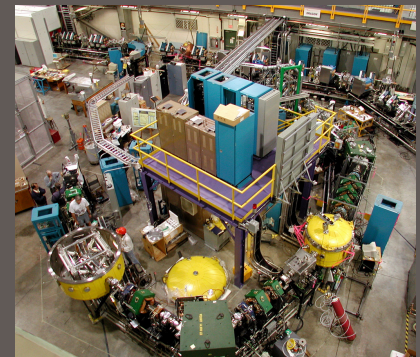
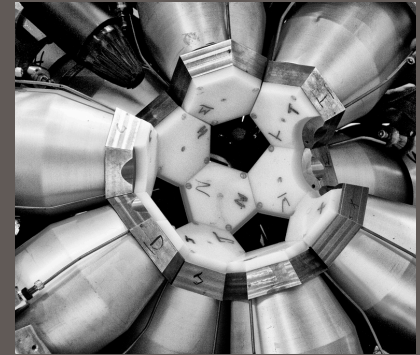


## Operational considerations for future multi-user RIB facilities

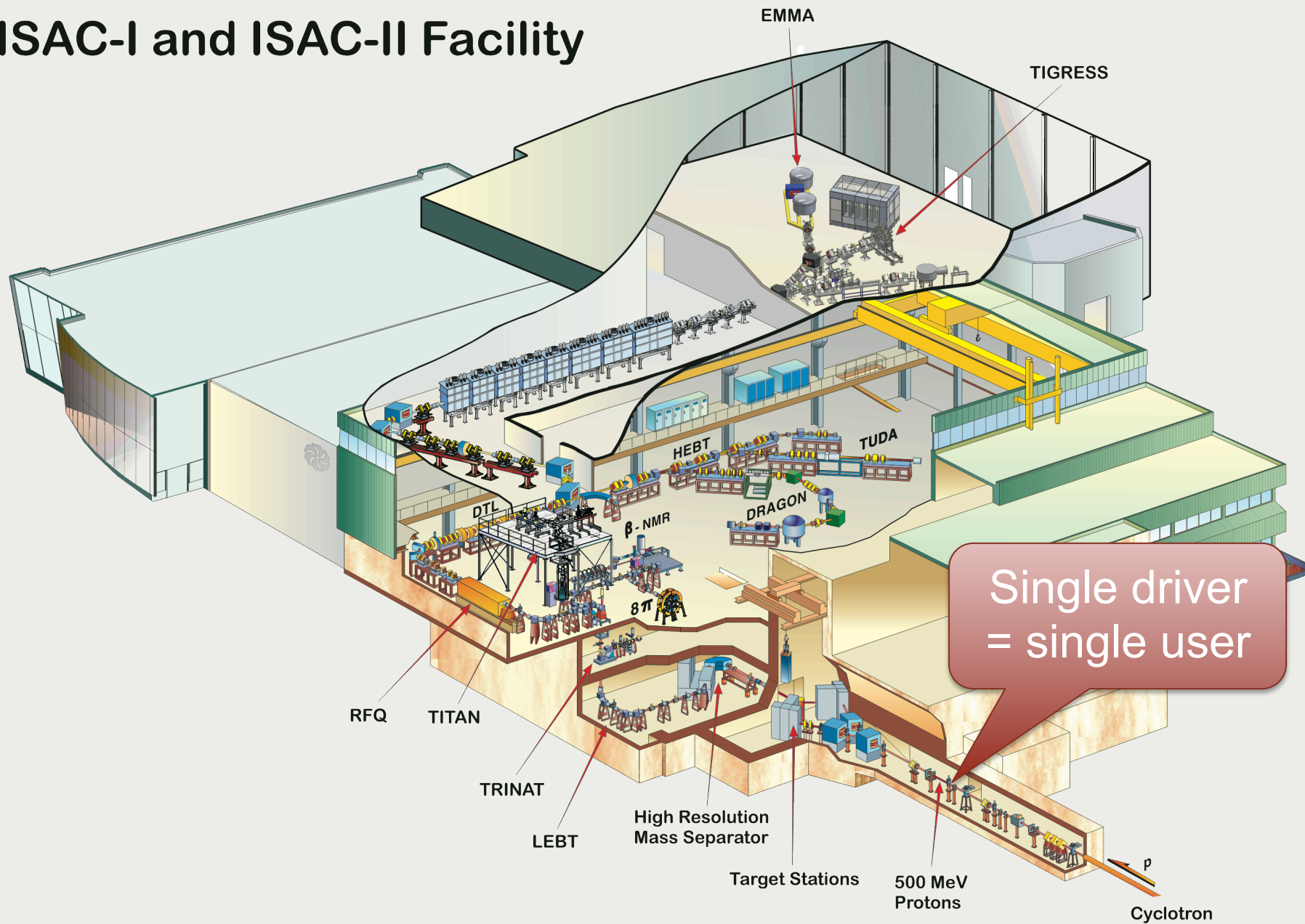
Colin Morton | Beam Delivery Group Coordinator | TRIUMF

Accelerating Science for Canada  
Un accélérateur de la démarche scientifique canadienne

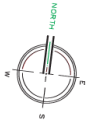
Owned and operated as a joint venture by a consortium of Canadian universities via a contribution through the National Research Council Canada  
Propriété d'un consortium d'universités canadiennes, géré en co-entreprise à partir d'une contribution administrée par le Conseil national de recherches Canada



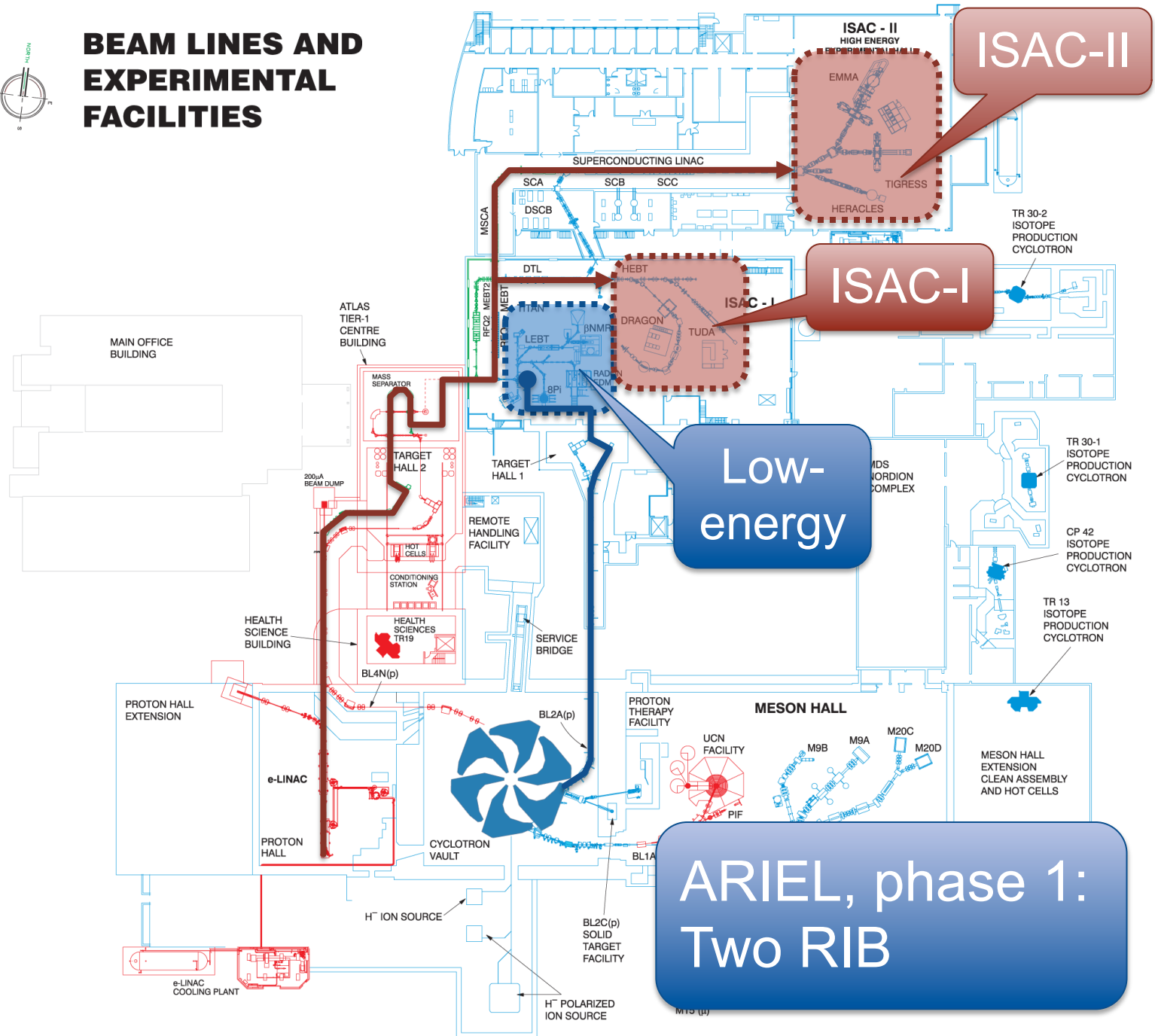
# ISAC-I and ISAC-II Facility



- Advanced Rare-IsotopE Laboratory
- Multiple-driver ISOL facility
  - 10 mA, 50 MeV superconducting e-linac (under construction)
  - a second 500 MeV proton beamline (future expansion)
- Couples to existing ISAC exp't beamlines
  - **Multiple RIB sources for delivery to experiments**



# BEAM LINES AND EXPERIMENTAL FACILITIES



ISAC-II

ISAC-I

Low-energy

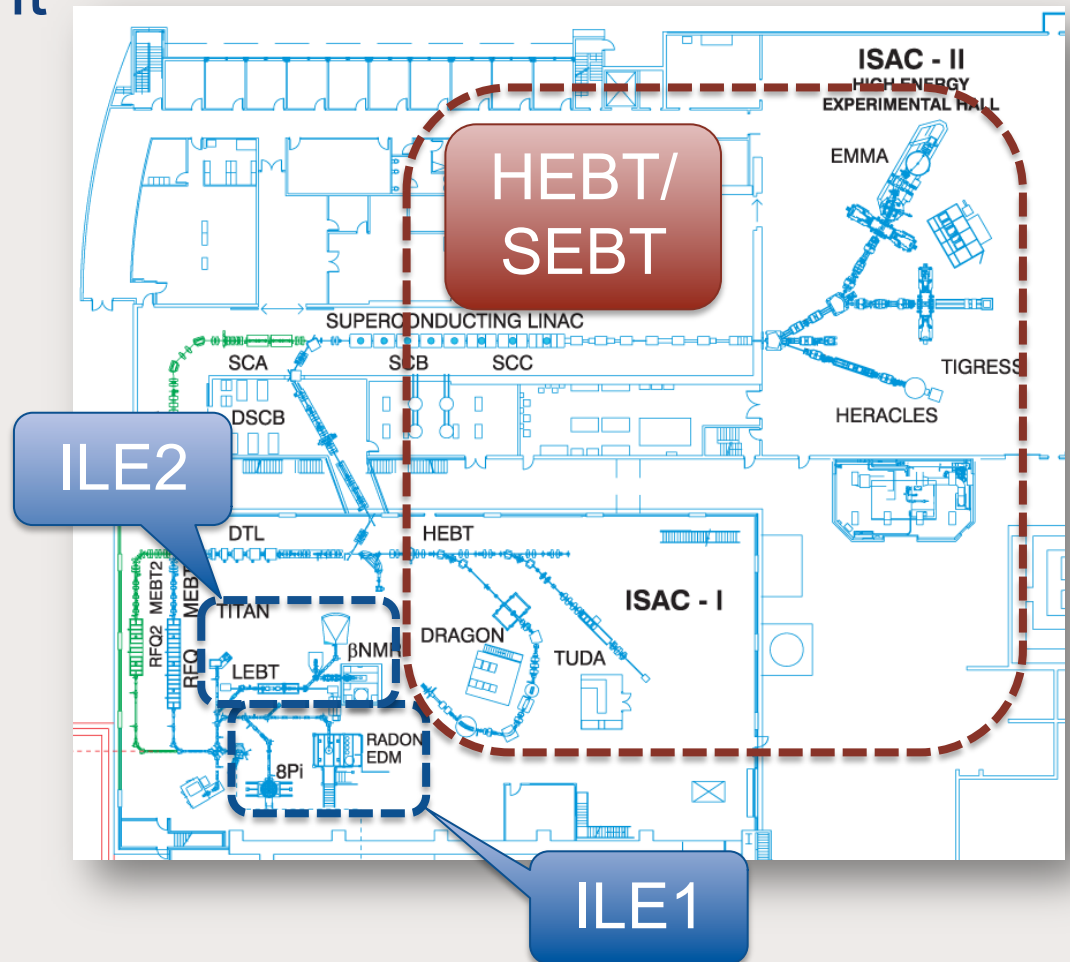
ARIEL, phase 1:  
Two RIB

# Multi-user operation

- **GOAL:** To maximize the amount of RIB available with the combined **ARIEL + ISAC** facility
  - Simultaneous delivery of multiple RIB to a shared experimental complex
- **Issues:**
  - Technical: configuration management, maintenance, controls integration, etc.
  - Operational: scheduling, staffing

# Experiment scheduling

- Three independent experimental areas:
  - ILE1:  $8\pi$ / GRIFFIN, Rn-EDM, etc.
  - ILE2: TITAN,  $\beta$ -NMR, etc.
  - HEBT/SEBT: High-energy locations



# Experiment scheduling

- Problems?
  - Beamline layout dictates where beam can/can't be delivered simultaneously
  - Switching beam paths has knock-on effects – tuning and setup time, personnel requirements, etc.
- Multiple RIB sources means more complexity, more constraints on scheduling

# Sample one-week schedule

	Monday			Tuesday			Wednesday			Thursday			Friday					
ILE1	ISAC RIB						Cyclotron maintenance											
ILE2																		ARIEL RIB
HEBT	ARIEL RIB																	ISAC RIB



ISAC RIB

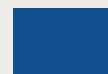


ARIEL RIB



# Sample one-week schedule

	Monday			Tuesday			Wednesday			Thursday			Friday		
<b>ILE1</b>	ISAC RIB			ISAC RIB			ISAC RIB			Cyclotron maintenance					
<b>ILE2</b>							Cyclotron maintenance						ARIEL RIB		
<b>HEBT</b>	ARIEL RIB						Cyclotron maintenance			ISAC RIB			ISAC RIB		



ISAC RIB



ARIEL RIB

# Sample one-week schedule

	Monday	Tuesday	Wednesday	Thursday	Friday
<b>ILE1</b>	ISAC RIB	ISAC RIB	ISAC RIB		
<b>ILE2</b>					ARIEL RIB
<b>HEBT</b>	ARIEL RIB		OLIS SIB	ISAC RIB	ISAC RIB

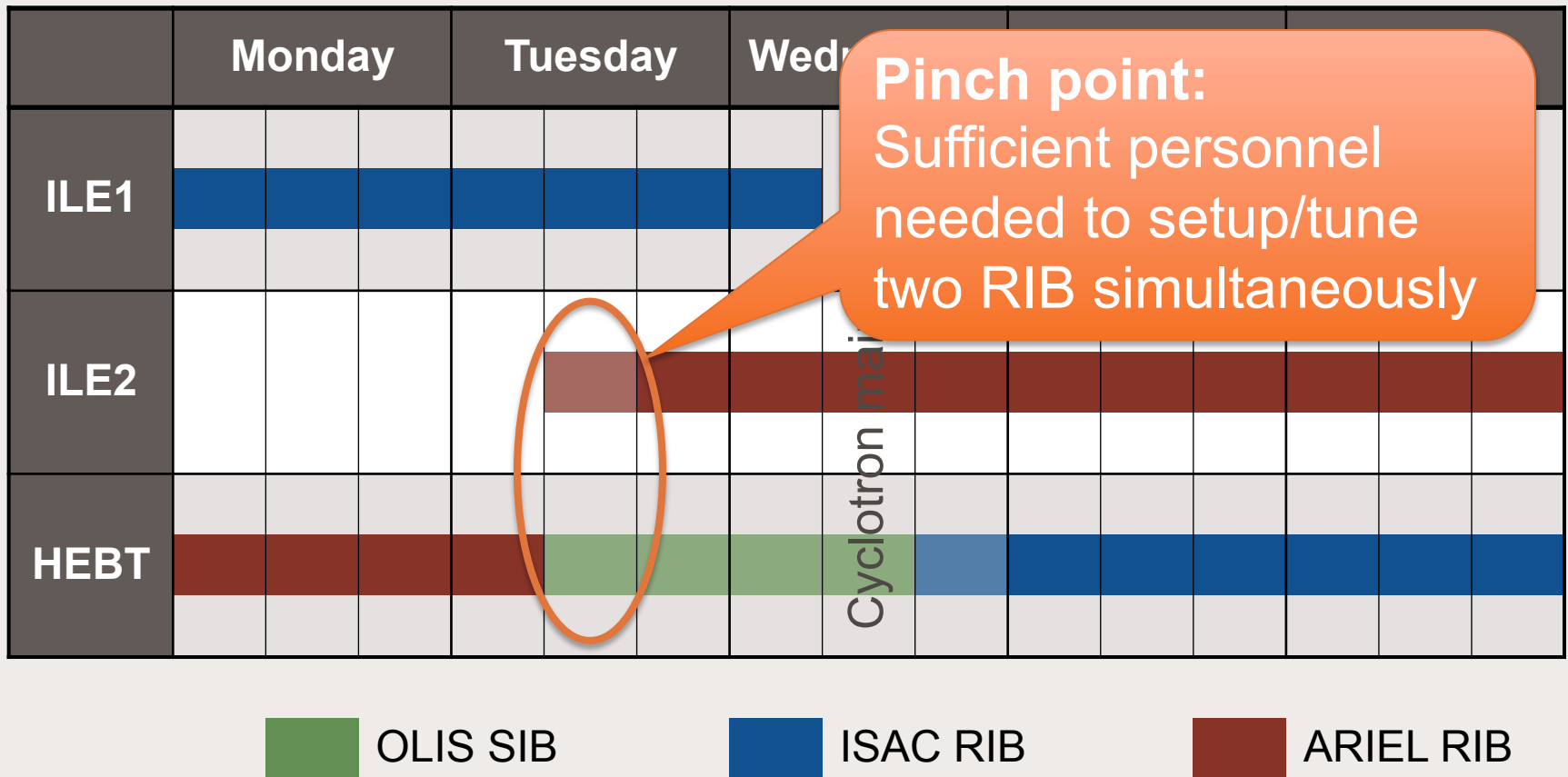
Cyclotron maintenance

 OLIS SIB

 ISAC RIB

 ARIEL RIB

# Sample one-week schedule



# Alternate one-week schedule

	Monday	Tuesday	Wednesday	Thursday	Friday
<b>ILE1</b>	ISAC RIB	ISAC RIB	ISAC RIB		
<b>ILE2</b>	ARIEL RIB	ARIEL RIB	ARIEL RIB	ARIEL RIB	ARIEL RIB
<b>HEBT</b>	ARIEL RIB		OLIS SIB	ISAC RIB	ISAC RIB

Cyclotron maintenance

 OLIS SIB


 ISAC RIB

 ARIEL RIB

# Conflict-free option

	Monday			Tuesday			Wednesday			Thursday			Friday		
ILE1	ISAC RIB			ISAC RIB			ISAC RIB			Cyclotron maintenance			Cyclotron maintenance		
ILE2	Cyclotron maintenance			Cyclotron maintenance			Cyclotron maintenance			ISAC RIB			ISAC RIB		
HEBT	ARIEL RIB	OLIS SIB		OLIS SIB		ARIEL RIB	ARIEL RIB			ARIEL RIB			ARIEL RIB		


 OLIS SIB

 ISAC RIB

 ARIEL RIB

# Conflict-free option

	Monday			Tuesday			Wednesday			Thursday			Friday		
<b>ILE1</b>	ISAC RIB			ISAC RIB			ISAC RIB			ISAC RIB			ISAC RIB		
<b>ILE2</b>				ARIEL RIB			ARIEL RIB			ARIEL RIB			ARIEL RIB		
<b>HEBT</b>	ARIEL RIB									OLIS SIB			ARIEL RIB		ARIEL RIB

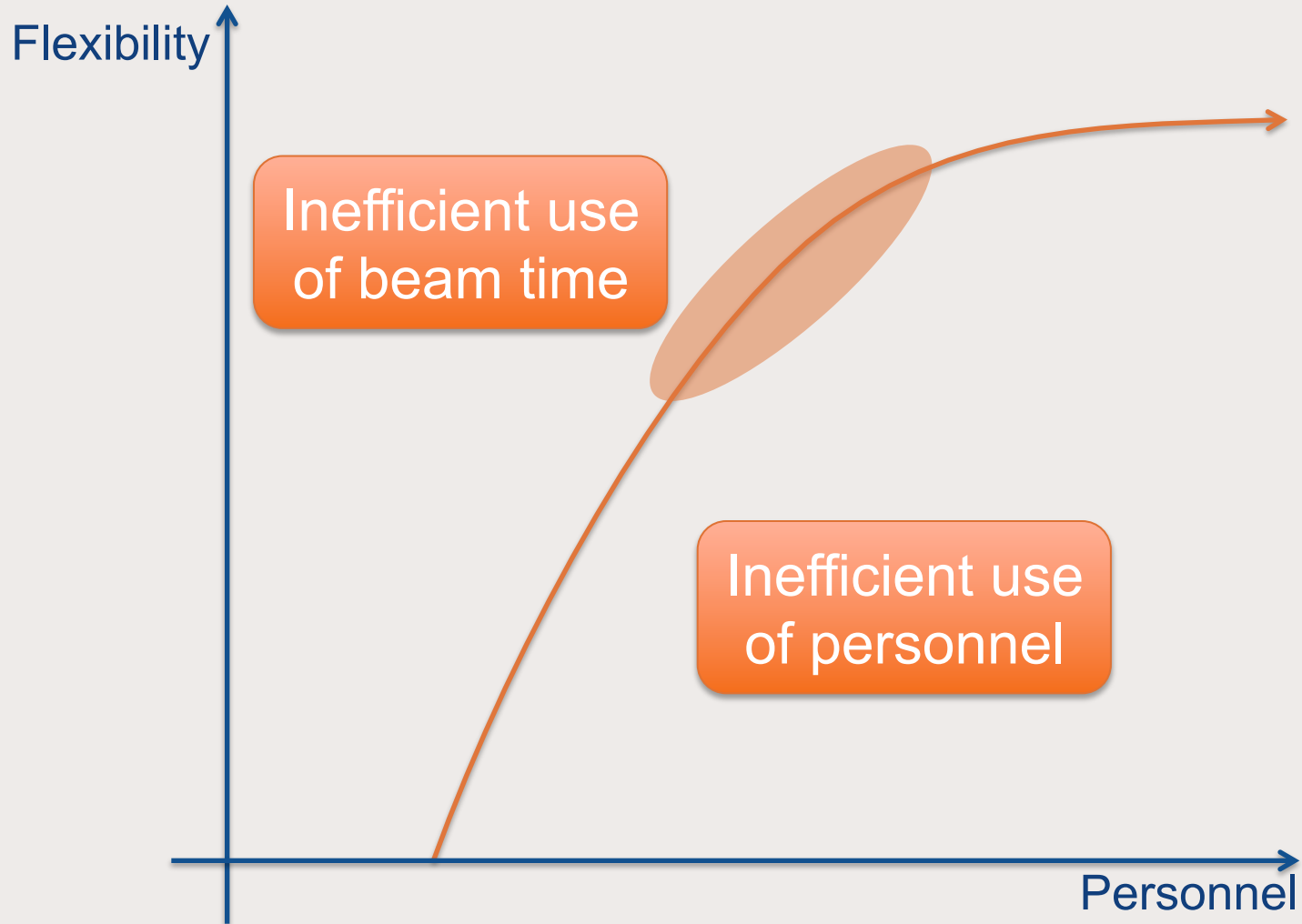

**OLIS SIB**

**ISAC RIB**

**ARIEL RIB**

# Experiment scheduling

- The easiest way to minimize conflicts?
  - **Deliver from either RIB source to a single experimental area for an extended period**
  - Stagger setup/tuning times so they don't overlap
- **Ideal situation:**
  - Many weeks' delivery to a single area
  - *e.g.*  ${}^8\text{Li}$  from  ${}^9\text{Be}(\gamma, p)$  at ARIEL to  $\beta\text{NMR}$  (ILE2)
- **Maintaining more flexibility requires more personnel**

# Experiment scheduling





# Operations and staffing

- Current situation:
  - One operations group, two sets of operators, two control rooms
- Main Control Room:
  - 15 operators – 3/shift, 24 hrs/day, 365 days/yr
- ISAC:
  - 10 operators – 2/shift, 12 hrs/day during shutdown, 24 hrs/day during running period
- Need to add both e-linac and ARIEL RIB operation and delivery

- **Responsibilities:**
  - Beam delivery
  - Safety; machine protection; maintenance coordination; work permits; building services...
- **Beam delivery experience:**
  - 2 ops/shift is sufficient to *e.g.* set up RIB to one destination while delivering stable offline beam to another
  - Setting up RIB and stable beam at the same time requires additional support (or more time)

- **Common control facility**
  - Both MCR and ISAC Ops in one location
  - Requires cross-training to take advantage of available personnel
  - Probably sufficient to meet e-linac needs
- **Reduced Ops responsibilities**
  - Move maintenance scheduling, work permits, building services, etc. out of the control room
  - Allow operators to focus on machine/safety/beam delivery

# Additional personnel

- Existing full complement doesn't provide full coverage:
  - 25 operators == ~100 weeks' vacation/year
  - Need two more operators just to provide full coverage
- To manage ARIEL RIB delivery:
  - Additional operator/shift (5–6 total), or
  - Expert support as needed?

- **Pros:**
  - Specialist knowledge; R&D outside beam delivery
- **Cons:**
  - Won't offer 24/7 coverage – acceptable
- **Key requirement:**
  - A well-defined service role – 50% of effort?
  - Service role could change with time
- **Need 30–40 hrs/week – 1 FTE, or 2 50% positions**
  - Assuming staggered startups, etc.

# In conclusion...

- Multi-user operation introduces additional complexity and constraints on facility scheduling
- Additional personnel are needed to take full advantage of a second RIB, but...
- ...some loss of flexibility has to be accepted to manage that need effectively
- Hiring Ph.D.-level physicists in lieu of operators may offer the greatest benefit per FTE

# Thank you!

# Merci

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