Collaboration








Universität Basel, IHEP Beijing, [University of **Birmingham**] Ruhr-Universität Bochum, Universität Bonn, Università di Brescia + INFN, Università di Catania, University of Silesia, University Cracow, GSI Darmstadt, TU Dresden, JINR Dubna, JINR Dubna, University of **Edinburgh**, Universität Erlangen, Northwestern University, INFN Sezione di Ferrara, Universität Frankfurt, LNF-INFN Frascati, INFN Sezione di Genova,Università di Genova, Universität Gießen, University of **Glasgow**, KVI Groningen, Institute of Physics Helsinki, FZ Jülich - IKP I, FZ Jülich - IKP II, IMP Lanzhou, Universität Mainz, Università di Milano, TU München, Universität Münster, BINP Novosibirsk, IPN Orsay, Università di Pavia, PNPI Gatchina St. Petersburg, IHEP Protvino, Stockholm University , Università di Torino, Università de Piemonte, Università di Trieste + INFN, Universität Tübingen, Uppsala Universitet, TSL Uppsala, Universidad de Valencia, Stefan Meyer Institut für subatomare Physik, Vienna, SINS Warschau







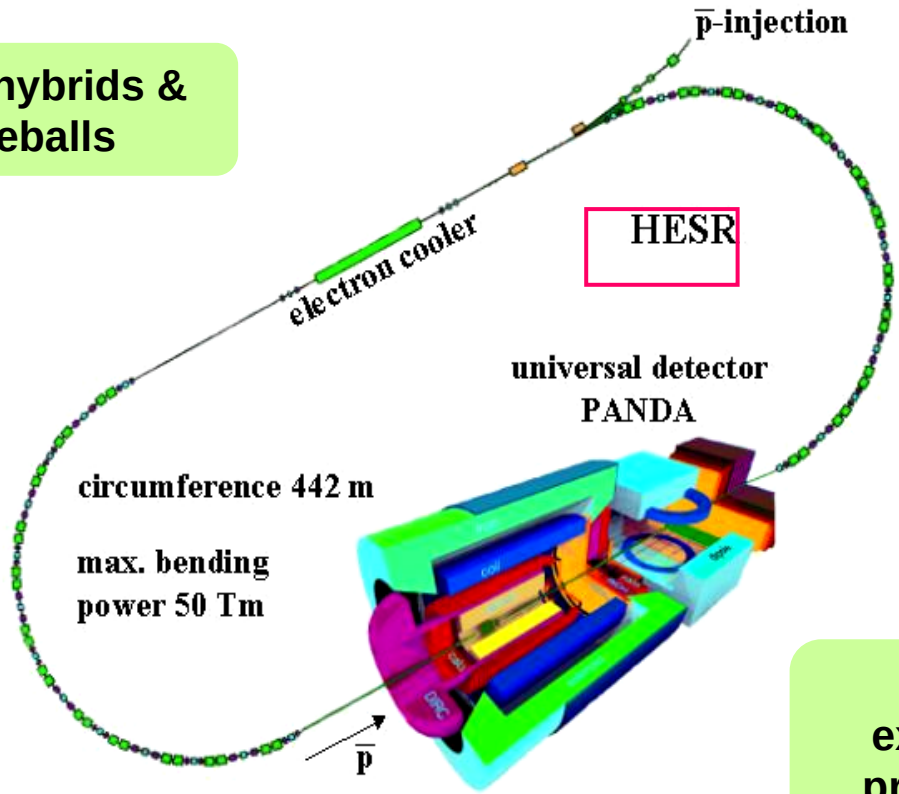
15 countries – 47 institutes – 400 scientists

PANDA physics programme

Charmonium spectroscopy

Exotics: charmed hybrids & heavy glueballs

Time-like form factors



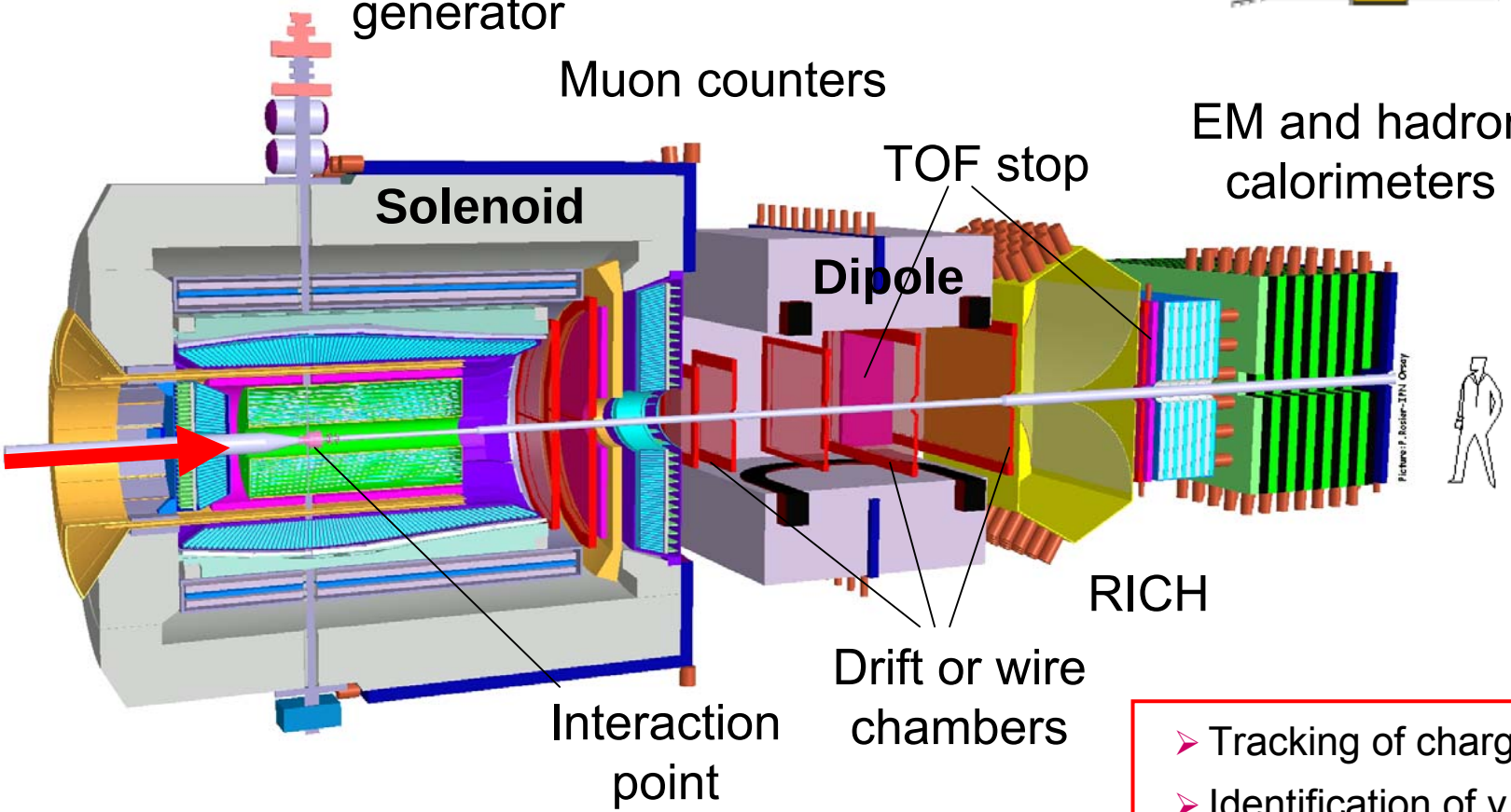
Medium modifications of charmed mesons

Drell-Yan processes

CP-violation (D & Λ - sector)

Hard exclusive processes

Hypernuclei



- Tracking of charged particles
- Identification of γ, $e^{\pm}$, $\mu^{\pm}$, $\pi^{\pm}$, $K^{\pm}$, p, anti-p
- High rate capability
- Fast trigger scheme

UK involvement

- HESR

  Present consortium = FZ Juelich, Univ. Stockholm, Uppsala

  - Opportunities for ASTEC, Cockcroft Inst.?

- **PANDA**

  (Glasgow, Edinburgh, Birmingham in the future)

  - Project management
  - Target and forward spectrometers
    - Superconducting target solenoid
    - Normal conducting forward dipole
  - Particle ID: Forward Cherenkov imaging detectors
  - Simulations & GRID computing

PANDA costing I

Cost Estimates Subsystem	Pellet Target	Cluster Target	MVD	STT	TPC	DIRC	Barrel TOF	Forward DC	Forward Cherenkov	Forward TOF	Barrel EMC	Forward EMC	Forward HCAL
Position	Cost [k€]	Cost [k€]	Cost [k€]	Cost [k€]	Cost [k€]	Cost [k€]	Cost [k€]	Cost [k€]	Cost [k€]	Cost [k€]	Cost [k€]	Cost [k€]	Cost [k€]
Material cost Remarks	415	400	180	460 Finuda & Wasa exp., Lamina quot.	990 ALICE & COMPASS	2530 BaBar	316 PHENIX TOF	630	130	139	11300 PWO 6700, APDs 3800, CMS prices	549	215
Engineering design			675	360	250				50			4	
Construction	100	60	336	500	250	14		141	80	10	516	14	30
Commissioning			75		100					14		4	
Electronics and DAQ Remarks	150 diagnostics & control	70	649	1800 R/O, HV, crates, cables	1800	350	30	499	960	60	3806	102	104
Spares:	Included		see detailed list	Included	130	97	4	42	48	7	190		17
Calibration	0		0		100	25							
Safety	15	15			80								
Installation	20	20	175			27		3		7	100	4	2
Infrastructure			50 FTE		700						100	0	
Maintenance and operation	10k€/y	30 k€/y	50 FTE					4k€/y				2 FTE/y	
Hired manpower	0		730										
Institute manpower	12 FTE	10 FTE	30 FTE	120 FTE		30 FTE	2 FTE	35 FTE	40 FTE	3 FTE	150 FTE	80 FTE	6 FTE
Total	700	565	2820	3120	4400	3043	350	1315	1268	237	16012	677	368
Risk item budget Remarks			1250 Estimated from the per-pixel added cost of a custom design.			300 Addtl. Polishing			1800 HMPID+ Aerogel RICH		4350 PbWO or BGO, Carbon fiber		
R&D	EU		external funding			EU		EU			EU	0	
Prototyping & tests	EU		external funding	50		EU					270	89	
Responsibility (institutes)	Uppsala, FZJ	Münster, Genova, Vienna, GSI	FZJ, Helsinki, TUD, Tomsk, Torino, Catania, Mainz, Protvino	LNF, FZJ, TUM, Dubna, Ferrara, Lanzhou, Tübingen Uppsala		GSI, Glasgow, Dubna, FZJ, Mainz, Vienna	Gießen,	Krakow, Dubna	GSI, Glasgow, Gießen, Edinburgh, Dubna, FZJ, Mainz, Vienna	PNPI St. Petersburg	Gießen, GSI, Orsay, Bochum, Frankfurt, Basel, Lanzhou, Minsk, Uppsala, Valencia, Warsaw	IHEP Protvino, Crakow, GSI	Krakow, GSI

PANDA costing II

Cost Estimates Subsystem	Muon Detector (DT)	GE Detector	Solenoid Magnet	Dipole Magnet	Interaction Region	Infra-structure	DAQ	Computing	Sub-Totals (Standard)	Sub-Totals (TPC Option)
Position	Cost [k€]	Cost [k€]	Cost [k€]	Cost [k€]	Cost [k€]	Cost [k€]	Cost [k€]	Cost [k€]	Cost [k€]	Cost [k€]
Material cost Remarks	112 (CMS DT option)	1050 Euroball Upgrade	2233 Offer from Ansaldo + 10% (size)	442	150	2000	4000	1120 CPU+Storage +Network (1st year)	28371	28901
Engineering design			558	238		100			1985	1875
Construction	50	150	939	702	50				3692	3442
Commissioning			104	89					286	386
Electronics and DAQ Remarks	280 R/O & HV/LV	350	25	15					9250	9250
Spares:	14		10	5			200		634	764
Calibration									25	125
Safety					10	100			140	220
Installation			235	142	10				745	745
Infrastructure	30	100						50	280	980
Maintenance and operation			2 mm/y	1 mm/y					0	0
Hired manpower						1800			2530	2530
Institute manpower			25 FTE	25 FTE	2 FTE	6 FTE	75 FTE	235 FTE	0	0
	486	1650	4104	1633	220	4000	4200	1170	47938	49218
Risk item budget Remarks	400 Larger detector		531 Steel and Conductor	187 Steel					8818	8818
R&D			EU	EU			EU		0	0
Prototyping & tests		200	140	107					856	806
Responsibility (institutes)	Torino, Dubna	Mainz, Catania, Torino, Stockholm	Glasgow, Dubna, GSI, Crakow, Genova, IMP Lanzhou		GSI	GSI	Gießen, TUM, GSI, Crakow, FZJ, Pavia, Torino, Milano, Warsaw	Bochum, Bonn, Glasgow, GSI, FZJ, Pavia, TUM, Torino, Warsaw		

PANDA capital costs

- Total
  - €50M to €59M euros (excluding VAT!)
- UK involvement
  - Spectrometers
    - Solenoid (budgetary quotation Ansaldo: €4.6M in total)
      - Superconducting coils & cryostat - €1.8M (tesla)
      - Return yoke (Mitchell Engineering)
    - Dipole (budgetary quotations Ansaldo, Danfysik: €1.8M in total)
      - Resistive coils (Holton & SigmaPhi)
      - Return yoke (Mitchell Engineering)
  - Forward particle ID (€3.1M in total)
    - Disc DIRC - €2.4M (Spanoptic, Crystran, IC Optical Systems)
  - Computing
    - GRID - €0.2M
- Anticipated UK contribution ≥ €6.2M