Neutral Beam Penetration and Photoemission Benchmark

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Proposed test cases for benchmark

- **Aim**: benchmark of beam codes and models in order to **verify correct implementation** and **explore applicability of different physics models**.
- All participating codes should do the test cases they are capable of with all possible beam models and provide detailed output, but primarily information on beam attenuation and beam emission.

1. Constant profile test cases

- **Aim**: study the dependence of beam dynamics on different parameters and plasma compositions. (1D beams in semi-infinite homogeneous plasma)
- **Processing**: statistical evaluation of massive amount of data with Pandas Dataframe, detailed physics analysis of outstanding cases or cases of particular interest

2. Plasma profile test cases

- **Aim**: compare the precision and explore the applicability of different beam models for realistic cases. (1D beams in plasma with given parameters along the beam)
- **Processing**: comparison of limited number of test cases with the purpose of drawing qualitative conclusions

Constant profile test cases

I. Constant profile test cases					
Calculation length: 2m					
1.	H(+) 100%		only proton coll.		
	Beams:	Energies:	Densities	Temperatures:	
	H	30, 100, 1000 keV	1E19, 1E20 m-3	0.1, 1 , 20 keV	
	Li, Na	30, 100 keV	1		
2.	H(+) 100%		Te = Ti		
	Beams:	Energies:	Densities:	Temperatures:	
	H	30, 100, 1000 keV	1E19, 1E20 m-3	0.1, 1 , 20 keV	
	Li,Na	30, 100 keV	1E19 m-3	0.1, 1 keV	Optional
3.	D(+) 100%		Te = Ti		
	Beams:	Energies:	Densities:		
	H	30, 100, 1000 keV	1E19, 1E20		
	Li,Na	30, 100 keV	1E19 m-3		
4.	He(2+) 100%		Te = Ti		
	Beams:	Energies:	Densities:		
	H	30, 100, 1000 keV	1E19, 1E20 m-3	0.1, 1 , 20 keV	
	Li,Na	30, 100 keV	1E19 m-3	0.1, 1 keV	Optional

Temperature effects

Isotope effects, scaling of rates

Incomplete data set!

5.	D(+) 95% + Be(4+) 5%		Te = Ti		
	Beams:	Energies:	Densities:	Temperatures:	
	H, D, T	30, 100, 1000 keV	1E19, 1E20 m-3	1 , 20 keV	
	Li,Na	30, 100 keV	1E19 m-3	1 keV	Optional
6.	D(+) 95% + C(6+) 5%		Te = Ti		
	Beams:	Energies:	Densities:		
	H	30, 100, 1000 keV	1E19, 1E20 m-3		
	Li,Na	30, 100 keV	1E19 m-3		
7.	D(+) 99.9% + W(64+) 0.1%		Te = Ti		
	Beams:	Energies:	Densities:	Temperatures:	
	H	30, 100, 1000 keV	1E19, 1E20 m-3	20 keV	
	Li,Na	30, 100 keV	1E19 m-3	20 keV	Optional
8.	D(+) 50% + T(+) 50%		Te = Ti		
	Beams:	Energies:	Densities:	Temperatures:	
	H	30, 100, 1000 keV	1E19, 1E20 m-3		
	Li,Na	30, 100 keV	1E19 m-3		
9.	D(+) 40% + T(+) 40% + He(2+)15% + Be(4+) 4.5% +C(6+) 0 + Ne(10+) 0.29% + W(64+) 0.01%				
	Beams:	Energies:	Densities:	Temperatures:	
	H	30, 100, 1000 keV	1E19, 1E20 m-3	20 keV	
	Li,Na	30, 100 keV	1E19 m-3	20 keV	Optional

Trace impurities

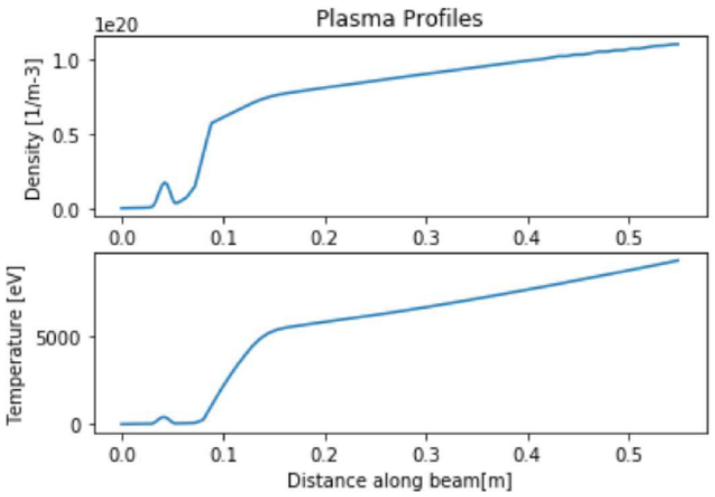
Multi-component plasmas

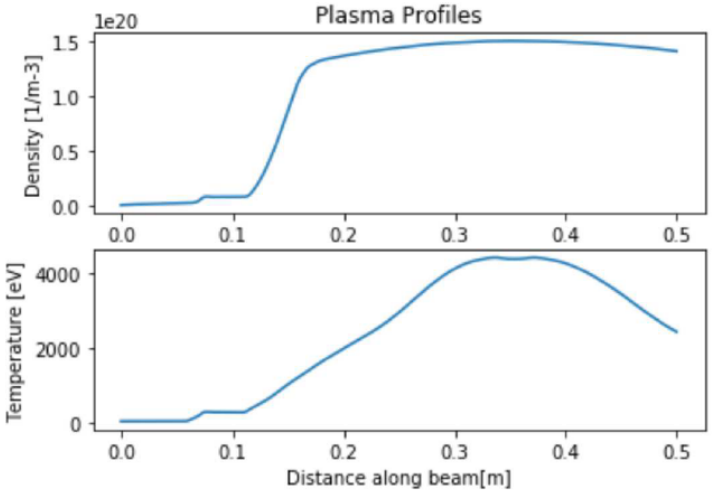
Plasma profile test cases

II. Plasma profile test cases			
profiles along beam will be provided			
1.	ITER scenario	(JINTRAC)	
	Beams:	Energies:	
	H	30, 100, 1000 keV	
	D, T	100 keV	
	Li, Na	100 keV	Optional
2.	ITER scenario with blob	(HESEL)	
	Beams:	Energies:	
	H	30, 100, 1000 keV	
	D, T	100 keV	
	Li, Na	100 keV	
3.	Island divertor	(W7-X-like)	
	Beams:	Energies:	
	H	30, 100, 1000 keV	
	Li, Na	100 keV	Optional

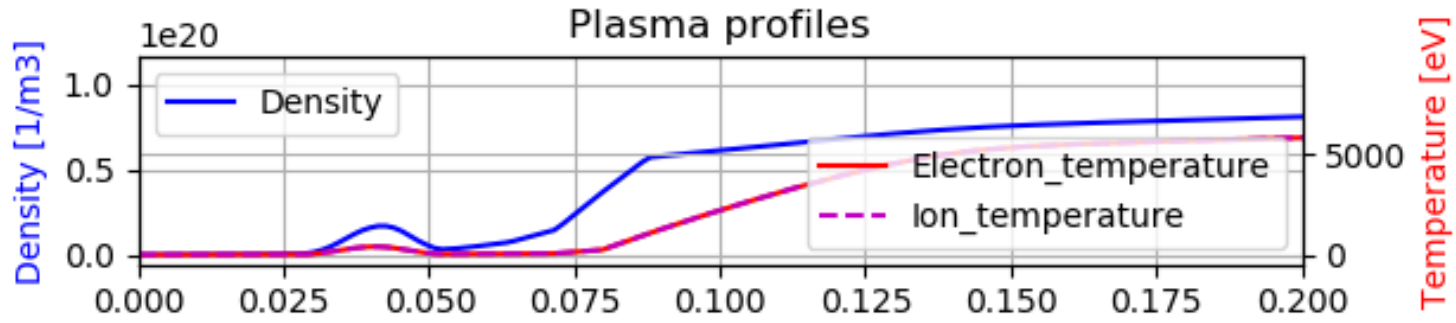
Profile for ITER

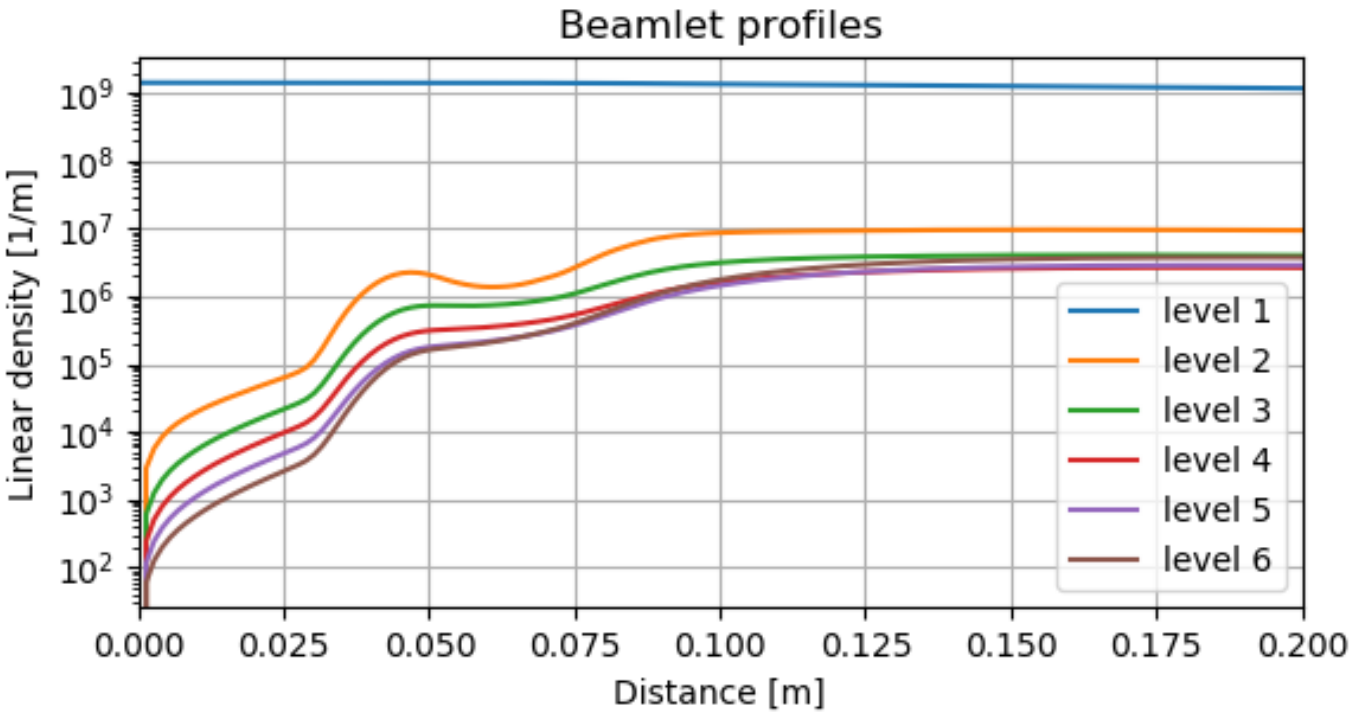
Localized features on profiles





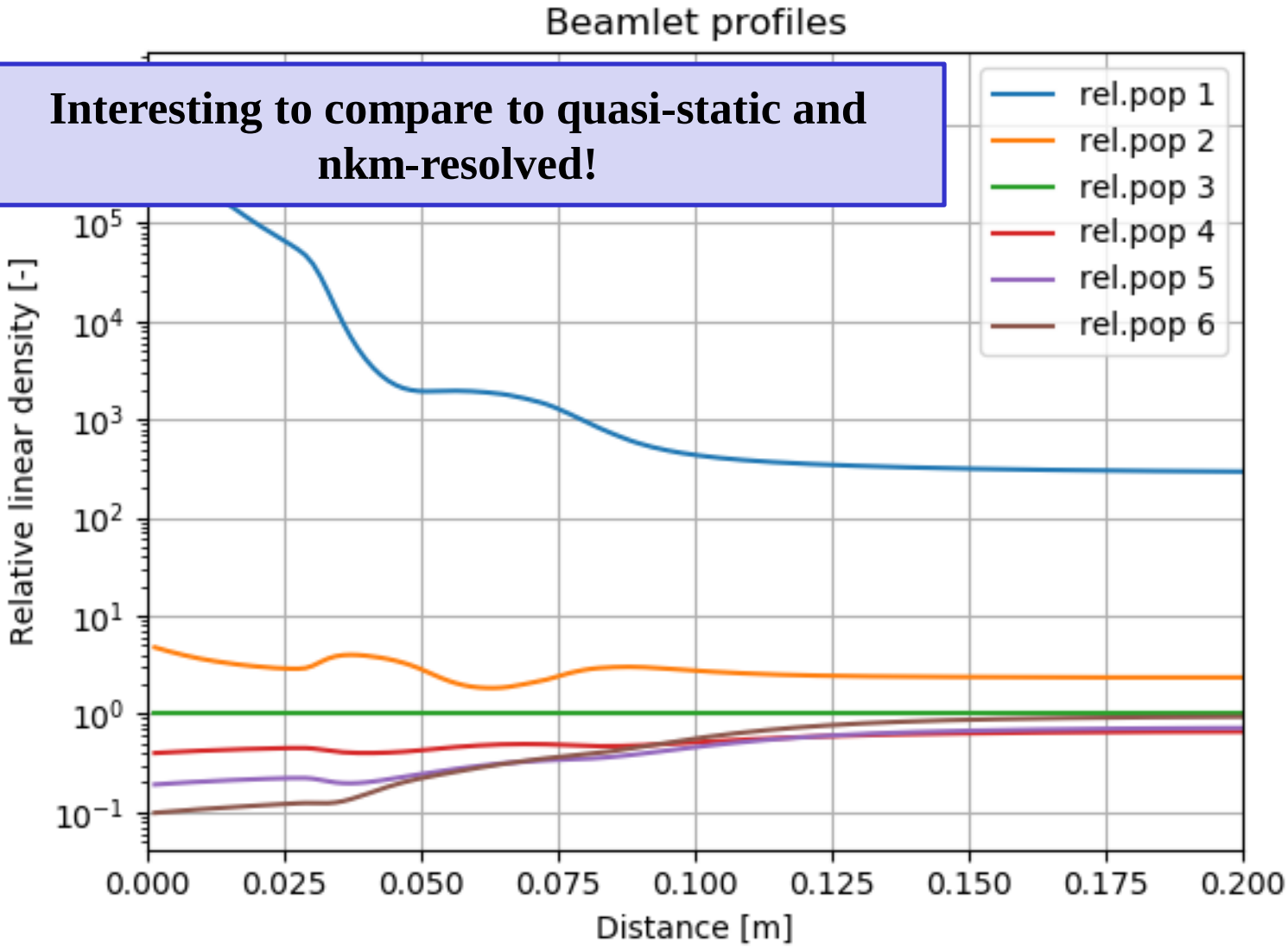
ITER scenario with blob (DNB-like)





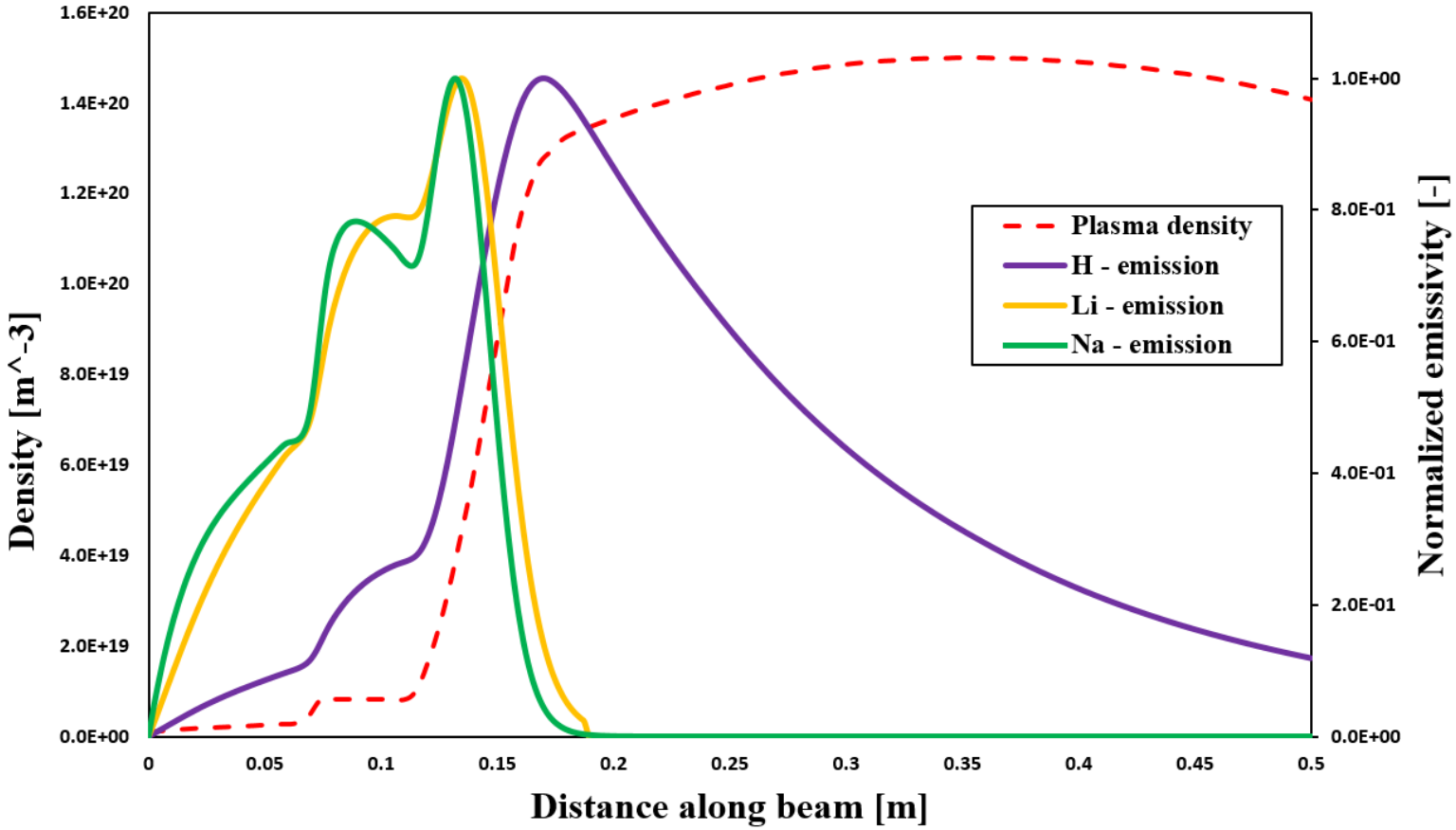
ITER scenario with blob (DNB-like)

Interesting to compare to quasi-static and nkm-resolved!



Island divertor – flat plateau

Non-monotonic emissivity profiles for perturbed radial profiles – could be exciting?



Summary and plans

1. **Understanding of data formats to be checked!**
2. **Benchmark cases to be completed** (till end of September)**:**
    1. Complete (as possible) coverage of test cases
    2. Further codes: SOS, ADAS, some Li/Na codes?
    3. Different physics models
3. **Report on benchmark results** (till November)
4. **Complement with references to related work**
5. **Publication of benchmark results**